PROCEEDINGS OF THE PACIFIC DIVISION
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

**Volume 23, Part I** **June 13, 2004**

# 85th ANNUAL MEETING OF THE AAAS PACIFIC DIVISION

# PROGRAM WITH ABSTRACTS

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Old Main Hall, Utah State University
(USU Photographic Services)

# ANNUAL MEETING OF THE AAAS, PACIFIC DIVISION AND ITS AFFILIATED SOCIETIES AND SECTIONS AT UTAH STATE UNIVERSITY LOGAN, UT June 13 - 17, 2004

## GENERAL INFORMATION

### ORGANIZATIONS, SOCIETIES, and SECTIONS SPONSORING SESSIONS at the ANNUAL MEETING

The following organizations, societies, and Pacific Division sections are sponsoring sessions at the 85th Annual Meeting of the AAAS Pacific Division:

**Western Society of Crop Science**
**Western Society of Soil Science**
**Agriculture and Horticultural Sciences Section**
**Anthropology and Archaeology Section**
**Atmospheric and Oceanographic Sciences Section**
**Biological Sciences Section**
**Chemistry Section**
**Computer and Information Sciences Section**
**Earth Sciences Section**
**Ecology and Environmental Sciences Section**
**Education Section**
**Engineering and Industrial Sciences Section**
**Health Sciences Section**
**History and Philosophy of Science Section**
**Psychology Section**
**Social, Economic and Political Sciences Section**

### UTAH STATE UNIVERSITY and VICINITY

Utah State University (USU) is located in Logan, at the southern end of the 60 mile long and 15 mile wide Cache Valley. Cache Valley is a true graben, in which the relatively level valley floor has dropped downward between a fault at the base of Wellsville Mountain to the west and the East Cache Fault and the prominent Bear River Range to the east. During the Pleistocene, the valley was submerged by an arm of Lake Bonneville, the ice-age predecessor to the Great Salt Lake. For a time, Lake Bonneville's outlet was north through the valley into Idaho. The University is constructed on the large, gravelly delta formed by the Logan River as it entered Lake Bonneville. The delta lies at the Provo level, and wave cut shorelines on the mountains behind the city mark the highest level of Lake Bonneville.

Located at 4,775 feet in elevation, Logan experiences an average high temperature of 79° F during June. Extremes of heat or prolonged hot spells are uncommon. Humidity is low and summer nights are cool, averaging 46 degrees F in June.

The region is also known as "Bridgerland" in honor of the famous fur trapper, scout and guide, Jim Bridger. Bridger went to work for the Rocky Mountain Fur Company at the age of 20, trapping, exploring and guiding expeditions for 46 years. He is credited with the discovery of the Great Salt Lake, although he believed that it was the Pacific Ocean. During the winter of 1824-25 Bridger and the Fur Company were trapping in what was then known as the Willow Valley. Trapping in the valley was excellent that winter, and the bundles of furs were "cached," or hidden, until spring when they could be

sent to eastern markets. Subsequently, the valley became known as the Cache Valley and it became a major rendezvous location for trappers. The first permanent settlement in the valley occurred in 1856 when seven families at Brigham Young's direction settled at what was first named Maughan's Fort and subsequently became the town of Wellsville.

Logan was founded in 1859. It was named by President John P. Wright after the Logan River, which ran by the early encampment, and also an Indian chief named Logan who had been kind to the settlers in the mid-west. The first buildings were two rows of log cabins with dirt floors and sod roofs, built facing each other after the pattern of Salt Lake City. The streets were wide enough for several wagons to pass each other at one time. The log cabins were replaced with native stone structures and finally structures of brick with wood framing. Although there were other settlements in the valley, Logan attracted the greatest number of settlers because of its location and abundant water supply. At the heart of the city is the Logan Latter-Day Saints Temple. Dedicated in 1877, it is the third oldest LDS temple in Utah and the structural and spiritual center of the valley. Downslope from the temple, in the Center Street neighborhood, are many historical homes constructed in the Queen Anne, Neoclassical, Prairie, and Spanish Revival styles.

With a population of over 45,000 in 2002, Logan is the commercial and cultural center of the Cache Valley. Downtown Logan has over 200 outlets, and the Cache Valley Mall features over 40 stores. Agriculture continues to dominate the basic economy, and the valley is known as the "garden spot of Utah." However, the city does have over 60 manufacturing industries. Culturally, Logan hosts the Summerfest Art Faire and Jazz Festival, Summer Theater, the Utah Festival Opera, and the Festival of the American West. The Nora Eccles Harrison Museum of Art on the Utah State University campus is a recognized center for 20th century sculpture, ceramics, painting, graphic arts, photography, and American Indian arts in the West.

Recreationally, the region has much to offer. The 40 mile Logan Canyon Scenic Byway provides breathtaking scenery alongside a rushing river. Geological markers, picnic spots and camping facilities are located throughout the canyon. Hiking and biking trails are well marked. Logan has several nearby golf courses. The Roland V. Jensen Living Historical Farm is 6.5 miles southwest of the University on Highway 89. Visitors travel back in time and can see how a farm of 1917 functioned, when farm work was done by horses. In Amalga, about 10 miles north of Logan, the Cache Valley Dairy Association operates one of the world's largest Swiss cheese factories, producing 60,000 pounds of cheese each day. Visitors can take a self-guided tour and sample many varieties of cheese.

Utah State University was founded in 1888 as the Agricultural College of Utah in order to "give young men and women in Utah a liberal education." The institution was subsequently known as the Utah State Agricultural College and, in 1957, was renamed Utah State University. In 1902 the landmark Old Main building, the oldest academic building in Utah in continual use, was completed. In 1983 portions of Old Main were destroyed by fire. The burned areas were subsequently restored and the rest of the building was renovated. R.O.T.C. came to the Agricultural College campus in 1918, with 450 men being trained by the end of World War I. In 1945, toward the end of World War II, a small group of German and Italian prisoners were housed on the Utah State Agricultural campus. The P.O.W. camp was decommissioned in the fall of 1946.

As a Carnegie Foundation Research I Institution, the University currently supports basic and applied research in a wide variety of areas. Total research expenditures in 2003 are projected at 141 million dollars. USU was the first university in the nation to have student experiments aboard NASA space shuttle flights and has flown more shuttle experiments than any other university. University research has resulted in the start-up of over 40 high-technology companies in the Cache Valley. The University has a strong presence in the international arena, with research and education efforts in 23 countries.

In Fall 2003, the student body included 23,474 students, 70 percent of them coming from Utah and about 4.4 percent international students from 84 countries. About 10.7 percent of the student body is enrolled in the 47 doctoral and 102 master's programs offered by the School of Graduate Studies. In 2003, the faculty approved 2,773 bachelor's, 925 master's and 59 doctorate degrees.

The 719 instructional faculty of Utah State University are organized into 41 academic departments within the seven colleges of Agriculture; Business; Education and Human Resources; Engineering; Humanities, Arts, and Social Sciences; Natural Resources; and Science. Extension County Agents are found in each of Utah's 29 counties. Faculty members develop and deliver educational programs based on the needs of local communities.

The 400 acre main campus features stately academic buildings surrounded by carefully groomed landscaping. Old Main Hall is a state arboretum with trees and shrubs native to Utah. Another 7,000 acres located throughout the state are used for agricultural and other research. The University Libraries — Merrill Library, Science and Technology Library, and Quinney Natural Resources Library — house more than 1,400,000 volumes, 13,979 periodicals, 1,200,000 federal publications titles, 76,600 USGS topographic maps covering the entire U.S., 2,203,000 microform items, and other film and video resources.

## REGISTRATION

The Registration Center will be in the foyer of the Eccles Science Learning Center (previously Widtsoe Hall and Maeser

Entrance to Eccles Science Learning Center, Utah State University

Lab) on the Utah State University campus. Hours for registration are:
*Sunday,* 2:00 - 5:00 p.m.
*Monday,* 8:00 a.m. - 5:00 p.m.
*Tuesday,* 8:00 a.m. - 5:00 p.m.
*Wednesday,* 8:00 a.m. - 2:00 p.m.

*About field trips*: Advance registration was required for all field trips due to limited seating in the vans and the need to inform some destinations of numbers of people arriving. However, space may be available on some of the excursions. If you are interested in one or more trips, inquire at the Registration Desk to see if space is still available. Please remember that at least one member of a family group requesting a field trip must be a paid meeting registrant.

The fees for registration are Professional, $80; Teachers K - 14, $60; Students, $40; Retired and Emeritus, $60; Participating Spouse, $40; One-day, $60.

## ACCOMMODATIONS and FOOD SERVICE

*Residence Halls*: Housing is available in the Utah State University residence halls for $15/night double or $25/night single. The residence halls consist of apartments with shared bathroom, living and dining areas, and three bedrooms. Each bedroom has two single beds and can accommodate a maximum of two persons per room. If you rent an entire apartment (all three bedrooms), you will be the only one in the apartment. If you rent one bedroom (single or double), you (and your roommate if applicable) will not have the entire apartment to yourself. If you rent a shared room and do not specify a roommate, a roommate will be assigned to your bedroom. Please be aware that individual bedroom doors do not have locks. Bedding is provided (sheets, blanket, pillow, pillowcase). No maid service or towels are provided. Elevators, ice machines, air conditioning, extra pillows, and blankets are not available. Individual apartment phones are also not available. However, pay phones are within walking distance. **No smoking is allowed in the facilities, including the bedrooms.**

Contacting residence hall staff: Should you need to contact residence hall staff, please call USU Housing Services, 800-863-1085 or 435-797-0277.

*University Inn:* The University Inn is a full-service hotel operating on the University of Utah campus. It is located within a five minute walk of all rooms used in this meeting. Amenities include free covered parking, free Aggie Ice Cream token for every guest, 24-hour guest services, all rooms non-smoking, access to USU fitness facilities, swimming pools, and outdoor tennis courts, full-size iron and ironing board, hair dryer, in-room coffee and hot chocolate, computer data port, cable TV with movie channels, a study table or desk, and electronic key access. Almost all rooms have two queen beds. Please note that **all rooms are non-smoking. The University Inn will assess a $199 cleaning fee to any lodging room that has been smoked in.**

Check-in time begins at 3:00 p.m. and check-out time is no later than 12:00 p.m. If you arrive prior to 3:00 p.m., the University Inn staff will make every attempt to accommodate you. However, in the event that rooms are not available, arrangements will be made to store your luggage until your room is available. In order to contact University Inn staff, call 800-231-5634 or 435-797-0017.

*On-Campus Dining*: The Taggart Student Center offers a variety of dining opportunities. The HUB, located on the east end of the bottom floor of the Taggart Student Center, has eight dining choices and is open for breakfast, lunch, and dinner. Varieties include Taco Time, Pizza Hut, Teriyaki Stix, Hogi Yogi, Sunset Strips, the Grill, fresh gourmet coffee at Cafe Ibis, and Aggie Ice Cream. The QUICKSTOP is at the west end of the Taggart Student Center, bottom floor, and offers a quick pick-up for small grocery items, a snack, or fast meal. CAROUSEL SQUARE offers casual dining, with a choice of Mexican entrees, wraps, a sandwich bar, a salad bar, and the MAIN DISH, which features daily entree specials. The Carousel Square also has fresh pasta and daily vegetarian specials. It is located on the second floor of the Taggart Student Center. The SKYROOM, located on the fourth floor of the Taggart Student Center, offers a full menu of fresh, chef-prepared entrees on Monday, Wednesday, and Friday. On Tuesday and Thursday they offer an all-you-care-to-eat buffet.

There is also a variety of restaurants, from fast food to elegant dining, in the vicinity of the University campus and a short distance away in downtown Logan.

Taggart Student Center (L.) and University Inn (R.)

*Local off-campus accommodations*: There are many hotels and motels in the Logan area. Nearby options include:

- **Alta Manor Suites**
  45 East 500 North, Logan, UT
  435-752-0808
- **Anniversary Inn Bed & Breakfast**
  169 East Center St., Logan, UT
  435-752-3443
- **Baugh Mansion**
  164 West 100 North, Logan, UT
  435-750-5860
- **Baugh Motel Best Western**
  153 South Main Street, Logan, UT
  435-752-5220 or 800-528-1234
- **Clint's Bed & Breakfast**
  165 North State St., Richmond, UT
  435-258-3768
- **Comfort Inn**
  447 North Main St., Logan, UT
  435-752-9141 or 800-424-6423
- **Crystal Inn**
  853 South Hwy. 89/91, Logan, UT
  435-752-0707
- **Days Inn**
  364 South Main St., Logan, UT
  435-753-5623
- **Logan House Inn**
  168 North 100 East, Logan, UT
  435-752-7727
- **Providence Inn Bed & Breakfast**
  10 South Main St., Providence, UT
  435-752-3432
- **Sherwood Hills Best Western**
  Hwy. 89/91, Wellsville, UT
  435-245-5054
- **Super 8 Motel**
  865 South Main St., Logan, UT
  435-753-8883
- **Weston Inn Best Western**
  250 North Main St., Logan, UT
  435-752-5700

Note that the AAAS Pacific Division presents the above hotels and motels for information only, not as an endorsement for any specific commercial enterprise.

## TRANSPORTATION and CAMPUS PARKING

*By Automobile:* Utah State University is located 83 miles northeast of Salt Lake City and 20 miles south of the Utah-Idaho border. From Salt Lake City, drive north on I-5 past Ogden and Willard and take exit 364 to Logan via Hwy 89/91. Continue through the scenic Sardine Canyon. Hwy 89 becomes Main Street in Logan. Turn right on 400 North. Continue to 700 East and turn left. Continue up the hill, curving to the right. After going through the intersection at the top of the hill, the Parking Terrace will appear on the right. The University Inn and Taggart Student Union are behind the parking lot and adjacent to the Parking Terrace. To check in at the University Inn, turn right into the parking lot and proceed through the gate to the end of the lot.

*By Air:* Logan is not served by a commercial carrier. However, Salt Lake City is served by major airlines. Car rentals are available at the airport. Cache Valley Limousine Airport Service offers shuttle service from the airport to Logan. As of May 8, 2004, the cost of the limousine service for one person was $44 one-way or $78 round trip. For two persons traveling together the cost was $59 one-way and $98 round-trip, and for three persons traveling together the cost was $74 one-way and $118 round-trip, a significant per-person savings over the single person rate. The trip takes about 1.5 hours. Reservations should be made at least a day in advance by calling 800-658-8526 or 435-563-6400.

*Parking:* Validation parking for the Parking Terrace will be provided to registrants staying in the University Inn. Registrants staying in the University Residence Halls will be given complementary passes for the adjacent parking lot, about a five minute walk to the Eccles Science Learning Center. Others may park in the Parking Terrace and pay the daily fee, currently $5.00.

## MEETING ROOMS

Sessions will meet in the new Eccles Science Learning Center, the Agricultural Sciences Building, the Taggart Student Center, and the University Inn. Each meeting room will be equipped with a 35 mm slide projector, an overhead projector, and a standard computer projector. Speakers requiring other specialized equipment must have made their requests when they submitted their abstracts. Specialized equipment can only be provided if available. If rental costs are incurred for specialized equipment, payment is the responsibility of the requestor.

A Speaker's Preview Room, complete with projection equipment, is in Agricultural Sciences 315 and will be available M, T, and W from 8:00 a.m. - 3:30 p.m.

## POSTER SESSIONS

Posters will be assigned display spaces of 40 in. X 60 in. (1 m X 1.5 m). Requests for additional space must have been made in advance. *By action of the Pacific Division Council in order to assure fairness, all student posters must fit within the assigned display space of 40 in. X 60 in. to be eligible for student Awards of Excellence. A request for extra space will disqualify a student from the award competition.*

Posters will be grouped by discipline and subject matter. Presenters should set up their posters no less than 15 minutes before the beginning of their presentation session. Presenters are expected to be available to discuss their work for at least

one hour during the time their poster is on display. Posters should remain in place until the close of the session, and be removed within 15 minutes of that time. Student posters will be judged for awards of excellence. Students must be present during the judging of posters. Additional information is found on page 29.

## SPECIAL EVENTS

*Sunday Evening Welcome Wagon and Cracker Barrel Mixer*, hosted by the Pacific Division and its affiliated societies and sections. All registrants and their families are invited to enjoy the conviviality of this social on June 13, immediately following the evening lecture, at about 8:00 p.m. A selection of soft drinks, chips and pretzels, and good conversation will be available. It will be held in the foyer next to Eccles Science Learning Center 007 (WIDT 007).

*Monday Evening USU President's Reception*. Utah State University President *Kermit L. Hall* will welcome conferees at an informal hosted reception following the AAASPD Presidential Lecture, about 8:00 to 9:30 p.m., in the foyer of Eccles Science Learning Center. All participants and their families are invited to enjoy this relaxed occasion. Non-registered family members are welcome, but must be accompanied by a registrant. Please wear your registration badge.

*Tuesday Evening Reception, Banquet, and Announcement of the Winners of the Student Awards for Excellence*. The no-host Divisional Dinner will be held Tuesday evening beginning at 6:00 p.m. at the Bullen Center, 43 South Main Street in Logan. The cost is $25 per person and you must have purchased your ticket in advance. Students who are in competition for an Award of Excellence are invited to attend as guests of the Division. Dinner will be preceded by a reception. Wine, beer and a variety of soft drinks will be available, starting about 6:00 p.m. Following dinner, Division representatives will announce the names of student winners of affiliated society and sectional Awards of Excellence and also winners of the Division's Laurence M. Klauber Award for Excellence (unrestricted), Geraldine K. Lindsay Award for Excellence in the Natural Sciences, J. Thomas Dutro, Jr. Award for Excellence in the Geosciences, Rita W. Peterson Award for Excellence in Science Education, the President's Award for Excellence (unrestricted), the Best Poster Award (for poster presentations only but otherwise unrestricted), and the AAAS–Robert I. Larus Travel Award, which provides for travel and other expenses for the awardee to attend the 2005 annual meeting of AAAS in Washington, D.C., February 17 - 22, in order to present his/her winning presentation as a poster.

The Klauber, Lindsay, Dutro, Presidents', Best Poster, Peterson, and AAAS–Larus awards are given to those students whose presentations are judged the most significant in the advancement or understanding of science. Eligible students must: (1) register for the meeting, (2) present the paper or poster, and (3) be the principal research investigator. Student presentations, oral and poster, are judged on their abstracts, content, style of delivery or presentation, and audiovisual aids and/or handouts (if used). The evaluation forms (oral and poster) are posted on the Division's website.

Following the presentation of student awards will be a talk, by Dr. Jan Sojka, Assistant Director of the Center for Atmospheric and Space Scicnces and Professor of Physics at Utah State University, on the USU "Get Away Special" space shuttle program.

*Business Meeting of the Council of the Pacific Division*. The Council of the AAAS, Pacific Division will hold its annual breakfast and business meeting at 7:00 a.m. on Wednesday, June 16, in the Center Colony Room at the Taggart Student Center. The Council will elect officers, discuss programs for the 2005 and 2006 annual meetings, and transact such other business as is required by the Division's By-Laws.

## STUDENT AWARDS for EXCELLENCE

The AAAS, Pacific Division offers each affiliated society and section participating in the annual meeting the opportunity to recognize outstanding student participants through the presentation of awards of excellence and cash prizes of $175 for first place and $100 for second place. Societies often supplement these awards with their own cash prizes.

In 2004, seven Division-wide awards are available: Laurence M. Klauber Award for Excellence (unrestricted); Geraldine K. Lindsay Award for Excellence in the Natural Sciences; J. Thomas Dutro, Jr. Award for Excellence in the Geosciences; Presidents' Award for Excellence (unrestricted); Rita W. Peterson Award for Excellence in Science Education; Best Poster Award (for posters only but otherwise unrestricted); and the AAAS-Robert I. Larus Travel Award, which provides travel and other expenses for the awardee to attend the 2005 annual meeting of AAAS in Washington, D.C., February 17 - 22, 2005, for the purpose of presenting his/her paper as a poster.

The Klauber, Lindsay, Dutro, Presidents', Peterson, Best Poster, and Larus awards are given to those students whose presentations are judged the most significant in the advancement or understanding of science. To be eligible, a student must (1) be registered for the meeting, (2) be the principal research investigator on the project, and (3) present the paper or poster. Student presentations, oral and poster, are judged on their abstracts, content, style of delivery or presentation, and audiovisual aids and/or handouts (if used). The evaluation forms for both oral and poster presentations are posted on the Division's website. Students who are in competition for awards are invited to be the Division's guests at the Division Banquet Tuesday evening, June 15. Festivities

that evening include the presentation of student awards. Tickets must have been reserved in advance on the Registration Form and picked up by noon on Tuesday.

## PUBLIC LECTURES

*Members of the general public are invited to attend these special lectures at no cost.*

***Sunday, June 13***
7:00 p.m.
Eccles Science Learning Center 007 (WIDT 007)

"Using Ecological Insight to Promote Drug Discovery and Conservation in Tropical Forests," *Dr. Phyllis Coley* (Department of Biology, University of Utah, 257 S 1400 EAST, Salt Lake City, UT 84112).

***Monday, June 14***
12:15 p.m.
Taggart Student Center, Walnut Room.

"Cerebral Laterality and Cerebral Dominance: Fact or Fiction?" *Dr. Fred C.C. Peng* (Neurological Institute, Department of Neurosurgery, Veterans General Hospital–Taipei, Taipai, Taiwan 11217).

***Monday, June 14***
7:30 p.m.
Eccles Science Learning Center 007 (WIDT 007)

Annual Presidential Lecture, *Dr. William B.N. Berry* (Department of Earth and Planetary Sciences, 307 McCone Hall, University of California, Berkeley, CA 94720-4767), President of the Pacific Division.

***Tuesday, June 15***
12:15 p.m.
Taggart Student Center, Walnut Room

"Beyond Global Warming: Global Cooling and the Next Ice Age," *Aden B. Meinel[1] and Marjorie P. Meinel[2]* ([1]Professor Emeritus, Department of Astronomy and the Optical Sciences Center, University of Arizona, Tucson, AZ, and Emeritus Distinguished Scientist, Jet Propulsion Laboratory, Observational Systems Division, California Institute of Technology, Pasadena, CA; [2]Retired, Jet Propulsion Laboratory, Observational Systems Division, California Institute of Technology, Pasadena, CA).

***Wednesday, June 16***
12:15 p.m.
Taggart Student Center, Walnut Room

"Command Strategies of the 9-11 Terrorist Attack on the World Trade Towers," *Mr. Henry Oman* (Consulting Engineer, 19221 Normandy Park Drive SW, Seattle, WA 98166).

***Wednesday, June 16***
7:30 p.m.
Eccles Science Learning Center, Room 053

"An overview of Yellowstone Park: 1872-2004," *Drs. J. Thomas Dutro[1] and Alan E. Leviton[2]* ([1]US Geological Survey, Room E 308, National Museum of Natural History, MRC-137, Washington D.C. 20560-0137, [2]Department of Herpetology, California Academy of Sciences, 875 Howard St., San Francisco, CA 94103).

## TOURS of the USU CENTER for INTEGRATED BIOSYSTEMS

The Center for Integrated BioSystems at Utah State University leads a progressive, interdisciplinary effort in research, core services, and biotechnology education serving agriculture and life sciences. The Center is a consortium of faculty, technical and office staff housed in a central facility on the USU campus. We collaborate and train scientists in academia, industry and national laboratories. The mission of the Center is to enhance society through the discovery and use of knowledge in functional genomics, proteomics, bionetworks and bioinformatics via a biosystems perspective.

We invite you to come and visit our facility during the AAAS Pacific Division meeting. We will give interested groups a guided, 20 – 30 minute tour of the facility. The times are:

Wednesday, 12:00 p.m.
Wednesday, 1:00 p.m.
Wednesday, 4:00 p.m.

Please meet in front of the Biotechnology Center, which is behind the Agricultural Sciences Building. Advance notice is not required.

For a tour at another time, please inquire at the front desk of the Biotechnology Center.

## FIELD TRIPS

All field trips are open to meeting registrants and their families. Due to limited space, advance registration is required for all trips. Occasionally, cancellations occur. If you are interested in one or more of these excursions, check at the Registration Desk on availability of space.

All field trips depart from and return to the open parking lot immediately in front of the University Inn (not the parking structure next to the University Inn). Plan on arriving a few minutes early. It's always a good idea to bring along a day pack and extra water, especially if the weather is warm. Please dress according to the weather and bring a hat and sun screen. Depending on the activities of the field trip, you may want to include a pair of binoculars and/or other items.

If you are going on one of the Sunday field trips, Pacific Division staff will be providing drivers with lists of participants so you do not need to worry about picking up your registration packet in advance. Registration will stay open until at least 5:00 p.m. on Sunday, perhaps a bit later to allow field trippers the opportunity to pick up their registration packets upon their return. Otherwise, registration will be open at 8:00 a.m. on Monday.

**SUNDAY**

*(1) Preston Valley Trail.* Sunday, June 13: 9:00 a.m. — mid-afternoon. Departs from the parking lot in front of the University Inn.

Fee: $20, which includes transportation, field guide and sack lunch.

Led by Mary Barkworth and Michael Piep (Department of Biology and Intermountain Herbarium, Utah State University), the Preston Valley Trail has probably more plant species per linear foot than any other trail near to Utah State University that is open in mid-June. It is narrow and winds up the north side of the ridge separating Green Canyon from Logan Canyon. We shall take it slowly, and possibly break into two groups – one continuing to the ridge and the other stopping lower down. The trail starts at about 5,900 feet in elevation in a shady maple area, winds to open slopes with mountain mahogany, then around and around to Douglas fir, breaking out at the top to a wonderful view over both canyons at an elevation of about 8,100 feet. The views are superb all the way up so those who decide not to go to the top will still have a great day. Bring a day pack for lunch and water. Birders will want to bring binoculars. Don't forget to dress for the weather and bring a hat, sunscreen, and closed-toe shoes.

*(2) History of local Indians, Mountain Men and early Mormon Settlements.* Sunday, June 13: 8:00 a.m. — 5:00 p.m. Departs from the parking lot in front of the University Inn.

Fee: $35, which includes transportation and sack lunch. Raspberry shakes, if available, are on your own.

Ross Peterson, Professor of History and Director of the Intermountain Center for Regional Studies will lead this trip, which heads up through Logan Canyon to Bear Lake, with a brief stop at the lake for raspberry shakes. We will then travel north along Bear Lake before turning south over the Wasatch Mountains into Cache Valley to the site of the Bear River Massacre.

*(3) Idaho Museum of Natural History.* Sunday, June 13: 9:00 a.m. — 4:00 p.m. Departs from the parking lot in front of the University Inn at 9:00 a.m.

Fee: $35, which includes transportation, entry to the museum, and sack lunch.

This trip will follow the Lake Bonneville channel north to the Idaho Museum of Natural History.

**WEDNESDAY**

*(4) Wasatch Formation.* Wednesday, June 16: 9:00 a.m. — 5:00 p.m. Departs from the parking lot in front of the University Inn at 9:00 a.m.

Fee: $25, which includes transportation and sack lunch.

Sponsored by the Western Society of Soil Science and led by Dr. Janis Boettinger (Department of Plants, Soils, and Biometeorology at USU), this field trip departs from the parking lot in front of the University Inn at 9:00 a.m, travelling up Logan Canyon to view glaciation in the Wasatch Formation, forest soils, glacial moraines, and ancient tropical soils.

**THURSDAY — SATURDAY**

*(5) Yellowstone National Park.* Thursday, June 17 — Saturday, June 19. Departs from the parking lot in front of the University Inn at 8:00 a.m. on Thursday. Returns about 5:00 p.m. on Saturday. Participants are advised to make arrangements for Saturday night in advance.

Fee: $275, which includes transportation by charter tour bus, written materials, and lunches. Other meals and items of personal nature are the responsibility of participants. Double occupancy only. If you are traveling alone, we will make every attempt to match you with another single participant of the appropriate gender. If we are unable to match you, we will refund the entire amount you paid for the trip. Minimum 18, maximum 25 participants.

Led by J. Thomas Dutro, Jr., retired from the U.S. Geological Survey and National Museum of Natural History (Smithsonian) and Alan E. Leviton, Chair of the Herpetology Department and Director of Scientific Publications at the California Academy of Sciences, 875 Howard St., San Francisco, CA. We depart Logan and travel north, entering Yellowstone National Park through the west entrance at West Yellowstone, Montana. Both nights will be spent at Old Faithful Inn. Thursday afternoon and Friday we will tour the two main loops of Yellowstone, observing the many hot springs and other signs of volcanic activity. Saturday morning we will depart Yellowstone, again through the west entrance, and return to Logan after a detour to Craters of the Moon National Monument.

***notes***

# GENERAL SESSIONS

## *Sunday, June 13*

### EVENING PUBLIC LECTURE

Eccles Science Learning Center 007 (WIDT 007)
7:00 p.m.

"Using Ecological Insight to Promote Drug Discovery and Conservation in Tropical Forests," *Dr. Phyllis Coley* (Department of Biology, University of Utah, 257 S 1400 EAST, Salt Lake City, UT 84112).

### WELCOME WAGON/CRACKER BARREL

Foyer in front of WIDT 007 (see above)
7:45 p.m.

Hosted by the AAAS Pacific Division and its affiliated societies and sections, all registrants and their families are invited to enjoy the conviviality of this event. A selection of soft drinks, chips, pretzels and good conversation will be available.

## *Monday, June 14*

### NOON PUBLIC LECTURE

Taggart Student Center, Walnut Room
12:15 p.m.

"Cerebral Laterality and Cerebral Dominance: Fact or Fiction?" *Dr. Fred C.C. Peng* (Neurological Institute, Department of Neurosurgery, Veterans General Hospital–Taipei, Taipai, Taiwan 11217).

### AAASPD PRESIDENTIAL LECTURE

Eccles Science Learning Center 007 (WIDT 007)
7:30 p.m.

Annual Presidential Lecture, *Dr. William B.N. Berry* (Department of Earth and Planetary Sciences, 307 McCone Hall, University of California, Berkeley, CA 94720-4767), President of the Pacific Division.

### USU PRESIDENT'S RECEPTION

Foyer of Eccles Science Learning Center
8:15 p.m.

Utah State University President, Dr. Kermit L. Hall, will welcome conferees at an informal, hosted reception. All registrants and their families are invited to enjoy this relaxed occasion. Non-registered family members are welcome, but must be accompanied by a registrant. Please wear your registration badge.

## *Tuesday, June 15*

### NOON PUBLIC LECTURE

Taggart Student Center, Walnut Room
12:15 p.m.

"Beyond Global Warming: Global Cooling and the Next Ice Age," *Aden B. Meinel[1] and Marjorie P. Meinel[2]* ([1]Professor Emeritus, Department of Astronomy and the Optical Sciences Center, University of Arizona, Tucson, AZ, and Emeritus Distinguished Scientist, Jet Propulsion Laboratory, Observational Systems Division, California Institute of Technology, Pasadena, CA; [2]Retired, Jet Propulsion Laboratory, Observational Systems Division, California Institute of Technology, Pasadena, CA).

## WESTERN SOCIETY of SOIL SCIENCE

Business Meeting
Agricultural Sciences 234
1:30 p.m.

## WESTERN SOCIETY of CROP SCIENCE

Business Meeting
Agricultural Sciences 202
3:15 p.m.

## RECEPTION and STUDENT AWARDS BANQUET

Bullen Center
43 S. Main Street, Logan
6:00 p.m.

The annual Pacific Division Banquet and Student Awards Banquet will be held at the Bullen Center, 43 S. Main St. in Logan. Starting at 6:00 p.m. will be a no-host reception. Wine, beer and a variety of soft drinks will be available.Dinner will start about 7:00 p.m. The cost is $25 and you must purchase a ticket in advance. Students who are in competitiion for Awards of Excellence are invited to be guests of the Division. Students must have indicated their intention of attending the banquet on their registration form and must have picked up their ticket by noon on Tuesday at the Registration Desk. Following dinner will be the announcement of the winners of the Awards of Excellence for the affiliated societies and sections of the Pacific Division. Winners of Division-wide awards will also be announced. Dr. Jan Sojka, Assistant Director of the Center for Atmospheric and Space Sciences and Professor of Physics at Utah State University will give a brief after-dinner talk on the USU "Get Away Special" space shuttle program.

# *Wednesday, June 16*

## COUNCIL of the PACIFIC DIVISION

Business Meeting
Taggart Student Center, Center Colony Room
7:00 a.m.

The Council of the AAAS Pacific Division will holds its annual business meeting and breakfast at 7:00 a.m. on Wednesday, June 16. The Council will elect officers, discuss programs for the 2005 and 2006 annual meetings, and transact such other business as is required by the Division's By-Laws. Visitors are welcome.

## NOON PUBLIC LECTURE

Taggart Student Center, Walnut Room
12:15 p.m.

"Command Strategies of the 9-11 Terrorist Attack on the World Trade Towers," *Mr. Henry Oman* (Consulting Engineer, 19221 Normandy Park Drive SW, Seattle, WA 98166).

## EVENING PUBLIC LECTURE

Eccles Science Learning Center, Room 053
7:30 p.m.

"An Overview of Yellowstone Park: 1872-2004," *Drs. J. Thomas Dutro[1] and Alan E.Leviton[2]* ([1]US Geological Survey, Room E 308, National Museum of Natural History, MRC-137, Washington D.C. 20560-0137, [2]Department of Herpetology, California Academy of Sciences, 875 Howard St. San Francisco, CA 94103).

# TECHNICAL SESSIONS

***1100*** (time italicized and underlined) indicates a student presentation in competition for Awards of Excellence.
* indicates the speaker from among several authors listed.

# I. SYMPOSIA and WORKSHOPS

## *Monday, June 14*

### *HALF-DAY SYMPOSIA*
### *MONDAY MORNING*

### ECOSYSTEM, SUSTAINABILITY and HEALTH

Agricultural Sciences 338
*Monday*
*8:30 a.m. – 11:50 a.m.*

Sponsored by the Pacific Division Sections on Agriculture and Horticulture and Ecology and Environmental Sciences.

Agriculture has changed dramatically, especially since the end of World War II. These changes allowed fewer farmers to produce the majority of the food in the U.S. Although these changes have had many positive effects, there have also been significant costs. Prominent among these are topsoil depletion, groundwater contamination, the decline of family farms, and the disintegration of economic and social conditions in rural communities. Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable agriculture integrates environmental health, economic profitability, and social and economic equity. Finally, *reaching toward the goal of sustainable agriculture is the responsibility of all participants in the system.*

Chair: Tilak R. Dhiman (Animal, Dairy and Veterinary Sciences, Utah State University).

0830 *Linking Plant Biochemical Diversity, Herbivore Culture, and Over-Grazing by Livestock: Have We Trained Herbivores to Over-Graze Rangelands?* FREDERICK D. PROVENZA (Dept. of Forest, Range, and Wildlife Sciences, Utah State Univ., Logan, UT).

0915 *Managing Forward by Looking Backward: Building Sustainable Grazing Operations,* BOB BUDD (Director of Land Management, The Nature Conservancy in Wyoming, 350 Red Canyon Road, Lander, WY).

**BREAK**

1020 *Potential Human Health Benefits of Forage Based Milk and Meat,* TILAK R. DHIMAN (Animal, Dairy and Veterinary Sciences, Utah State University, Logan, UT).

1105 *Geospatial Technology Applications for Agricultural Sustainability,* V. PHILIP RASMUSSEN[1] and DENNIS L. WRIGHT[2] ([1]NASA Geospatial Extension Program, [2]NASA Affiliated Research Center, Plants, Soils, Biometeorology Department, Utah State University, Logan, UT).

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### ELECTROMAGNETIC TECHNIQUES in SOIL SCIENCE

Agricultural Sciences 234
*Monday*
*8:40 a.m. – 11:30 a.m.*

Sponsored by the Western Society of Soil Science

The success of time domain reflectometry (TDR) sparked interest in a variety of other electromagnetic methods of investigating soil water, salinity, geometry and interfacial properties. Methods such as impedance, ground penetrating radar and electromagnetic induction are being used to determine soil properties with a minimum disturbance. Moreover, some of these techniques have potential applications to mapping soil properties on field or larger scales. This seminar will bring together researchers using a variety of electromagnetic methods to report on the state of the science.

Presiding: Lynn M. Dudley (Department of Plants, Soils & Biometeorology, Utah State University).

0840 *Welcome,* Matthew La Force (Geosciences Department, San Francisco State University)

0845 *Electrical Spectra of Soils Determined by Vector Network Analyzer,* SALLY D. LOGSDON (USDA-ARS-National Soil Tilth Laboratory, Ames, IA).

*0900* *Low Frequency Impedance Analysis of Soils,* ROBERT N. LOVE*[1], LYNN M. DUDLEY[1], and STEPHEN BIALKOWSKI[2] ([1]Department Plant, Soils & Biometeorology., [2]Department of Chemistry & Biochemistry, Utah State University, Logan, UT).

0915 *Geometrical effects on electromagnetic wave interaction with moist materials,* DAVID A. ROBINSON*[1], S. B. JONES[1], S.P. FRIEDMAN[2], M. BLONQUIST[1], and M.G. SCHAAP[3] ([1]Department of Plants, Soils and Biometeorology, Utah State University, Logan UT; [2]Volcani Center (ARO), Bet Dagan, Israel; [3]GEB Jr. Salinity Lab USDA-ARS, Riverside, CA).

0930 *Toward Standardizing Electromagnetic Sensor Characterization and Calibration,* SCOTT B. JONES*[1], J. MARK BLONQUIST JR[1]., DAVID A. ROBINSON[1], V. PHILIP RASMUSSEN[1] and DANI OR[2] ([1]Dept. Plants, Soils and Biometeorology, Utah State University, Logan UT; [2]Civil & Environmental Engineering Department; University of Connecticut, Storrs, CT).

*0945* *A Low Cost Time Domain Transmission Sensor with TDR Performance Characteristics,* J. M. BLONQUIST*, JR., S. B. JONES, and D. A. ROBINSON (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

**BREAK**

*1030* *Automated Analysis of TDR Waveforms for Water Content Determination in Saline Soils,* SETH HUMPHRIES*[1], SCOTT B. JONES[1], and DANI OR[2] ([1]Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT; [2]Civil & Environmental Engineering Department, University of Connecticut, Storrs, CT).

*1045* *EM-38 Calibration for Salinity Assessment in the Arkansas Valley*, JAMES WITTLER (Soil and Crop Science Department, Colorado State University, Ft. Collins, CO).

*1100* *Common and Multi-Offset Ground Penetrating Radar in Assessing Soil Water Content and Dynamics in the Vadose Zone,* ROBERT HEINSE*[1], DANA LAASS[2] and PETER SCHIKOWSKY[2] ([1]Department of Plants, Soils and Biometeorology, Utah State University, Logan, UT; [2]Institute of Geophysics and Geology, Leipzig University, Leipzig, Germany).

*1115* *Comparison of Synthetic Aperture Radar (SAR) Data with NOAA AVHRR Derived NDVI in the Gaza-Negev-Sinai Border Regions*, GUY SERBIN*[1], GIL REVIVO[2] and DAN G. BLUMBERG[3] ([1]Department of Plants, Soils and Biometeorology, Utah State University, Logan, UT; [2]Simigon Distributed Training Solutions, Herzliya, Israel; and [3]Department of Geography and Environmental Planning, Ben Gurion University of the Negev, Beer Sheva, Israel).

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## COLORADO PLATEAUX to GREAT BASIN — A NATURAL LABORATORY from GRADE SCHOOL to GRAD SCHOOL

Agricultural Sciences 302
*Monday*
*10:00 a.m. – 11:20 a.m.*

Sponsored by the Pacific Division Section on Education

The Colorado Plateaux and Great Basin are occupied by, or surrounded by, a large number of educational institutions that work with all ages of "students", grade school through grad school and beyond. This is an open symposium to allow everyone interested an opportunity to share the sorts of activities they are carrying out in these spectacular regions of western North America.

Chair: C. Frederick Lohrengel II (Department of Geology, Southern Utah University, Cedar City, UT).

1000 *A Cooperative University – Middle School Ecosystem Field Experience along the Colorado Plateaux – Great Basin Transition of Southern Utah,* HAROLD ORNES (College of Science, Southern Utah University, Cedar City, UT).

1020 *Recruiting Quality Majors: New York High School Students Experience the Geology of Southern Utah,* MARK R. COLBERG, ROBERT L. EVES, and C. FREDERICK LOHRENGEL II (Division of Geosciences, Southern Utah University, Cedar City, UT).

1040 *Natural History of the Colorado Plateaux and Basin and Range: A K-12 - National Park Cooperating Association - University Partnership,* G. POLLOCK[1], D. CANTU[1], R.L. EVES[2], J.E. BOWNS[2], and R.L. MARTIN[2] ([1]Bryce Canyon Natural History Association, Bryce Canyon, UT; [2]Southern Utah University,Cedar City, UT).

1100 *Brian Head Field Ecology: Pros and Cons of Applied Ecology and Education Partnerships on the Colorado Plateaux*, KATE GRANDISON (Biology Department, Southern Utah University,Cedar City, UT).

## *EDUCATION WORKSHOP*

### ENHANCING ACTIVE LEARNING THROUGH KNOWLEDGE CONSTRUCTION USING the SEMANTIC NETWORKING PROGRAM, *Semantica* Education 3.0.3

Agricultural Sciences 119
*Monday*
*10:00 a.m. – 12:00 p.m.*
repeated
*Wednesday*
*1:00 p.m. – 3:00 p.m.*

*If you haven't preregistered for this workshop, please check at the Registration Desk for availability of space.*

Organized by Kathleen Fisher (Center for Research in Mathematics and Science Education, San Diego State University, San Diego, CA 92120).
Sponsored by the Pacific Division Section on Education.

Semantic Research, Inc. is pleased to announce a workshop designed to help registrants become familiar with a unique knowledge structuring tool, *Semantica* Education 3.0.3. *Semantica* is a *groundbreaking,* cross-platform thinking tool for students and teachers. Based on 30 years of research on how humans store information in long-term memory, *Semantica* enables experts and learners alike to easily capture what they know and create interactive, multi-dimensional structures of knowledge that promote retention, recall, and transfer of knowledge.

Research has shown that when students actively construct their knowledge with a scaffolding tool such as *Semantica*, they necessarily shift from habits of rote learning to meaningful understanding, with active engagement being more effective than fact memorization for deep, sustained conceptual understanding. Hake showed in a large trial of over six thousand students that an interactive-engagement curriculum resulted in an average gain of *almost two standard deviations above traditional methods* [1]. A recent publication by Bencher [2] reports that *learning gains have doubled* when using an active learning approach compared with the same course taught in a traditional lecture/recitation method in the introductory physics classes at MIT. Numerous exploratory research studies with semantic networking suggest that students who construct their knowledge with this tool may learn twice as much as those who don't [3].

Workshop participants will work on PCs with a tutorial to familiarize them with its features. Although the workshop will be held in a PC laboratory, the Mac interface is similar, so Mac users are encouraged to attend as well. To attain the greatest benefit from the workshop, it is suggested you bring along an outline from a course you teach in order to have a ready source of material to enter into your semantic network. All participants who complete the workshop will receive a free, fully functional copy of Semantica 3.0.3.

1. Hake, R.R. (1998). *"Interactive-engagement vs traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses,"* Am. J. Phys. 66: 64-74; on-line as ref. 24 at http://www.physics.indiana.edu/~hake
2. Belcher, J.W. (2003), *"Improving Student Understanding with TEAL"* [TEAL = Technology Enhanced Active Learning], Vol. XVI No. 2 October/November 2003 The MIT Faculty Newsletter: http://web.mit.edu/fnl
3. Fisher, K. M. (In Preparation). Summary of research on learning with semantic networks. To be distributed at the workshop.

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## *HALF-DAY SYMPOSIA*
### *MONDAY AFTERNOON*

### CARBON and NITROGEN in SOIL ECOSYSTEMS

Agricultural Sciences 234
*Monday*
*1:15 p.m. – 5:00 p.m.*

Sponsored by the Western Society of Soil Science

Presiding: Paul Grossl (Utah State University)

1315 *Topographic Stratification of Soil Carbon and Nitrogen on a Palouse Hillslope*, ALLYSON YOUNG* and JODI JOHNSON-MAYNARD (Soil and Land Resources, University of Idaho, Moscow, ID).

1330 *Changes in Root Biomass and Intrinsic Permeability of Degraded Meadow Soils,* HILLARY J. TALBOTT* and PAUL A. McDANIEL (Division of Soil Science & Land Resources, University of Idaho, Moscow, ID).

1345 *Relationship of Microbial Biomass to Soil Organic Carbon Accumulations on Semi-arid Mineland Reclamation sites in Wyoming,* JONATHAN D. ANDERSON*, PETER D. STAHL, and LACHLAN J. INGRAM (University of Wyoming, Department of Renewable Resources, Laramie, WY).

1400 *Earthworm Populations During the First Five Years of Direct Seeding: Implications for Productivity*, JODI JOHNSON-MAYNARD, KARL UMIKER, and STEPHEN GUY (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID).

1415 *Earthworm Populations in Different Experimental Coffee Management Systems,* YANIRIA SANCHEZ-DE LEON* and JODI JOHNSON-MAYNARD (Plant, Soil and Entomological Sciences, University of Idaho, Moscow, ID).

1430 *Urease Encoding Genes in Ammonia-Oxidizing Bacteria,* TERESA E. KOPER*[1], AMAL F. EL-SHEIKH[2], JEANETTE M. NORTON[3], MARTIN G. KLOTZ[2], SETH G.THACKER[3], and RITA M. NELSON[3] ([1]Departments of Biology and [3]Plants, Soils, and Biometeorology, Utah State University, Logan UT; [2]Department of Biology and Center for Genetics and Molecular Medicine, University of Louisville, Louisville KY).

**BREAK**

1500 *Changes in Soil N Transformations after Repeated Application of Dairy Waste,* MUSSIE Y. HABTESELASSIE*[1], JOHN M. STARK[2], BRUCE E. MILLER[3] and JEANETTE M. NORTON[1] ([1]Dept.of Plants, Soils and Biometeorology; [2]Dept. of Biology; [3]Dept. of Agricultural Systems Technology and Education, Utah State University, Logan, UT).

1515 *Comparison of Annual and Multi-Year N-Based and P-Based Manure Applications,* J.G. DAVIS*, C.C. TRUMAN, K.V. IVERSEN, and K.C. DOESKEN (Colorado State University, Fort Collins, CO; USDA-ARS Southeast Watershed Research Laboratory, Tifton, GA; and USDA-ARS, Auburn, AL).

1530 *Balancing Chemical and Biological Nitrogen Management in Irrigated* Phaseolus vulgaris *(L.) Cropping Systems,* KELLI MAXWELL* and W. BART STEVENS (Powell Research and Extension Center, University of Wyoming, Powell WY).

1545 VIEW POSTERS
Lobby, Eccles Science Learning Center.

## EMERGING DISEASES of SIGNIFICANCE in the WEST

Eccles Science Learning Center 130
*Monday*
*1:30 p.m. – 3:15 p.m.*

Organized by Robert Sidwell (Institute for Antiviral Research, Utah State University, 5600 Old Main Hill, Logan, UT 84322-5600).
Sponsored by the Pacific Division Sections on Biology and Medical Sciences.

This symposium will consider those viral diseases which appear to be increasing as threats to human and animal populations in the west. Epidemiological evidence will be considered, and research directions for the control of these diseases will be reviewed.

Co-chairs: Robert Sidwell and John Morrey (Institute for Antiviral Research, Utah State University, Logan, UT).

1330 Introduction, Robert Sidwell.

1335 *Emerging Diseases of Importance to Western Populations,* ROBERT ROLFS (State Epidemiologist, Utah State Health Department, Salt Lake City, UT).

1355 *Emerging Diseases of Importance to Livestock and other Animals,* CLELL V. BAGLEY, D.V.M. (Professor and Extension Specialist, Extension Services, Utah State University, Logan, UT).

1415 *Hantavirus: A Significant Threat?* RICHARD DOUGLASS (Professor of Biology, Montana Tech of the University of Montana, Butte, MT).

1435 *West Nile Virus and Mad Cow Disease: Current Research Directions,* JOHN D. MORREY (Institute for Antiviral Research, Department of Animal, Dairy and Veterinary Sciences, Utah State University, Logan, UT).

1455 *SARSCoV, The "Super Pathogen": What Is Being Done About It?* DALE L. BARNARD (Institute for Antiviral Research, 5600 Old Main Hill, Utah State University, Logan, UT).

1515 Questions.

## MOBILE ELEMENTS: MOLECULAR MECHANISMS and EVOLUTIONARY APPLICATIONS

Eccles Science Learning Center 053
*Monday*
*1:30 p.m. – 5:00 p.m.*

Organized by Lynn B. Jorde (Department of Human Genetics, Eccles Institute of Human Genetics, University of Utah, Salt Lake City, UT) and Mark A. Batzer (Department of Biological Sciences, Biological Computation and Visualization Center, Louisiana State University, Baton Rouge, LA).
Sponsored by the Pacific Division Section on Anthropology and Archaeology

Mobile elements, which make up about 30% of the human genome, are DNA segments that are capable of making copies of themselves that are then inserted elsewhere in the genome. These elements can influence many important evolutionary processes, including mutation and rearrangement of chromosomes. This project will ascertain and analyze *Alu* and L1 mobile elements, which make up nearly 30% of the human

genome. These elements can influence many important evolutionary processes, including mutation, recombination, translocation, and exon/gene shuffling. They may also play an important role in the development of new species. Because of their unique properties, these elements are excellent tools for phylogenetic analysis. In this symposium, we will present recent research on the use of mobile elements in primate evolutionary research. In addition, we will discuss molecular mechanisms responsible for mobile element insertion and the potential roles of mobile elements in recombination and genomic instability.

Co-chairs: Lynn B. Jorde and Mark A. Batzer

1330 *Introduction*

1335 *Studies of a Human Retrotransposon,* NICOLAS GILBERT, SHIELA PRIGGE, TAMMY MORRISH, and JOHN V. MORAN* (Departments of Human Genetics and Internal Medicine, University of Michigan Medical School, Ann Arbor, MI).

1405 *Factors Influencing L1 Retrotransposition*, PRESCOTT DEININGER, VICTORIA PEREPELITSA-BELANCIO, MOHAMED EL-SAWY and ASTRID ENGEL (Tulane Cancer Center, Tulane University, New Orleans, LA).

1425 *Mobile Elements and Primate Phylogenetics,* DAVID A. RAY[1]*, JINCHUAN XING[1], DALE J. HEDGES[1], MICHAEL A. HALL[1], MEREDITH E. LABORDE[1], BRIDGET A. ANDERS[1], BRITTANY R. WHITE[1], NADICA STOILOVA[1], JUSTIN D. FOWLKES[1], KATE E. LANDRY[1], LEONA G. CHEMNICK[2], OLIVER A. RYDER[2], and MARK A. BATZER[1] ([1]Department of Biological Sciences, Biological Computation and Visualization Center, Louisiana State University, Baton Rouge, LA; [2]Center for Reproduction of Endangered Species, Zoological Society of San Diego, San Diego, CA).

**BREAK**

1520 *Mobile Elements and Primate Genomic Evolution,* DAVID A. RAY[1], PAULINE A. CALLINAN[1], ABDEL-HALIM SALEM[1,2], JINCHUAN XING[1], DALE J. HEDGES[1], LYNN B. JORDE[3] and MARK A. BATZER[1]* ([1]Department of Biological Sciences, Biological Computation and Visualization Center, Louisiana State University, Baton Rouge, LA; [2]Department of Anatomy, Faculty of Medicine, Suez Canal University, Ismailia, Egypt; [3]Department of Human Genetics, University of Utah Health Sciences Center, Salt Lake City, UT).

1550 *Mobile Elements and the Evolution of Human Populations,* L.B. JORDE[1]*, W.S. WATKINS[1], A.R. ROGERS[1], M.J. BAMSHAD[1], A.E. BRASSINGTON[1], M.L. CARROLL[2], S.V. NGUYEN[2], J.A. WALKER[2], and M.A. BATZER[2] ([1]Department of Human Genetics, University of Utah School of Medicine, Salt Lake City, UT; [2]Department of Biological Sciences, Louisiana State University, Baton Rouge, LA).

1620 *Estimating the Ages of* Alu *Insertions,* DAVID J. WITHERSPOON*, W. SCOTT WATKINS, MARK A. BATZER and LYNN B. JORDE (Department of Human Genetics, Eccles Institute of Human Genetics, University of Utah, Salt Lake City, UT).

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## USE of INTERMOUNTAIN NATIVE PLANTS in SUSTAINABLE URBAN LANDSCAPES

Eccles Science Learning Center 046
*Monday*
*1:30 p.m. – 4:40 p.m.*

Organized by Roger Kjelgren (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT 84322).

Sponsored by the Pacific Division Sections on Agriculture and Horticultural Sciences and Ecology and Environmental Sciences.

Drought and population growth in the Intermountain West are straining municipal water supplies, particularly through the use of water on urban amenity landscapes. This symposium will present an overview of the role that Intermountain native plants can play in creating urban landscapes that are ultra-low water use and that honor the distinctive high-desert character of the region.

Chair: Roger Kjelgren (Department of Plants, Soils, and Biometeriology, Utah State University).

Keynote Presentations

1330 *The Changing Face of the High Desert Urban Landscape,* ROGER KJELGREN (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

1410 *Utah's Choice: A New Native Plant Selection and Tagging Program*, SUSAN MEYER (Research Ecologist, USDA-Forest Service Shrub Sciences Laboratory, Provo, UT).

**BREAK**

Research Reports

1510 *Seed Propagation of Native Shrubby Saltbushes (*Atriplex: *Chenopodiaceae),* S.C. GARVIN and S.E. MEYER (USDA-Forest Service Shrub Sciences Laboratory, Provo, UT).

1525 *Irrigation and Growing Media Effects on Pot-In-Pot Production of Intermountain West Native Perennial Wildflowers and Shrubs*, AMY CROFT (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

*1540* *Comparison of Conventional Above-ground Versus Pot-In-Pot Production of Intermountain West Perennial Wildflowers,* GUILLERMO CARDOSO (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

*1555* *Salinity Tolerance of Four Ornamental Herbaceous Perennials*, NICKOLEE ZOLLINGER (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

*1610* *Drought Tolerance of Ornamental Herbaceous Perennials,* NICKOLEE ZOLLINGER (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

1625 *Drought Tolerance of Western Native Perennial Wildflowers Using Line Source Irrigation,* TERESA CERNY and ROGER KJELGREN (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

## *Tuesday, June 15*

## *HALF-DAY SYMPOSIA*
### *TUESDAY MORNING*

### NUCLEAR TRANSFER: IMPLICATIONS and STATUS

Agricultural Sciences 302
*Tuesday*
*8:00 a.m. – 12:00 p.m.*

Organized by Kenneth L. White (Department of Animal, Dairy and Veterinary Sciences, Center for Integrated Biosystems, Utah State University, Logan, UT 84322-4815).

Sponsored by the Pacific Division Section on Biological Sciences.

This symposium will provide an update of the current research developments in the area of somatic cell nuclear transplantation using animal cells to produce live offspring. Presentations will focus on application and efficiencies of the process to various species, developmental implications and gene expression profiles of nuclear transfer embryos and the relation to somatic cell nuclear re-programming efficiencies.

Chair: Kenneth L. White (Utah State University)

0800 Welcome and Introduction

0805 *Current Status of Nuclear Transfer in Animal Agriculture – Successes and Challenges*, KENNETH L. WHITE (Animal, Dairy and Veterinary Sciences Department, Center for Integrated Biosystems, Utah State University, Logan, UT).

*0845* *Nuclear Transfer Cytoplasts Derived from Cow Oocytes Support Increased Development* In Vivo *but Not* In Vitro *Compared to Heifer-Oocyte-Derived Cytoplasts,* KENNETH I. ASTON (Animal, Dairy, and Veterinary Sciences Department, Center for Integrated Biosystems, Utah State University, Logan, UT).

0925 *Conditioned Media Effects on Chromosome Composition of Bovine Cloned Embryos*, T. D. BUNCH and G. P. LI (Animal, Dairy and Veterinary Sciences Department, Center for Integrated Biosystems, Utah State University, Logan, UT).

**BREAK**

1015 *Gene Expression Patterns in Nuclear Transfer Embryos Compared to In Vitro Produced Control Embryos,* LEE F. RICKORDS (Animal, Dairy and Veterinary Sciences Department, Center for Integrated Biosystems, Utah State University, Logan, UT).

1055 *Placental Abnormalities Caused by Somatic Cell Nuclear Transfer,* QUINTON A. WINGER (Animal, Dairy and Veterinary Sciences Department, Center for Integrated Biosystems, Utah State University, Logan, UT).

1135 Panel question/answer.

## TRACE ELEMENT BIOGEOCHEMISTRY and SOIL REHABILITATION

Agricultural Sciences 234
*Tuesday*
*9:00 a.m. – 10:00 a.m.*

Sponsored by the Western Society of Soil Science.

Presiding: Rich Koenig (Washington State University)

0900 *Selenium in the Environment,* GEORGE F. VANCE (Wyoming Reclamation Ecology Center and Department of Renewable Resources, University of Wyoming, Laramie, WY).

0915 *Can Land Application of Saline-Sodic Coalbed Methane (CBM) Water be a Sustainable Practice: Effects on Soil Properties,* GIRISHA K. GANJEGUNTE*, LYLE A. KING and GEORGE F. VANCE (Department of Renewable Resources, University of Wyoming, Laramie, WY).

0930 *Background Trace Element Concentrations in the Franciscan Complex, San Francisco, California,* MEGAN SIMPSON and MATTHEW La FORCE* (Department of Geosciences, San Francisco State University, CA).

0945 *Iodide Sorption and Volatilization in Soil Environment,* PAUL R. GROSSL*[1], STEPHAN TROLOVE[2], and MARY HUBBARD[1] ([1]Dept. Plants, Soils and Biometeorology, Utah State University, Logan, UT; [2]Crop & Food Research, Hastings, New Zealand).

**BREAK**

1015 View and judge posters.
Lobby, Eccles Science Learning Center

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# *HALF-DAY SYMPOSIA*
## *TUESDAY AFTERNOON*

## IMPROVING LEARNING in LARGE LECTURE SCIENCE CLASSES

Eccles Science Learning Center 053
Tuesday
1:30 p.m. – 4:50 p.m.

Organized by Kathleen M. Fisher (Department of Biology and Center for Research in Mathematics and Science Education, San Diego State University, 6475 Alvarado Road, Suite 206, San Diego, CA 92120).
Sponsored by the Pacific Division Section on Education.

Two vignettes will be presented to demonstrate different strategies for engaging students in deep-level processing of complex science ideas, using sophisticated yet simple-to-use personal response software. One product, entitled "AnyQuestions," was developed by one of the presenters, Dr. Sharon Lightner, and her student, Lee Barken. It is a personal response system that utilizes Pocket PCs and accomodates forced response or the input of free text as responses. The other system, currently being used by two presenters, Dr. Minou Spradley and Dr. Jeanne Weidner, is the "eInstruction Classroom Performance System" distributed for higher education by McGraw-Hill publishers. This system utilizes personal response pads for students to respond to multiple choice or true/false questions. The presenters will be the "teachers" and the audience will be the "students". All participants will be assigned code names to maintain confidentiality. Following the vignettes, presenters will reflect on their use of this and other personal response device software in actual classrooms and on their use of engagement strategies with students, highlighting issues and benefits.

Presenters:

Sharon Lightner (College of Business Administration, San Diego State University, San Diego, CA 92120). Dr. Lightner has won many teaching awards, including several for teaching a synchronous course by video simultaneously to students in Europe, Asia and the US. Her newest innovation is an easy-to-use but sophisticated response system that runs on Pocket PCs that she has used with classes of about 40 students.

Minou Spradley (Department of Biology, San Diego City College, San Diego, CA 92101). Dr. Spradley teaches general biology and physiology and has used ConcepTests and other interactive strategies along with the McGraw-Hill student response system in large lectures.

Jeanne Weidner (Department of Biology, San Diego State University, San Diego, CA 92120). Berkeley-trained in neurobiology education, Dr. Weidner has developed an interactive lecture/laboratory course for prospective teachers and frequently uses ConcepTests.

Kathy Williams (Department of Biology, San Diego State University, San Diego, CA 92120). Dr. Williams is a leader in interactive teaching in large classes. She has frequently used evidence-based tests in her ecology course to increase student interest, attendance, and performance.

1330 Presentation of two vignettes with presenters as the "teachers" and participants as the "students." About 1.5 hours.

**BREAK**

1520 Reflections of presenters. About 1.5 hours.

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# *ALL DAY SYMPOSIA*
## *TUESDAY*

## FUTURE CLIMATE CHANGE: IMPLICATIONS for WESTERN ENVIRONMENTS

Taggart Student Center, Auditorium
*Tuesday*
*8:30 a.m. – 5:20 p.m.*

Organized by Frederic H. Wagner (Ecology Center and College of Natural Resources, Utah State University, Logan, UT 84322-5200).

Sponsored by the Pacific Division Sections on Atmospheric and Oceanographic Sciences, Biological Sciences, Earth Sciences, and Ecology and Environmental Sciences.

Inferences on global climate change in recent years have been based on widely published time series on air temperatures, weather-station measurements for various regions, and for the entire globe over the past ~150 years; trends over the past 1,000 years based on a variety of proxies and modeling efforts; and trends over the past 160,000 years based on ice cores from the Greenland and Antarctic ice sheets. The first three papers in this symposium present evidence from recent research on temperature trends shown by other proxies: bore holes in the earth, air temperatures shown by ice cores from a western U.S. glacier, and tree rings. The next three papers present evidence that the temperature increases are forced by human emissions of greenhouse gases, especially $CO_2$. The authors discuss other variables affecting temperatures that must be taken into account when inferring anthropogenic forcing from the measured trends. Global circulation models (GCMs) project much larger temperature increases during the 21st century than those of the 20th, based on predicted increases in $CO_2$ emissions. Environmental effects during the 20th century are thus a limited portent of environmental changes likely to occur in the 21st, and the first six papers in the second half of the symposium report recent research showing the wide range of environmental effect that occurred during the 1900s throughout western U. S. These include especially the effects on hydrologies of the water-short West and on diverse western ecosystems. The final paper discusses factors that must be considered, from a scientist's perspective, in devising policies to address the global warming problem.

Chair: Frederic H. Wagner (Utah State University).

0830 *Introduction,* FREDERIC H. WAGNER (Ecology Center and College of Natural Resources, Utah State University, Logan, UT).

0840 *Surface Warming in the Northern Hemisphere Inferred from Borehole Temperatures,* DAVID S. CHAPMAN* and ROBERT N. HARRIS (Department of Geology and Geophysics, University of Utah, Salt Lake City, UT).

0910 *Ice-core and Stream-flow Evidence of Rapid Climate Change at High-altitude Areas, Wind River Range, Wyoming,* DAVID J. NAFTZ[1]*, KIRK A. MILLER[2], and LIZ OSWALD[3] ([1]U. S. Geological Survey, Salt Lake City, UT; [2]U. S. Geological Survey, Cheyenne, WY; [3]U. S. D. A. Forest Service, Lander, WY).

0940 *Reconciling Natural, Multi-decadal Climate Variability and Predictions of Anthropogenic Climate Change in Western U.S.*, STEPHEN T. GRAY* and LISA J. GRAUMLICH (Big Sky Institute, Montana State University, Bozeman, MT).

**BREAK**

1030 *Changes in Tropopause Height: A New"Fingerprint" of Human Effects on Climate,* B. D. SANTER[1]*, T. M. L. WIGLEY[2], A. J. SIMMONS[3], P. KÅLLBERG[3], G. A. KELLY[3], S. UPPALA[3], C. AMMANN[2], J. S. BOYLE[1], W. BRÜGGEMANN[4], C. DOUTRIAUX[1], M. FIORINO[1], C. MEARS[5], G. A. MEEHL[2], R. SAUSEN[6], K. E. TAYLOR[1], W. M. WASHINGTON[2], M. F. WEHNER[7], and F. J. WENTZ[5] ([1]Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Laboratory, Livermore, CA; [2]National Center for Atmospheric Research, Boulder, CO; [3]European Centre for Medium-Range Weather Forecasts, Shinfield Park, Reading, U.K.; [4]University of Birmingham, Edgbaston, Birmingham, U.K.; [5]Remote Sensing Systems, Santa Rosa, CA; [6]Deutches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, D-82234 Wessling, Germany; [7]Lawrence Berkeley National Laboratory, Berkeley, CA).

1100 *Climate-change Implications of U. S. U. Lidar Observations of the Mesophere*, VINCENT B. WICKWAR*, JOSHUA P. HERRON, and TROY A. WYNN (Center for Atmospheric and Space Sciences, Utah State University, Logan, UT).

1130 *Natural Climates of the Last Millenium: Where Are We in Modeling the Recent Past?* CASPAR M. AMMANN (National Center for Atmospheric Re-

search, Climate and Global Dynamics Division – Paleoclimatology, Boulder, CO).

**LUNCH**

1330 *Variability and Trends in Mountain Snowpacks in Western North America,* PHILIP MOTE[1]*, ALAN HAMLET[1], MARTYN CLARK[2], and DENNIS LETTENMAIER[1] ([1]JISAO/SMA Climate Impacts Group, University of Washington, Seattle, WA; [2]Center for Science and Technology Policy Research, University of Colorado, Boulder, CO).

1400 *Variability and Trends in Alpine Glaciers,* DANIEL B. FAGRE (U.S.G.S. Northern Rocky Mountain Science Center, Glacier National Park, MT).

1430 *Variability and Trends in Spring Runoff in the Western United States,* JESSICA LUNDQUIST[1]*, DAN CAYAN[1,2], and MIKE DETTINGER[1,2] ([1]Scripps Institution of Oceanography, [2]U. S. Geological Survey, University of California San Diego, La Jolla, CA).

**BREAK**

1520 *Observed Impacts of Climate Change on Natural Systems in the United States,* JOHN H. MATTHEWS (Department of Integrative Biology, University of Texas, Austin, TX).

1550 *Ecological Consequences of Forest-insect Disturbance Regimes Altered by Climate Change,* JESSE A. LOGAN[1]* and JAMES A. POWELL[2] ([1]Rocky Mountain Research Station, U. S. D. A. Forest Service, Logan, UT; [2]Department of Mathematics and Statistics, Utah State University, Logan, UT).

1620 *A Synthesis of Recent Climate Warming Effects on Terrestrial Ecosystems of Alaska,* VALERIE A. BARBER[1]*, GLENN PATRICK JUDAY[1], ROSANNE D'ARRIGO[2], EDWARD BERG[3], F. STUART CHAPIN III[4], LARRY HINZMAN[5], HENRY HUNTINGTON[6], TORRE JORGENSEN[7], DAVID McGUIRE[8], TOM OSTERKAMP[6], BRIAN RIORDAN[1], VLADIMIR ROMANOVSKY[9], SCOTT RUPP[1], MATTHEW STURM[10], DAVID VERBYLA[1], JOHN WALSH[11], ALEX WHITING[12], MARTIN WILMKING[1] ([1]Forest Sciences-School of Natural Resources and Agriculture, University of Alaska Fairbanks, Fairbanks, AK; [2]Tree-Ring Laboratory, Lamont-Doherty Earth Observatory, Palisades, NY; [3]Kenai National Wildlife Refuge, Soldotna, AK; [4]Biology and Wildlife Dept., University of Alaska Fairbanks, Fairbanks, AK; [5]Water and Environmental Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775; [6]Huntington Consulting, Anchorage, AK; [7]ABR, Inc. Environmental Research and Services, Fairbanks, AK; [8]Alaska Cooperative Fish and Wildlife Research Unit, University of Alaska Fairbanks, Fairbanks, AK; [9]Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK; [10]USA-CRREL-Alaska, Ft. Wainwright, AK; [11]International Arctic Research Center, University of Alaska Fairbanks, Fairbanks, AK; [12]Native Village of Kotzebue, Kotzebue, AK).

1650 *Policies to Combat Global Warming,* TOM M. L. WIGLEY (National Center for Atmospheric Research, Boulder, CO).

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## LORDS of the RINGS: DENDROCHRONOLOGY YESTERDAY, TODAY and TOMORROW

University Inn 507
Tuesday
9:00 a.m. – 3:00 p.m.

Organized by Donald J. McGraw (University of San Diego, San Diego, CA).

Sponsored by the Pacific Division Sections on Biological Sciences, Earth Sciences, Ecology and Environmental Sciences, and History and Philosophy of Science.

Dendrochronology, or tree-ring dating, achieved maturity as a science (or 'group of sciences' comparable, say, to oceanography) during the 20th century. This series of talks includes a mix of both the history of and modern applied aspects of this science. Specific topics will include discussions about the founder of the field, archaeological applications (both North American and Asian), astronomy connections, consideration of early pioneers and their efforts, stable isotopes in tree rings, climatological features, and the future of dendrochronology.

Chair: Donald J. McGraw (University of San Diego, San Diego, CA).

0900 *Introduction*, Donald J. McGraw

0910 *Contributions of A. E. Douglass to Astronomy, the Development of Dendrochronology and the Institutional Growth of Science in the American Southwest*, GEORGE E. WEBB (Department of History, Tennessee Tech University, Cookeville, TN).

0940 *What Can the Stable Oxygen Isotopic Composition in Tree Ring Cellulose Tell Us About the Past?* JOHN S. RODEN (Biology Department, Southern Oregon University, Ashland, OR).

**BREAK**

1030 *The Growth, Development and Application of North American Tree-Ring Dating,* STEPHEN E. NASH

(Head of Collections, Department of Anthropology, The Field Museum, Chicago IL).

1100 *Tree-Ring Isotope Rhythms: Climate and Dating from the Bands*, STEVEN W. LEAVITT (Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ).

1130 *The Role of Bristlecone Pine in the Calibration of the Radiocarbon Dating Technique: The Early Work of Edmund Schulman,* DONALD J. McGRAW **(**University of San Diego, San Diego, CA).

**LUNCH**

1330 *Toward a Dendrochronology to Better Understand Central Asian Archaeology,* IRINA P. PANYUSHKINA (Laboratory of Tree Ring Research, University of Arizona, Tucson, AZ).

1400 *Douglass' "Cycle Problem" and the Scientific Community's Reception of the New Science of Dendrochronology*, GEORGE E. WEBB (Department of History, Tennessee Tech University, Cookeville, TN).

1430 *Recent Contributions to the Tree-Ring Method, Theory and Data, and Suggestions for Future Research*, STEPHEN E. NASH (Head of Collections, Department of Anthropology, The Field Museum, Chicago IL).

## *Wednesday, June 16*

## *HALF-DAY SYMPOSIA*
### *WEDNESDAY MORNING*

### NSF ADVANCE: EXAMINING A LEAKY PIPELINE — RESEARCH on the ACADEMIC CAREERS of WOMEN in SCIENCE

Agricultural Sciences 234
*Wednesday*
*9 a.m. – 12:00 p.m.*

Organized by Ronda Roberts Callister (Department of Management and Human Resources, Utah State University, Logan, UT 84322-3555).

National Science Foundation (NSF) statistics show women leaving science and engineering careers at much higher rates than men. They also show that the percentage of women at full professor rank has not changed in the last two decades - despite dramatically increasing percentages of women getting Ph.D.s in these fields (new Ph.D.s in Biology are now approximately 50% women, for example).

Questions about why this is happening prompted NSF to develop its Advance program. In the fall of 2001, NSF began awarding grants of up to $3 million. Two rounds of Advance awards have been made. Several of these institutions will be discussing their programs of research to address these questions.

Chair: Ronda Callister (Utah State University)

0900 *Introductions*, Ronda Callister

0910 *Examining the Leaky Pipeline in Puerto Rico,* SARA BENÕTEZ and IDALIA RAMOS (University of Puerto Rico at Humacao, Humacao, PR).

0945 *Gender Differences in the Quality of Work Life in Science Departments,* RONDA CALLISTER (Management and Human Resources Department, Utah State University, Logan, UT).

**BREAK**

1035 *Perceptions of Faculty and Administrators at the University of Puerto Rico at Humacao about Gender Bias in Faculty Recruitment Practices,* MARIA DEL C. CRUZ and MYRNA AYALA (ADVANCE Program and Department of Education, University of Puerto Rico at Humacao, CUH Station, Humacao, PR).

1110 *Changing the Culture at the University of Rhode Island: Assessing Readiness for Change,* BARBARA SILVER[1], LISA HARLOW[2] and KATE WEBSTER[2] ([1]University of Rhode Island, Kingston, RI; [2]Psychology Dept. University of Rhode Island, Kingston, RI).

1145 General questions and discussion.

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## *EDUCATION WORKSHOP*

### ENHANCING ACTIVE LEARNING THROUGH KNOWLEDGE CONSTRUCTION USING the SEMANTIC NETWORKING PROGRAM, *Semantica* Education 3.0.3

Agricultural Sciences 119
*Wednesday*
*1:00 p.m. – 3:00 p.m.*

*Please refer to page 15 for the description of this workshop.*

# *HALF-DAY SYMPOSIA*
## *WEDNESDAY AFTERNOON*

### STRATEGIES to ACCOMMODATE DUAL CAREER COUPLES in ACADEMIC SCIENCES and ENGINEERING DEPARTMENTS

Agricultural Sciences 234
*Wednesday*
*1:30 p.m. – 5:00 p.m.*

Organized by Kim Sullivan (Department of Biology, Utah State University, Logan, UT 94322-5305; E-mail: yejunco@biology.usu.edu).

Partner accommodation is a significant recruitment and retention issue for colleges and universities. National Science Foundation data indicate that 55% of women scientists and 32% of male scientists are married to another scientist. The challenges of recruiting and retaining dual career couples in the science and engineering fields is particularly difficult for colleges and universities located outside of major metropolitan areas where the college or university is often the only higher education institution in the area and the major employer. Speakers will each take about 15 minutes to discuss the challenges facing dual career couples and efforts being made to recruit and retain dual career couples. Survey results from 19 ADVANCE universities will be presented. A workshop will follow the presentations to discuss best practices and develop a white paper.

1330 Introduction and National Perspective - Chris Hailey (Utah State University)
1345 University of Puerto Rico–Humaco - Idelia Ramos
1400 New Mexico State University - Lisa Frehill
1415 University of Rhode Island - Barb Silver
1420 Utah State University's Dual Career Committee
1435 Potential speakers from Kansas State and Case Western Reserve University
1450 Survey of best practices at ADVANCE Institutions-Kim Sullivan (Utah State University)

**BREAK**

1520 Discussion and development of white paper.

# *ALL DAY SYMPOSIA*
## *WEDNESDAY*

### AGRICULTURAL GENOMICS: WHO, WHAT and WHY?

University Inn 507
*Wednesday*
*9:00 a.m. – 4:00 p.m.*

Organized by Kamal A. Rashid (Center for Integrated BioSystems, Utah State Univesity, 4700 Old Main Hill, Logan, UT 84322-4700; E-mail: krashid@cc.usu.edu).
Sponsored by the USU Center for Integrated BioSystems and the Pacific Division Sections on Agriculture and Horticultural Science, and Biological Sciences.

The Utah State University Center for Integrated BioSystems proudly presents a one day symposium in conjunction with the June 13-17, 2004 American Association for the Advancement of Science, Pacific Division annual meeting to be held on the USU campus. The symposium focuses on the recent advances in agricultural genomics for plants, animals and microbes. The symposium addresses the impact and new developments for agricultural sciences. Presentations and discussions will focus on utilization of functional genomics, proteomics and bioinformatics data and how to turn such data into applicable knowledge and industrial products.

Additionally, we invite you to visit our facility during the AAASPD meeting. We have scheduled three tours around this symposium (at 12:00 p.m., 1:00 p.m. and 4:00 p.m. on Wednesday) but also invite you to contact us at the Biotechnology Building if you are interested in touring the facility at other times. The tours meet at the front entrance of the Biotechnology Building and last for about 20 minutes.

Chair: Kamal A. Rashid (Utah State University)

0900 Welcoming remarks.
0915 PLENARY TALK: *Complexity is the Grand Challenge for Biology and Computing*, GEORGE S. MICHAELS (Chief Scientist and Director, Bioinformatics and Computational Biology, Pacific Northwest National Laboratory, Richland, WA).

**BREAK**

Session I: Microbial Genetics

1030 *Using Genomics in the Food Industry,* BART WEIMER (Center for Integrated BioSystems, Utah State University, Logan, UT).
1100 *Genomics of Plant-associated Bacteria,* MICHAEL L. KAHN (Institute of Biological Chemistry and School of Molecular Biosciences, Washington State University, Pullman, WA).

**LUNCH**

1200 Tour of the Biotechnology & Genomics Research Center (meet in front of the Biotechnology Center–behind the Agricultural Sciences Building).
1300 Tour of the Biotechnology & Genomics Research Center (see above).

Session II: Animal Genomics

1330 *Advances in Livestock Genomics,* NOELLE E. COCKETT (Department of Animal, Dairy and Veterinary Sciences, Utah State University, Logan, UT).

1400 *Conditional Gene Targeting Strategies to Determine the Role of Transcription Factor AP-2g during Pre- and Peri-Implantation Mouse Development,* QUINTON A. WINGER[1,2] and TREVOR WILLIAMS[2] ([1]Utah State University, Dept of Animal, Dairy and Veterinary Sciences, Logan, UT; [2]University of Colorado Health Sciences Center, Dept of Craniofacial Biology and Cellular & Developmental Biology, Denver, CO).

**BREAK**

Session III: Plant Genomics

1445 *Development of an Integrated Sorghum Genome Map as a Tool for Gene Discovery and Map-based Cloning,* PATRICIA E. KLEIN[1], ROBERT R. KLEIN[2] and JOHN E. MULLET[1] ([1]Institute for Plant Genomics and Biotechnology, Texas A&M University, College Station, TX; [2]USDA-ARS, Southern Plains Agricultural Research Center, College Station, TX).

1515 *From Models to Crops: Integrated Medicago Genomics for Alfalfa Improvement,* GREGORY D. MAY (Plant Biology Division, The Samuel Roberts Noble Foundation,, Ardmore, OK).

1545 Concluding remarks.

1600 Tour of the Biotechnology & Genomics Research Center (meet in front of the Biotechnology Center–behind the Agricultural Sciences Building).

# II. CONTRIBUTED PAPER SESSIONS

***1100*** (time italicized and underlined) indicates a student presentation in competition for Awards of Excellence.
* indicates the speaker from among several authors listed.

## *Monday, June 14*

### ANTHROPOLOGY and ARCHAEOLOGY, EDUCATION, and SOCIAL, ECONOMIC, and POLITICAL SCIENCES
**Joint Session**

Cosponsored by the Pacific Division Sections on **Anthropology and Archaeology:** Section Chair *Walter Carl Hartwig*, Division of Basic Medical Sciences, Touro University College of Osteopathic Medicine, Mare Island, CA 94592; **Education:** Section Chair *Kathleen M. Fisher*, Center for Mathematics and Science Education, 6475 Alvarado Road, Suite 206, San Diego State University, San Diego, CA 92120; **Social, Economic and Political Sciences:** Section Chair *Mark Aldrich*, Department of Economics, Smith College, Northampton, MA 01063.

**ORAL PRESENTATIONS**
Agricultural Sciences 317
*Monday*
*1:30 p.m. – 3:50 p.m.*

Chair: Walter Carl Hartwig (Touro University College of Osteopathic Medicine, Mare Island, CA).

1330 *The Skookum Imprint: Trace Evidence of Sasquatch?* D.J. MELDRUM[1] and D.R. SWINDLER[2] ([1]Dept. of Biological Sciences, Idaho State University, Pocatello, ID; [2]Dept. of Anthropology, University of Washington, Seattle, WA).

*1350* *Supply-Side Fluctuations Viewed as Evolutionary Game Dynamics,* YUYA SASAKI (Department of Economics, Utah State University, Logan, UT).

*1410* *Outgrowing Our Roots: Agrarian Restructuring in the New West*, ERIC B. JENSEN (Department of Sociology, Social Work, and Anthropology, Utah State University, Logan, UT).

1430 *Project-based Learning in the Dow Wetlands, Antioch, California,* WILLIAM B. N. BERRY* and RANDY FISCHBACK (Department of Earth and Planetary Science, University of California, Berkeley, CA and Dow Chemical Company, Pittsburgh, CA).

**BREAK**

*1510* *A Study of Learning Organization and Faculty Development—A Northwest University as Example,* HSIENYI LIN* and DALE GENTRY (College of Education, University of Idaho, ID).

1530 *Using Geographic Information System (GIS) Software to Meet State and National Standards in Teaching Science and Geography,* SANDRA SMITH (Sequim Community School, Sequim, WA).

**POSTER SESSION**
Lobby, Eccles Science Learning Center
Tuesday
9:00 a.m. – 1:00 p.m.
(Please refer to page 31.)

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### WESTERN SOCIETY of SOIL SCIENCE

President: Matthew J. LaForce, Department of Geosciences, San Francisco State University, 1600 Holloway Ave., San Francisco, CA 94132-4163; laforce@sfsu.edu.

President-Elect and Program Chair: Paul Grossl, Department of Plants, Soils and Biometeorology, Utah State University, Logan, UT 84321-4820; grossl@cc.usu.edu.

Secretary-Treasurer: Jodi Johnson-Maynard, Department of Plant, Soil, & Enthomological Sciences, University of Idaho, P.O Box 442339, Moscow ID 83844-2339; jmaynard@uidaho.edu.

Past President: Jessica Davis, Dept. of Soil & Crop Sciences, Colorado State University, 1170 Campus Delivery, Fort Collins, CO 80523 -1170; jgdavis@lamar.colostate.edu.

**ELECTROMAGNETIC TECHNIQUES in SOIL SCIENCE**
Agricultural Sciences 234
*Monday*
*8:40 a.m. – 11:30 a.m.*
(Please refer to page 13.)

**CARBON and NITROGEN in SOIL ECOSYSTEMS**
Agricultural Sciences 234
*Monday*
*1:15 p.m. – 3:45 p.m.*
(Please refer to page 15.)

**POSTER SESSIONS**
Lobby, Eccles Science Learning Center
*Monday*
*1:30 p.m. – 5:30 p.m.*
*Tuesday*
*9:00 a.m. – 1:00 p.m.*
(Please refer to page 31.)

Program continues on page 29.

## *Tuesday, June 15*

## BIOLOGICAL SCIENCES and ECOLOGY and ENVIRONMENTAL SCIENCES

Agricultural Sciences 338
*Tuesday*
*8:15 a.m. – 4:15 p.m.*

Cosponsored by the Pacific Division Sections on **Biological Sciences**, Chair: *A. Michelle Wood*, Department of Biology, University of Oregon, Eugene, OR 97403; **Ecology and Environmental Sciences**, Chair: *Michael S. Parker*, Department of Biology, Southern Oregon University, Ashland, OR 97520.

Chair: Michael S. Parker (Southern Oregon University).

0815 Opening comments.

*0820* *Additive Response to Combined Cancer Therapies in Six Lymphoid Cell Lines,* BRACKEN M. WEBB*, MICHAEL R. PHILLIPS, BYRON K. MURRAY, and KIM L. O'NEILL (Department of Microbiology, Brigham Young University, Provo, UT).

0840 *Expression of NADPH Oxidase Homologs in Human Tumor Cells,* AGNES JUHASZ*, SUSAN MARKEL, MARIANNE METZ, LINDA MATSUMOTO, JOSEPHUS VAN BALGOOY and JAMES H. DOROSHOW (Medical Oncology Department, City of Hope Comprehensive Cancer Center, Duarte, CA).

*0900* *Effects of Electromagnetic Fields (EMF) on Angiogenesis of Breast Cancer and Macrophages Measured using the Chorioallantoic Membrane (CAM) Assay,* RUSSELL L. HAMBLIN*, DEVIN D. TWITCHELL, BYRON K. MURRAY, and KIM L. O'NEILL (Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT).

*0920* *Detecting Apoptosis: A Comparison of the Comet Assay and the Annexin-V Method Using Six Lymphoid Cell Lines,* MICHAEL R. PHILLIPS*, BRACKEN M. WEBB, BYRON K. MURRAY, and KIM L. O'NEILL (Department of Microbiology, Brigham Young University, Provo, UT).

*0940* *Inhibition of Benzo[a]Pyrene Induced DNA Damage in HepG2 Cells by the Organosulfur Compound N-acetyl Cysteine (NAC) as Measured by the Comet Assay,* MICHAEL O'NEIL, LONI O'NEIL, AMANDA STEVENS*, COREY SPEERS, BYRON MURRAY, and KIM O'NEILL (Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT).

**BREAK**

*1020* *Measurement of MDA Levels as a Marker of Lipid Peroxidation in Serum,* CHRIS TRIMBLE, LEE D. MCLEMAN, SEIGA OHMINE, S. BRIANT STRINGHAM, DAVID P. TOMER, KIM L. O'NEILL and BYRON K. MURRAY (Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT).

1040 *Lipid Peroxides Generated by the Ozonation of Biological Fluids are Effectively Neutralized by Phytochemicals with Antioxidant Capacity*, DAVID P. TOMER*, LEE D. MCLEMAN, SEIGA OHMINE, S. BRIANT STRINGHAM, CHRIS TRIMBLE, NICHOLAS J. BUCHKOVICH, KIM L. O'NEILL, and BYRON K. MURRAY (Department of Microbiology and Molecular Biology, Brigham Young University, 775 WIDB, Provo, UT).

*1100* *Effects of Prolactin (PRL) on the Expression of PRL and PRL Receptor Long Form (PRL-L-R) mRNA in the Skin of Mink (*Mustela vison*),* JASON HUNT*, MALCOLM SHIELDS and JACK ROSE (Department of Biological Sciences, Idaho State University, Pocatello, ID).

*1120* *Prolactin (PRL) and PRL-Receptor-Long Form (PRL-L-R) mRNA Expression in the Testis and Epididymis of Sexually-immature and –mature Mink (*Mustela vison*),* JONATHON LORDS*, JASON HUNT, MALCOLM SHIELDS and JACK ROSE (Department of Biological Sciences, Idaho State University, Pocatello, ID).

*1140* *Pygmy Rabbits (*Brachylagus idahoensis*): Methods of Detection, Habitat Preferences, and Distribution in*

*Nevada,* EVELINE S. SÉQUIN* and PETER F. BRUSSARD (Department of Biology, Program in Ecology, Evolution, and Conservation Biology, University of Nevada at Reno, Reno, NV).

**LUNCH**

Chair: A. Michelle Wood (University of Oregon).

1315 *Raster-Based Spatial Evolutionary Game Dynamics,* YUYA SASAKI (Department of Environment and Society, Utah state University, Logan, UT).

1335 *A Kinetic Analysis of Bluetongue Virus mRNA Using Quantitative Real-Time PCR,* GARRY MILLER*, MAGGIE BUCCAMBUSO, YI-CHEN LEE, and JOSEPH LI (Biology Department, Utah State University, 5305 Old Main Hill, Logan, UT).

1355 *Effect of 3-dimensional and Color Contrast Patterns on Nest Location Performance of Two Solitary Bees (Hymenoptera: Megachilidae)*, CHRISTELLE GUÉDOT (Biology Department, Utah State University, Logan, UT).

1415 *Screening Candidate Fungicides for Control of Chalkbrood Disease in Alfalfa Leafcutting Bees,* (Megachile rotundata*),* CRAIG HUNTZINGER*, ROSALIND JAMES, JORDI BOSCH, and WILLIAM P. KEMP (USDA-ARS Bee Biology and Systematics Laboratory, North Logan, UT).

1435 *The Mechanism of the Cat Twist,* J. RONALD GALLI (Department of Physics, Weber State University, Ogden, UT).

**BREAK**

1515 *Cytotaxonomy, Karyomorphology and Genome Analysis of Six Species of* Allium *(Alliaceaee)***,** TASNEEM F. KHALEEL (Department of Biological and Physical Sciences, Montana State University, Billings, MT).

1535 *A Search for Congruence between Ontogeny and Phylogeny: Within-Group Variation in Morphological Integration in Clover (*Trifolium repens *L.) in Different Aged Pastures,* JACK MAZE* and ROY TURKINGTON (Department of Botany, University of British Columbia, Vancouver, B. C.).

1555 *SeasonalFluxes of Water Vapor and $CO_2$: Their Decoupling from the Atmosphere Above a Grassland Steppe of Northern Kazakhstan,* NICANOR SALIENDRA*[1], KANAT AKSHALOV[2], DOUGLAS JOHNSON[3], TAGIR GILMANOV[4] and EMILIO LACA[5] ([1]Dept. of Forest, Range and Wildlife Sciences, Utah State University, Logan, UT; [2]Baraev Research and Production Center for Grain Farming, Akmolinskaya Oblast , Kazakhstan; [3]USDA-ARS Forage and Range Research Laboratory, Utah State University, Logan, UT; [4]Dept. of Biology and Microbiology, South Dakota State University, Brookings, SD; [5]Dept. of Agronomy and Range Science, University of California, Davis, CA).

**POSTER SESSION**

Lobby, Eccles Science Learning Center
*Monday*
*9:00 a.m. – 1:00 p.m.*
(Please refer to page 31.)

## COMPUTER and INFORMATION SCIENCES, EARTH SCIENCES, and ENGINEERING and INDUSTRIAL SCIENCES

Agricultural Sciences 317
Tuesday
1:30 p.m. – 3:00 p.m.

Cosponsored by the Pacific Divison Sections on **Computer and Information Sciences**, Chair: *Alan E. Leviton*, California Academy of Sciences, 875 Howard St., San Francisco, CA 94103; **Earth Sciences**, Chair: *J. Thomas Dutro, Jr.***,** U.S. Geological Survey (E-308), National Museum of Natural History, Washington, D.C., 20560-0137; **Engineering and Industrial Sciences**, Chair: *Henry Oman*, 19221 Normandy Park Drive S.W., Seattle, WA 98116.

Chair: Henry Oman

1330 Opening Remarks

1340 *Study of Spider Silk with a Particular Emphasis on Surface Behavior,* AUTUMN GARZA-GOSSETT* and V.A. RAVI (Chemical and Materials Engineering Department, California State Polytechnic University, Pomona, CA).

1400 *Peering into the Earth's Most Critical Layer Using Geophysics: Environmental and Engineering Case Studies–Faults, Sinkholes, Cavities, Groundwater, Groundwater Contamination*, ALVIN K. BENSON (Department of Physics, Utah Valley State College, Orem, UT).

1420 *Two-Stage Algorithm for Global Optimization,* ZSOLT UGRAY*[1] and LEON LASDON[2] ([1]Business Information Systems Department, Utah State University, Logan, UT ; [2]MSIS Department, University of Texas, Austin, TX).

1440 *Plant Layout Design with Heuristics,* ZSOLT UGRAY* and KARINA HAUSER (Business Information Systems Department, Utah State University, Logan, UT).

**POSTER SESSION**
Lobby, Eccles Science Learning Center
*Tuesday*
*9:00 a.m. – 1:00 p.m.*
(Please refer to page 31.)

## WESTERN SOCIETY of CROP SCIENCE
### of the AMERICAN SOCIETY of AGRONOMY

President: Shree Singh, University of Idaho, 3793 N 3600 E, Kimberly, ID, USA 83341-5076; singh@kimberly.uidaho.edu.
President-Elect: Leonard Panella, USDA-ARS, Crop Res. Lab., 1701 Center Ave., Fort Collins, CO, USA 80526-2083; lpanella@lamar.colostate.edu.
Past President: Robert Zemetra, Department of Plant, Soil & Ent. Sci., University of Idaho, Moscow, ID, USA 83844-2339; rzemetra@uidaho.edu.
Secretary-Treasurer: David Hole, Utah State University-PSB Dept., 4820 Old Main Hill, Logan, UT, USA 84322-4820; dhole@mendel.usu.edu.

**CONTRIBUTED PAPERS**
Agricultural Sciences 202
*Tuesday*
*8:45 a.m. – 2:45 p.m.*

Chair: Shree Singh, Kimberly (Research & Extension Center, University of Idaho)

0845 *Response of Dry Bean Cultivars and Landraces to Seven Cropping Systems in Southern Idaho,* H. TERAN[1]*, D. WESTERMANN[2], R. ALLEN[1], R. PARROTT[3], K. MULBERRY[3], J. SMITH[4], M. DENNIS[1], R. HAYES[1], C. G. MUNOZ[1], and S. P. SINGH[1] ([1]Univ. of Idaho, [2]USDA-ARS, Kimberly, ID, [3]Organic bean grower, [4]Bean grower).

0900 *Quantitative Resistance to White Mold in Common Bean,* J. MAXWELL*, M. A. BRICK, P. BYRNE, X. SHAN, and H. F. SCHWARTZ (Colorado State University).

0915 *Response of Common Bean Cultivars and Landraces to Drought Stress,* C. MUNOZ[1]*, R. ALLEN[1], D. WESTERMANN[2], M. DENNIS[1], R. HAYES[1], H. TERAN[1], and S. P. SINGH[1] ([1]Univ. of Idaho and [2]USDA-ARS).

0930 *Cold Germination and Emergence of Different Canola Genotypes,* C. CHEN*, and K. NEILL (Montana State University, Bozeman, MT).

0945 *Development of a High Omega 3 Oilseed: Camelina,* D. L. JOHNSON (Montana State University, Bozeman, MT).

**BREAK**

Chair: Dennis Cash (Department of Animal & Range Sciences, Montana State University)

1030 *PINB is the Limiting Factor in the Reduction of Grain Softness in Wheat!* C. G. SWAN*, F. MEYER, A. HOGG, J. M. MARTIN, and M. J. GIROUX (Montana State University, Bozeman, MT).

1045 *Gene Expression Analysis of M955 a Low Phytic Acid Barley Mutant,* D. E. BOWEN[1]*, M. J. GUTTIERI[1], V. RABOY[2], and E. SOUZA[1] ([1]University of Idaho; [2]USDA-ARS Aberdeen ID).

1100 *Modification of Wheat Straw for Use as a Biofuel,* M. KUMAR*, J. L. HANSEN, and R. S. ZEMETRA (University of Idaho).

1115 *Interspecific* Leucaena *Hybrids for Fodder and High-value Hardwood,* J. BREWBAKER (University of Hawaii).

1130 *Precision Agriculture Technology to Plan and Manage a New Research and Extension Center,* D. A. CLAYPOOL[1]*, H. J. FARAHANI[2], R. P. BELDEN[1], and L. C. MUNN[1] ([1]University of Wyoming, [2]USDA-ARS).

**LUNCH**

Chair: David Claypool (Department of Plant Sciences, University of Wyoming)

1315 *Development of an Imazamox Resistant Wheat Cultivar Suitable for the Pacific Northwest,* A. CARTER*, J. HANSEN, T. KOEHLER, and R. ZEMETRA (University of Idaho).

1330 *Developing a Method for Transferring Genes from the C Genome of Jointed Goatgrass into the Genomes of Wheat,* J. L. HANSEN*, and R. S. ZEMETRA (University of Idaho).

1345 *Effects of Late Summer Harvest on Alfalfa Productivity and Stand Life in the Northern U.S.,* S. D. CASH*, R. L. DITTERLINE, K. D. KEPHART, and S. L. BLODGETT (Montana State University, Bozeman, MT).

1400 *Integrating Daily Patterns of Pasture Soluble Carbohydrate Level and Grazing Behavior,* T. C. GRIGGS[1]*, J. W. MACADAM[1], H. F. MAYLAND[2] and J. C. BURNS[3] ([1]Utah State University, Logan, UT; [2]USDA-ARS, Kimberly, ID).

1415 *Forage Quality of Spring Cereal Forage Varieties in Montana,* D. M. WICHMAN[1]*, S. D. CASH[2], P. F. HENSLEIGH[2], K. D. KEPHART[3], M. P. WESTCOTT[4], D. L. JOHNSON[5], P. F. LAMB[6], and M. KNOX[4] ([1]Central Agricultural Research Center,

MAES, Montana State University, Bozeman, MT; [2]Montana State University, Bozeman, MT; [3]SARC, Montana State University, Bozeman, MT; [4]WARC, Montana State Univeristy, Bozeman, MT; [5]NWARC, Montana St. University, Bozeman, MT; [6]NARC, Montana State University, Bozeman, MT).

1430 *Field-pea and Oats Cropping in Mixture in Alaska: As an Alternative Approach to Quality Forage Production and Weed Control,* S. BEGNA* and D. FIELDING (USDA-ARS, Fairbanks, AK).

**BREAK**

1515 Business Meeting (Agricultural Sciences 202).

**POSTER SESSION**
Lobby, Eccles Science Learning Center
*Monday*
*1:30 p.m. – 5:30 p.m.*
(Please refer to page 31.)

## WESTERN SOCIETY of SOIL SCIENCE

(Program continued from Monday, page 25.)

**TRACE ELEMENT BIOGEOCHEMISTRY and SOIL REHABILITATION**
Agricultural Sciences 234
*Tuesday*
*9:00 a.m. – 10:00 a.m.*
(Please refer to program on page 26.)

1000 View and judge student posters.

**LUNCH**

1330 Business Meeting (Agricultural Sciences 234).
Presiding: Matthew La Force (San Francisco State University)

**POSTER SESSIONS**
Lobby, Eccles Science Learning Center
*Monday*
*1:30 p.m. – 5:30 p.m.*
*Tuesday*
*9:00 a.m. – 1:00 p.m.*
(Please refer to page 31.)

***notes***

# III. CONTRIBUTED POSTER SESSIONS

*(16)* (number italicized and underlined) indicates a student presentation in competition for Awards of Excellence.
* indicates the presenter from among several authors listed.

NOTE TO PRESENTERS: Tack board stands for poster presentations will be set up in the lobby of the Eccles Science Learning Center. Two presentations will be assigned to each side of the stands. Presenters are expected to be available to discuss their poster presentations at posted times. Presenters must cooperate fully with the time frames for which their presentations are scheduled. The poster stands have numbers on them which coincide with the numbers assigned to the posters in this program (see number in parentheses by the title of each presentation). Presenters are expected to use the appropriately numbered display space for their poster. Posters may be set up in the half-hour preceding the starting time of each session. Posters should remain up until the ending time of the session, and then must be removed immediately. Presenters assume full responsibility for the security of their poster materials.

Those presenting posters must be present at least one hour during the display period and must post the time when they will be on hand to discuss their work.

**Students presenting posters must be present until judging is completed. Ordinarily, two or three judges will visit each student poster.**

## *Monday, June 14*

## *MORNING SESSION*

Lobby, Eccles Science Learning Center
*Monday*
*9:00 a.m. – 1:00 p.m.*

### BIOLOGY

(*6*) *Stress Inducing Cross Protection to UV-B Radiation and Heat of* Metarhizium anisopliae *Conidia*, DRAUZIO E.N. RANGEL*, ANNE J. ANDERSON and DONALD W. ROBERTS (Department of Biology, Utah State University, Logan, UT).

(*7*) *Atomic Force Microscopy Adhesion Mapping of Bacterial Biofilms,*GOPINATH NARASIMHAN*[1], JESSE JOHNSON[1], BRANDT ESPLIN[2], ANNE ANDERSON[2], DAVID BRITT[1] (Departments of Biological Engineering[1] and Biology[2], Utah State University Logan, UT).

(*8*) *Influence of Pluronics™ on Planktonic and Biofilm Growth of a Soil Bacterium,* HEATH HALL*[1], SPENCER MANN[1], DAVID W. BRITT[1], BRANDT ESPLIN[2], and ANNE J. ANDERSON[2] (Departments of Biological Engineering[1] and Biology[2], Utah State University, Logan, UT).

(*9*) *Production of a Monoclonal Antibody against 9L Gliosarcoma,* JANELL L. KNAUFF* and JOAN M. REDD (Department of Biological Science, Walla Walla College, College Place, WA).

(*10*) *1,25-Dihydroxyvitamin D3 Stimulates Vesicular Transport within 10 sec in Polarized Intestinal Epithelial Cells,* TREMAINE M. STERLING* and ILKA NEMERE (Department of Nutrition and Food Sciences and the Center for Integrated BioSystems, Utah State University, Logan UT).

(*11*) *Differential Effects of SDZ 211-939 on Human and Bovine Voltage-gated Sodium Channel Inactivation May Be Due To Differences in the DII-DIII Linkers,* TYCE J. KEARL*[1], PETER C. RUBEN[1], and MEIKE MEVISSEN[2] ([1]Department of Biology, Utah State University, Logan, UT ; [2]Institute of Veterinary Pharmacology, University of Bern, Bern, Switzerland).

(*12*) *Inhibition of CXCR4/SDF-1α Mediated Angiogenesis by Tannic and Ellagic Acid in Breast Cancer Cells,* D.D. TWITCHELL, K.T. MEIER, B.K. MURRAY, and K.L. O'NEILL (Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT).

(*13*) *The Effects of Prolactin (PRL) on Mink* (Mustela vison*) Guard and Under-hair Fiber Length,Under-hair Follicle Depth and Skin Epidermal Thickness*, MARCUS HARRIS*, ERIC SWENSON, JASON HUNT, MALCOLM SHIELDS and JACK ROSE (Department of Biological Sciences, Idaho State University, Pocatello, ID).

(*14*) *Reproductive Inhibition by Methyl Farnesoate in the Tadpole Shrimp* Triops longicaudatus*, a Possible Endocrine Alternative for Population Control,* WILLIAM K. NELSON* and BRIAN TSUKIMURA (California State University Fresno, Fresno, CA).

(15) *Molecular Biogeographic Analysis of the Relationships between* Papilio indra *Sub-Species,* JAMES PRICE*, DEVONE BURTON, AMANDA BUTLER, KRISTI GOODWIN, BRAD GRAHAM, MELISA GRIFFITH MICHELLE HOGG, REBEKAH MARTINEAU, BENJAMIN MCCUMBER, HARLEY MULLEN, PETER

RAVEN, BRIAN STURGILL, DERREL WALKER, KIM WAGSTAFF, JOSEPH WRIGHT, and WAYNE WHALEY (Department of Biology, Utah Valley State College, Orem, UT).

(16) *Problem Solving Dynamics of Stomatal Networks*, JEVIN WEST*, SUSANNA MESSINGER, DAVID PEAK, and KEITH MOTT (Biology Department and Physics Department, Utah State University, Logan UT).

(17) *Confirmation of* Poa *hybrids and Transgene Movement from* Poa pratensis *L.,* AMY ANDERTON (Utah State University, Logan, UT).

### CHEMISTRY

(1) *The Genetic Algorithm Based Elucidation of the Structure of the Multiply Aromatic Clusters of Main Group Elements,* ANASTASSIA N. ALEXANDROVA* and ALEXANDER I. BOLDYREV (Department of Chemistry and Biochemistry, Utah State University, Logan, UT).

(2) *Digitally Enhanced Thin-Layer Chromatography*, AMBER I. HESS (Stevenson School, Pebble Beach, CA).

(3) *Ozonic Acid and Ionic Salts of the* $O_4^{2-}$ *Dianion,* BEN ELLIOTT* and ALEXANDER I. BOLDYREV (Department of Chemistry and Biochemistry, Utah State University, Logan, UT).

(4) *Aggregation of 1,1′-diethyl-2,2′-cyanine Dye on Polyvinyl Sulfate: A Quantitative Study of the Kinetics of the Electron Transfer in the "J-Aggregates",* HUSSEIN SAMHA (Department of Physical Science, Southern Utah University, Cedar City, UT).

(5) *Novel Homocysteine Bridged SOD-SAM Electrode,* QINSHU SUN (Department of Pharmacology and Pharmaceutical Chemistry, Jining Medical College, Jining, Shandong 272013, P. R. China).

### ECOLOGY and ENVIRONMENTAL SCIENCES

(18) *Soil Nitrogen Dynamics Beneath Yellow Starthistle (*Centaurea Solstitialis*) and Smooth Brome (*Bromus Inermis*) Canopies: A Mechanism for Arrested Succession?* JULIE P. RIEDER (Utah State University, Logan, UT).

(19) *Alkaloids and Old Lace: Pollen Toxins Exclude Generalist Pollinators from Death Camas (*Toxicoscordion [=Zigadenus] paniculatum*) (*Melanthiaceae*),* MELISSA WEBER*[1], MORGAN G. YOST[1], JAMES H. CANE[1,2], and DALE R. GARDNER[3] ([1]Biology Department, Utah State University, Logan, UT; [2]USDA – ARS, Bee Biology & Systematics Laboratory, Logan, UT ; [3]USDA – ARS, Poisonous Plant Research Lab, Logan, UT).

## *AFTERNOON SESSION*

Lobby, Eccles Science Learning Center
*Monday*
*1:30 p.m. – 5:30 p.m.*

Presenters—please read note to presenters at the beginning of this poster section, page 31.

### AGRICULTURE and HORTICULTURAL SCIENCE

(4) *Perenniality Traits in* Poa annua *L. Populations Throughout Utah's Diverse Environments,* ALEX N. STOY* and PAUL G. JOHNSON (Dept. of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

(5) *Effects of Saline Irrigation and Rooting Media Organic Matter on Growth and Development of Two Western Native Perennials,* RACHEL N. JEPPSON* and JENNIFER W. MACADAM (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT).

(6) *Characteristics of Root Growth in a Management Intensive Grazing System,* JEFF O. LARSEN*, RHONDA L. MILLER, LUKE A. PETERSEN, and VAUGHN J. THACKER (Agricultural Systems Technology and Education Department, Utah State University, Logan, UT).

### WESTERN SOCIETY of CROP SCIENCE

(7) *Production and Forage Quality of Irrigated Cereals in Montana,* S. D. CASH*, L. M. M. SURBER, A. L. TODD, D. M. WICHMAN, and R. L. DITTERLINE (Montana State University, Bozeman, MT).

(8) *Stage of Maturity, Time of Sampling, and Method of Drying Effects on Forage Quality of Haybet Barley,* L., M. M. SURBER*, S. D. CASH, J. G. P. BOWMAN, and L. BARNEY (Montana State University, Bozeman, MT).

(9) *Nitrate Concentration of Cereal Forage Species at Three Stages of Maturity,* L. M. M. SURBER*, S. D. CASH, J. G. P. BOWMAN, and A. L. TODD (Montana State University, Bozeman, MT).

(10) *Complementation of the Pina (Null) Allele with the Wild Type Pina Sequence Restores a Soft Phenotype in Transgenic Wheat,* H. WANJUGI[1]*, M. J. GIROUX[1], J. M. MARTIN[1], and A. BLECHL[2] ([1]Montana State University, Bozeman, MT and [2]ARS Crop Improvement and Utilization Research Unit).

(11) *Nutrient Management for Winter Wheat Quality in Varying Moisture Regimes,* J. CLAWSON*[1], D. HOLE[1], R. KOENIG[2], B. MILLER[1], E. SOUZA[3], and S. CLAWSON[1]* ([1]Utah State University; [2]Washington State University; [3]University of Idaho).

(12) *Irrigated Winter and Spring Wheat Response to P in Calcareous High Lime Soil,* B. BROWN*, R. GIBSON, and K. HUBER (University of Idaho).
(13) *Trigonelline in Soybean Seeds and Seedlings under Stress Conditions,* Y. D. CHO[1]*, A. B. TURNIPSEED[2], D. A. LIGHTFOOT[3], and A. J. WOOD[3] ([1]Eastern New Mexico Uni. Portlales, NM, [2]South Dakota State U. Brookings, SD , [3]Southern Illinois U. Carbondale, IL).
(14) *Resistance Genes to Multiple Races of Fusarium Wilt in Common Bean,* M. BRICK[1]*, J. B. OGG[1], P. BYRNE[1], H. F. SCHWARTZ[1], and J. D. KELLY[2] ([1]Colorado State University, [2]Michigan State University).
(15) *Change in XTH Activities, Cell Wall Extensibility and Hypocotyl Elongation of Soybean Seedlings at Low Water Potential,* Y. WU[1]*, B. R. JEONG[2], S. C. FRY[3], and J. S. BOYER[2] ([1]Utah State University, [2]University of Delaware, [3]University of Edinburgh).
(16) *Laccase Gene Expression in Maize and Arabidopsi,* V. HAROLDSEN*, E. DAVIS, M. X. LIANG, X. N. CAI, E. BUSHMAN and Y. WU (Utah State University, Logan, UT).
(17) *Proteomic Analyses of Mature Barley Seeds among Recombinant Chromosome Substitution Lines Generated from a Cross between Barley spontaneum and Harrington barley,* D. ROCHE (Utah State University, Logan, UT).
(18) *Differences in Carbon Isotope Discrimination between Two Rowed and Six Rowed Barley Lines,* Q. JIANG*, D. ROCHE, and D. HOLE (Utah State University, Logan, UT).

### WESTERN SOCIETY of SOIL SCIENCE

(1) *Iron Nutrition and Suppression of Cotton Root Rot on Calcareous Soil,* JOHN E. MATOCHA (Texas A&M University, TAES).
(2) *Pasja Yield Responses to Fertilizers under Different Cultivation Methods in New Zealand*, LEANNA REYNOLDS* and ANDREA PEARSON (Crop & Food Research, Hastings, New Zealand).
(3) *Use of Plants and Fish Wastes for Ameliorating Hazards Associated with Coal Bed Methane Waters,* GEORGE F. VANCE*, JOHN G. WOIWODE, ROGER M. HYBNER, KEVIN FITZSIMMONS and GIRISHA K. GANJEGUNTE (Department of Renewable Resources, University of Wyoming, Laramie, WY).

## *Tuesday, June 15*

## *MORNING SESSION*

Lobby, Eccles Science Learning Center
*Tuesday*
*9:00 A.m. – 1:00 p.m.*

Presenters—please read note to presenters at the beginning of this poster section, page 31.

### ANTHROPOLOGY

(14) *A Rotary Dental Mill in* Paranthropus*?* GORDON STRASENBURGH (Society for Scientific Exploration, North Bend, OR).

### COMPUTER and INFORMATION SCIENCES

(*1*) *PLSC Specifications of ARM AMBI-AXI Hardware Protocol,* UDIT M. DAVE* and ANNETTE BUNKER (Verification Research Group, Utah State University, Logan, UT).
(*2*) *Automated Hardware Protocol Verification Using Symbolic Trajectory Evaluation*, ROHIT SARASWAT* and ANNETTE BUNKER (Department of Electrical and Computer Engineering, Utah State University, Logan, UT).

### EDUCATION

(10) *Long-term Mudpot Monitoring: An Ideal Project for Undergraduate Research,* ANNE STURZ*, CHARLES KOEHLER, THERESA COMPTON and JENNIFER PRICHARD (Department of Marine Science, University of San Diego, San Diego, CA).

### HEALTH SCIENCES

(11) *Duration of Heart Problems among Non-Insulin-Dependent Diabetics: Socioeconomic Status Differences,* STEPHEN J. MOREWITZ (Stephen J. Morewitz, Ph.D., & Associates, San Francisco, CA).
(12) *Hypertension Impairment and Socioeconomic Differences among Persons with Insulin-Dependent Diabetes,*

STEPHEN J. MOREWITZ (Stephen J. Morewitz, Ph.D., & Associates, San Francisco, CA).

(13) *Non-enzymatic Glycation in Diabetes – Is it Really Non-Enzymatic? Is it Really Only a Disease Process?* LARRY M. BRAND (San Diego, CA).

## PSYCHOLOGY

(*15*) *Stability of the Mismatch Negativity Response to Frequency, Location, and Duration,* MARIE IMWINKELRIED*, KATE LAMVIK*, EVANTHIA ROUSSOS*, and STANLEY E. LUNDE (University of California-Los Angeles, Los Angeles, CA).

(*16*) *3D Localization of the Mismatch Negativity Response to Auditory Stimuli,* YING LUU*, PHIVAN PHAM, SUSAN SABAL, MICHELLE WATSON and STANLEY E. LUNDE (University of California-Los Angeles, Los Angeles, CA).

(*17*) *Adolescent Development and Environments,* DENISE E. TAYLOR* and RANDALL M. JONES (Family, Consumer, and Human Development Department, Utah State University, Logan, UT).

## SOCIAL, ECONOMIC and POLITICAL SCIENCES

(*3*) *Are Stock Options Congruent with Maximizing Share Holder Value? A Mathematical Derivation,* AMANDA GAIL BERRY (Stevenson School, Pebble Beach, CA).

## WESTERN SOCIETY of SOIL SCIENCE

(*4*) *Metal(loid) Solubility as Affected by Redox Changes in Mining-Impacted Sediments*, DOUGLAS C. FINKELNBURG*, GORDON R. TOEVS, and MATTHEW J. MORRA (Environmental Sciences Program, University of Idaho, Moscow, ID).

(*5*) *Influence of Reclamation Management Practices on Soil Bulk Density and Infiltration Rates,* GYAMI SHRESTHA* and PETER D. STAHL (Department of Renewable Resources, University of Wyoming, Laramie, WY).

(*6*) *Using Soil Texture to Guide Variable-Rate Nitrogen Fertilization,* JARED E HOBSON*, JASON W. ELLSWORTH and APRIL B. LEYTEM (Twin Falls Research and Education Center, University of Idaho, Twin Falls, ID).

(*7*) *Nitrogen Leaching in Management Intensive Grazing,* LUKE PETERSEN*, VAUGHN THACKER, and RHONDA MILLER (Agricultural Systems Technology and Education Department, Utah State University, Logan, UT).

(*8*) *Soil and Vegetation Impacts From Land Application of Saline-Sodic Coalbed Methane Waters,* LYLE A. KING*, GEORGE F. VANCE, and GIRISHA K. GANJEGUNTE (Department of Renewable Resources, University of Wyoming, Laramie, WY).

(*9*) *Evaluation of Geospatial Technologies for Variable Rate Nitrogen Management in Potatoes,*TOM R. BOWEN*, BRYAN G. HOPKINS, and JASON ELLSWORTH (University of Idaho, Idaho Falls, ID).

# ABSTRACTS

**Abstracts are listed in alphabetical order by first author.**
**Not all authors submitted an abstract.**

*The Genetic Algorithm Based Elucidation of the Structure of the Multiply Aromatic Clusters of Main Group Elements,* **ANASTASSIA N. ALEXANDROVA and ALEXANDER I. BOLDYREV** (Department of Chemistry and Biochemistry, Utah State University, 0300 Logan, UT 84322; E-mail: alexandrova@cc.usu.edu).

The Genetic Algorithm optimization strategy inspired by the Darwinian evolution process has been employed for the search for global minima of the homoatomic and heteroatomic clusters of main group elements. The successful usage of both the gradient-following optimization technique implemented in Gaussian 03 package and the features of the Genetic Algorithm for the creation of a population, crossover, mutation and "natural selection" processes have been demonstrated. The Genetic Algorithm based program, written by Alexandrova, was employed to find the global minima of clusters of boron, lithium and magnesium. It was tested on the species having structures known from preliminary works, and was further applied to novel systems. The thus elucidated lowest energy structures were exposed to a more careful *ab initio* treatment and to analysis of the chemical bonding within them. We discovered that multiple aromaticity and antiaromaticity play a crucial role in the stabilization of the considered species. This work is a combined report on the features of the developed Genetic Algorithm based technique and the novel explanation of the chemical bonding within the species found by our program.

*Natural Climates of the Last Millenium: Where Are We in Modeling the Recent Past?* **CASPAR M. AMMANN** (National Center for Atmospheric Research, Climate and Global Dynamics Division – Paleoclimatology, 1850 Table Mesa Drive, Boulder, CO 80307).

Any human climate change is and will present itself superimposed on natural climate variability. It is therefore crucial to determine the full range of natural background variability, and to verify if current climate models reproduce the main aspects of past climates correctly. While internal climate variability such as El Niño-Southern Oscillation or the North Atlantic Oscillation are simulated directly in the model, externally forced climate variations have to be generated through appropriate forcing histories in transient simulations. Dominant forcings over the Millenium are solar irradiance changes and influence from explosive volcanism.

Solar-irradiance changes have been accurately measured only over the last few decades. Assumptions on additional century-scale trends, although commonly applied in climate studies, have recently been questioned. We present results from multi-century transient simulations with a coupled Ocean-Atmosphere General Circulation Model (GCM) forced by a range of forcing estimates: previously considered best-guess values (~0.25% of Total Solar Irradiance), very large solar changes (0.65% TSI) as well as essentially absent low-frequency trends (0.1% TSI). The temporal evolution of the forcing was based on 10-Beryllium fluxes measured in polar ice cores.

Volcanic effects on climate are of a different nature. Their primary impact is only short lived and manifests itself through rather abrupt cooling with limited duration of a few months to a couple of years. Subsequently, the climate system recovers to the initial state over some time. If a sequence of large eruptions with stratospheric sulfur injection occurs in a short time period, then the cumulative effect of these events can cause a decadal or multi-decadal scale cooling.

We show what signals solar-irradiance changes and volcanic aerosol left in transient, fully coupled simulations with the NCAR Climate System Model. We can clearly identify solar fingerprints as well as volcanic cooling episodes and compare them directly with proxy-based climate records. In particular, the simulations allow us to discuss the role of solar irradiance changes over the past centuries and millennia and highlight what the role of the sun was during the 20$^{th}$ century. Apparently, the sun did play an important role in climate variability of past centuries, but at the same time observations of temperature during the 20$^{th}$ century became increasingly inconsistent with the sun as the dominant forcing. In fact, smaller rather than larger irradiance changes are most consistent with climate records over the past Millenium.

*Relationship of Microbial Biomass to Soil Organic Carbon Accumulations on Semi-arid Mineland Reclamation sites in Wyoming,* **JONATHAN D. ANDERSON**, **PETER D. STAHL, and LACHLAN J. INGRAM** (University of Wyoming, Department of Renewable Resources, P.O. Box 3354 Laramie, WY 82071; E-mail: jonathanderson@hotmail.com).

A strong positive linear relationship between microbial biomass (MB) and soil organic carbon (SOC) has been shown to be present in undisturbed soil systems. Studies of MB and SOC in reclaimed mine land soils in Wyoming, observed that MB did not recover to that measured in undisturbed native soil even after 20 years of reclamation. In contrast, SOC was accumulating in amounts greater than that found in undisturbed native soils. In the results of the current study, in which we are examining reclamation management practices on SOC sequestration, we have observed that while the expected strong positive relationships between MB and SOC occur in undis-

turbed native sites, this relationship was not found in a majority of the reclaimed soils we examined. None of a range of variables including electrical conductivity, pH, water holding capacity or total nitrogen appear to be negatively influencing the relationship between MB and SOC. We hypothesize that relatively homogenized soil pore spaces and loss of soil structure, due to topsoil disturbance, in the reclaimed soils may be limiting MB recovery. This is leading to a retarded decomposition rate and, in turn, an accumulation of SOC, thus resulting in the disintegration of the relationship between MB and SOC. It may also be possible that coal contamination of reclaimed soils is complicating the results of the relationship between MB and SOC.

*Confirmation of* Poa *hybrids and Transgene Movement from* Poa pratensis L., **AMY ANDERTON** (Utah State University, 379 Boulevard, Logan, UT 84321-4722; E-mail: alanderton@hotmail.com).

Kentucky bluegrass (*Poa pratensis* L.) is grown all over the world because of its superior turfgrass qualities. Improvement in weed control is of some interest to turfgrass managers and a privately owned company is trying to meet their needs by establishing some lines of bluegrass that are resistant to the active ingredient in Round-Up®, glyphosate, an efficient herbicide. In order to provide it to the market, gene flow needs to be studied between the transgenic bluegrass and other *Poa* species.

Gene flow potential studies have been performed on transgenic bluegrass and other *Poa* species, but not under field conditions. I am confirming that under field conditions resistant seedlings taken from the field have the glyphosate resistant gene, and that these seedlings are hybrids from the transgenic bluegrass and another *Poa* species.

Using polymerase chain reaction methods to amplify a segment of the glyphosate resistance gene, I confirmed that the gene was in each putative hybrid. To confirm each putative hybrid is an offspring from the transgenic bluegrass and another *Poa* species and not seed contamination, I used the chloroplast genome for identification.

All of the putative hybrids are confirmed as being offspring from a transgenic bluegrass and another *Poa* species. This investigation is needed to see if these newly introduced genes could contaminate the natural species and bring in new phenotypes. This research will contribute to the overall study of gene flow with transgenic grasses and other *Poa* species, and aid in the future studies of genetic engineering with grasses.

*Nuclear Transfer Cytoplasts Derived from Cow Oocytes Support Increased Development* In Vivo *but Not* In Vitro *Compared to Heifer-Oocyte-Derived Cytoplasts,* **KENNETH I. ASTON** (Animal, Dairy, and Veterinary Sciences Depatment, Center for Integrated Biosystems, Utah State University, Logan, UT 84322-4815; E-mail: kiaston@cc.usu.edu).

Somatic cell nuclear transfer (SCNT) has recently emerged as an important technology in agricultural, pharmaceutical, and biomedical research. While progress has been made in improving the efficiency of SCNT, rates of development to term remain very low in all species studied thus far. It has been demonstrated that one reason for the low efficiency of the process is incomplete reprogramming of the donor nucleus. Although the exact mechanism for reprogramming has not yet been characterized, it is certain that factors within the oocyte cytoplasm are involved. The rate of *in vitro* development to the morula/blastocyst stage of nuclear transfer (NT) embryos is often used as an indicator of developmental competence. This study evaluates *in vitro* development of NT bovine embryos as well as the subsequent pregnancy establishment and retention rates of these embryos. The current study also compares the developmental competence of bovine NT embryos derived from cow and heifer oocytes. Nuclear transfer was performed, and the resulting embryos (cow-NT and heifer-NT) were cultured *in vitro* for 6-7 days prior to embryo transfer (ET). Following ET, pregnancy status was evaluated around embryonic day 30, and confirmed pregnancies were subsequently monitored approximately every thirty days. Rates of *in vitro* development to the morula/blastocyst stage were similar between cow-NT and heifer-NT groups, however, pregnancy establishment and retention was higher in the cow-NT group than in the heifer-NT group, demonstrating the idea that *in vitro* development is not always an accurate indicator of developmental competence. This data further indicates an apparently important difference between cow and heifer oocytes in their capacity to efficiently reprogram the donor nucleus. Further studies will elucidate the physiological differences between cow and heifer oocytes and hopefully some of the factors involved in the process of nuclear reprogramming.

*Emerging Viral Diseases of Importance to Livestock and Other Animals*, **CLELL V. BAGLEY, D.V.M.** (5600 Old Main Hill, Utah State University, Logan, UT 84322; E-mail: clellb@ext.usu.edu).

Great progress occurred during the past century in veterinary medicine and animal health. Yet as the new century dawned, the United States was seeing the repeat of a scene of equine encephalitis from 70 years previously. Now in 2004 most states have had many cases and Utah is expecting a massive outbreak of West Nile Virus disease, this other form of equine encephalitis. Avian influenza has occurred in recent months in several countries with associated human illness and death. A slightly different strain, not associated with human illness, occurred at two different U.S. locations. Millions of domestic birds were destroyed in the various locations to stop the spread of this disease. In addition to the disease effects, there have been dramatic effects on national economies,

family livelihoods and availability of protein food sources for humans as an aftermath of these disease control efforts. Because of massive increases in global travel and animal transport, the risk of introduction of foreign animal diseases into the U.S. has increased accordingly in recent years. The events of 9/11 emphasize the vulnerability of the U.S. to bioterrorism against both man and animals. Examples of these emerging and potential viral diseases will be related to the role of Regulatory Agencies, animal producers, veterinarians and the average citizen in preventing or controlling these potentially devastating diseases.

*A Synthesis of Recent Climate Warming Effects on Terrestrial Ecosystems of Alaska,* **VALERIE A. BARBER[1], GLENN PATRICK JUDAY[1], ROSANNE D'ARRIGO[2], EDWARD BERG[3], F. STUART CHAPIN III[4], LARRY HINZMAN[5], HENRY HUNTINGTON[6], TORRE JORGENSEN[7], DAVID McGUIRE[8], TOM OSTERKAMP[6], BRIAN RIORDAN[1], VLADIMIR ROMANOVSKY[9], SCOTT RUPP[1], MATTHEW STURM[10], DAVID VERBYLA[1], JOHN WALSH[11], ALEX WHITING[12], MARTIN WILMKING[12]** ([1]Forest Sciences-School of Natural Resources and Agriculture, University of Alaska Fairbanks, Fairbanks, AK 99775; [2]Tree-Ring Laboratory, Lamont-Doherty Earth Observatory, Palisades, NY 10964; [3]Kenai National Wildlife Refuge, Soldotna, AK 99669; [4]Biology and Wildlife Dept., University of Alaska Fairbanks, Fairbanks, AK 99775; [5]Water and Environmental Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775; [6]Huntington Consulting, Anchorage, AK; [7]ABR, Inc. Environmental Research and Services, Fairbanks, AK 99775; [8]Alaska Cooperative Fish and Wildlife Research Unit, University of Alaska Fairbanks, Fairbanks, AK 99775; [9]Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK 99775; [10]USA-CRREL-Alaska, Ft. Wainwright, AK 99703; [11]International Arctic Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775; [12]Native Village of Kotzebue, P. O. Box 296, Kotzebue, AK 99752).

The instrument-based record in Alaska displays a strong, late 20th-century warming. Climate in Alaska also displays a record of sudden regime shifts. Precipitation is highly variable in Alaska and shows no strong trends. However, effective moisture (P-PET) has decreased, resulting in widespread shrinkage and drying of lakes and ponds in regions of low or moderate precipitation. Overall glacial mass balance is negative, although some glacial systems are in positive mass balance. Permafrost is warming across Alaska and ground subsidence associated with thawing of ice-rich permafrost is commonly observed. Since buildings and infrastructure can cause warming of the permafrost, it is difficult to distinguish from climatic warming in some cases. The annual period of snow and ice cover is decreasing and growing season is increasing in length with greater NDVI greenness in the tundra region. North of the Brooks Range, tall shrubs have advanced into the tundra, and warming experiments show that low shrub cover would significantly increase with additional warming. White spruce populations at treeline include some that grow more with warming as well as some that grow less with warming. Major species in the boreal forest region also include similarly responding populations, but growth on many of the most productive sites has declined. Recent high temperatures have caused widespread tree stress. Major outbreaks of tree-damaging insects have occurred due to both tree stress and direct temperature controls on insects. Millions of acres of beetle-killed trees on the Kenai Peninsula are a potential fire hazard. The extent of forest fires in Alaska is positively associated with specific temperature factors. These changes are confronting people with a variety of challenges, ranging from obtaining subsistence food, to health and safety. Scenarios of future Alaska climate produced by GCMs project significant future warming that would exceed the apparent tolerance of some component species of current ecosystems.

*SARSCoV, The "Super Pathogen": What Is Being Done About It?* **DALE L. BARNARD** (Institute for Antiviral Research, 5600 Old Main Hill, Utah State University, Logan, UT 84322-5600; E-mail: honery@cc.usu.edu).

Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus, called SARS-associated coronavirus (SARSCoV). It is a life-threatening and highly contagious febrile respiratory illness that was initially described in early 2003 in patients from Guangdong Province in southern China, quickly followed by numerous cases in Vietnam, Hong Kong, Singapore, Canada, the United States, and a few in other countries. What was and is most disturbing, in addition to the mortality rate of the disease, is the almost uncanny ability of the virus to be disseminated by most routes of transmission, contributing to its already legendary "super pathogen" status, striking terror into humans at its very mention. Successful control of outbreaks have involved near draconian measures, including quarantining, meticulous epidemiological reporting, and full and immediate disclosure by countries with outbreaks. Treatment for the disease has only been supportive, as there are no approved or universally recommended therapies and no vaccines have been developed to date.

Because of the extremely sophisticated technology available to scientists today, much has been learned quickly about the virus, its structure, genes, phylogeny and its interactions with cells, which has contributed greatly to the current research aimed at eliminating the disease of SARS caused by SARSCoV. With the aid of such information, much research is now focused on transmission, control, early diagnostic detection, vaccine development, and chemotherapy. This presentation will review some of the latest findings on

all of these aspects of current research with an emphasis on detection, vaccine development, and chemotherapy.

*Field-pea and Oats Cropping in Mixture in Alaska: As an Alternative Approach to Quality Forage Production and Weed Control,* **S. BEGNA and D. FIELDING** (USDA-ARS, Fairbanks, AK; E-mail: ffshb@uaf.edu).

Intercropping of legumes with non-legumes is an ancient cropping method to increase quality and dry matter (DM) yield of forage with minimum inputs. Annual legumes such as field pea or beans, when grown alone or intercropped with oats, have been shown to produce high quality forage under Alaskan conditions. The objectives of this field study were to evaluate two varieties of oats (Toral and Calibre) and field peas (Carneval and Orb) grown in mixture and sole-cropped for forage yield and quality and their response to weeds. Harvested at flowering, oat (var. Toral with 8577kg ha-1) sole-cropped, averaged over weed treatments (weed-free, weed-free until flowering, and no weed control), yielded significantly more DM than sole-cropped peas, but not more than the second sole-cropped oat variety Calibre (6896 kg ha-1) or oat and peas cropped in mixture (over all avg. 6296 kg ha-1). More importantly, quality measures for the intercropped forage was improved over oats alone: crude protein content (9.5, 18.7, and 11.2%), neutral detergent fiber (62.3, 34.4, and 57.6%), and acid detergent fiber (35.9, 26.2, and 33.6) for oats, peas, and oat-peas in mixture, respectively. Moreover, crude protein content of the dominant weed, common lambsquarters, from which >80% of the DM of weeds came, ranged from 13 to 33% suggesting its usefulness as forage at least in conjunction with the crops. Thus, pea-oats cropping in mixture seems to show a potential as an alternative and sustainable approach for optimum yield and high quality forage and weed control under Alaskan subarctic conditions.

*Examining the Leaky Pipeline in Puerto Rico,* **SARA BENÕTEZ and IDALIA RAMOS** (University of Puerto Rico at Humacao, Humacao, PR 007791; E-mail: saraibenotez@aol.com, iramos@www.uprh.edu).

For years the University of Puerto Rico has had a high rate of women undergraduates in science (up to 70% in some areas). However, these rates of participation are not represented in the faculty. This study is part of an effort to understand this particular situation and to develop strategies to promote the advancement of women at all levels in the academia. With a 35% student response rate, preliminary information has been gathered to identify factors that motivate undergraduate women to pursue a college degree in sciences and to continue studying at the graduate level. This information was obtained by sending questionnaires to all the students of natural sciences of the UPR-Humacao and to the social sciences students of UPR-Cayey that graduated between 1997 and 2003. In addition, two structured group interviews were carried out with UPR-H undergraduate students to examine the experiences of women in the sciences and to explore their future plans in this field. Survey participants indicate that individual factors are having great importance in their decision to pursue a college degree. Despite the fact that only few institutional and department factors were reported as having motivated the sciences students to continue with their studies, the ones that have been mentioned seem to point to gender differences. Factors such as environment that promoted cooperation among students and a sense of community in the university will be discussed. This work is supported by NSF-SBE-0123654 and the UPR-Humacao.

*Peering into the Earth's Most Critical Layer Using Geophysics: Environmental and Engineering Case Studies– Faults, Sinkholes, Cavities, Groundwater, Groundwater Contamination*, **ALVIN K. BENSON** (Department of Physics, Utah Valley State College, Orem, UT 84058; E-mail: bensonal@uvse.edu).

Since human civilization and all life are totally dependent on the upper three meters of the Earth's subsurface, it is probably the most important layer in our planet. Most of our drinking water percolates through this layer. This layer is the foundation for housing, roadways, airports, dams, and other engineering structures, and it contains the majority of human history. This layer is also expected to provide storage for most of our waste products. Yet, the upper three meters of the Earth's subsurface is one of the most complex and least understood ecosystems on Earth. By acquiring geophysical data at the surface, this critical layer can be mapped and the physical properties estimated, providing vital information necessary to help us better use and manage this critical region.

Depths to the water table and stratigraphic information will be investigated at numerous sites using a variety of geophysical data. In addition, the approximate boundaries of contaminant plumes in aquifers will be outlined from surface-acquired geophysical data at sites in Arizona and Utah. Correlation will be investigated between the results of surface experiments and data taken from strategically located wells. Shallow faults will be mapped and the characteristics of the associated subsurface deformation determined to improve our understanding of the potential for future surface ruptures at investigated sites. Data from surface experiments will be correlated with trench data. Examples will also be shown that demonstrate the use of geophysical methods to map underground excavations and/or cavities, to reveal sinkholes, underground caves, and archaeological sites.

*Are Stock Options Congruent with Maximizing Share Holder Value? A Mathematical Derivation,* **AMANDA GAIL BERRY** (Stevenson School 3152 Forest Lake Road, Pebble Beach, CA 93953; E-mail: run_Amanda_run@sbcglobal.net).

If stock options do not align management and shareholder interests but create non-congruent incentives, is there a way to align these incentives? Mathematics gives the opportunity to answer these questions. A simplified hypothetical firm, that has a publicly traded stock, is constructed facing the decision to invest in one of two drugs each with a range of probabilities of specific returns on these investments. The expected return to the shareholder and to the option holder is calculated for each drug. This exercise is repeated on four types of distributions: asymmetric, symmetric with constant frequency, symmetric with constant decreasing frequency, and normal probability distribution. In each of these cases it is shown that by using the algorithm of maximizing expected return the choice of which drug to invest in is different for the stockholder and the option holder. These examples demonstrate that it can be in the option holder's interest to choose an investment with lower expected rate of return and a higher variability (risk). Then leverage is incorporated into the analysis. It is demonstrated that when debt is added at an interest rate equal to the return on assets, the variability of the return increases and as a consequence the return to the option holder is augmented while the expected return of the company does not change. Finally, by defining maximizing shareholder value using a present value formulation an option package that is congruent with shareholder objectives is derived mathematically. This formula requires: the call option must be accompanied by simultaneously requiring management to issue a put, the exercise price must equal the current price at time 0 and the exercise price must be reset at the end of each year to equal, the new stock price, the option award must be discounted over time. This derivation poignantly demonstrates an option holder and a stock holder interests are aligned only when the option holder incorporates the probability of loses in investment decisions. It is pivotal that companies that currently issue stock options change their current methods. By continuing the current method of stock options, companies are putting shareholders in suboptimal investments and assuming unwarranted risky positions. This project supports the contention that the current (generic) practice of issuing stock options encourages management to invest in risky projects while adding leverage to augment the return.

*The Relevance of Relevance: Addressing the Decline in Science Literacy in America,* **WILLIAM B.N. BERRY** (Department of Earth and Planetary Science, University of California, Berkeley, CA 94720).

*Science for All Americans* is one element of the AAAS long-term program, Project 2061, aimed at enhancing science literacy among Americans. The introduction to that book points out: "Most Americans are not science literate. One has only to look at international studies of educational performance to see the U.S. students rank near the bottom in science and mathematics." Studies of science literacy among American high school students have shown steady decline in performance for more than thirty years. Many corporations point out that the lack of science literate students is a real concern for them because the pool of potential employees is diminishing yearly. One consequence is that certain corporate operations are sent outside the U.S. Project 2061 aims at focussing on core essentials in science literacy and in teaching them more effectively. *Science for All Americans* draws attention to the need for reform in teaching science and for the need for widespread collaboration, including that between business and academia. The collaboration between the University of California Environmental Science Teaching Program (ESTP), a program aimed at enhancing science literacy among K-12 students, and the Dow Chemical Corporation may comprise one model of an industry-academia collaboration envisioned by Project 2061. Dow gave a former brownfield in Antioch, California to ESTP to use as a base for project-based or "hands-on" science instruction. Instruction at that site is directed toward showing students how an understanding of the basics of science is relevant to their daily lives and how science literacy may provide them with tools relevant for employment. Many of the students who take part in ESTP programs at that site are from low-income families and from populations underrepresented in California's state colleges and universities. Instruction in many schools from which the students come includes only two or three science courses, none of which are at the advanced level. The rate at which students drop out of these schools between grades nine and twelve ranges from 40 to 70 percent. Upon learning the relevancy of basic science in their lives, many students taught in ESTP programs tend to stay in school and to enroll in college and universities.

*Project-based Learning in the Dow Wetlands, Antioch, California,* **WILLIAM B. N. BERRY and RANDY FISCHBACK (**Department of Earth and Planetary Science, University of California, Berkeley, CA 94720-4767 and Dow Chemical Company, Pittsburgh, CA 94519; E-mail: bberry@berkeley.edu).

United States students ranked below those of several other industrialized nations in science literacy among 15 year olds in a 2000 study by the Program for International Student Assessment. The National Assessment of Educational Progress analysis of science education in US schools noted a decline in science understanding among 12$^{th}$ grade students from 1996 to 2000, 81 percent of whom scored at a "below proficient" level. The nation's students must be prepared to compete effectively for jobs that necessitate an understanding of science. Otherwise, jobs may be lost to applicants educated outside the US. To meet the challenge of increasing science literacy among the nation's students, Dow Chemical Company adopted a policy of fostering project-based learning. The Pittsburgh, California Dow facility implemented this policy when it bought a nearby 450 acre brownfield and turned it

over to the University of California Berkeley Environmental Science Teaching Program (ESTP) to develop project-based learning programs that will enhance regional K-12 science education. ESTP developed a number of such programs for use at the site. For example, Middle School students at The Learner Centered School are taught basic biology and chemistry through hands-on projects by ESTP. Professional development programs that enable local science teachers to augment their skills in project-based learning are conducted by ESTP in the summer. Dow organizes an environmental fair once a year at the site at which ESTP staff demonstrate a number of project-based learning projects that may be used in many science classes.

*A Low Cost Time Domain Transmission Sensor with TDR Performance Characteristics,* **J. M. BLONQUIST, JR., S. B. JONES, and D. A. ROBINSON** (Department of Plants, Soils, and Biometeorology, Utah State University, Old Main Hill 4820, Logan, UT 84322; E-mail:jmarkb@cc.usu.edu).

Time domain reflectometry (TDR) has become a standard method of determining water content in soils and porous media. However, the cost of instrumentation limits its application, especially for agricultural and urban soil water management. We report on a new time domain transmission (TDT) sensor which has the performance characteristics of commonly used TDR devices for a fraction of the cost. We approximate the sampling volume of the sensor and compare it to that of TDR. We demonstrate that the sensor accurately determines permittivity from travel time measurements by comparing the TDT sensor with two TDRs and a network analyzer providing measurements of frequency dependent permittivity. The reported rise time of the TDT sensor is 180 picoseconds, which suggests a frequency bandwidth and upper frequency limit similar to TDR. We determine the maximum passable frequencies of the two TDRs and the TDT sensor in non-relaxing media and demonstrate that they are in fact quite similar. In addition to having accuracy and frequency characteristics similar to TDR the instrument offers the advantage of having the electronics and analysis firmware mounted in the head of the probe which reduces attenuation experienced using TDR with long cables. We see the Acclima Digital TDT Sensor, originally developed for closed-loop turf irrigation control, potentially providing a rugged, low cost alternative to TDR in precision laboratory instrumentation applications in addition to a variety of hydrologic and water management applications.

*Gene Expression Analysis of M955 a Low Phytic Acid Barley Mutant,* **D. E. BOWEN[1], M. J. GUTTIERI[1], V. RABOY[2], and E. SOUZA[1]** ([1]University of Idaho; [2]USDA-ARS Aberdeen ID; E-mail: dbowen@uidaho.edu).

Phytic acid (myo-inositol hexakisphosphate, InsP6) is the major phosphorus (P) storage molecule in seeds. Low phytic acid (lpa) mutants affect the synthesis of InsP6, without affecting the amount of total seed P. InsP6 is unavailable to non-ruminant animals, making it a problem in phosphorus nutrition and management. In addition, InsP6 also chelates divalent cations, including Fe, Ca, and Zn. Low Phytate crops improve phosphorus availability and also might provide a benefit in mineral nutrition. In addition to nutritional benefits, the lpa trait is important in ameliorating phosphorus pollution through more efficient use of seed phosphorus. Mutants expressing a low phytic acid (lpa) phenotype have been developed in crops such as maize (*Zea mays* L.), barley (*Hordeum vulgare* L.), rice (*Oryza sativa* L.), soybean (*Glycine max* (L.) Merr), and recently wheat (*Triticum aestivum* L.). These are valuable tools to study the many effects of the lpa phenotype in biochemical, genetic, and applied research. A viable low phytic acid barley line, M955 has been produced by chemical mutagenesis and has a 90-95% reduction in phytic acid compared to wild-type barley lines. Little is known on the downstream genetic effects of the lpa mutation. This study uses gene expression profiling experiments to analyze gene expression differences in M955 compared to isogenic wild-type lines. Three methods are being employed; real time (RT) PCR, differential display PCR and GeneChip® oligo-arrays. Our results indicate that the lpa mutation tends to slow development, and affect certain genes in pathways removed from the direct pathways of phytic acid synthesis. This ongoing research will aid in understanding the biochemistry, metabolism, and downstream effects of the lpa mutation.

*Evaluation of Geospatial Technologies for Variable Rate Nitrogen Management in Potatoes,* **TOM R. BOWEN, BRYAN G. HOPKINS, and JASON ELLSWORTH** (University of Idaho, 1776 Science Center Dr., Suite 205, Idaho Falls, ID 83402-1575; E-mail: tbowen@uidaho.edu).

Potatoes (*Solanum tuberosum*) are particularly sensitive to nitrogen (N) nutrition. The fertilizer N needed is related to both residual soil N and yield potential and, as such, is hypothesized to be spatially variable. Three methods of variable-rate N fertilization were compared to the traditional method of uniform application in five potato fields in Eastern Idaho. The methods used to divide the fields into application zones included: 1) grid sampling, 2) bare soil imagery with intensive soil sampling, and 3) electrical conductivity mapping with bare soil imagery and intensive sampling. On average, the variable rate N resulted in better total (1.9 M $ha^{-1}$) and US No. 1 (2.7 M $ha^{-1}$) yields over traditional fertilization. All three methods showed an increase in net return over the traditional scenario with grid at \$135 $ha^{-1}$, imagery \$376 $ha^{-1}$, and imagery + conductivity at \$319 $ha^{-1}$; although only the latter two methods were statistically significant. Incidence of hollow heart was also reduced with the variable rate N application. Combining the conductivity technology with bare soil imagery did not result in further improvements in yield and grade, although it should be noted that this method performed better

than the others in one of the five fields evaluated. Although further work is needed to support these findings, it appears that using geospatial technologies for variable rate N management in potatoes is economically viable. It is also probable that this technology will improve N use efficiency, which will likely have positive environmental benefits.

*Non-enzymatic Glycation in Diabetes – Is it Really Non-Enzymatic? Is it Really Only a Disease Process?* **LARRY M. BRAND** (3598 Wellesly, San Diego, CA 92122; E-mail: lmbrand@ucsd.edu).

Quantitation of a glycated hemoglobin, HbA1c, is used clinically to reflect the time-averaged level of the non-enzymatic Schiff's base reaction of blood glucose with this protein, followed by an irreversible rearrangement to a 3-fructoseamino-linked protein. However, evidence from the literature indicates that this reaction sequence is a reversible quasi-equilibrium, involving multiple enzymatic processes. Moreover, the level of glycation occurring by these processes is both highly variable and substantial even in healthy individuals, averaging for hemoglobin 10% to 50% of the HbA1c level seen in diabetic patients. "Non-enzymatic" glycation of membrane phosphatidylethanolamine appears to be even greater than protein glycation; both apparently occur even in invertebrates lacking hyperglycemic diseases. It is proposed that glycation of cellular proteins and membrane components is a regulated process characteristic of an enzymatic pathway, and may represent a physiological signal transduction mechanism. Such a signaling pathway, involving a mix of enzymatic and non-enzymatic elements (in the manner of NO, CO and peroxide signaling) thus involves transient, Schiff's base formation with targets, followed in some cases by Amadori rearrangement to a longer-acting structure that is either cleaved off enzymatically or converted to further signaling molecules that trigger NO or ROS release. Glycation-based glucose signaling may have may have important roles in host defense, immune responses, memory formation, and metabolic regulation, disruption of which by abnormal levels of glycation produces the observed cascade of further pathologic events.

*Resistance Genes to Multiple Races of* Fusarium *Wilt in Common Bean,* **M. BRICK[1], J. B. OGG[1], P. BYRNE[1], H. F. SCHWARTZ[1], J. D. KELLY[2]** ([1]Colorado State University, [2]Michigan State University; E-mail: mbrick@lamar.colostate.edu).

*Fusarium oxysporum* f. sp. phaseoli (Fop) is a soil borne pathogenic fungus that causes a vascular wilt disease in common bean (*Phaseolus vulgaris*). Races of the pathogen occur and genetic sources of resistance are race specific, and, resistance genes to multiple races occur. The line LEF-2RB has been shown to possess resistance to races 1, 4 and 5 Fop. Test show that resistance to all three races is controlled by a single dominant gene and is unique from the single dominant gene that controls race 4 reported in other pinto lines such as Sierra or Fisher. Results from attempts to tag the resistance genes found in Sierra and LEF-2RB will be reported.

*Irrigated Winter and Spring Wheat Response to P in Calcareous High Lime Soil,* **B. BROWN**, **R. GIBSON**, **and K. HUBER** (University of Idaho; E-mail: bradb@uidaho.edu).

UI Parma Research and Extension Center, 29603 U of I Lane, Parma, ID 83660.<br><br>UI fertilizer P recommendations are assumed to differ for winter and spring wheat, but it is not clear whether the differences are due to different planting dates or to the genotypes grown. Irrigated field studies were conducted on a calcareous silt loam at Parma for four years (2000-03) to evaluate the response to available P of winter (Stephens and Madsen) and spring (Treasure and Whitebird) soft white genotypes all fall planted. Similar studies were conducted at the same site for three years (2001-03) to evaluate the response to P of the spring genotypes planted in both fall and spring. Higher available P increased yield in all years and increased dough stage whole plant biomass, P concentrations, and P uptake in some years. Fall planted winter and spring genotypes did not differ in their response to available P. Fall or spring planting dates also did not affect the yield response to available P even though fall plantings were generally more productive than spring plantings. Grain protein and final starch viscosity decreased as higher available P increased yield, but cookie diameter was largely unaffected. The results suggest that irrigated spring and winter wheat in western Idaho have similar P requirements.

*Managing Forward by Looking Backward: Building Sustainable Grazing Operations,* **BOB BUDD** (Director of Land Management, The Nature Conservancy in Wyoming, 350 Red Canyon Road, Lander, Wyoming 82520; E-mail: bbudd@tnc.org).

With the explosion of technological means to achieve management ends beginning in the late 1940s, many managers were convinced that managing for yield, even in monocultures, was the most advantageous approach to agriculture. As a result, consumer food chains were altered, land management was changed, and cultural norms were shattered. More recently, efforts to maintain biological diversity, along with radical swings in the cost of inputs and price of products, has led many to question the sustainability of ranching and farming practices, as well as the ecosystem components and function. At Red Canyon Ranch, in central Wyoming, management over the past ten years has focused on observing and studying ecosystem response to changes in grazing practices, fire regime, and other management approaches. While many view these changes as innovations, most are merely re-establishment of practices put in place by native cultures and early pioneers. Similar shifts have

occurred in Africa and Asia, where biological problems are merely symptomatic of cultural shifts that may not lead to sustainable ecosystems or economies. A combined approach of management, evaluation, market development and public support for biological values may lead to greater sustainability of ecosystems and economies.

*Conditioned Media Effects on Chromosome Composition of Bovine Cloned Embryos*, **T. D. BUNCH and G. P. LI** (Animal, Dairy and Veterinary Sciences Department, Center for Integrated Biosystems, Utah State University, Logan, UT 84322-4815; tombunch@cc.usu.edu; gpengli@cc.usu.edu).

The somatic chromosome number (2n) for a species is usually stable and therefore has been used to assess embryo/fetal viability. Polyploidy (≥ 2n) in the mammalian system is always fatal and results in severe developmental aberrations. Various chemicals such as colcemid and colchicine can affect the meiotic and mitotic spindle apparatus and alter the normal 2n. Exogenous media that embryos are exposure to may also have an effect on diploid chromosome number. Data will be presented that shows how culture media affects the chromosome number in bovine cloned embryos. Four experiments were designed to evaluate the overall and temporal effects of conditioned media (CM) by bovine cumulus cells on development of nuclear transfer (NT) bovine embryos and to examine the chromosomal composition and allocation of inner cell mass (ICM) and trophectoderm (TE) of the subsequent blastocysts. The nuclear transfer embryos were cultured in various CR1aa media conditioned (CM) by preculture with bovine cumulus cells. Development to the blastocyst stage in BSA-containing CM (BCM) and serum-containing CM (SCM) were similar to co-culture group (24% -30%). The 24 hr-conditioned BCM yielded higher blastocyst development than 48 hr- and 72 hr-conditioned BCM. Temporary exposure of embryos to BCM and SCM followed by CR1aa was also studied. Morula and blastocyst development were not different among the groups cultured in BCM for 72, 96, and 168 hr, but were significantly higher ($P<0.01$) than groups exposed to BCM for 24 hr and 48 hr, respectively. Blastocyst development in SCM for 24 hr (29%), 96 hr (25%) and 168 hr (27%) were much higher ($P<0.05$) than those in SCM for 48 hr (12%) and 72 hr (10%). The analyses of chromosomal composition of the resulting blastocysts indicate approximately 80% of the blastocysts cultured in CR1aa with co-culture or groups initially exposed to BCM for 24 hr followed by culture in CR1aa were diploid. However, the incidence of diploidy were only 36% to 60% in SCM-cultured groups and groups cultured in BCM beyond 48 hr. Conditioned media did not affect the allocation of ICM and TE in the blastocyst. No difference was found in the ratio of inner cell mass to total cells in co-culture, BCM or SCM groups (0.424, 0.441 and 0.473, respectively). In conclusion, bovine cumulus cell-conditioned medium and CR1aa with co-culture supported comparable development and blastocyst ICM: total cell ratio of bovine NT embryos. However, conditioned medium affected the blastocyst chromosomal composition and induced higher mixploidy.

*Gender Differences in the Quality of Work Life in Science Departments,* **RONDA CALLISTER** (Management and Human Resources Department, Utah State University, Logan, UT 84322-3555; E-mail: Ronda.Callister@usu.edu).

Approximately 300 out of 400 faculty members in science and engineering departments at Utah State University responded to surveys about their perceptions of the quality of work life in their department. The results of the analyses of these data will be presented. Previous research suggests that women will perceive a more difficult work environment especially in those fields where the percentage of women is very low. This work is supported by SBE-0244922 and Utah State University.

*Comparison of Conventional Above-ground Versus Pot-In-Pot Production of Intermountain West Perennial Wildflowers,* **GUILLERMO CARDOSO** (Department of Plants, Soils, and Biometeorology, Utah State University, Logan UT 84322).

This study compared conventional above ground container production versus below ground pot-in-pot nursery production for three Intermountain West native perennial wildflower species for use in low water landscapes. Root zone temperatures, water use, and crown and root growth were measured for two growing cycles in 2003. All above ground plants had root zone temperatures much hotter than those in the pot-in-pot system, and had somewhat higher water use. Foliage and root growth of *Aquilegia caerulea* was most affected by above ground conditions, while *Penstemon palmeri* and *Mirabilis multiflora* exhibited moderately greater top and root growth in the pot-in-pot system. Pot-in-pot nursery production offers modestly increased growth rates compared to conventional methods for the production of Intermountain native perennials.

*Development of an Imazamox Resistant Wheat Cultivar Suitable for the Pacific Northwest,* **A. CARTER**, **J. HANSEN**, **T. KOEHLER**, **and R. ZEMETRA** (University of Idaho; E-mail: cart7287@uidaho.edu).

Winter wheat is a major crop grown in the Pacific Northwest (PNW). Due to the presence of similar biochemical pathways, grass weed species such as jointed goat-grass, downy brome, annual ryegrass, and others are very hard to control in wheat using herbicides. The presence of grass weeds decreases both the yield and quality of the wheat due to competition and dockage. These decreases result in an economic loss for the producer. Development of an Imazamox resistant wheat variety has made it possible to control grass weed species in wheat. Previous work has shown excellent weed control with minimal crop injury. This resistance trait was bred into three soft white winter wheats adapted to the

PNW. The F1 progeny and subsequent back-cross progeny were screened using a 2X spray rate of Imazamox. Seven BC3S1 lines that showed good tolerance to Imazamox were selected for large scale evaluation. The BC3S2 generations of these were planted and will be sprayed with a 1X and 2X spray rate at both early (tillering) and late (21 days after tillering) time periods. Plants will be evaluated for injury and variation in agronomic traits due to herbicide application. Yield and end-use quality data will also be evaluated. After a second year of testing, the best lines will be selected and released as Imazamox resistant cultivars for producers in the PNW. The release of these cultivars will provide producers an economic alternative for grass weed control.

*Effects of Late Summer Harvest on Alfalfa Productivity and Stand Life in the Northern U.S.,* **S. D. CASH**, **R. L. DITTERLINE**, **K. D. KEPHART**, **and S. L. BLODGETT** (Montana State University, Bozeman, MT; E-mail: dcash@montana.edu).

Alfalfa persistence in northern climates depends on many factors. Despite major genetic improvements in multiple pest resistance and winterhardiness, alfalfa must have appropriate management to optimize stand longevity and yield. Many producers and advisors do not follow the fall "hardening" recommendation for alfalfa: avoid cutting or grazing for four to six weeks before a killing frost. The objective of this study was to provide a demonstration of the effects of poor harvest timing in our alfalfa cultivar testing program. In 2000, 18 cultivars (fall dormancy classes 2, 3 and 4) were established in a randomized complete block (r=3) trial under irrigation near Bozeman, MT. Paired plots of each cultivar were planted; half were harvested under our typical (T) three-cut system, and half were harvested intensively (I, same schedule as T plus an additional cut each year on 1 September). Plots were harvested for four years, and final stand counts and root yields were evaluated in August 2003. Across years, the intensive harvest schedule significantly (P0.05). All plots had acceptable stands (>36 plants per square meter) at termination, except for two cultivars that had poor stands in both I and T. Intensive harvesting reduced crown and root mass by 11 to 55%, and there were significant differences among cultivars. This trial has been a useful demonstration for producers to visualize the impacts of late summer harvests on alfalfa yield and stand longevity.

*Production and Forage Quality of Irrigated Cereals in Montana,* **S. D. CASH**, **L. M. M. SURBER**, **A. L. TODD**, **D. M. WICHMAN**, **and R. L. DITTERLINE** (Montana State University, Bozeman, MT; E-mail: dcash@montana.edu).

Cereal forages are a major source of winter feed for livestock producers, comprising 11% of all hay harvested in Montana. Six cereal forage species (18 cultivars) were grown in a randomized complete block design field trial (r = 4) under irrigated conditions in Bozeman, MT. Plots were 1.7 x 6.7 m with seven rows spaced on 15-cm centers. Forage clip samples were collected prior to harvest when most entries were in the grain watery to milk stage. A 0.3 m clip sample was cut at stubble height, and dried at 60 degrees C for 48 h for dry matter (DM) determination. At harvest, yields were measured with a self-propelled forage harvester. Forage clip samples were ground to pass a 1-mm screen in a Wiley mill and evaluated for crude protein (CP) and fiber (ADF and NDF) concentrations. There were significant differences among crops for forage yield, CP, ADF and NDF. Across years, forage DM yields ranged from 4.3 to 10.2 Mg per ha. Several barley (*Hordeum vulgare* L.) cultivars developed for high feed grain yields had competitive forage production and superior forage quality levels compared to hooded "hay" barley, oat (*Avena sativa* L.) and other species. Hooded or awnless barley cultivars have been developed for dry hay production, however the forage quality characteristics of these could likely be improved by breeding.

*Drought Tolerance of Western Native Perennial Wildflowers Using Line Source Irrigation,* **TERESA CERNY and ROGER KJELGREN** (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT 84322).

We investigated the effectiveness of a line source irrigation system for comparing the irrigation requirements of twelve traditional and Intermountain West native herbaceous perennial wildflower species. Water coverage perpendicular to the main irrigation line decreased with increasing distance from the main line. Water application rate and uniformity were measured across the study. Application rates for positions closest to the sprinkler were unaffected by wind speeds up to 4 m $s^{-1}$. However, application rates with increasing distance from the main irrigation line were influenced by wind speeds as low as 1 m $s^{-1}$. Nine of the species had similar shoot biomass under all irrigation treatments suggesting that limited water application rates did not affect dry matter production and that have potential for use in low water landscapes. Two species, *Aquilegia crysantha* and *Echinacea purpurea*, exhibited decreasing biomass with lower irrigation rates. Line source irrigation studies offer a means to assess the response of a large number of perennial species to drought, but precautions regarding irrigating at the times of wind speeds below 1 m $s^{-1}$ and ensuring uniform rooting volumes by the use of border species are necessary for quality data.

*Surface Warming in the Northern Hemisphere Inferred from Borehole Temperatures,* **DAVID S. CHAPMAN and ROBERT N. HARRIS** (Department of Geology and Geophysics, The University of Utah, Salt Lake City, UT 84112).

Temperature-depth profiles measured in boreholes contain a temporal record of past changes in surface ground temperature (SGT) and provide valuable constraints on

climatic variations over the last few centuries. We construct a Northern Hemisphere mid-latitude (30-60° N) reduced temperature-depth profile from a global borehole temperature database compiled for climate reconstruction. This reduced temperature profile is interpreted in terms of past, surface ground-temperature change and indicates warming on the order of 1° C over the past 200 years. The combination of an initial temperature (the primary free parameter) with the last 140 years of gridded surface air temperature (SAT) data yields a synthetic temperature profile that is an excellent fit to observations. The model accounts for 99% of the observed variance in yields an RMS misfit of only 12 mK with the average Northern Hemisphere temperature-depth profile. The good correlation suggests that this reduced temperature profile shares much information with the mean SAT record over large areas and long time-scales. Our borehole analysis indicates 0.7°±0.1° C of ground warming between pre-industrial time and the 1961-1990 mean SAT, and another 0.3° C of warming to the present day.

*Cold Germination and Emergence of Different Canola Genotypes,* **C. CHEN**, **and K. NEILL** (Montana State University; E-mail: cchen@montana.edu).

Previous seeding date studies showed higher canola seed yield with an early planting date at central Montana, but the minimum temperature required for canola to germinate and the heat units required for canola to emerge are not well known. A growth chamber study was conducted at the Central Agricultural Research Center (CARC), MSU in 2003, to determine the base temperature and heat unit required for germination and emergence for 17 canola cultivars. Fifty seeds from each variety or breeding line were planted on a germination paper placed inside a Petri dish with three replications. The germination paper was soaked with 15 ml distilled water. The Petri dishes were incubated in a growth chamber under 6, 10, and 15° C. Another 50 seeds from each variety or breeding line were planted in a Petri dish filled with sieved Judith clay loam soil with three replications. The seeds were planted at 1.3 cm depth. Soil moisture was about 20%. The Petri dishes were incubated at 6, 10, and 15° C in a growth chamber. The Petri dishes were checked every day and the germination and emergence of the seeds were counted. Germination and emergence rate were calculated by dividing germination and emergence counts to the total seeds planted. The base temperature (minimum temperature) for germination was found ranging from 1.0 to 3.3° C for the canola cultivars in this study, but varied among the cultivars. The heat unit required to reach 50% emergence ranged from 49.9 to 79.9 growing-degree-days, which means that it takes 8 to 13 days for the canola to reach 50% emergence under an average daily temperature of 6° C. There were great variations among the cultivars for heat unit required for emergence.

*Trigonelline in Soybean Seeds and Seedlings Under Stress Conditions,* **Y. D. CHO[1], A. B. TURNIPSEED[2], D. A. LIGHTFOOT[3], and A. J. WOOD[3]** ([1]Eastern New Mexico Uni. Portlales, NM, [2]South Dakota State U. Brookings, SD, [3]Southern Illinois U. Carbondale, IL; E-mail: young.cho@enmu.edu).

Trigonelline (TRG) has been shown to function as a compatible solute as well as a cell cycle regulator, and is more concentrated in legumes than other non-legume dicots. The objectives of this study were to examine TRG concentration in Glycine max seeds and seedlings grown under stress conditions, and to determine the association of TRG concentrations in seedlings with seedling development. Seed germination ranged from 71-92 % across genotypes at different NaCl concentrations and high temperature (45°C) with RH 95% and was inhibited by stress. The rank order of germination rate and seedling growth remained among genotypes under different treatments. The mean TRG concentrations in dry seeds of four genotypes ranged from 44.4-74.6 μg g-1dw and significantly ($P<0.05$) differed to those in seedlings of the genotypes under stress conditions. Growing seedlings gradually biosynthesized TRG through nicotinamide metabolism up to10.2 folds as compared to the values in seeds. TRG concentrations in young seedlings were not significantly altered, but lengths of seedlings decreased significantly ($P<0.05$) in all genotypes as stressed particularly with relatively high (100 mM) concentration of NaCl. TRG concentrations in genotypes grown at different concentrations of NaCl were significantly correlated to seed germination rates, but were positively correlated ($r=0.52^{**}$) to the abnormal development of seedling.

*Nutrient Management for Winter Wheat Quality in Varying Moisture Regimes,* **J. CLAWSON[1], D. HOLE[1], R. KOENIG[2], B. MILLER[1], E. SOUZA[3], S. CLAWSON[1]** ([1]Utah State University; [2]Washington State University; [3]University of Idaho; E-mail: slzrk@cc.usu.edu).

Winter wheat yield in the western United States is limited by two major factors: nutrients (such as nitrogen) and moisture. Nevertheless, producers are under pressure to produce a quality wheat product consisting of high protein, and high test-weight while maintaining high yield. Moisture stress may modify flour protein composition. This can cause interactions between end-use quality and total flour protein content. Previous rain-fed nutrient research found that the addition of high amounts of compost to soil increases yield above what can be explained due to addition of soil nutrients. This increase in yield by compost was attributed to non-nutrient effects, possibly due to such factors as early spring soil warming, increased soil water-holding capacity, and reduced compaction. This research examined the interactions of moisture and nutrient supply on yield, flour quality, agronomic traits, and both organic and inorganic nutrient fate within the soil profile with both hard white (Golden Spike)

and soft white (ID 576) winter wheat under line-source irrigation. The line source irrigation system provides evapotranspiration replacement in the nearest strip while the furthest strips were rain fed only. Ten nutrient treatments ranged from 0-224 kg N ha-1 (supplied as inorganic ammonium nitrate) and 0-100 Mg ha-1 dry weight compost (organic material supplied as composted dairy waste). The organic fertilizer treatments yielded above the inorganic treatments and the highest yield was achieved in the 100 Mg ha-1 dry compost rate. Of the two wheat varieties the soft white (ID 576) yielded above the hard white (Golden Spike).

*Precision Agriculture Technology to Plan and Manage a New Research and Extension Center,* **D. A. CLAYPOOL[1], H. J. FARAHANI[2], R. P. BELDEN[1], and L. C. MUNN[1]** ([1]University of Wyoming, [2]USDA-ARS; E-mail: claypool@uwyo.edu).

The Wyoming Agricultural Experiment Station (WAES) purchased land in 2003 to establish a new research and extension center (REC) to replace the Torrington and Archer stations. The Sustainable Agriculture Research and Extension Center (SAREC) consisting of approximately 200 irrigated, 485 dryland crop, and 650 rangeland hectares, is located in Goshen County. It will be a field laboratory for investigating various aspects of crop and livestock production. Initially, baseline soil and yield data were collected for land use planning to identify areas best suited for various types of experimental work and to plan an irrigation system. Yield maps were produced for the irrigated land (planted to oats) and dryland winter wheat acreage in 2003. The irrigated land and 200 acres of the dryland area were mapped with a Veris® 3100 Soil Electrical Conductivity (EC) Mapping System. Soils were sampled on a 1-ha grid and correlated with EC data. A GIS (Geographic Information System) computer program is being used to combine and analyze the relationships between yields, EC, and other soil properties. In the future GIS will be used to plan and coordinate research studies as well as to maintain a detailed history of field use. The combination of yield and soil EC maps plus detailed soil sampling and analysis means that much more will be known about the soils at SAREC before research begins than during the establishment of any previous Wyoming REC.

*Advances in Livestock Genomics,* **NOELLE E. COCKETT** (Department of Animal, Dairy and Veterinary Sciences, Utah State University, Logan, UT 84322-4700; E-mail: Noelle.Cockett@usu.edu).

Genome maps in livestock species have been under development for the last decade. Advances in this research area are remarkable, given the paucity of funding and personnel devoted to these projects. The cattle and swine linkage maps are the most highly developed of the livestock species, with 3,000 and 2,200 loci, respectively. Linkage maps of the minor species are less complete, with 1,000 and 1,070 mapped loci on the horse and sheep maps, respectively. Genome mapping in chickens has been a challenge because a large number of micro-chromosomes exists in this species. Despite this added complexity, the chicken linkage map has about 2,000 assignments. In addition to the linkage maps, physical maps exist for each species, which are created by direct assignment of a gene or marker to an intact chromosome or chromosomal fragment using *in situ* hybridization, somatic cell hybrid analysis, or radiation hybrid mapping. In addition, a project to obtain the complete bovine genome sequence is underway, and funding to support a porcine genome sequence project is being sought. Using these resources, several livestock traits of economical importance have been localized to specific regions. The causative gene has been identified for a proportion of these mapped traits using a positional candidate cloning approach. This method requires not only analysis of the trait itself but also the development of a comparative map for the species of interest. Anchor loci that are mapped in both "map-poor" and "map-rich" species allow orientation of the maps across species and therefore, localization of specific genes.

*Recruiting Quality Majors: New York High School Students Experience the Geology of Southern Utah,* **MARK R. COLBERG, ROBERT L. EVES, and C. FREDERCK LOHRENGEL II** (Division of Geosciences, Southern Utah University, Cedar City, UT).

Southern Utah University (SUU), Division of Geosciences, is faced with seriously increased competition for students within its traditional recruiting area, the direct result of nearby two-year institutions expanding their missions to four-year roles. Because of this increased competition, it is obvious that students must be recruited from new source areas. Research indicates that New York State has one of the most outstanding high school Earth Science programs in the United States, and it became a target area for recruiting quality students to the SUU geoscience program.

Located in the Colorado Plateau to Basin and Range transition zone, SUU is situated in one of the most spectacular and diverse geologic regions in the world. SUU is surrounded by classic southwestern geologic exposures and extensive public lands. In order to use this resource to its maximum advantage, a one-week field program was arranged that would accommodate a maximum of 30 students from New York high schools. The target audience is comprised of juniors and seniors who have participated in an Earth science course, and have expressed an interest in a geoscience career. The field program provides students with a positive learning experience, and stresses basic geologic concepts while utilizing the stunning regional geology of southern Utah as an outdoor classroom. Students receive transferable college credit for participation.

To make contact with potential participants, a letter was sent to high school principals requesting the name(s) of the

earth sciences teacher(s) in the school. The response was limited (apparently principals do not forward materials to faculty members). However, there was sufficient response to conduct a field experience during late July, 2003. This initial offering was extremely successful and received positive reviews from all participants. The final results of this pilot offering are not yet known, but we are convinced that enrollment of students into SUU's program will result from an intense, and consistent, follow-up with the participants, until they are ready to enter university.

*Irrigation and Growing Media Effects on Pot-In-Pot Production of Intermountain West Native Perennial Wildflowers and Shrubs*, **AMY CROFT** (Department of Plants, Soils, and Biometeorology, Utah State University, Logan UT 84322).

This study investigated the pot-in-pot production system as a method of producing the native and drought adapted plant material needed for water-wise landscaping in the Intermountain West. The effect of two irrigation systems, drip irrigation and overhead sprinkler irrigation, and two growing media types, a commercial media and a locally constructed media, on the growth and quality of 56 perennial species and 20 shrub species was compared over two years. Irrigation method did not have a significant effect on plant growth and quality, but media type did have a significant effect. The commercial media performed better than the locally constructed media. The pot-in-pot system was projected to be profitable over a 10 year period, with investment costs being recovered within two years.

*PLSC Specifications of ARM AMBI-AXI Hardware Protocol,* **UDIT M. DAVE and ANNETTE BUNKER** (Verification Research Group, Utah State University, Logan, UT 84322; E-mail: bunker@helios.ece.usu.edu).

Verification engineers find it difficult to write specifications with current formal specification languages like LTL and CTL. This difficulty is one of the reasons that formal methods are not widely accepted. As a solution to this problem, we propose Protocol Live Sequence Charts (PLSCs) as a formal specification language and claim that PLSCs are not only expressive enough but also conceptually accessible for widespread hardware protocol compliance verification. Previous work in this area uses PLSCs to specify the Virtual Component Interface (VCI), a system-on-chip communication standard developed by the Virtual Socket Interface Alliance (VSIA) and Peripheral Component Interconnect (PCI), a complex industrial standard. We present the latest specification in this series, the ARM AMBA-AXI (Advanced Extensible Interface), a modern pipelined protocol. Future work aims to establish that PLSCs are expressive enough to unambiguously specify today's most complex industrial communication protocols.

*Comparison of Annual and Multi-Year N-Based and P-Based Manure Applications,* **J.G. DAVIS, C.C. TRUMAN, K.V. IVERSEN, and K.C. DOESKEN** (Colorado State University, Fort Collins, CO; USDA-ARS Southeast Watershed Research Laboratory, Tifton, GA; and USDA-ARS, Auburn, AL; E-mail: Jessica.Davis@Colostate.edu).

This 4-yr study (2000-2003) compares beef manure application strategies in their impact on soil and plant nutrient concentrations and nutrient runoff and leaching. The treatments were a fertilizer control, annual N-based manure application, N-based applied every other year, annual P-based, P-based applied every other year, and P-based applied once every four years. By the third year of the study, soil test P levels in the soil surface reflected the amount of $P_2O_5$ applied either as manure or fertilizer, but there was no significant treatment effect below 30 cm. Corn earleaf P concentration also followed the pattern of increasing with P application rate. However, soil $NO_3$-N did not reflect application rates in a similar manner, and soil $NH_4$-N was not significantly impacted by treatment at any depth. On the other hand, nutrient concentrations in runoff in year four were directly related to the amount of nutrient applied during the previous 4-yr period. The annual N-based manure application treatment had significantly higher soluble P in runoff than the annual P-based manure application rate; however, there was no difference in runoff P concentrations between the annual and 4-yr P-based manure application treatments.

*Factors Influencing L1 Retrotransposition*, **PRESCOTT DEININGER, VICTORIA PEREPELITSA-BELANCIO, MOHAMED EL-SAWY and ASTRID ENGEL** (Tulane Cancer Center, Tulane University, New Orleans, LA 70112; E-mail: pdeinin@tulane.edu).

L1 elements are the dominant mobile element that drives the mobility of almost all RNA-mediated retrotransposition in the human genome. This activity represents a major contributor to human genetic instability leading to disease. This type of retrotransposition has caused extensive changes to the mammalian genome, leading to almost half of the genome being represented by molecular fossils of these retrotransposition events. We will present two novel aspects of regulation associated with L1 elements. The first is that these elements attenuate their expression by premature polyadenylation of their transcripts. These prematurely terminated transcripts are presumably non-functional and may represent a way in which L1 elements minimize their impact on the human genome. This attenuation mechanism appears to vary in different cell types, suggesting the possibility that it may also serve to regulate the rate of L1 retrotransposition. We have further shown that several heavy metals are capable of stimulating L1 retrotransposition. This suggests that various environmental influences may alter the rate at which L1 elements cause damage to the genome. In this particular case, the metals appear to act by inhibiting as yet undefined

DNA repair pathways that may influence retrotransposition rates.

*Perceptions of Faculty and Administrators at the University of Puerto Rico at Humacao about Gender Bias in Faculty Recruitment Practices,* **MARIA DEL C. CRUZ and MYRNA AYALA** (ADVANCE Program and Department of Education, University of Puerto Rico at Humacao, CUH Station, Humacao, PR 00791; E-mail: ma_cruz47@hotmail.com, m_ayala@webmail.uprh.edu).

The University of Puerto at Humacao (UPRH) is a public undergraduate institution with approximately 4,300 students and 350 faculties. We will present the results of a survey among UPRH faculty population to find out if there are differences in men and women recruitment conditions and representation in the science and non-science programs. Descriptive analyses of qualitative and quantitative data will be used to gather conclusions. This work is supported by NSF-SBE-0123654 and the UPRH.

*Potential Human Health Benefits of Forage Based Milk and Meat,* **TILAK R. DHIMAN** (Animal, Dairy and Veterinary Sciences, Utah State University, Logan, UT 84322-4815; E-mail: trdhiman@cc.usu.edu).

There is a growing interest in consuming health promoting foods. Scientific information on healthful foods will provide basis for marketing and purchasing these products. Conjugated linoleic acid (CLA) has been studied recently mainly because of its potential in protecting against cancer. The *cis*-9, *trans*-11 isomer is the principle dietary form of CLA found in food products of ruminant origin. Milk and meat from animals grazing pasture or fed forage alone with no grain supplementation has 3 times more CLA than milk and meat from animals fed conserved forages and grain. Vitamin E supplementation may prevent or delay coronary heart diseases, protect against the development of cancer by enhancing immune functions in humans. The amount of alpha-tocopherol (vitamin E) in milk and meat from animals grazing on pasture is double than milk and meat from animals fed conserved forages and grain. Omega-3 fatty acids are considered essential for human health and must be supplied through the diet. Additionally, a proper ratio between Omega 3 and Omega 6 fatty acids (1:4) prevents disease development. Milk and meat from animals grazing pasture or fed forages have higher levels of omega -3 and more favorable ratio between omega 3 and 6 fatty acids than milk and meat from animals fed conserved forages and grain. Scientific studies support our hypothesis that that milk and meat from animals grazing pasture or fed forages have higher levels of healthful lipids and vitamins as compared to milk and meat from conventionally raised animals.

*Hantavirus: A Significant Threat?* **RICHARD DOUGLASS** (Montana Tech of the University of Montana, Butte, MT; E-mail: RDouglass@mtech.edu).

Hantaviruses are rodent-borne pathogens that produce chronic persistent infections in their reservoir hosts. Hantaviruses occur in many places in the world . Prior to 1993, only two hantaviruses had been described in North America, Prospect Hill and Seoul viruses . Neither was known to cause significant human disease in the United States. In 1993, an outbreak of a respiratory illness of unknown etiology in the Four Corners region of the southwestern United States led to the isolation and identification of Sin Nombre virus (SNV) and to the description of hantavirus pulmonary syndrome (HPS). The primary reservoir of SNV was determined to be the deer mouse, *Peromyscus maniculatus.* Recognition of HPS presented unique opportunities to study the ecology of reservoir hosts. A series of cross-sectional and longitudinal studies were initiated to describe the extent of hantavirus infection in North American reservoir species and to increase understanding of reservoir ecology and host-virus dynamics. These studies were intended to provide the requisite data for predicting outbreaks and designing mechanisms to reduce human infection. They were based on a critical assumption: that human risk is directly related to reservoir population density in sylvan or natural settings . However, most human cases of HPS are acquired in peridomestic settings, including human dwellings, out-buildings, corrals, and ranch yards. This presentation describes outcomes of longitudinal sylvan studies, peridomestic studies and human risk of contracting HPS from SNV infected deer mice.

*Ozonic Acid and Ionic Salts of the $O_4^{2-}$ Dianion,* **BEN ELLIOTT and ALEXANDER I. BOLDYREV** (Department of Chemistry and Biochemistry, Utah State University, 0300 Old Main Hill, Logan, UT 84322-0300, USA; E-mail: boldyrev@cc.usu.edu).

In development of high-order oxygen species, we recently reported the results of our study of the $O_4^{2-}$ dianion.[1] We have further investigated, using ab initio methods, the ozonic acid form, $H_2O_4$, of the $O_4^{2-}$ dianion and its ionic salts. The acid itself was found to be unstable toward dissociation into the OH and $HO_3$ radicals. Further, the probing of the $Li_2O_4$ salt was inconclusive, suggesting that it too is unstable. However, through selection of the "superalkali" cation, $FLi_3^{2+}$, we have made positive progress toward the goal of stabilizing the dianion. The $FLi_3O_4$ molecule is a true minimum and is stable against all dissociation channels. We believe that our continued work on these species will lead to the synthesis of the first and future, high-order, covalently-bound oxygen content compounds, which may be useful as High Energy

Density Materials, compact oxygen storage, or new strong oxidizers.

[1]H. J. Zhai, X. Yang, X. B. Wang, L. S. Wang, B. Elliott, A. I. Boldyrev *J. Am. Chem. Soc.*, **2002**, 124(23), 6742

*Variability and Trends in Alpine Glaciers,* **DANIEL B. FAGRE** (U.S.G.S. Northern Rocky Mountain Science Center, Glacier National Park, MT 59936).

The glaciers of Glacier National Park, Montana, are shrinking and may be gone within our lifetimes. At the end of the Little Ice Age (ca. 1850) an estimated 150 glaciers occurred within current park boundaries. By 1968, only 37 were deemed viable or large enough to warrant being named on maps. Aerial photography acquired in 1993 indicated that the largest of park glaciers had shrunk to less than a third of the area previously covered, and many of the smaller glaciers had disappeared or were no longer large enough to be considered glaciers. The area within park boundaries covered by ice and permanent snow was reduced from 99 $km^2$ to 26 $km^2$. Furthermore, several computer models estimated that all glaciers would be gone between 2030 and 2050 at current warming rates in the northern Rocky Mountains. Recent analysis of 1998 aerial photographs documents the continuing reduction of glacierized area within Glacier Park. As few as 26 ice masses are still functioning as glaciers. Ice radar measurements of glaciers has ecological consequences because late-summer streamflow is maintained by glacial melt in mountain watersheds.

*Metal(loid) Solubility as Affected by Redox Changes in Mining-Impacted Sediments*, **DOUGLAS C. FINKELNBURG, GORDON R. TOEVS, and MATTHEW J. MORRA** (Environmental Sciences Program, University of Idaho, Moscow, ID 83844; E-mail: fink4961@uidaho.edu).

Floodplain sediments along the South Fork of the Coeur d'Alene River in Idaho are enriched in Pb, Zn, As, Cd, and other trace elements as a result of over one hundred years of mining activity in the Silver Valley mining district. Factors responsible for mobilization of the contaminants and their release into the river are not well understood. Our objective was to characterize the mobility of metal(loids) in contaminated pond sediments that undergo yearly redox changes. Total metal(loid) concentrations in the sediments were determined on cores retrieved using Plexiglas pipe. Sediment pore water was sampled to depths of 36 cm using equilibrium samplers installed in the sediment and retrieved 4 weeks later. Sediment analysis showed lead concentrations as high as 12,056, As 256, Cd 129, and Zn 10,074 mg/kg. $NO_3^-$ and $SO_4^{2-}$ were present in the pore water at detectable concentrations in spring, but only minimal $SO_4^{2-}$ was detected in summer-collected pore water samples. $Fe^{2+}$ was found to increase with depth both in spring and summer pore water samples averaging 135 mg/L in summer and 85 mg/L in spring pore water samples. Despite redox changes as determined using indicative species, no As, Cd, Pb, or Zn were detected in pore water collected in any season. Our investigations indicate that redox changes in saturated sediments may not be extreme enough to cause seasonal metal(loid) release. Increased understanding of the mechanisms controlling metal(loid) solubility within these environments is vital to developing contaminant management practices to control potential human and biotic health risks.

*The Mechanism of the Cat Twist,* **J. RONALD GALLI** (Department of Physics, Weber State University, Ogden, UT 84408-2508; E-mail: jrgalli@weber.edu).

It has been well documented that a typical cat is capable of executing a torque-free twist in mid-air to land on its feet from an inverted position. The mechanism by which this occurs will be explained and demonstrated with the aid of a mechanical model which has been invented and constructed by the author.

The "mechanical cat" is made from copper tubing, springs, and other metal parts. It has evolved legs and a head, with face, (it does not need a tail), and it now performs very consistently compared to when it was first described in writing in The Physics Teacher Vol. 33, Sept.1995.

*Can Land Application of Saline-Sodic Coalbed Methane (CBM) Water be a Sustainable Practice: Effects on Soil Properties,* **GIRISHA K. GANJEGUNTE, LYLE A. KING and GEORGE F. VANCE** (Department of Renewable Resources, University of Wyoming, Laramie, WY 82071; E-mail:girishag@uwyo.edu).

Changes in soil physical and chemical properties due to land application of coalbed methane (CBM) waters were investigated in study sites located in the Powder River Basin (PRB) of Wyoming. CBM water samples were collected and analyzed for pH, EC, and SAR values. Water quality data indicated that the EC and SAR value were greater than the recommended values for irrigation use (<0.75 dS $m^{-1}$ and <10 SAR). Soil samples were collected from 6 control and irrigated sites to a depth of 120 cm; irrigated sites have received CBM water applications for up to 3 years. Soil physical (infiltration rates, bulk density, and hydraulic conductivity) and chemical (pH, EC, and SAR of saturation paste extracts) properties were determined following standard methods. Differences in soil physical properties between irrigated and control fields indicated a general trend of greater bulk densities, lower infiltration rates and lower hydraulic conductivities in CBM water irrigated fields. Significant differences ($p = 0.05$) were observed with regards to soil chemical properties (e.g. pH, ECe, and SAR) between sites that received CBM water irrigation and control sites. Thus, irrigation with saline-sodic CBM water is beginning to show adverse impacts on both soil physical and chemical properties. It is estimated that the

cumulative CBM water production in the PRB region will exceed 366,000 ha-m and the results of this study will be useful in understanding the potential implications of this development on soils of PRB region.

*Seed Propagation of Native Shrubby Saltbushes (*Atriplex: *Chenopodiaceae),* **S.C. GARVIN and S.E. MEYER** (USDA-Forest Service Shrub Sciences Laboratory, Provo UT).

Shrubby members of the genus *Atriplex* are widely used in the revegetation of disturbed wildlands and have tremendous potential as ornamental plants in low water use landscapes. They are fast-growing, evergreen shrubs that flower primarily in spring but hold their often showy fruits well into the following fall and winter, providing year-round interest. The seeds of native shrubby species are borne within heavy, fused bracts, making it impossible to separate filled and unfilled fruits using standard cleaning equipment, and fill is often low. The seeds are often dormant at harvest and require treatment for dormancy release. Species and accessions from North American warm deserts, for example, Desert Holly (*A. hymenelytra*) and Quailbrush (*A. polycarpa*) are generally readily germinable at harvest, whereas seeds of Fourwing Saltbush, especially those of cold desert accessions, are generally dormant at harvest and require a period of dry after-ripening to become germinable. Seeds of Shadscale (*A. confertifolia)* are deeply dormant at harvest and require high temperature dry after ripening to become responsive to cold stratification. Seed propagation of these plants is relatively straightforward once dormancy is broken, although the seedlings are prone to damping off diseases and must be planted in a well-drained medium and watered carefully to avoid this problem.

*Study of Spider Silk with a Particular Emphasis on Surface Behavior,* **AUTUMN GARZA-GOSSETT and V.A. RAVI** (Chemical and Materials Engineering Department, California State Polytechnic University at Pomona, 3801 West Temple Ave., Pomona, CA 91768; E-mail: asgossett@csupomona.edu).

The area of spider silk research is a part of an emerging field of science, biomimetics, the multi-disciplinary study of the form and function relationships in natural systems and materials. Current research of spider silk as a fiber includes extensive investigation of the mechanical engineering properties and molecular composition. However, there is an absence of examination of the surface behavior of spider silk. Through a comprehensive and critical analysis of literature, surface character experimentation and electron microscope analyses this project provides an initial exploration of the surface characteristics of spider silk.

*Studies of a Human Retrotransposon,* **NICOLAS GILBERT, SHIELA PRIGGE, TAMMY MORRISH, and JOHN V. MORAN** (Departments of Human Genetics and Internal Medicine, University of Michigan Medical School, Ann Arbor, MI 48109-0618; E-mail: moranj@umich.edu).

LINE-1 elements (L1s) are abundant non-LTR retrotransposons that comprise ~17% of human DNA. The majority of L1s (>99.8%) harbor mutations and cannot mobilize (i.e., retrotranspose). However, the average human genome contains ~60-100 retrotransposition-competent L1s (RC-L1s), and their movement can, on occasion, cause disease. RC-L1s are 6 kb in length and contain a 5' untranslated region (UTR) that harbors an internal promoter, two open reading frames (ORF1 and ORF2), and a 3' UTR that ends in a poly (A) tail. ORF1 encodes a 40-kDa RNA binding protein (ORF1p or p40), whereas ORF2 has the potential to encode a 150-kDa protein (ORF2p) with demonstrated endonuclease and reverse transcriptase activities. We recently have developed an assay to monitor L1 retrotransposition in cultured human cells. My laboratory uses this assay in conjunction with molecular biological and biochemical methods to address the following questions: 1) What is the molecular mechanism of L1 retrotransposition? 2) How does L1 retrotransposition affect the human genome? and 3) Can engineered L1s be harnessed for practical purposes? My talk will focus on recent advances our laboratory has made toward answering these questions.

*Brian Head Field Ecology: Pros and Cons of Applied Ecology and Education Partnerships on the Colorado Plateaux*, **KATE GRANDISON** (Biology Department, Southern Utah University, 351 w. Center, Cedar City, UT 84720. E-mail: grandison@suu.edu).

Since 1995, Utah science teachers have been learning ecology through ecological monitoring of spruce-fir habitat on the Colorado Plateaux in south-western Utah. The course is a collaborative effort between science educators and land and wildlife management agencies, to establish baseline data and enhance the existing knowledge about effects of different management activities and spruce bark beetle effects in spruce-fir forests. Participating agencies are Southern Utah University, Dixie National Forest, Utah Division of Wildlife Resources, and Cedar Breaks National Monument. Teachers assist agencies for one week collecting data from small mammal traps, insect pitfall traps, bird surveys, snag and down wood surveys, a pollinator bee survey, and bat and owl surveys. This provides teachers with hands-on experience in survey techniques and analysis, and supplies management agencies with important ecological data. However, eight years of measurements of biotic and abiotic components along the three separate transects have yielded variable results. Small-mammal species diversity and richness, insect abundance and ground vegetation varies between transects and years, but forest songbirds do not; and solitary bee abundance is high. Variation may be due to highly variable weather and snow depth conditions, inherent differences among sampling locations, erratic spread of spruce bark beetles, and/or year-

to-year differences in teacher techniques. Nonetheless the study has provided management agencies with long-term baseline data for these spruce-fir forest areas as well as a classroom model for inquiry for secondary science teachers.

*Reconciling Natural, Multi-decadal Climate Variability and Predictions of Anthropogenic Climate Change in Western U.S.,* **STEPHEN T. GRAY and LISA J. GRAUMLICH** (Big Sky Institute, Montana State University, Bozeman, MT 59717).

Potential interactions between naturally-occurring, low-frequency climate variability and anthropogenic warming present one of the most formidable challenges to detecting and predicting future climate-change impacts. In many regions, characterization of low-frequency climate modes has been hampered by the short length of instrumental records. In western North America, however, tree-rings provide the long-duration (500-1,000 year) proxies needed to evaluate the strength and stability of decadal to multi-decadal variations within and prior to the instrumental era. Spectral analysis of drought-sensitive tree-rings demonstrates that the climate of western North America is marked by strong modes of variability in the 50-70 year domain that produce significant changes in regional precipitation over timescales from one to several decades. The resulting droughts and pluvial events tend to be spatially coherent at the subcontinental scale and, as demonstrated in a suite of paleo-vegetation and paleo-hydrologic studies, can synchronize physical and biological processes across the Great Plains, the U.S.-Canadian Rockies, and the Colorado Plateau. A growing consensus among conservation biologists, hydrologists, agriculturalists, and human-health experts suggests that such multi-decadal variability could alternately mask or amplify the effects of anthropogenic warming, and could increase the range of future climate-change responses beyond those modeled from trace-gas forcing alone. Evidence also indicates that these multi-decadal variations are linked to slow, internal changes in the Atlantic and Pacific Oceans and, therefore, can be separated from anthropogenic warming trends. Given a more complete understanding of key ocean-atmosphere processes, this multi-decadal variability may ultimately be predictable over time frames from 1-10 years.

*Integrating Daily Patterns of Pasture Soluble Carbohydrate Level and Grazing Behavior,* **T. C. GRIGGS[1], J. W. MACADAM[1], H. F. MAYLAND[2] and J. C. BURNS[3]** ([1]Utah State University, Logan, UT; [2]USDA-ARS, Kimberly, ID; [3]USDA-ARS, Raleigh, NC; E-mail: tgriggs@ext.usu.edu).

Herbage soluble carbohydrate (SC) levels fluctuate diurnally and are often highest in evening. Livestock preference, intake, or performance have been shown to increase with higher SC concentrations in hay and pasture herbage. Daily SC patterns have been evaluated in intact swards, but few assessments have been made during progressive defoliation of orchardgrass (*Dactylis glomerata* L.) via grazing. We tested the hypothesis that evening allocation of daily herbage in rotationally-stocked orchardgrass increases mean daily dietary SC levels, relative to morning allocation. Soluble carbohydrate levels were compared in June, August, and October during 24-h clipping sequences initiated at 1900 h (PM) and 0700 h (AM). Sward height decreased from 40 to 8 cm at a rate of 0.33 of current sward height every 6 h. Differences among 24-h mean SC levels were small. Daily mean SC levels for PM and AM treatments were 144 vs. 136, 91 vs. 88, and 71 vs. 60 g kg-1 in October, June, and August, respectively. Other work showing increased rate or duration of grazing by livestock in evening suggests that daily mean dietary SC levels may be more divergent under actual grazing than in our simulations. Estimated differences in daily mean dietary SC levels for PM and AM herbage allocation, adjusted for diurnal patterns of grazing behavior, will be presented.

*Iodide Sorption and Volatilization in Soil Environment,* **PAUL R. GROSSL[1], STEPHAN TROLOVE[2], and MARY HUBBARD[1]** ([1]Dept. Plants, Soils, and Biometeorology, Utah State University, Logan, UT 84322-4820 and [2]Crop & Food Research, Hastings, 265 Lawn Rd, RD 2, New Zealand; E-mail: grossl@cc.usu.edu).

The environmental fate of iodine (I) as a biocide in soil is not well understood. The active killing agent in biocide formulations is elemental iodine ($I_2$). Since $I_2$ has an extremely limited lifetime, the important species to study from an environmental fate standpoint is the end-point metabolite iodide ($I^-$). Upon analysis of our own and previously reported data, we concluded that iodide volatility in soils is influenced more by the capacity of a specific soil to retain iodide than by its ability to generate potentially volatile forms of iodine. Initial studies predicted, via correlation matrices and modeling, that the volatility of iodide from a specific soil can be anticipated and/or predicted to a large degree based on its indigenous iodine ($I^-$) content, organic matter content (OM), and its pH. Experiments were conducted to measure iodide adsorption onto soils with varying amounts of organic matter (OM), where OM levels ranged from about 4.5 to 13% and varying pH values ranging from 5.0 to 6.5. Iodide retention by these soils was low with a distribution coefficient (kd) value averaging about 1. The amount of added iodide absorbed to these soils ranged from about 9 to 14%. It appears that pH has a greater effect on iodide adsorption than the amount of organic matter. Ongoing studies are examining the mechanisms responsible for the observed adsorption behavior of iodine in soils, which will help in understanding its biogeochemical cycling in the environment.

*Effect of 3-dimensional and Color Contrast Patterns on Nest Location Performance of Two Solitary Bees (Hymenoptera:*

*Megachilidae)*, **CHRISTELLE GUÉDOT** (Biology Department, Utah State University, Logan, UT 84322-5310; christelle@biology.usu.edu).

We addressed the importance of 3-dimensional patterns and color contrast patterns as cues used in nest location by *Osmia lignaria* Say and/or *Megachile rotundata* (F.) females. We manipulated the surface of the nesting site testing 3-D patterns of three different depths (1-cm, 2-cm, and 6-cm) and three different color contrasts (black-black, black-gray, and black-blue). Both species perceived 3-D patterns as well as color patterns. Bees responded to changes to the nesting surface by increasing nest location time and displaying disoriented behaviors (hovering flights, reorientation flights, wrong nest visitations). The increase in the depth of the 3-dimensional pattern as well as in the brightness of the color contrast led to an increase in the level of confusion. We observed differences between species in the minimum depth detected, 1cm with *M. rotundata*, 2cm with *O. lignaria*, and the level of confusion for the blue treatment (*M. rotundata* being more confused than *O. lignaria*).

*Changes in Soil N Transformations after Repeated Application of Dairy Waste,* **MUSSIE Y. HABTESELASSIE[1], JOHN M. STARK[2], BRUCE E. MILLER[3] and JEANETTE M. NORTON[1]** ([1]Dept.of Plants, Soils and Biometeorology; [2]Dept. of Biology; [3]Dept. of Agricultural Systems Technology and Education, Utah State University, Logan, UT 84322; E-mail: mussiey@cc.usu.edu).

A silage cornfield was treated with ammonium sulfate (AS), liquid dairy-waste (LC) or dairy-waste compost (DC) over the past 5 years. Soil N process rates and pool sizes were monitored to assess their effects on nitrification, mineralization, and nitrate leaching. Plots receiving DC showed significantly higher gross rates of mineralization and nitrification than other treatments. After 5 years of application (2002), potentially mineralizable N (No) and rate of mineralization (k) for plots receiving high DC level were 44.7 $\pm$ 7.2 mg inorganic N $kg^{-1}$ soil and 0.035 $\pm$ 0.016 $day^{-1}$ respectively. This was more than 150 % higher than the AS and low LC treatments. Correspondingly higher carbon mineralization rates were also observed in these plots. An enzymatic assay was developed to examine kinetics of urea hydrolysis. Soils treated with DC showed large elevation in urease activity. In 1999, post-season sampling showed the highest nitrate accumulation (42 mg N/kg soil) at 60-90 cm depth in the plots receiving high level of DC, with continued downward movement for subsequent years. While N from AS and LC are available for plant uptake during the early growing season, the N from compost continues to mineralize even after harvest. The results demonstrate the large increase in N process rates and labile N pools associated with repeated DC application, and hence the importance of management of the timing of N release versus plant demand to prevent undesirable environmental impacts.

*Influence of Pluronics™ on Planktonic and Biofilm Growth of a Soil Bacterium,* **HEATH HALL[1], SPENCER MANN[1], DAVID W. BRITT[1], BRANDT ESPLIN[2], and ANNE J. ANDERSON[2]** (Departments of Biological Engineering[1] and Biology[2], Utah State University, Logan, UT 84322; Email: hrh@cc.usu.edu).

Pluronics™ are copolymers of hydrophilic poly (ethylene oxide), PEO, and hydrophobic poly (propylene oxide), PPO, arranged in a triblock configuration, PEO-PPO-PEO. They are frequently employed as coatings to inhibit protein and cell adsorption to surfaces (i.e. biofouling). Here we investigate the influence of a range of Pluronics™, varying in molecular weight and hydrophobic / hydrophilic content, on planktonic and biofilm growth of a soil bacterium, *Pseudomonas chlororaphis*. This bacterium tenaciously binds to root surfaces as it aggressively colonizes. *P. chlororaphis* was used in the research as a model bacterium closely related to *Pseudomonas aeruginosa,* a notorious human pathogen that forms biofilms during infection. All investigated Pluronics™ greatly diminished bacterial adhesion to tissue culture polystyrene. Unexpectedly, it was also observed that certain Pluronics™ dramatically reduced phenazine production, orange colored secondary metabolites, suggesting a possible interruption of quorum sensing systems.

*Effects of Electromagnetic Fields (EMF) on Angiogenesis of Breast Cancer and Macrophages Measured using the Chorioallantoic Membrane (CAM) Assay,* **RUSSELL L. HAMBLIN, DEVIN D. TWITCHELL, BYRON K. MURRAY, and KIM L. O'NEILL** (Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT 84606; E-mail: rlh68@email.byu.edu).

Angiogenesis is the formation of new blood vessels. This vasculature formation occurs naturally in tissue repair and the normal healing process of wounds. Macrophages play a large part in this normal healing process as they secrete angiogenic cytokines such as regulatory growth factors. It has been shown that tumors often have macrophages located around the periphery and even inside the tumor. These macrophages are called Tumor-associated macrophages (TAMs). Recent research suggests that TAMs may actually induce inflammation and subsequent angiogenesis at the site of the tumor, thus inadvertently aiding the tumor in its growth. There is currently a controversy surrounding EMF as a factor in the development of some kinds of cancer. With the increase in technology we are constantly exposed to EMF in everyday life. Research has shown that long-term exposure to EMF may correlate with tumor growth. Work in our lab using the CAM assay has shown that macrophages significantly increase the amount of angiogenesis, and that the breast cancer

cell lines MDA-MB-435's and MDA-MB-231's also cause greater amounts of angiogenesis on the CAM assay than does normal chick embryo development. We hypothesized that EMF exposure will increase the amount of angiogenesis of the two cell lines as well as of the macrophages. The effects of EMF on the angiogenesis produced by the above-mentioned breast cancer cell lines will be discussed. The effects of EMF on the macrophages and their subsequent induction of angiogenesis will also be discussed.

*Developing a Method for Transferring Genes from the C Genome of Jointed Goatgrass into the Genomes of Wheat,* **J. L. HANSEN**, **and R. S. ZEMETRA** (University of Idaho; E-mail: jhansen@uidaho.edu).

One of the challenges facing wheat breeders is finding new sources of genes for biotic and abiotic stress resistance/ tolerance. Related species, such as jointed goatgrass (*Aegilops cylindrica*) could be used as a source for such genes. One problem in using jointed goatgrass is that the gene(s) could be on the unshared C genome limiting the potential for transfer and retention of the genes in wheat (*Triticum aestivum*). The use of a Ph1 deletion allowing homeologous chromosome pairing and/or the gametocidal gene on chromosome 2C that induces chromosome deletions and translocations in gametes lacking the 2C chromosome could increase the potential of chromatin exchanges between the C genome of jointed goatgrass and the A, B or D genome of wheat. To accomplish this, crosses were made between Wichita monosomic 5B and A. cylindrica. F1 plants were grown and identified as 34 or 35 chromosome lines using mitotic analysis then crossed back to wheat. Increased chromosome pairing was observed in the 34 chromosome lines showing increases in number of bivalents and decreased number of univalents compared to the 35 chromosome lines confirming homeologous chromosome pairing in the lines lacking chromosome 5B. Seed set was also greatly reduced in the 34 chromosome lines compared to the 35 chromosome lines. The action of the 2C chromosome in the F1 gamete may add a second level of chromosome recombination in the F1 gamete or if present may induce chromosome recombination in subsequent backcross generations. The level of chromosome recombination in the BC1 generation will determined by genomic in situ hybridization (GISH) of the 34 and 35 chromosome populations. If successful the combination of the two genetic chromosome recombination systems could lead to a rapid method to utilize jointed goatgrass as a source of genes for wheat.

*Laccase Gene Expression in Maize and Arabidopsi,* **V. HAROLDSEN**, **E. DAVIS**, **M. X. LIANG**, **X. N. CAI**, **E. BUSHMAN and Y. WU** (Utah State University, Logan, UT 84322; E-mail: harovm@comcast.net).

Laccases are believed to be involved in lignification and oxidation of phenolic compounds in plants, although there is little genetic evidence to support their physiological functions. Laccases comprise multigene families of proteins in all the plants studied so far. It is believed that laccases may perform other functions in plants than previously proposed. We found the transcript level of one of the maize laccase genes (zmLac1) increased in roots upon treatment of a high concentration of NaCl, suggesting laccases may play an important role in plant tolerance to salinity. To provide genetic evidence for this hypothesis, we are using Arabidopsis as a model system. There are 17 annotated laccase genes in the TAIR database (www.arabidopsis.org). Using RT-PCR, we found 10 of 17 laccase genes are expressed in the Arabidopsis roots. A similar number of laccase genes are expressed in the silique. Several laccase genes are expressed in leaf tissue and inflorescence tissue. Currently, we are studying the effect of NaCl treatment on the laccase transcript levels in Arabidopsis using RT-qPCR. We have also identified several T-DNA insertional mutants for some of the laccase genes from the Salk mutant collection. These mutants will be used to examine how the mutation(s) will affect plant growth and development and response to environmental stresses such as salinity.

*The Effects of Prolactin (PRL) on Mink* (Mustela vison*) Guard and Under-hair Fiber Length, Under-hair Follicle Depth and Skin Epidermal Thickness*, **MARCUS HARRIS, ERIC SWENSON, JASON HUNT**, **MALCOLM SHIELDS and JACK ROSE** (Department of Biological Sciences, Idaho State University, Pocatello, ID 83209; E-mail harrmarc@isu.edu).

To determine the effects of PRL on guard and under-hair fiber length, under-hair follicle depth, and skin epidermal thickness, we treated mink with melatonin (MEL) to inhibit PRL secretion, haloperidol (HAL) to increase PRL secretion, and as controls. Subsequently, in early-March, hair growth (anagen) was induced, out of season, by plucking over the caudal dorsal surface. This artificial hair growth was then compared with spontaneous anagen in the cephalic dorsal region. Thus, each animal served as its own control. Spontaneous anagen occurred in control mink in mid-April, while HAL advanced anagen by 3-weeks, and MEL completely blocked anagen. Plucking, advanced anagen by 2-3 weeks in control and HAL mink, and interestingly, over-rode MEL inhibition. In control and HAL-treated mink, plucking increased guard hair length, compared to MEL or non-plucked control and HAL-treated animals. Under-hair fiber length was greater in all plucked mink although HAL reduced fiber length suggesting that PRL may inhibit hair growth. MEL had no effect on under-hair fiber length. However, depth of under-hair follicles following spontaneous anagen was much less for MEL than all other groups, which may explain, in part, why mink pelts obtained commercially

with MEL are often of inferior quality, with loose hair fibers that come out during processing. Although unaffected by plucking, MEL dramatically increased epidermal thickness in plucked and non-plucked skin. This implies that MEL-produced hair fibers differ in composition and perhaps structure from fibers that develop spontaneously, and may confer on the former, greater tensile strength and resistance to abrasion.

*Common and Multi-Offset Ground Penetrating Radar in Assessing Soil Water Content and Dynamics in the Vadose Zone,* **ROBERT HEINSE[1], DANA LAASS[2] and PETER SCHIKOWSKY[2]** ([1]Department of Plants, Soils and Biometeorology, Utah State University, Logan, UT 84322-4820; [2]Institute of Geophysics and Geology, Leipzig University, 04341 Leipzig, Germany; E-mail: heinse@cc.usu.edu).

Soil water content determinations with Ground Penetrating Radar (GPR) gauge the same physical property as Time Domain Reflectometry (TDR) and Remote Sensing Surface Reflection Methods, namely the dielectric permittivity, at an intermediate scale. The transformation process of converting measured travel times to velocities and subsequently, to dielectric permittivity, and finally, to water content, requires knowledge of the propagation geometry. Common-Midpoint (CMP) acquisition geometries are frequently used to determine the velocity of electromagnetic waves from radar reflections. We propose a GPR methodology for soil water content determinations that uses common offset measurements to get multi-coverage CMP data with more efficiency in time. The purpose of this study is to assess the feasibility of multi-offset GPR measurements in vadose zone studies and to define a suitable protocol for field acquisition and data processing to yield time-lapse water content distributions. One major goal is to assess the advantage of multi-offset GPR over monostatic GPR, and in particular over rivaling/contributing galvanic or inductively coupled resistivity methods for water content determination. We found that resorting the data after CMP's and correction for the normal moveout, stacking significantly improved the signal quality. Results from multi-offset GPR measurements in vadose zone studies are compared with results using other GPR methods. The main supporting point for the proposed method is the universality of the data set that allows extracting relevant subsurface information non-invasively, and delivers information on both water content distribution as well as subsurface structure.

*Digitally Enhanced Thin-Layer Chromatography*, **AMBER I. HESS** (Stevenson School, 3152 Forest Lake Road, Pebble Beach, CA 93953; E-mail: amber@klhess.com).

Thin-layer chromatography (TLC) is a widely used method to determine the number of components in a mixture, to determine the identity of substances, to monitor the progress of a reaction, or to determine the effectiveness of a purification.

Last year I reported the ability, using digital photography and color enhancement, to detect color in a chemical's spots on fluorescent TLC plates. Further work shows that a photo-editing program combined with TLC (Digitally Enhanced TLC) is competitive in many applications with the much more expensive high-performance thin-layer chromatography (HPTLC).

Digitally Enhanced TLC enables the user to perform qualitative analysis by detecting fluorescence in the sample often invisible to the naked eye and/or performing a simple multi-spectral scan that can uniquely identify some compounds. Surprisingly, Digitally Enhanced TLC also enables the user to perform accurate quantitative analysis by constructing calibration curves.

Digitally Enhanced TLC is very easy to utilize. All that is needed is a digital camera and a computer with a photo-editing program. Certain colors in the picture of a TLC slide may not be visible to the human eye, but the camera and computer can pick them out. TLC spots often can be differentiated from each other with a multi-spectral scan using photo-editing software's ability to break the image down into red, green, and blue components. Quantitative analysis requires nothing more than the optical density readout function available in every photo-editing program.

Digitally Enhanced TLC is a valuable tool that can be added to every chemist's TLC toolbox.

*Using Soil Texture to Guide Variable-Rate Nitrogen Fertilization,* **JARED E HOBSON, JASON W ELLSWORTH and APRIL B LEYTEM** (Twin Falls Research and Education Center, University of Idaho, Twin Falls, ID 83303; E-mail: hobs0809@uidaho.edu).

Variable-rate nitrogen fertilization is a management practice that is more and more common in production agriculture. Unfortunately, effective use of variable-rate technology is limited by a lack of methods to assess site-specific soil N status. Soil texture may be a simple and stable method of obtaining information to use in guiding variable-rate N fertilization. Two sugar beet fields were chosen in south central Idaho to represent the variability in the area. In each field N treatments of 0.5x, 1.0x, and 1.5x of the recommended N fertilizer rate were established in 24 row strips the length of the field replicated 3 times. In each field, fifteen test areas, encompassing the three treatments in a replication were selected to capture the variability in the field. Soil texture was determined for each test area. While one site showed no difference in yield and sugar content among nitrogen treatments, the other site showed a 5-ton yield increase and a 2% sugar content increase at the lowest rate when compared to the middle rate. There was no difference in yield and sugar content between the lowest and highest nitrogen rates. Petiole

nitrate values at one site were an average of 5800 ppm higher in the clay loam test areas compared to the silt loam test areas. Soil texture is an important consideration when determining variable-rate nitrogen recommendations for sugar beets. Soil texture is a one-time soil test that can be combined with other information to build sound variable-rate nitrogen recommendations.

*Automated Analysis of TDR Waveforms for Water Content Determination in Saline Soils,* **SETH HUMPHRIES[1], SCOTT B. JONES[1], and DANI OR[2]** ([1]Dept. Plants, Soils, and Biometeorology, Utah State University, Old Main Hall 4820, Logan, UT 84321-4820; [2]Civil & Environmental Engineering Department, University of Connecticut, Storrs, CT 06269-2037; E-mail: sethdh@cc.usu.edu).

Time Domain Reflectometry (TDR) instruments and analysis programs have been developed for water content determination from travel time of a porous medium's permittivity. However, time domain analysis fails under lossy conditions such as in saline soils because of signal (wave) attenuation. Our objective was to automate a processing and analysis procedure to extend the capabilities of dielectric determination using TDR under saline conditions. This is done by transforming the TDR wave into the frequency domain for analysis. In order to perform analysis in the frequency domain two waves are needed for each probe; the first wave is obtained with the probe in air and the second wave with the probe in the sample. These two waves are prepared then transformed via an FFT algorithm. They are then divided to become the $S_{11}$ or scatter function. The magnitude of the $S_{11}$ is analyzed to find the resonant frequency, which corresponds to the dielectric permittivity of the sample. This tedious and complex process has been automated, providing a user friendly graphical user interface that plots original waveforms and the complex components of the $S_{11}$ facilitating detailed analysis. The program described provides rapid transformation and processing of input waveforms for frequency domain analysis of dielectric for water content determination. This program will enhance the capabilities of researchers to determine dielectric properties of saline soil as well as discovery of frequency dependant soil characteristics.

*Effects of Prolactin (PRL) on the Expression of PRL and PRL Receptor Long Form (PRL-L-R) mRNA in the Skin of Mink* (Mustela vison)*,* **JASON HUNT, MALCOLM SHIELDS and JACK ROSE** (Department of Biological Sciences, Idaho State University, Pocatello, ID 83209; E-mail: huntjaso@isu.edu).

To determine the effects of PRL on the expression of PRL and PRL-L-R mRNA in mink skin following natural and plucking-induced hair growth, mink were treated with melatonin (MEL), to inhibit PRL secretion, haloperidol (HAL), to increase PRL secretion, or as controls. Hair growth (anagen) was induced over the lower dorsal surface by plucking, while the remaining skin was observed for spontaneous anagen. In control mink, spontaneous anagen began in mid-April. HAL induced anagen 3-weeks earlier, while MEL completely inhibited spontaneous anagen. Depilation of control and HAL-treated mink induced anagen 2-3 weeks earlier, as well as over-riding MEL inhibition. Skin PRL mRNA expression in non-depilated skin increased sharply on April 22 in controls and on April 1 in HAL-treated mink; both times corresponding to when mink entered anagen. MEL inhibited PRL mRNA expression in non-depilated skin, suggesting that PRL may stimulate skin PRL production. PRL-L-R mRNA expression was variable, although our data suggest that its expression may be up-regulated by PRL. No clear relationship between PRL and PRL-L-R expression following depilation could be detected, most likely as a result of the production of cytokines, growth factors, and hormones in response to wounding. These data clearly demonstrate the presence of PRL and PRL-L-R genes in mink skin and show that drugs conventionally used to alter pituitary PRL secretion also influence skin endocrinology. Finally, it is now evident that the endocrine regulation of hair cycles must now include the role of locally produced hormones and receptors and their non-classic autocrine and paracrine actions.

*Screening Candidate Fungicides for Control of Chalkbrood Disease in Alfalfa Leafcutting Bees, (*Megachile rotundata*),* **CRAIG HUNTZINGER, ROSALIND JAMES, JORDI BOSCH**, and **WILLIAM P. KEMP** (USDA-ARS Bee Biology and Systematics Laboratory, 1410 North 800 East, North Logan, UT 84341; zinger@biology.usu.edu).

Chalkbrood, a bee disease caused by pathogenic fungi of the genus *Ascosphaera*, is one of the major mortality factors in alfalfa leafcutting bee populations managed for alfalfa pollination. Methods to effectively control the chalkbrood problem remain elusive. We studied the effect of four fungicides, Benlate®, Rovral®, Captan®, and Orbit™ on: 1) growth inhibition in cultures of *Ascosphaera aggregata*, 2) adult bee mortality from topical fungicide applications, and 3) larval mortality and incidence of chalkbrood from fungicide applications incorporated into the pollen provision. Benlate, Rovral and Orbit were able to achieve 90% inhibition of fungal growth at concentrations of 5.65µg a.i./ml, 17.6µg a.i./ml, and $1.21 \times 10^{-6}$µl a.i./ml respectively. Applications incorporating Benlate (1.2mg a.i./µl) and Rovral (0.8mg a.i./µl) into pollen provisions significantly increased the number of healthy larva and significantly decreased the incidence of chalkbrood when compared to the controls.

*Stability of the Mismatch Negativity Response to Frequency, Location, and Duration,* **MARIE IMWINKELRIED, KATE LAMVIK, EVANTHIA ROUSSOS,** and **STANLEY E. LUNDE** (University of California-Los Angeles, 1312

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The event-related potential (ERP) is an average of the responses elicited in the brain by repeated stimuli. The mismatch negativity (MMN) is a negative component of the ERP that represents an attention-independent response to discriminable changes in repetitive auditory stimuli. MMN is a promising technique for diagnosing neurodevelopmental disorders in infants, young children and difficult-to-test populations. However, signal-to-noise and intra-subject reliability are serious issues. This study investigates the reliability of MMN using a new oddball paradigm (Naatanen et al., 2004) with the independent variables frequency, location, and duration. Stimuli were presented 2/sec to healthy college students in blocks of 916 stimuli. The standard stimulus was a 75 ms complex tone (500 Hz fundamental frequency). The frequency deviants vary by +/- 10%, the location deviants had an inter-aural shift of 0.8ms to the left (Lf) or right (Rt), and the duration deviant was 25 ms. MMNs were calculated by subtracting the standard from the deviant ERP and were evaluated using statistical methods to quantify signal-to-noise ratios based on point biserial r (Cacace et al., 2003). The stability of MMNs were evaluated by statistical analyses of the consistency of r-values using programs written in Matlab6. Preliminary analysis shows the greatest MMN stability in 550 Hz deviants followed by Rt, duration, 450 Hz, and Lf deviants. Largest MMN amplitudes were found in duration deviants, followed by 450 Hz, 550Hz, Rt, and Lf deviants. Data also shows larger magnitudes of r-values than those reported by Cacace et al., suggesting a more effective paradigm.

*Outgrowing Our Roots: Agrarian Restructuring in the New West*, **ERIC B. JENSEN** (Department of Sociology, Social Work, and Anthropology, Utah State University, 0730 Old Main Hill, Logan, UT 94322-0730; E-mail: ericjensen@cc.usu.edu).

The Mountain West is the most socially and economically dynamic region in the United States. Rapid population growth and increasing economic diversity are creating a radically different western landscape: the New West. Observers of these changes predict increasing conflicts between the new economy and more traditional economic sectors—farming, ranching, mining, and forestry. This research examines the impacts of population growth and development on farming and ranching in the Mountain West. Using survey data from farmers and ranchers in four counties in Utah and Colorado, we compare farm structure, operation expansion, off-farm income, and exits from agriculture in high and low population growth counties. Although development is impacting western agriculture, we find that the relationship is not as fatalistic as is commonly implied by popular media and other research.

*Effects of Saline Irrigation and Rooting Media Organic Matter on Growth and Development of Two Western Native Perennials,* **RACHEL N. JEPPSON and JENNIFER W. MACADAM** (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT 84322-4820; E-mail: rachelnelson@cc.usu.edu and jenmac@cc.usu.edu).

The high cation exchange capacity of organic matter improves nutrient status in the soil for plant growth by preventing nutrient ions, such as $Ca^{++}$, $Mg^{++}$, and $K^{+}$, from leaching. However, organic matter may also have a higher capacity to adsorb harmful salts such as $Na^{+}$ from the soil solution. Saline soils have been found to both inhibit growth and cause bolting as well as lower stomatal conductance levels. *Penstemon barbatus* (Cav.) Roth and *Eriogonum jamesii* Benth. were grown in four different ratios of pumice and peat and irrigated at increasing levels of salinity for six weeks to understand the plants' response to salinity and the peat's ability to offset any negative affects. As salinity levels increased through irrigation, *Penstemon* plant growth and weight decreased by approximately 15% and 49% from the highest salinity treatment compared with the control. However, when plants grew in the highest ratio of peat, they experienced a slight increase in growth (14%) and weight (20%) compared with lowest peat rooting media treatment. The growth and weight of *Eriogonum* decreased slightly as saline irrigation increased, but rooting media ratios had no effect. Stomatal conductance in both species decreased as salinity levels increased, especially in the *Eriogonum* which decreased 19% during week 6 from the highest saline treatment to the control.

*Differences in Carbon Isotope Discrimination Between Two Rowed and Six Rowed Barley Lines,* **Q. JIANG***, **D. ROCHE**, **and D. HOLE** (Utah State University, Logan, UT 84322; E-mail: qjiang@cc.usu.edu).

For the last twenty years carbon isotope discrimination ($\Delta$) has been extensively used in order to estimate the water use efficiency of $C_3$ cereals species. Genetic lines of barley belong to two phenotypic classes for ear morphology, two-rowed (2R) or six-rowed (6R), a simply inherited trait. No experimental work has been attempted to test if values for $\Delta$ differ between these two barley types for flag leaf, awn, and seeds. Here, we present data indicating that among breeding lines/varieties of both ear types grown in different conditions of water availability within line source experiments at two location years, $\Delta$ values for 2R are usually lower than those found in 6R types. In an independent experiment conducted on double haploid progenies, issued from a cross between Harrington (2R) and Morex (6R), that segregate for ear type, we found that $\Delta$ values for penultimate leaves and awns in field-collected materials are also lower in 2R progenies. Some of these observed differences may be due to differences in

precocity as indicated by heading dates. This working hypothesis would confirm the importance of earlier maturity in $C_3$ cereals in order to avoid terminal water stress during the grain filling period. Another contributing hypothesis would be, considering the individual fertile tiller as a physiological unit, that the carbon metabolism of each tiller may be intrinsically different between the two types since size of flag leaf and 'grain load' per tiller are known to differ. Testing the segregation of values for $\Delta$ in several plant tissues among unselected (Harrington X Morex) doubled haploid lines may provide further unexpected insights on the influence of the *vrs-1* and *int-c* loci on carbon metabolism.

*Earthworm Populations During the First Five Years of Direct Seeding: Implications for Productivity*, **JODI JOHNSON-MAYNARD, KARL UMIKER, AND STEPHEN GUY** (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844-2339; E-mail: jmaynard@uidaho.edu).

Long-term tillage studies show that direct seeding (DS) can significantly impact earthworm populations. Less is known about short-term changes in density of these organisms that significantly impact residue incorporation, aggregation, and nutrient cycling. Our objective is to evaluate changes in earthworm numbers in the first five years following conversion to DS. Replicate tilled and DS plots were created in a long-term conventionally tilled site at a University of Idaho research farm near Genesee, ID. The research site is a typical Palouse hillslope with well defined summit, backslope, toeslope, and footslope positions. The rotation is wheat-pea-barley. Earthworms were sampled each year during the second, third, and fourth years of DS. Mean earthworm density in the tilled plots was relatively constant over the three sampling years and ranged from 41 to 39 individuals $m^{-2}$. Earthworm density within DS plots averaged 127 individuals $m^{-2}$ in year 2 and 153 individuals $m^{-2}$ in year 3. During each year of the study, earthworm numbers were highest in plots planted to pea. This is likely due to the presence of barley, a high residue crop, in the previous year. Density values within the footslope and toeslope positions did not reflect the impact of tillage. These data indicate that earthworm numbers are higher under DS and are still responding to changes after four years. Crop and position on the landscape also influence earthworm populations. The implications of changes in earthworm density for plant productivity will be discussed.

*Toward Standardizing Electromagnetic Sensor Characterization and Calibration,* **[1]SCOTT B. JONES, [1]J.MARK BLONQUIST JR., [1]DAVID A. ROBINSON, [1]V. PHILIP RASMUSSEN and [2]DANI OR** ([1]Dept. Plants, Soils and Biometeorology, Utah State University, Logan UT; [2]Civil & Environmental Engineering Department; University of Connecticut, Storrs, CT 06269-2037; E-mail: scott.jones@usu.edu).

Electromagnetic (EM) sensor measurements provide information on both dielectric permittivity (related to water content) and in many cases porous media electrical conductivity. Unfortunately, EM sensors measure dielectric using a wide variety of circuitry and algorithms leading to variations in the measured frequency band and ultimately the resulting dielectric. Our objectives were to i) develop a methodology for characterizing EM sensor performance using well defined and readily available reference dielectrics and models and ii) suggest a standard for comparison of sensors measuring dielectric permittivity and electrical conductivity. Fluids of known (based on Cole-Cole parameters) or measurable (using a Network Analyzer) frequency-dependent dielectric provide a homogenous system for immersion of sample-scale sensors. Fluids were selected to provide relaxation frequencies both within and outside of the measurement range of common sensors. Test conditions included dielectrically lossy and lossless and electrically conductive and non-conductive systems and combinations thereof. Maximum passable frequencies ($f_{max}$) were inferred from network analyzer and sensor dielectric measurements in various liquids. Criteria for qualitative assessment of sensors include accuracy, precision, effective measurement frequencies and performance under lossy and lossless conditions. An approach for dealing with EM sensors that do not measure dielectric directly (i.e., via travel time) is also suggested. Measurement results from seven different EM instruments highlight the need for this standard approach to provide objective and readily available techniques for characterization, calibration and comparison of EM sensors.

*Mobile Elements and the Evolution of Human Populations,* **L.B. JORDE[1], W.S. WATKINS[1], . A.R. ROGERS[1], M.J. BAMSHAD[1], A.E. BRASSINGTON[1], M.L. CARROLL[2], S.V. NGUYEN[2], J.A. WALKER[2], and M.A. BATZER[2]** ([1]Department of Human Genetics, University of Utah School of Medicine, Salt Lake City, UT 84124; [2]Department of Biological Sciences, Louisiana State University, 202 Life Sciences Building, Baton Rouge, LA 70803; E-mail: lbj@genetics.utah.edu).

Because of their unique properties, mobile elements are highly useful for reconstructing human evolutionary history. Using 100 *Alu* insertion polymorphisms, we analyze human genetic diversity for 710 individuals representing 31 populations from Africa, East Asia, Europe, and India. *Alu* diversity is highest in Africans (0.349) and lowest in Europeans (0.298). *Alu* insertion frequency is lowest in Africans (0.463) and substantially higher in non-Africans (0.55). Because the lack of an insert is the ancestral state, this distribution is in accordance with an African origin of modern humans. Large genetic distances are observed among African populations and between African and non-African populations. The root of a neighbor-joining network is located

closest to the African populations. These findings are also consistent with an African origin of modern humans and with a bottleneck effect in the human populations that left Africa to colonize the rest of the world. Genetic distances among all pairs of populations show a significant product-moment correlation with geographic distances ($r = 0.69$, $p < 0.00001$). FST, the proportion of genetic diversity attributable to population subdivision, is 0.141 for the major continental populations. We have also analyzed 6 unlinked genomic regions each having 8 – 11 SNPs surrounding a polymorphic *Alu* insertion. These 56 SNPs, like the *Alu* insertion polymorphisms, exhibit highest variation in Africans and show that Africans are the most divergent group of populations. Linkage disequilibrium between SNP pairs declines with increasing distance between marker pairs. Generally, LD is lowest in Africans, intermediate in Europeans, and highest in Asians.

*Expression of NADPH Oxidase Homologs in Human Tumor Cells,* **AGNES JUHASZ*, SUSAN MARKEL, MARIANNE METZ, LINDA MATSUMOTO, JOSEPHUS VAN BALGOOY and JAMES H. DOROSHOW** (Medical Oncology Department, City of Hope Comprehensive Cancer Center, Duarte CA; E-mail: ajuhasz@coh.org).

Recent studies have demonstrated the presence of at least six novel membrane oxidases in epithelial cells that share homology with gp91*phox* (Nox2) found in phagocytic leukocytes. These flavoproteins catalyse the NADPH-dependent reduction of oxygen to superoxide and hydrogen peroxide. NADPH oxidases are now recognized as an important part of several signal transduction pathways. ROS have been shown to regulate a large number of biological processes including gene expression, oxygen sensing, regulation of vascular tone, bone development, cell growth, aging, carcinogenesis, and even mediation of sperm-oocyte fusion. We have compared the expression of the NOX family member genes in a panel of 47 human tumor cell lines and tumors and adjacent normal tissues of patients with breast, colon, kidney, prostate, gastric, lung, ovary, liver, melanoma, testicular cancer, CML and brain tumors.

Currently, we are studying the Nox1 gene expression, the extracellular hydrogen peroxide production and inhibition in colon cancer cell lines. We have demonstrated that the flavoprotein inhibitors (DPI and derivates) reduced the cell proliferation in cell lines acting as S1/G1 cell cycle inhibitors, decreased the superoxide production and cell growth. DPI and DTI had effect on the expression of other genes. Recently we mapped with DNA microarray and proteomics methods, which proteins were effected.

We designed small inhibiting RNAs (siRNA) targeting the Nox1 and NoxOR1 genes for specific inhibition.

Upregulated Nox expression increase the ROS production that are involved in growth control through oxidant-mediated events, and the Nox mRNAs can be target for the control of cell proliferation.

*Genomics of Plant-associated Bacteria,* **MICHAEL L. KAHN** (Institute of Biological Chemistry and School of Molecular Biosciences, Washington State University, Pullman, WA 99164-6340; E.mail: kahn@wsu.edu).

Many plant-associated bacteria are represented in the 500 or more bacterial genomes that are at some stage of having their DNA sequences determined. Sequencing represents a tremendous advance in the study of many of these organisms—some move instantly from genetic obscurity to having megabases of their sequence available for all to read. Each of these bacteria has a story and it is appropriate to ask how the sequence information can be used to understand how the bacteria function in their unique niches. For example, the 6.7 Mb DNA sequence of the nitrogen-fixing, symbiotic bacterium *Sinorhizobium meliloti* contains about 6300 ORFs while closely related mammalian pathogens are about half this size, presumably reflecting the relative complexity of niches the bacteria must inhabit. Predicting mechanisms of adaptation to these niches from annotation alone has significant limits. So, while *S. meliloti* is predicted to have many sugar kinases, annotation can not resolve the issue of which sugars *S. meliloti* can metabolize since the kinase substrates are unknown. Regulatory proteins are easily identified but their function is likely to be more subtle than annotation using the currently available functional information can reveal. There is thus a need to bring the sequence information into a more biological context. I will present a strategy now being used to more completely characterize *S. meliloti*, particularly a genome scale effort to manipulate all of the predicted open reading frames. One challenge in *S. meliloti* and many other bacteria is to move from studying the genetics of a small number of genes to the genomics of a very large number of genes that have an unknown relationship to free-living behavior and the host-microbe interaction.

*Differential Effects of SDZ 211-939 on Human and Bovine Voltage-gated Sodium Channel Inactivation May Be Due To Differences in the DII-DIII Linkers,* **TYCE J. KEARL[1], PETER C. RUBEN[1], and MEIKE MEVISSEN[2]** ([1]Department of Biology, Utah State University, 5305 Old Main Hill, Logan, UT 84322; [2]Institute of Veterinary Pharmacology, University of Bern, Laenggass-Strasse 124, CH-3012 Bern, Switzerland; E-mail: tyce@cc.usu.edu)

Voltage-gated sodium channels ($Na_v1.5$) regulate the rising phase of the action potential in cardiac myocytes. Channel activity can be modulated by the application of specific drugs. The effects of SDZ 211-939 on human and bovine channel isoforms were studied in our experiment. Human and bovine channels have a high degree of structural homology. However, there is substantial difference in the

primary sequence of DII-DIII linkers between the two channels. In the absence of SDZ, the two channel isoforms shared similar biophysical properties. Addition of SDZ had little effect on the rate or probability of activation, but resulted in a sustained plateau current during a prolonged depolarizing pulse, indicating that SDZ inhibits fast inactivation. SDZ was found to have a significantly greater effect on human than bovine channels, evidenced by a larger sustained plateau current. Sustained current has been associated with stronger heart contractions in other studies. The differential effect of SDZ suggests that the DII-DIII linker may play a role in the action of SDZ on the channel isoforms.

*Cytotaxonomy, Karyomorphology and Genome Analysis of Six Species of* Allium *(Alliaceaee)*, **TASNEEM F. KHALEEL** (Department of Biological and Physical Sciences, Montana State University-Billings, 1500 N.30th Street, Billings, MT 59101); tkhaleel@msubillings.edu).

Cytotaxonomy, chromosome morphology, karyotype and genome analysis of six species of *Allium* is presented. The genus *Allium* comprises about 600 species of bulbous plants distributed throughout the world. Controlled hybridization of cultivated *Allium* species is an important breeding strategy which is best accomplished using information on evolution, chromosomal relationships and interspecific compatibility. *Allium* chromosomes are large and lend themselves to detailed karyomorphological studies and genome analysis. There are three basic chromosome numbers (7, 8 and 9) with polyploidy ranging to 13x. North American species with n=7 are considered more primitive and show only metacentric chromosomes. The old world species have n=8 with karyotypes composed of acrocentric, submetacentric and metacentric chromosomes. This study focuses on four old world species and two North American species. *A. christophii* Trant V. (2n=16) in which the karyotype shows 4 acrocentric (two with satellites), 8 submetacentric and 4 metacentric chromosomes; *A .giganteum* Regel (2n=16) shows 4 acrocentric (two with satellites) and 12 metacentric; *A. nutans* L (2n =32+2) shows 12 acrocentric (four with satellites), 8 submetacentric and 14 metacentric and *A. odorum* L. (2n=32), with 6 acrocentric, 10 submetacentric and 16 metacentric chromosomes. The North American species in this study are *Allium cernuum* Roth. (2n=14) with 10 submetacentric and 4 metacentric chromosomes and *A. moly* L. (2n=14) with 4 submetacentric and 10 metacentric chromosomes. In conjunction with morphology, chromosome characteristics and karyotype symmetry having a high degree of stability may be indicators of species relationships.

*Soil and Vegetation Impacts From Land Application of Saline-Sodic Coalbed Methane Waters,* **LYLE A. KING, GEORGE F. VANCE, and GIRISHA K. GANJEGUNTE** (Department of Renewable Resources, University of Wyoming, Laramie, WY 82071; E-mail: lyleking@uwyo.edu).

Impacts from land application of saline-sodic, coalbed methane (CBM) co-product water on soil chemical and physical properties and on several vegetation characteristics were investigated in northern Wyoming's Powder River Basin (PRB). Data represent the first field season (2003) of a two-year study on sites receiving 1-3 years of CBM water application with center-pivot and side-roll irrigation methods. CBM water applied to these sites had salinity (EC) values ranging from 2.0 to 4.0 dS m-1 and sodicity (SAR) values ranging from 15-38. Compared to non-treated control plots, treated plots (irrigated with CBM water) had elevated bulk density values in subsoil horizons, consistently slower infiltration rates, and consistently slower hydraulic conductivity rates within the profile. Except for a single coarse-textured plot, all treated plots also had elevated soil EC and SAR values in the surface horizons (upper 30 cm) compared to control plots. After 2-3 seasons of CBM water application, biomass production of native perennial grasses was increased, but total production, aerial cover, and diversity of non-grass species was decreased, relative to the control plots. Mycorrhizae infection of three native perennial grass species was increased relative to control plots with 2 years of CBM water application.

*The Changing Face of the High Desert Urban Landscape,* **ROGER KJELGREN** (Department of Plants, Soils, and Biometeorology, Utah State University, Logan UT 84322; E-mail: rkjel@mendel.usu.edu).

Urbanization and population growth is straining water supplies in the Intermountain West. From 50%-70% of all treated municipal water is applied to urban amenity landscapes. These landscapes are 80-90% cool season turfgrass, almost exclusively Kentucky bluegrass (*Poa pratensis*). Bluegrass requires about 80% of local evapotranspiration rates to maintain acceptable appearance, but actual landscape irrigation is often 2-4 times this amount due to poor design and maintenance, and improper operation that results in excessive application rates. Improving landscape irrigation efficiency will reduce water consumption, but often is not sustainable long term because of the large shift in behavior required to alter irrigation practices. Alternative landscapes that require less water than bluegrass due to non-uniformity, hardscape, and adapted plant material offer the most sustainable option for reducing water consumption in irrigated urbanizing western landscapes. Ultra- low water use/ non-irrigated landscapes are achievable by using plants native to the Intermountain West that are adapted to drought. Challenges in achieving native low water landscapes include identifying suitable species, developing suitable nursery production methods, and marketing these plants to potential stakeholders including landscape architects, governmental agencies, nurseries, and the general public.

*Development of an Integrated Sorghum Genome Map as a Tool for Gene Discovery and Map-based Cloning,* **PATRICIA E. KLEIN[1], ROBERT R. KLEIN[2] and JOHN E. MULLET[1]** ([1]Institute for Plant Genomics and Biotechnology, Texas A&M University, College Station, TX 77843 and [2]USDA-ARS, Southern Plains Agricultural Research Center, College Station, TX 77845, E-mail: pklein@tamu.edu).

Integrated genome maps are valuable for map-based cloning, comparative genome analysis, and as sources of sequence-ready clones for sequencing projects. We have been constructing an integrated map of the sorghum genome. A high-density genetic map was developed using a RIL population and AFLP technology. Physical map construction was accomplished using four sorghum BAC libraries from two genotypes. The integration of the physical/genetic/cytogenetic maps relied on a combination of DNA fingerprinting, marker-content mapping, BAC sequence scanning and BAC-based fluorescence *in situ* hybridization.

The sorghum genome map is being used to aid in the comparative analysis of grass genomes and to accelerate the identification and characterization of agronomically important genes. BAC sequence scanning was used to develop sequence-based alignments between sorghum and rice chromosomes. This analysis will ultimately enhance our understanding of cereal genome structure and evolution. Map-based cloning efforts for a number of important sorghum genes including those involved in fertility restoration, maturity, and abiotic stress tolerance have begun. The major fertility restoration gene in sorghum, *Rf1*, was targeted for positional cloning because of its critical role in hybrid seed production. A minimum tiling path of BAC clones spanning the *Rf1* locus was assembled and a 0.5Mbp region surrounding *Rf1* was sequenced. The development of a high-resolution map for the *Rf1* locus was accomplished in part by identifying sequence polymorphisms in overlapping BACs derived from the two sorghum genotypes. The culmination of these efforts was the identification of a member of the pentatricopeptide repeat (PPR) gene family that cosegregates with *Rf1*.

*Production of a Monoclonal Antibody against 9L Gliosarcoma,* **JANELL L. KNAUFF and JOAN M. REDD** (Department of Biological Science, Walla Walla College, 204 S. College Avenue, College Place, WA 99324; E-mail: knauja@wwc.edu).

We have previously generated T cells from the DA strain of rat that specifically lyse 9L gliosarcoma cells from Fischer rats *in vitro* and do not lyse normal cells. We hypothesize that the antigen on 9L recognized by the T cells is a tumor specific antigen (TSA). In order to identify this antigen and determine whether it is a true TSA, we need to develop a probe specific to the antigen. Hybridomas were produced from hyper-immunized Fischer rats and secreted antibodies were screened for reactivity to 9L and normal Fischer cells. We isolated a monoclonal antibody specific for 9L that did not bind to normal Fischer cells. This antibody will be used in future studies to identify the putative TSA on 9L cells.

*Urease Encoding Genes in Ammonia-Oxidizing Bacteria,* **TERESA E. KOPER[1], AMAL F. EL-SHEIKH[2], JEANETTE M. NORTON[3], MARTIN G. KLOTZ[2], SETH G.THACKER[3], and RITA M. NELSON[3]** ([1]Departments of Biology and [3]Plants, Soils, and Biometeorology, Utah State University, Logan UT 84322-4820; [2]Department of Biology and Center for Genetics and Molecular Medicine, University of Louisville, Louisville KY 40292; E-mail: teresa@biology.usu.edu).

Ammonia oxidizing bacteria (AOB) mediate the first, rate-controlling step in nitrification. Many ammonia-oxidizing bacteria produce urease (urea amidohydrolase EC 3.5.1.5) and are capable of using urea for chemolithotrophic growth. We sequenced the urease operon from two AOB, the β-proteobacterial *Nitrosospira* sp. NpAV and the γ-proteobacterial *Nitrosococcus oceani*. In both organisms, all 7 urease genes were contiguous: the three structural urease genes *ureABC* were preceded and succeeded by the accessory genes *ureD* and *ureEFG*, respectively. Southern analyses revealed two copies of *ureC* in the *Nitrosospira sp*. NpAV genome, while a single copy of the *ure* operon was detected in the genome of *N. oceani.* The *ureC* gene encodes the peptide containing the active site and conserved nickel binding ligands; these conserved regions were suitable primer targets for obtaining further *ureC* sequences from additional AOB. In order to develop molecular tools for detecting the ureolytic ecotype of AOB, *ureC* genes were sequenced from several soil AOB. These new sequences were combined with UreC sequences in public databases to construct alignments and make phylogenetic inferences. The UreC proteins from β-proteobacterial AOB formed a monophyletic group that is distinct from other β-proteobacteria. Sequence motifs conserved for proteobacteria and variable regions possibly discriminatory for *ureC* from β-proteobacterial AOB were identified for future use in environmental analysis of ureolytic AOB. These gene sequences are the first publicly available for *ure* genes from autotrophic AOB.

*Modification of Wheat Straw for Use as a Biofuel,* **M. KUMAR, J. L. HANSEN, and R. S. ZEMETRA** (University of Idaho; E-mail: rzemetra@uidaho.edu).

Alternative sources of energy will be needed as the availability of oil decreases and price of oil increases. Increases in the cost of fuel affect agricultural producers greatly because the increase in operating costs can not always be recovered if commodity prices are low. What is needed is an alternative source of fuel that could be supplied by producers that would also increase their financial return. Utilization of wheat straw as a substrate for ethanol has potential since the producer could sell both seed and straw

from his crop, increasing the net return for the crop. One problem with wheat straw is that the lignin content of the straw makes it cost-prohibitive to extract the cellulose and hemi-cellulose that is used as the substrate for ethanol production. This project explores the possibility of down-regulating lignin production in the wheat straw using anti-sense or over-expression suppression of the ccr1 protein in the lignin biosynthesis pathway to reduce the lignin content of the straw. Constructs with the sequence or partial sequence of the ccr1 gene from wheat were introduced into spring and winter wheat cultivars using particle gun bombardment. Transgenic wheat plants were recovered and were grown to maturity in the greenhouse. Nodes from the straw were collected and analyzed for lignin content using the Klason analysis for acid insoluble and acid soluble lignin. The affect of the introduced sequences from the wheat of the ccr1 gene on lignin content in the straw will be discussed. If successful, reduced lignin wheat cultivars could increase profitability for wheat producers while supplying an alternative fuel source for the nation.

*Characteristics of Root Growth in a Management Intensive Grazing System,* **JEFF O. LARSEN, RHONDA L. MILLER, LUKE A. PETERSEN, and VAUGHN J. THACKER** (Agricultural Systems Technology and Education Department, Utah State University, 2300 Old Main Hill, Logan, UT 84322-2300; E-mail: jolarsen@cc.usu.edu).

Management intensive grazing (MIG) practices are becoming increasingly popular among dairy farmers. MIG is a rotational grazing practice that has been found to decrease farm input costs and increase pasture productivity. Despite the popularity of MIG, many are concerned about its environmental impacts. Increased stocking rates on pasture lands can contribute significantly to ground water contamination. In this study four grass species, meadow brome (*Bromus riparius* Rehm), perennial ryegrass (*Lolium perenne* L.), tall fescue (F*estuca arundinacea* Schreb), and orchardgrass (*Dactylis glomerata* L.), and two legume species, birdsfoot trefoil (L*otus corniculatus* L.) and white clover (*Trifolium repens* L.), were combined in eight grass-legume mixtures in 32 test plots to examine nutrient leaching. Differences were observed among the grass-legume mixtures, with orchardgrass plots consistently leaching more nitrogen. It is hypothesized that root distribution affects nutrient utilization and may account for the leachate differences. To test this hypothesis root cores were taken and analyzed for length and density. Root distribution patterns and the correlation with nutrient leaching will be presented.

*Tree-Ring Isotope Rhythms: Climate and Dating from the Bands*, **STEVEN W. LEAVITT** (Laboratory of Tree-Ring Research, 105 W. Stadium, Bldg. #58, University of Arizona, Tucson, AZ 85721).

Stable-isotope analysis (C, O, H) of tree rings has been used for several decades now as a proxy measure of interannual environmental variability, which might contain information beyond that derived from the traditional analysis of tree-ring widths. More recently, measurements of seasonal stable-isotope variability in tree rings from around the world are revealing patterns of changing composition that can be linked to seasonal climate variation. Examples of these patterns are presented and the environmental cause of the seasonal variation of stable-carbon isotope composition is explored. At least in the southwestern U.S., the tree-ring isotopic patterns may serve as a useful indicator of seasonal moisture status, although storage of photosynthates may play an important role in the expression of the signals. The regularity of these patterns also provides the basis for a supplemental dating tool when the species do not have regular identifiable ring boundaries, such as may often be the case in tropical and subtropical environments.

*A Study of Learning Organization and Faculty Development—A Northwest University as Example,* **HSIENYI LIN and DALE GENTRY** (College of Education, University of Idaho, ID 83843; E-mail: lin_hsienyi@hotmail.com).

The knowledge taught by a traditional university has a limited life-span because of rapid innovations throughout society. The general purpose of this research is to understand the current relationship between processes used in learning organizations and a university, and further, to explore faculty members' perceptions of the characteristics of a university in relation to those processes and faculty development in that university. The specific purpose of this study is to investigate and explore faculty members' perceptions of the current status of the university as a learning organization (Peter Senge's Systems Thinking, Personal'Mastery, Mental Models, Shared Vision and Team Learning) and faculty development (Intellectual Capability in Teaching, Current Knowledge in Teaching, Student Advising, Class Organization and Management and Communication) at the university, using survey research.

To achieve the aims mentioned above, a study was conducted beginning Fall, 2003. The research started by exploring the theories of learning organization and faculty development through related papers and articles from which the fundamental theory was formed, the framework constructed, and the research questions derived. The independent variables were characteristics of the faculty; the dependent variables were faculty responses regarding learning organization and their own professional development. In order to gather related data and information, the study used a questionnaire entitled, "Learning Organizations"and Faculty Development Inventory.""The study sample consisted of faculty members. Data were analyzed using descriptive statistics, correlation, and regression analysis.

*Ecological Consequences of Forest-insect Disturbance Regimes Altered by Climate Change,* **JESSE A. LOGAN[1] and JAMES A. POWELL[2]** ([1]Rocky Mountain Research Station, U. S. D. A. Forest Service, 860 N. 1200 East, Logan, UT 84321; [2]Department of Mathematics and Statistics, Utah State University, Logan, UT 84322).

Insects in aggregate are the greatest cause of forest disturbance. Outbreaks of both native and exotic insects can be spectacular events in both their intensity and spatial extent. In the case of native species, forest ecosystems have co-evolved (or at least co-adapted) in ways that incorporate these disturbances into the normal cycle of forest maturation and renewal. The time frame of response to changing climate, however, is typically much shorter for insects (typically one year) than for their host forests (decades or longer). The impact of climate change is therefore disproportionately expressed, leading to potentially catastrophic disruption of these co-adapted disturbance-based relationships. Insects responding to increasing temperature can expand their ranges into new and novel habitats, resulting in native species acting as introduced pests. In this talk, I will describe work with the native mountain pine beetle and spruce beetle, and the introduced gypsy moth as examples of how climate warming can dramatically alter forest-ecosystem disturbance regimes. The resulting impacts range from intensification of co-adapted disturbances (such as mountain pine beetle disturbance regimes in lodgepole pine forests) to potential loss of keystone species (mountain pine beetle invasion of high-elevation, five-needle pine ecosystems). Climate warming also holds consequences for increased establishment of exotic pests, like the gypsy moth, with potentially serious consequences for aspen and other sensitive species. These impacts are already either beginning to be expressed, or soon will be. Economic consequences are both immediate and severe (e.g. unprecedented timber loss to mountain pine beetle in British Columbia). Ecosystem consequences range from loss of biodiversity and resilience to adverse impacts on carbon sequestration and global biogeochemical cycles. Finally, the resulting management implications and potential responses are briefly discussed.

*Electrical Spectra of Soils Determined by Vector Network Analyzer*, **SALLY D. LOGSDON** (USDA-ARS-National Soil Tilth Laboratory, 2150 Pammel Dr., Ames, IA 50011; E-mail: logsdon@nstl.gov).

The apparent dielectric and bulk electrical conductivity have traditionally been measured at one frequency and related to water content or salinity. Inconsistencies suggest other soil properties are measured. The purpose of this study was to measure soil electrical properties across a range of frequencies, and to relate the spectra to soil properties. We measured the reflection scattering parameter for six soils packed into two sizes of truncated coaxial chambers. The soils ranged from kaolinitic to smectitic, and were each measured at four water contents. The frequencies ranged from 300 kHz to 3 GHz. The scattering parameter was converted to complex electrical properties: permittivity, electrical conductivity, and resistivity. The smaller chamber had larger permittivity values at lower frequencies. The d.c. electrical conductivity fitted from the electrical conductivity spectra was correlated 1:1 with that fitted from resistivity spectra, but the fitted relaxation frequency and exponent did not agree between the electrical conductivity and resistivity spectra. Multiple relaxations were required to fit the complex permittivity spectra, and the fitted parameters did not agree with those from the electrical conductivity or resistivity spectra. Also fitting the complex permittivity spectra resulted in non-unique parameters. Most of the dielectric dispersion occurred at frequencies less than 30 MHz, and dielectric dispersion was greatest for the calcareous soil and high for the smectitic soils. Other than water content, pH was the soil property most strongly correlated to the fitted parameters. Study is ongoing to determine the physical and chemical significance of the spectra.

*Prolactin (PRL) and PRL-Receptor-Long Form (PRL-L-R) mRNA Expression in the Testis and Epididymis of Sexually-immature and –mature Mink (*Mustela vison*),* **JONATHON LORDS, JASON HUNT, MALCOLM SHIELDS and JACK ROSE** (Department of Biological Sciences, Idaho State University, Pocatello, ID 83209; E-mail: huntjaso@isu.edu).

PRL may influence sexual development and subsequent reproductive physiology of male mink. Therefore, we have quantified PRL and PRL-L-R mRNA expression in the testis and epididymis of, 1: sexually-immature mink , not having undergone a seasonal reproductive cycle and, 2: sexually mature animals that have experienced seasonal changes in circulating gonadotrophins, gonadal steroids and the tissue manifestations that accompany these hormones. Tissues collected in November, had total RNA extracted and analyzed by Real Time Polymerase Chain Reaction. PRL mRNA abundance did not differ between epididymis and testis, nor between sexually-mature and -immature mink. In contrast, PRL-L-R mRNA abundance was greater in the testis of sexually-immature mink, compared to mature mink as well as epididymis of mature and immature mink ($P<0.05$). Low gonadal PRL mRNA production, compared to PRL-L-R mRNA, suggests local (autocrine/paracrine) actions of PRL that probably do not contribute to systemic hormone levels. Previously, (Kabbaj et al., 2003; Biol. Reprod., 68:722-734) we showed that serum PRL levels were low during the first year of life in male mink, which might lead to the conclusion that PRL has no role in sexual development of this species. However, here we illustrate the local production of hormone and receptor, with quantitative differences between sexually immature and mature animals, which strongly supports a role for PRL signaling in the male gonad. Future studies, with in

situ hybridization procedures will be used to localize potential PRL effects to either Leydig cells (testosterone production?) and/or seminiferous tubule epithelium (sperm development?).

*Low Frequency Impedance Analysis of Soils*, **ROBERT N. LOVE[1], LYNN M. DUDLEY[1], and STEPHEN BIALKOWSKI[2]** ([1]Department Plant, Soils & Biometeorology., [2]Department of Chemistry & Biochemistry, Utah State University, 1415 Old Main Hill, Logan, Utah 84322; E-mail: rnlove@mendel.usu.edu).

Methods that determine soil properties using induced electromagnetic (EM) waves, such as time domain reflectometry and ground penetrating radar, are important tools for monitoring the soil environment. The EM waves cause distortions in the electric fields of matter, and combined phases of contrasting permittivity such as soil particles and water exhibit large changes in permittivity and conductivity as frequency is varied. Where soils are concerned, virtually all work has been done in the very high frequency range (30-300MHz) where water polarization is the relaxation mechanism. At low frequencies (<1MHz), there is a lack of knowledge about the interactions between soil systems and induced EM fields. Five possible polarization mechanisms have been proposed; i) bound water rotation, ii) liquid films, iii) surface roughness, iv) confined DDL's, and v) extended DDL's. Our objective is to identify the dominant chemical and physical mechanisms influencing the dielectric properties in the low frequency domain, and then develop an appropriate model. Using a HP 4194A Impedance Analyzer and a four electrode test cell, we report results for impedance experiments on frequencies between 100 Hz to 15 MHz and using sample that varied water content, clay content and soil particle surface ions. Initial results have shown differences in the impedance spectra as water content increased, impedance increased, as clay content increased, impedance decreased, and different surface ions gave different results.

*Variability and Trends in Spring Runoff in the Western United States,* **JESSICA LUNDQUIST[1], DAN CAYAN[1,2], and MIKE DETTINGER[1,2]** ([1]Scripps Institution of Oceanography, [2]U. S. Geological Survey, UCSD MC-0213, 9500 Gilman Dr., La Jolla, CA 92093-0213).

In the western United States, over half of the water supply is derived from mountain snowmelt, where the snow provides a natural reservoir, delaying runoff and providing water in spring and summer when it is needed most. Interannual variability in both the magnitude and timing of spring runoff is tremendous, and western states have developed elaborate reservoir systems to store water from wet years in order to weather droughts. However, while the population continues to grow, some alarming changes have been noted in recent decades in western U.S. late-season runoff. The fraction of water that runs off as snowmelt during late spring and summer has declined (Roos. 1991. 59th Western Snow Conf, Juneau, AK:29-36; Wahl. 1992. *Pp. 701-710 in Managing Water Resources During Global Change*, Amer. Water Res. Assoc., Reno, NV.; Dettinger and Cayan. 1995. J. Climate 8:606-623) by 10-25%. Warmer winters and springs have led to earlier snowmelt and a higher percentage of precipitation falling as rain, rather than snow. Snowmelt runoff timing has advanced approximately 1-3 weeks earlier in many mountainous catchments across western North America (Stewart et al. 2004. Clim. Change 62:217-232). In many western locations, lilac (*Syringia vulgaris*) and honeysuckle (*Lonicera tatarica* and *L. korolkowii*), responding to increased temperatures, early runoff, or both, are reaching their springtime morphological growth stages 1-3 weeks earlier than in the 1970s (Cayan et al. 2001. Bull. Amer. Meteorol. Soc. 82:399-415). Climate projections (Dettinger et al. 2004. Clim. Change 62:283-317; Knowles and Cayan. 2002. Geophys. Res. Lett. 29:18) suggest that California could lose one third of its present-day, spring snowpack by the middle of the 21st century. Hydrologists have long known that snow is a key component of the water budget, yet most operational runoff models are based on past statistics, rather than spatially and temporally distributed physical processes. In a changing climate, the statistics of the past may be unreliable, so increased measurements at high altitudes are needed to physically understand the magnitude and timing of critical processes like snow melt, sublimation, and runoff. For example, recent increased hydroclimatic monitoring in Yosemite National Park has demonstrated that in some years, such as 2002, the onset of spring melt and runoff may be completely independent of elevation (Lundquist et al. 2004. J. Hydrometeorol: In press).

*3D Localization of the Mismatch Negativity Response to Auditory Stimuli,* **YING LUU, PHIVAN PHAM, SUSAN SABAL, MICHELLE WATSON and STANLEY E. LUNDE** (University of California-Los Angeles, 1312 Murphy Hall, Los Angeles, CA 90095; E-mail: feiyingluu@yahoo.com; slunde@lde.dds.ca.gov).

Mismatch negativity (MMN) is an electrical brain response elicited by the automatic detection of change, a deviant, in sequence from the sensory memory trace of repeating auditory stimuli, the standard (Naatanen, 1992). Schall et al. (2003) reported specific MMN neural sources for the duration deviant to be in the frontal, parietal, and insular cortices as well as in the temporal-prefrontal lobes. In our study, Low Resolution Electromagnetic Tomography (LORETA; Pascual-Marqui et al., 1999) was used to convert MMN amplitudes computed from 19-electrodes into current source density in 3D Talairach space. The high temporal resolution of LORETA enabled sub-second analysis of the dynamics of MMN neural generators during the processing of a stimulus. A standard stimulus of 75 ms and a duration deviant of 25 ms were presented in a sequence of tones based on a modified version of Naatanen's optimum paradigm (Naatanen et al., 2004). Results showed that neuronal

generators were primarily activated in the right superior and middle temporal gyri, right parietal lobe, the right middle frontal gyrus, right insula, and right fusiform gyrus during the early part of the response. As the response peaks, activity increases in the left hemisphere in the parietal lobe with activity still present in the right temporal gyri. These results contribute to knowledge of the dynamics of neural processing during auditory discrimination. MMN has clinical applications in the diagnosis of infants and young children for neurodevelopmental disorders because it does not require attention or performing tasks.

*Iron Nutrition and Suppression of Cotton Root Rot on Calcareous Soil,* **JOHN E. MATOCHA** (Texas A&M University, TAES).

Cotton (*Gossypium hirsutum* L) usually does not exhibit Fe deficiency chlorosis symptoms as do certain monocot plants. Observations showed plant mortalities from a severe cotton root rot disease (*Phymatotrichopsis omnivorum*) were considerably higher in areas where monocot plants (sorghum) showed Fe chlorosis. This possible association of Fe stress in cotton and incidence of cotton root rot (PRR) gave impetus to greenhouse and field studies of Fe requirements of cotton and the effects of Fe nutrition on severity of PRR on highly calcareous soils. Cotton responded to soil amendments, which reduced soil pH and also to supplemental Fe through various Fe carriers. Dry matter yields increased 51, 76, and 164 percent, respectively, for 4,000, 8,000, and 16,000 kg $ha^{-1}$ granular elemental S. Plant mortalities from PRR occurred later in the growth cycle. Substantial reductions in plant losses were measured with 8,000 and 16,000 kg $ha^{-1}$ applied S. This highly $CaCO_3$ buffered soil showed large reductions in soil pH with the increased dry matter and reduction in plant losses to PRR. Response in plant growth and disease suppression from barnyard manure was apparently a direct response to Fe and possibly other trace elements present in the manure rather than a pH depression effect. Plant growth and Fe uptake response occurred with Chel-138 rates of 5 mg Fe $kg^{-1}$ while significant reduction in plant mortality required 15 mg Fe $kg^{-1}$ soil. Largest response in growth, Fe uptake, and disease suppression was measured with 5 mg Fe $kg^{-1}$ as Amaranthus plant complexed-Fe.

*Observed Impacts of Climate Change on Natural Systems in the United States,* **JOHN H. MATTHEWS** (Department of Integrative Biology, University of Texas, Austin, TX 78712-0900).

North American ecosystems face pressures from habitat loss, land-use changes, pollution, and invasive species. Have human-induced climate shifts already added to these pressures, or is anthropogenic climate change largely a concern of future decades and centuries? The answer depends on whether the magnitude of climate impacts can be accurately estimated for the coming century. Several studies demonstrate the links between climate change and the distribution and behavior of particular North American species independent of other ecological forces. Moreover, we have conducted global analyses that allow broad characterizations of biological impacts for different taxa and ecosystems that can be used to infer future responses to climate change in North America. To date, most responses appear to be ecological in nature (e.g. changes in distribution) rather than evolutionary (and adaptational). Therefore, climate change is likely to lead to significant changes in the makeup of natural communities. Many North American species have already felt the hand of a changing climate, and the coming century will see those effects strengthen.

*Quantitative Resistance to White Mold in Common Bean,* **J. MAXWELL**, **M. A. BRICK**, **P. BYRNE**, **X. SHAN**, **H. F. SCHWARTZ** (Colorado State University; E-mail: gijudd@rocketmail.com).

White mold caused by *Sclerotinia sclerotiorum* (Lib.) de Bary, is a major pathogen of common beans (*Phaseolus vulgaris* L.). Yield loss due to white mold infections can reach up to 80%. Currently most common bean cultivars are susceptible to white mold and there is a need to develop resistant cultivars. The objective of this study was to determine the effect of a major QTL (quantitative trait loci) which confers partial resistance to white mold in a pinto bean genetic background. Greenhouse tests were conducted on recombinant inbred lines (RILs) developed from a resistant x susceptible cross. The Petzolt and Dickson straw test was used to evaluate the parents and 115 RILs. Correlation coefficients for the association between the known QTL and resistance were 0.23 ($p = 0.0167$) and 0.43 ($p = 0.0211$) for independent evaluations of the RILs. A more saturated linkage map is being developed to find additional markers linked to major genes for resistance to white mold.

*Balancing Chemical and Biological Nitrogen Management in Irrigated* Phaseolus vulgaris *(L.) Cropping Systems,* **KELLI MAXWELL and W. BART STEVENS** (Powell Research and Extension Center, University of Wyoming, 747 Road 9, Powell WY, 82435; E-mail suzann@uwyo.edu).

The association between dry bean (*Phaseolus vulgaris* L.) and its associated rhizobium symbiont (*R. phaseoli*) has been shown to be inefficient and as such unable to provide adequate N for maximum bean production. Fertilization with inorganic N is sometimes recommended, but disadvantages of adding fertilizer N include, increased input costs, delayed maturity and inhibition of $N_2$ fixation. It is not clear whether supplemental N is most beneficial during early growth stages prior to nodulation, or during reproductive growth stages when N uptake is the highest. Field studies were established at two Wyoming sites with differing soil properties to compare fertilized, unfertilized and inoculated plantings for seed yield

and pod maturation, nodulation, and $N_2$ fixation. A similar greenhouse experiment was conducted where *P. vulgaris* varieties 'Maverick' and 'Focus' were grown in pots until the R3 growth stage after which root nodules were counted, weighed and assayed for $N_2$ fixation activity using the acetylene-reduction technique. Preplant broadcast, sidedress, and split applications of N fertilizer were evaluated in both the field and greenhouse experiments. Yield responses were inconsistent among different N timing treatments, but delaying part or all of N application until the V6 to R1 growth stage allowed beans to mature more quickly than when all N fertilizer was applied before planting. Nodule number and mass were affected by both rate and timing of N application with both parameters decreasing with higher amounts of N and earlier timing of N application.

*From Models to Crops: Integrated Medicago Genomics for Alfalfa Improvement,* **GREGORY D. MAY** (Plant Biology Division, The Samuel Roberts Noble Foundation, 2510 Sam Noble Pkwy, Ardmore, OK 73402; E-mail: gdmay@noble.org).

With more than 18,000 types of legumes belonging to the pea family (Leguminosae), these plants are second only to grasses in economic importance worldwide. Forage and pasture legumes are an important source of nutrition for animal and dairy production. Moreover, in comparison with other crops, the production of legumes reduces economic and environmental costs given their ability to fix nitrogen.

*Medicago truncatula* is a forage legume commonly grown in Australia, and is closely related to the world's major forage legume: alfalfa (*M. sativa*). *M. truncatula* has been chosen a model species for genomic studies in view of its small diploid genome and fast generation time, features that are not shared with more agronomically important legume species. Genes from *M. truncatula* share high sequence identity to, and synteny with, the corresponding genes from alfalfa and other legumes. These features make *M. truncatula* an excellent model for understanding the genetics and molecular biology of agronomically important legumes with more complex genomes.

We have taken a global approach in studying the genetic and biochemical events associated with the growth and development of *M. truncatula*. Our approach includes: EST and genome sequencing, expression, metabolite and protein profiling, and the generation of gene knockout systems. The resulting multidisciplinary databases developed in our program are being interfaced to provide scientists with an integrated set of tools to address fundamental questions pertaining to legume biology. Results from our program will be discussed, and we will begin to examine the question: Can crop species benefit from model organisms?

*A Search for Congruence between Ontogeny and Phylogeny: Within-Group Variation in Morphological Integration in Clover* (Trifolium repens *L.) in Different Aged Pastures,* **JACK MAZE and ROY TURKINGTON** (Department of Botany, University of British Columbia, Vancouver, B. C., V6T 1Z4, Canada; E-mail: jmaze@interchange.ubc.ca).

This is part of a continuing study seeking features shared by ontogeny and phylogeny. The approach is to apply a common statistic, within-group variation in integration, to the products of ontogeny and phylogeny in a search for common underlying patterns. Within-group variation in integration, an estimate of the relationship among variables, increases as more distantly related grass species are compared. It is also higher in grape leaves that develop in a higher energy environment. The grape leaf results can be placed in a thermodynamic context, energy dynamics occurring via matter transformation. It is tempting to use the similar responses in grape leaves and grasses, to argue for some sort of thermodynamically driven change in phylogeny. The present study compares grape leaves with clovers of a common genetic origin in pastures whose time of existence, and of the clovers there, offers a comparison of the affect of age with that of a modified energy environment. The clovers in the oldest pasture had the highest within-group variation in integration, arguing for a time-related change like those seen in one growing season in grape leaves. This isn't necessarily a test of the idea that evolutionary changes are thermodynamically driven, they are of greater duration than the ages of the pastures studied here. But it indicates that the idea is worth pursuing, both in search of a closer analytical relationship between thermodynamically-related changes and phylogeny and to seek a probable mechanism.

*The Role of Bristlecone Pine in the Calibration of the Radiocarbon Dating Technique: The Early Work of Edmund Schulman,* **DONALD J. McGRAW (**University of San Diego, 5998 Alcala Park, San Diego, CA 92110; E-mail: mcgraw@sandiego.edu).

Edmund Schulman (1908-1958) was an early pioneer in the field of dendrochronology at A.E. Douglass' Laboratory of Tree-Ring Research, University of Arizona, where, from 1939-1953, Schulman focused on climatological research using especially two coniferous trees: the pinyon pine and the Douglas-fir which were of value in deriving proxy weather histories. However, neither species grew to the great age of the Giant Sequoia, Douglass' then preferred species, and so did not offer in a single tree a very long tree-ring chronology. Schulman traveled the western U. S. seeking out yet other species that might also be very long-lived and offer easily read rings, unlike the challenging ones typical of the sequoia. In his search, he fell upon the bristlecone pine in 1953 in the White Mountains of California and found it invaluable in building long chronologies for his dendroclimatological studies. His sudden death in 1958 came about just as he was

alerting the world of both tree-ring studies and broader areas of the sciences to the great value of this species. This early history will be the focus of this talk. It is derived from the book in preparation by this author that will chronicle the foregoing and many other aspects of the early bristlecone studies. That larger work will end with Schulman's efforts and those of his followers to use bristlecone chronologies in the calibration of Willard Libby's then fairly newly-established dating technique of carbon 14 ($^{14}C$), or radiocarbon dating.

*Beyond Global Warming: Global Cooling and the Next Ice Age,* **ADEN B. MEINEL[1] and MARJORIE P. MEINEL[2]** ([1]Professor Emeritus, Department of Astronomy and the Optical Sciences Center, University of Arizona, Tucson, AZ, and Emeritus Distinguished Scientist, Jet Propulsion Laboratory, Observational Systems Division, California Institute of Technology, Pasadena, CA; [2]Retired, Jet Propulsion Laboratory, Observational Systems Division, California Institute of Technology, Pasadena, CA).

Ice and benthic cores record the drama of the Ice Ages for the last 10 million years. A number of theories have been proposed over that past 150 years to explain the clock-like precision of recurrences of the ice ages. But all have failed to explain what is observed in recent higher resolution temperature records. Extensive records of temperatures during the Ice Ages have now been obtained from ice and planktonic cores ranging from the northern polar regions to the southern polar regions.

Our attention was drawn to this topic when we saw curious regular features in these temperature records. We wondered if they could be signatures of unexpected solar activity. We present the evidence supporting this conjecture. Piecing these clues together leads to the conjecture that the Sun is a variable star of 112 Ky period. But this conclusion is in disagreement with current models of the interior of the Sun, which exclude the possibility of a variable solar luminosity. This means that either 1) what we deduce from the core chronologies as being of solar origin is incorrect, or 2) something may be missing in set of differential equations used to compute solar models.

Climate change is a topic of much current interest, especially in the context of Global Warming. The geo core temperature records show that major climate changes must have occurred over the past million years. Comparing the Greenland ice core record with the Vostok record shows that the ocean temperature near Greenland 120,000 years ago suffered a drop in temperature of ≈ 6°C in about 300 years. This is very large compared to the temperature drop during the Little Ice Age, which started about 1300 and finally ended in 1940 when anthropogenic Global Warming took center stage. Yet this drop in environmental temperature of about 1°C was sufficient to cause great distress as alpine glaciers invaded the valleys and threatened villages and set the stage for the Irish Potato Famine.

The Greenland ice core record indicates that the ocean thermal conveyor had stopped. This lesser Ice Age lasted ≈ 5,000 years, but was just a prelude to the slow descent of temperatures into main Ice Age which lasted an additional 100,000 years, and which finally ended only 20,000 years ago. This raises the question of whether a future shut down of the Gulf Stream by Global Warming will precipitate a similar Ice Age which then will grow in severity over the next 300 years.

We will identify the pieces of the puzzle about signatures of solar luminosity events in the Ice Age chronologies and present how the pieces fit together. Our emerging hypothesis concerning the Ice Ages can be stated in four words: Sun first, nature following.

*The Skookum Imprint: Trace Evidence of Sasquatch?* **D.J. MELDRUM[1] and D.R. SWINDLER[2]** ([1]Dept. of Biological Sciences, Idaho State University, Pocatello, ID 83209, email:meldd@isu.edu; [2]Dept. of Anthropology, University of Washington, Seattle, WA 98195; E-mail: meldd@isu.edu).

The most abundant tangible evidence of Sasquatch is footprints. Occasional imprints of other body parts have been found. The partial imprint of a large animal was discovered 9/22/2000, near Skookum Meadows, Gifford-Pinchot National Forest, Washington state, by investigators of the Bigfoot Field Researchers Organization (BFRO). Found in moist loamy soil at a site baited with fruit and scent attractant, it preserves the forearm, buttock, thigh, lower leg and heel, including the calcaneal tendon. After photodocumentation, an area 3.5 x 5.0 feet was cast in hydrocal. Footprints of bear, elk, deer, and coyote were also present, but not correlated with the imprint. Of these, elk was the most likely potential candidate responsible for the imprint. Comparisons with elk bedding imprints revealed incongruent anatomy, especially of the heel imprint, dissimilar hair patterns, and lack of hoof prints positioned and oriented consistent with bedding and standing postures. These features are most consistent with an 8-9 foot hominoid. Most distinctive is the correlation of a well-developed buttock and calcaneal tendon, indicative of bipedalism. Anterior to the calcaneal tendon is a marked hollow indicating an elongated heel, as evidenced consistently in purported Sasquatch footprints and presumed an adaptation to the hominoid's large mass and flexible midfoot. The plantar surface of the heel exhibits coarse dermatoglyphics, similar to ridge detail in some purported Sasquatch footprint casts.

*Utah's Choice: A New Native Plant Selection and Tagging Program*, **SUSAN MEYER** (Research Ecologist, USDA-Forest Service Shrub Sciences Laboratory, Provo, UT).

In the winter of 2003, the Intermountain Native Plant Growers Association was founded to promote the use of native plants in residential, commercial, and institutional landscapes, and to coordinate efforts to make these plants more available

in the trade. The core program of INPGA is Utah's Choice, a marketing program that includes forty of the best Intermountain natives for residential landscape use. The program includes color photo tags for each species, color signs for use in retail nursery display, a promotional CD, posters, brochures, and a website at: www.utahschoice.org. To date 30 nurseries have joined INPGA, as well as several seed companies and landscape design firms. Program sponsors include the Utah State University Center for Water Efficient Landscaping, the Utah Botanical Center, the Utah Native Plant Society, the Utah Division of Water Resources, and the Central Utah Water Conservancy District. To aid member nurseries in getting these plants into production, INPGA has initiatied a seed bank service that will include the establishment of seed production blocks for hard-to-obtain species. The program has received considerable press, and a marketing study showed that a large segment of the public is ready to switch to low input landscaping. A key role for INPGA at this stage is in trying to make sure that supply can keep up with demand created by the marketing program.

*Complexity is the Grand Challenge for Biology and Computing*, **GEORGE S. MICHAELS** (Chief Scientist and Director, Bioinformatics and Computational Biology, Pacific Northwest National Laboratory, Richland, WA 99352; E-mail George.Michaels@pnl.gov).

Systems Biology methods seek to gain a comprehensive and predictive understanding of the dynamic, interconnected processes underlying living systems. The advancement of high throughput biology and quantitative "Omics" approaches for systems analysis of biological systems will involve teaming of disciplines to drive new discoveries. The development of biomarkers for environmental events, personalized medicine and bioproducts/processes discovery all share a signature recognition requirement that will be driving a new focus on data intensive computing. New experimental methods, biotechnologies, quantitative technologies, data analysis algorithms, and hardware architectures are needed to address these grand challenges. The DOE Genomics program: Genomes To Life (GTL) is focused on addressing these challenges for to produce new developments that impact the national energy and environment needs.

*A Kinetic Analysis of Bluetongue Virus mRNA Using Quantitative Real-Time PCR,* **GARRY MILLER, MAGGIE BUCCAMBUSO, YI-CHEN LEE, and JOSEPH LI** (Biology Department, Utah State University, 5305 Old Main Hill, Logan, UT 84321; gtmiller@cc.usu.edu).

Bluetongue Virus (BTV) belongs to the Reoviridae Family and consists of 24 serotypes worldwide, five of which are found in the United States—BTV2, 10, 11, 13, and 17. BTV can cause fever, fetal malformation, and even death in ruminants. Thus, BTV is also of economic importance in both import and export of cattle in the United States. Many countries restrict the export of cattle that test positive for BTV. As a result, it has been estimated that BTV *costs the U.S. $125 million annually* due to lost trade. Bluetongue Virus consists of ten RNA segments, (L1, L2, L3, M3, M2, M1, S1, S2, S3, and S4) which enable the virus to replicate while taking over the host cellular machinery. *Kinetic analyses* of gene regulation for all ten BTV segments have been performed using cell culture, Quantitative Real-Time Polymerase Chain Reaction (qRT-PCR), gel electrophoresis, and standard PCR techniques. However, this report will focus largely on the preliminary results of the sequential expression of M3 and S4 genes, which encode for two nonstructural proteins—NS1 and NS3/3A during viral replication. NS1 proteins are the tubules that may aid in transporting viral progeny to the plasma membrane. The functions of NS3 proteins are less resolved, but are considered to play a role in viral progeny release.We intend to establish a complete kinetic analysis of all ten BTV mRNAs by a qRT-PCR assay to improve BTV infection testing for the cattle industry and anti-viral agent testing for the inhibition of BTV replication.

*Hypertension Impairment and Socioeconomic Differences among Persons with Insulin-Dependent Diabetes,* **STEPHEN J. MOREWITZ** (Stephen J. Morewitz, Ph.D., & Associates, CA & IL, 695 Noe St., Ste. 1, San Francisco, CA 94114; E-mail: morewitz@earthlink.net).

Persons with diabetes are at increased risk for life-threatening cardiovascular disease. However, little is known about the possible impact of socioeconomic status (SES) conditions in facilitating or inhibiting cardiovascular disease among individuals with diabetes. SES factors may influence hypertension morbidity and mortality by affecting access to health care, patient compliance, physical activity, weight loss efforts, and nutritional patterns. The present study results will provide information on how to help diabetics with hypertension who require appropriate assessment, treatment, and rehabilitation because of their hypertension-associated impaired functioning and decreased quality of life. The following null hypothesis is tested: There are no differences in hypertension impairment between low-SES persons with insulin-dependent diabetes (IDDM) and high-SES individuals with IDDM. Data from the population-based 1998 National Health Interview Survey (N=30,534 adults) were used. Chi-Square and multivariate statistical procedures evaluated the possible relationship between hypertension impairment and annual family income among individuals with IDDM, after adjusting for age, gender, race, frequency of physical activity, and other predictors. The null hypothesis was rejected. Persons with IDDM who have family incomes less than $20,000 (17%) were more than twice as likely as those with incomes of $20,000 or more (5.8%) to report that hypertension caused difficulties with their daily functioning (Chi-Square=13.42, df=2, $p<.001$). These differences remained significant after controlling for predictor variables. Hypertension disease

prevention programs that emphasize physical activity, weight reduction, proper nutrition, and access to health care should target individuals with IDDM from low-SES backgrounds to treat their cardiovascular disease and related complications.

*Duration of Heart Problems among Non-Insulin-Dependent Diabetics: Socioeconomic Status Differences,* **STEPHEN J. MOREWITZ** (Stephen J. Morewitz, Ph.D., & Associates, CA & IL, 695 Noe St., Ste. 1, San Francisco, CA 94114; E-mail: morewitz@earthlink.net).

Cardiovascular disease can be life-threatening conditions for persons with diabetes. However, more research is needed to evaluate the effects of socioeconomic status (SES) conditions in facilitating or inhibiting cardiovascular disease among individuals with diabetes. SES factors may influence participation in physical activity, weight loss efforts, nutritional patterns, and access to health care, which in turn affects cardiovascular disease-related morbidity and mortality among persons with diabetes. These findings will help diabetics with cardiovascular disease who require appropriate assessment, treatment, and rehabilitation because of their cardiovascular disease and related impaired functioning and decreased quality of life. The present investigation tests the null hypothesis that there are no differences in duration of heart problems (in years) between low-SES persons with non-insulin-dependent diabetes (NIDDM) and high-SES individuals with NIDDM. Data from the population-based 1998 National Health Interview Survey (N=30,534 adults) were used. T tests and multivariate statistical procedures evaluated the possible relationship between duration of heart problems and family income among individuals with NIDDM, after adjusting for age, gender, race, frequency of physical activity, and other predictors. The null hypothesis was rejected. Persons with NIDDM who have family incomes less than $20,000 had duration of heart problems (19.96 years) that were more than two times the duration of heart problems among individuals with NIDDM who had family incomes of $20,000 or more (9.21 years) ($t=-2.64$, $df=128$, $p<.01$). These differences remained significant after controlling for predictor variables. Cardiovascular disease prevention programs that emphasize physical activity, weight reduction, proper nutrition, and access to health care should target individuals with NIDDM from low-SES backgrounds to treat their cardiovascular disease and related complications.

*West Nile Virus and Mad Cow Disease: Current Research Directions,* **JOHN D. MORREY (**Institute for Antiviral Research, Department of Animal, Dairy and Veterinary Sciences, Utah State University, Logan, UT 84322-4700; E-mail: jmorrey@cc.usu.edu).

Currently there are no treatments for West Nile virus (WNV) infection or Creutzfeldt-Jakob disease (CJD), a prion disease like mad cow disease. The NIH is funding development for therapies for WNV and CJD. This presentation addresses 5 obstacles that need to be overcome. 1) Is there a narrow window for treatment between onset of symptoms and brain infection? Experiments with viral-reactive antibodies and antioxidants suggest that West Nile disease might be treatable after the virus has infected the brain; yet current drugs for rodent prion disease need to be administered before experimental infection. 2) Can therapies be delivered beyond the blood-brain-barrier (BBB)? Smaller, hydrophobic, more positively charged compounds are more likely to pass the BBB. Biochemical agents can facilitate drugs through the BBB such as Cereport™ and mannitol. Moreover, drugs can be delivered directly into the ventricular spaces of the brain. 3) Is neurological disease reversible particularly when neurons are infected? Some viruses can be cleared from neurons without damaging the cells. Removing normal prion protein from diseased rodents will reverse some pathology. 4) What are clinical markers for disease outcome so that therapies can be evaluated for efficacy? WNV viral titers do not necessarily correlate with outcome. Parameters such as motor/cognitive function, EEG, intracranial pressure, photon emission tomography, CSF viral load/antibody might better predict outcome of WNV infection. CJD cannot be diagnosed without brain biopsies. 5) What are the implications for treating natural vs. intentional aerosolized WNV infection? These five obstacles might be overcome with appropriate research.

*Variability and Trends in Mountain Snowpacks in Western North America,* **PHILIP MOTE[1], ALAN HAMLET[1], MARTYN CLARK[2], and DENNIS LETTENMAIER[1]** ([1]JISAO/SMA Climate Impacts Group, Box 354235, University of Washington, Seattle, WA 98195; [2]Center for Science and Technology Policy Research, University of Colorado, Boulder, CO 80303).

Manual and automated measurements of spring snow-water equivalent (SWE) in the mountainous West are examined in combination with a simulation of the region's snow by a hydrology model. Declines in spring SWE since the mid-20$^{th}$ century were widespread, and were largest in the relatively mild mountain areas of northern California and the Pacific Northwest, even though in many cases winter precipitation has increased. In most mountain ranges, relative declines grow from minimal at ridgetop to substantial at snowline. Analysis of the separate influences of temperature and precipitation trends underscores the varying sensitivity to temperature across the region and even within mountain ranges, and provides an additional means of estimating future temperature-driven losses in the region's snow resources.

*Response of Common Bean Cultivars and Landraces to Drought Stress,* **C. MUNOZ[1], R. ALLEN[1], D. WESTERMANN[2], M. DENNIS[1], R. HAYES[1], H. TERAN[1], and S. P. SINGH[1]** ([1]Univ. of Idaho and [2]USDA-ARS; E-mail: muno5646@uidaho.edu).

Drought is a major limiting factor for common bean production worldwide. Moreover, there is increasing shortage of irrigation water in the Pacific Northwest U.S. Development of drought resistant cultivars with enhanced water use efficiency is essential. Our objective was to evaluate 16 dry bean cultivars and landraces under drought-stressed (four irrigation) and non-stressed (seven irrigation) conditions at the University of Idaho-Kimberly Research and Extension Center in 2003. Each plot consisted of eight rows each 7.6m long with four replications. Watermark probes connected to Hansen data loggers were installed at 23, 46 and 92 cm depths in two replicates of each of six cultivars to determine soil water potential and water use efficiency. Also, total amount of water applied and run-off and soil moisture before and after each irrigation were measured using the gravimetric method. Drought stress reduced seed yield by 62% and 100-seed weight by 9.7%. In contrast, average maturity was delayed by 7 d due to drought stress. Large differences among cultivars and landraces were observed for all three characters, and for % reduction due to drought, and drought susceptibility index (DSI). Cultivars Othello, Mesa, and Matterhorn and landrace Common Red Mexican had lower DSI values and least reduction due to drought stress, thus indicating higher level of drought resistance. Mesa followed by Common Red Mexican and Othello had the highest seed yield under drought-stressed condition. Common Red Mexican had similar 100-seed weight and maturity in both environments. Topaz, Buster, UI 59, and Common Pinto were highly susceptible to drought stress. Differences in water and nutrient use efficiency were also observed.

*Ice-core and Stream-flow Evidence of Rapid Climate Change at High-altitude Areas, Wind River Range, Wyoming,* **DAVID J. NAFTZ[1], KIRK A. MILLER[2], and LIZ OSWALD[3]** ([1]U. S. Geological Survey, 2329 Orton Circle, Salt Lake City, UT 84119; [2]U. S. Geological Survey, 2617 E. Lincolnway, Cheyenne, WY 82001; [3]U. S. D. A. Forest Service, 333 E. Main St., Lander, WY 82520).

Ice cores from the Polar Regions have provided important paleoenvironmental information, including reconstruction of air-temperature trends on time scales greater than 100,000 years before present. Ice cores from mid-latitude areas provide shorter-term paleoenvironmental records; however, these records can still provide important historical information on environmental change. The Wind River Range in northwestern Wyoming provides the only reliable ice-core records of environmental change in the continental United States. In 1998, continuous ice cores about 160m in length were collected at altitudes greater than 4,000m from Upper Fremont Glacier. Detailed chemical and isotopic analyses of these cores have resulted in a unique record of environmental change in the western United States since the early 1700s. As determined from variations in the isotopic record preserved in the glacial ice, the average annual air temperature at this site increased from 2-5° C since the termination of the Little Ice Age.

This accelerated, high-altitude warming may have caused or contributed to a glacial outburst flood (jokulhlaup) during September 2003 in the Wind River Range. A 12-ha, ice-dammed lake at the head of Grasshopper Glacier burst, causing an instantaneous release of an estimated 3.2 million $m^3$ of water. The resulting flood wave arrived at the USGS gage site on Dinwoody Creek, approximately 30km downstream, on September 9, 2003. The instantaneous peak discharge was determined to be 35.7 $m^3$ per second. This was the 8th largest peak flow recorded at this site in 38 years of record. Annual peak flows typically occur in mid- to late-June as a result of snowmelt runoff. No flood-related fatalities were reported.

*Atomic Force Microscopy Adhesion Mapping of Bacterial Biofilms,* **GOPINATH NARASIMHAN[1], JESSE JOHNSON[1], BRANDT ESPLIN[2], ANNE ANDERSON[2], DAVID BRITT[1]** (Departments of Biological Engineering[1] and Biology[2], Utah State University Logan, UT 84322; Email: gopinath@cc.usu.edu).

Microbial biofilms cost the nation billions of dollars annually through equipment damage, product contamination, energy losses and medical infections. Biofilm formation can be viewed as a cascade of adsorption and signaling events, culminating in irreversible adhesion. Thus, the adhesive properties of planktonic and biofilm associated bacteria of a great interest. Here we use electron and atomic force microscopy to investigate the biofilm forming behavior of wild type, quorum sensing mutants, and small colony variants of *Pseudomonas chlororaphis*, a root colonizing bacterium. Electron microscopy reveals a robust multilayered biofilm structure for the wild type, whereas the quorum sensing mutant formed only monolayer biofilms. In contrast, the small colony variant formed exaggerated mucoidal biofilms. The adhesive properties of the various biofilms were investigated using atomic force microscopy operating in a digital pulsed force mode in an effort to understand the underlying physiochemical properties responsible for these greatly differing biofilm architectures.

*Recent Contributions to the Tree-Ring Method, Theory and Data, and Suggestions for Future Research*, **STEPHEN E. NASH** (Head of Collections, Department of Anthropology, The Field Museum, 1400 S. Lake Shore Drive, Chicago IL 60605).

The pace of worldwide archaeological tree-ring research has accelerated in the last two decades, and significant contributions have recently been made in archaeological chronology and chronometry, paleoenvironmental reconstruction, and the study of human behavior in both the Old and New Worlds. This paper reviews a sample of recent contributions to tree-ring method, theory, and data, and makes some suggestions for future lines of research.

*The Growth, Development and Application of North American Tree-Ring Dating,* **STEPHEN E. NASH** (Head of Collections, Department of Anthropology, The Field Museum, 1400 S. Lake Shore Drive, Chicago IL 60605).

Tree-ring dating emerged to provide accurate, reliable dates at a time when North American archaeologists had no absolute dating techniques available to frame their analyses. This presentation examines the growth, development, and application of North American tree-ring dating when it was the only reliable chronometric yardstick.

*Reproductive Inhibition by Methyl Farnesoate in the Tadpole Shrimp* Triops longicaudatus, *a Possible Endocrine Alternative for Population Control,* **WILLIAM K. NELSON and BRIAN TSUKIMURA** (California State University Fresno, 2555 E. San Ramon Ave. MS# SB73, Fresno, CA 93740; E-mail: willnelson@csufresno.edu).

We tested whether the crustacean hormone methyl farnesoate (MF) inhibits the development of adult characteristics, including mature gonads, in the tadpole shrimp species *Triops longicaudatus*. *T. longicaudatus* infests rice fields in California's central valley, dislodging growing rice cotyledons while foraging, reducing crop yields. Copper sulfate, the pesticide used to control tadpole shrimp populations, is a class I toxin and its use may soon be eliminated by the EPA. MF is an analog of insect juvenile hormone, which, in insects, inhibits adult metamorphosis, including gonadal development. If MF has juvenilizing effects in *T. longicaudatus*, it may be used in rice fields to reduce population sizes, thus providing an alternative method of tadpole shrimp control. We produced food pellets in two MF concentrations (0.0001% and 0.001 % by weight) as a delivery mechanism, along with control pellets with no MF. These pellets were tested both in lab and field trials. Tadpole shrimp were collected from each group at days 5 and 10, and analyzed for oocyte production. Data from lab trials showed significant decreases in oocyte development at both concentrations, suggesting MF inhibits ovarian development in juveniles. This supports the contention that MF has juvenilizing activities and may be effective in reducing rice field *T. longicaudatus* populations. Additionally, we are testing for the presence MF metabolic machinery, which would confirm that MF is a native hormone in *T. longicaudatus*. Endocrine structures have not been characterized in this species; therefore, we are examining several tissues for MF metabolism using $^{3}$H radio-labeling enzyme assays.

*Command Strategies of the 9-11 Terrorist Attack on the World Trade Towers,* **HENRY OMAN** (Consulting Engineer, 19221 Normandy Park Drive SW, Seattle, WA 98166).

Chen Shui-bian, President of Taiwan, came to welcome participants at the opening session of the 26th Annual International Carnahan Conference on Security Technology in Taipei. He was followed by a 70-chart presentation by Hsinchun Chen on the strategic planning and command structure that ran the terrorist attack on the two World Trade Towers in New York on September 11, 2001. Chen had graduated from the University of Taiwan in 1981. After receiving his PhD at New York University, he wrote four books, 150 articles, and founded the Artificial Intelligence Lab at the University of Arizona. One of their objectives was to develop effective communication between police forces of cities to better solve crime problems. After September 11 his team was expanded to 40 researchers with a $15 million budget. The successful research approach was to develop a new and complex computer program for analyzing millions of transmitted messages and identifying the ones related to the terrorist attack. The resulting third-generation COPLINK Criminal Structural Analysis technology can now find associations between criminals in a network, and detect leaders and participants. This technology was able to reproduce the command structure of the terrorist network that crashed airplanes into the World Trade Towers and the Pentagon. For example, since a terrorist team could not defeat the opponent's army, the attack had to get the maximum possible publicity. Therefore, the crash of the airplane into the second tower was delayed until television crews could set up their cameras after the crash into the first tower! The COPLINK team's analysis revealed the organization of the terrorist team, the locations of the commanders, the communication links that were adopted, and the techniques used to maintain discipline of the suicide-destined participants. Now the COPLINK program is analyzing terrorist options and techniques for early identification of their possible actions.

*Inhibition of Benzo[a]Pyrene Induced DNA Damage in HepG2 Cells by the Organosulfur Compound N-acetyl Cysteine (NAC) as Measured by the Comet Assay,* **MICHAEL O'NEIL, LONI O'NEIL, AMANDA STEVENS, COREY SPEERS, BYRON MURRAY, and KIM O'NEILL** (Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT 84602; E-mail: mto3@email.byu.edu).

One of the most effective strategies in cancer control is chemoprevention through diet. Previous research has shown that naturally occurring organosulfur compounds from garlic and onion to be effective against carcinogenesis. The effect of one of these compounds, N-acetyl cysteine (NAC) was of special importance. NAC's anti-carcinogenic effect in the human cell line HepG2 are, however, less understood. HepG2 cells are human hepatoblastoma cells that have maintained their xenobiotic metabolizing competence. Because they are similar in function to cells obtained from human liver tissue, they are ideal for research *in vitro*. Benzo[a]pyrene (B[a]P) is an especially potent carcinogen found naturally in incompletely combusted organic compounds. The extent and

mechanisms of its carcinogenesis have been well documented. The comet (single cell gel electrophoresis) assay is a rapid and sensitive technique for quantifying DNA damage. Though the anti-carcinogenic effects of organosulfur compounds against B[a]P have been previously established in rodent models, the correlation between human and rodent metabolic systems has been shown to be minimal. The effects of these compounds in HepG2 are as yet undetermined.

HepG2 cells were pre-treated with 25, 50, 100, and 200 μM NAC and allowed to incubate for 24 hours. Cells were then treated with 25 μM B[a]P in the presence of fresh NAC and again allowed to incubate for 24 hours. DNA damage was then assessed sing the comet assay. HepG2 cells treated with 200 μM NAC showed a 79% decrease in DNA damage as compared with the positive control. Our data helps to establish the significant chemopreventative properties of NAC.

*A Cooperative University – Middle School Ecosystem Field Experience along the Colorado Plateaux – Great Basin Transition of Southern Utah,* **HAROLD ORNES** (College of Science, Southern Utah University, Cedar City, UT).

Southern Utah University's (SUU) Cedar Mountain Science Center is a member of the Organization of Biological Field Stations (OBFS) and for seven years has operated a series of summer kids camps based at the SUU Mountain Property and Cabin, near Cedar City. Located in the heart of Southern Utah's geography and numerous ecoregions, the environmental science camps focus on both environmental issues and the state core curriculum in science for middle school. Typically, there will be 200 6th grade students and several teachers (receiving graduate credit) who have a two-day and one night experience ranging from alpine to hot desert ecosystems. Our students visit these ecosystems with State, Federal, and University experts and local ranchers who visit with our students and teachers in situ for first hand environmental perspectives and information. Students also learn science process skills by collecting field data on existing scientific studies being conducted in our region.

*Toward a Dendrochronology to Better Understand Central Asian Archaeology,* **IRINA P. PANYUSHKINA** (Laboratory of Tree Ring Research, University of Arizona, Tucson, AZ 85721).

The presentation describes ongoing efforts to infer climate from tree rings preserved in Iron Age archaeological sites using a long-term proxy record of summer temperature from growth rings of living and dead larch trees in the Altai Mountains, Russia. The potential of dendrochronology for enhancing understanding of the Central Asian nomads is evident in the climatic reconstruction and absolute dating of archaeological sequences in the Altai from 900 BC to the present, and the grand strategy is to illuminate timing of events in Central Asian archaeology as was done for U.S. Southwestern archaeology 70 years ago.

We developed a 1245-year tree-ring width chronology of larch (*Larix sibirica*) calendarly cross-dated with living trees. Climatic calibrations showed that the tree-ring variability strongly depends on summer temperature fluctuations. Most of the sites of living and dead larch were established at upper tree-line of the Korumdu and Maashey Valleys, the Severo-Chuyskiy range, and surrounding the main cluster of studied archaeological sites. Over 150 total tree-ring specimens of larch from archaeological sites of Iron Age nomads called Siberian Scythians of Pazyryk culture (radiocarbon dates range from 600 B.C. to 100 B.C.), Hun-Sarmatian period (A.D. 100-500) and Turkic period (A.D. 400-600) were collected and contributed for the study. The archaeological sites are randomly distributed between 1800 m and 2350 m *asl* elevation. Most of those sites are located in the Chuya River basin as well as sites for living and dead trees. The cross-dated tree-ring widths from archaeological timbers were confidently overlapped in 3 floating chronologies with 421, 296 and 181-year lengths for the period from to 900 B.C. to A.D. 400.

Precise statistical screening of low and high-frequency variability of tree-ring series associated with summer temperature established statistical characteristics for a tree-ring width chronology of larch with the strong climatic signal. Comparison of model tree-ring variability with tree rings from archaeological timbers identified series that might be generated by summer temperature fluctuations. Presumably, the archaeological series that passed the screening test will be averaged into a chronology built for climatic reconstruction. The important insight gained from the series screening is that we can have a 3,000-year reliable temperature record from larch tree rings in Inner Eurasia in future. Averaging series into climate proxy record have to be cautiously verified.

We also demonstrated that dendrochronology tremendously refines dating of floating archaeological sequences previously based just on radiocarbon dating. For the first time in the history of Pazyryk culture studies, we crossdated every tomb from in Ulandryk-1 burial field and built a floating chronology of the site. The Ulandryk-1 site was completely excavated in 1970s. Most tombs contained remains of children and woman. The radiocarbon dating showed that the ancient cemetery lasted over 300 years. Nevertheless, the crossdaing indicates that most burial mounds were constructed within ten years. Climate associated decadal variability of the Ulandryk-1 chronology showed that during the period of cemetery development there were no extreme summer climate events.

*Cerebral Laterality and Cerebral Dominance: Fact or Fiction?* **FRED C.C. PENG** (Department of Neurosurgery, Veterans General Hospital—Taipei, #201 Shih–Pai Road, Section 2, Taipei, Taiwan).

The tradition of **laterality** or **dominance** is based on hemispheric functional dissimilarity. However, a closer look at behaviors and the medical literature reveals that there are problems, derived from the conceptions of localized brain functions assigned to the two hemispheres as "specializations," for instance, language, music, and painting.

The purpose is: (1) to repudiate as fiction such notions with evidence from human behaviors and (2) to point out that it is the wrong views of brain functions that have led to the erroneous localization specializations.

This presentation will indicate that all behaviors are memory-governed. When brain functions manifest themselves ad behaviors, there is no one-to-one correspondence between a certain brain function and a particular behavior. The traditional approach is to establish such correspondences, thereby leading to the erroneous regional differences and specializations. For instance, nobody can paint blindfolded, nor is mouth painting lateralized to one hemisphere, and all four limbs are involved when playing the pipe organ.

I shall conclude that once this traditional approach is rectified, the brain functions of the two hemispheres, though dissimilar, must be unified and integrated in conjunction with the spinal cord and the peripheral nervous system in order to account for the manifestations of behaviors subserved by them as the neural substrates underlying those behaviors. There is no dominant hemisphere for language, music, painting or the like; nor is there cerebral laterality for abstract thinking and calculation, which involve the basal ganglia. Such purported hemispheric or regional specializations are none other than fiction.

*Nitrogen Leaching in Management Intensive Grazing,* **LUKE PETERSEN, VAUGHN THACKER, and RHONDA MILLER** (Agricultural Systems Technology and Education Department, Utah State University, 2300 Old Main Hill, Logan, UT 84322; E-mail: lukeapete@cc.usu.edu).

Management intensive grazing (MIG) practices are becoming increasingly popular among dairy farmers. MIG is a rotational grazing practice that increases pasture productivity and allows for increased stocking rates. Despite the popularity of MIG, many are concerned about its environmental impacts. Increased stocking rates on irrigated pasture lands can contribute significantly to ground water contamination through nitrogen leaching. This study examines nitrogen leaching in intensively grazed paddocks to determine if forage species differ in their nitrogen utilization. Four grass species, meadow brome (*Bromus riparius* Rehm), perennial rygrass (*Lolium perenne* L.), tall fescue (*Festuca arundinacea* Schreb), and orchardgrass (*Dactylis glomerata* L.), and two legume species, birdsfoot trefoil (*Lotus corniculatus* L.), and white clover (*Trifolium repens* L.), were combined in eight grass-legume mixtures in 32 test paddocks to examine nitrogen leaching. Samples were collected weekly using porous ceramic cup lysimeters at depths of 60 and 90 cm and analyzed for nitrite/nitrate and ammonia. Significant differences in leachate concentrations were observed among the eight grass-legume mixtures.

*Detecting Apoptosis: A Comparison of the Comet Assay and the Annexin-V Method Using Six Lymphoid Cell Lines,* **MICHAEL R. PHILLIPS, BRACKEN M. WEBB, BYRON K. MURRAY, and KIM L. O'NEILL** (Department of Microbiology, Brigham Young University, Provo, UT 84604; E-mail: mike.phillips@gmx.net).

Quick and accurate methods of determining the efficacy of new cancer treatments are needed. In this study, we evaluated two common assays of apoptosis detection: the comet assay and the Annexin-V method. The comet assay allows visualization of DNA cleavage while Annexin-V (FITC conjugated) measures the increase in exposed phosphatidyl serine on the membrane of apoptotic cells. Comparing the results of these assays enabled us to set critical parameters for quick and easy detection of apoptosis using Annexin-V and flow cytometry. To induce apoptosis, six lymphoid cell lines were subjected to hyperthermic shock at 43° C and the levels of apoptosis were then measured by these two assays. The results of the comet assay varied across the six different cell lines; the BJAB showing the most resistance (5.3% apoptotic), and the YAC-1 exhibiting extreme sensitivity (100% apoptotic). The same cell lines were then assayed using Annexin-V every 2 hours for 8 hours and then again at 24 hours. These samples were also counter-stained with propidium iodide to determine membrane permeability. The Annexin-V results showed similar trends to those of the comet assay; however, the Annexin-V data showed lower percentages of apoptotic cells. The comet assay accurately measures the true number of apoptotic cells in each sample, which allowed us to determine the accuracy of the Annexin-V staining. Upon comparison, we concluded that the increase in the amount of total bound FITC, regardless of membrane permeability, must be measured in order for Annexin-V to reflect true levels of apoptosis.

*Natural History of the Colorado Plateaux and Basin and Range: A K-12 - National Park Cooperating Association - University Partnership,* **G. POLLOCK[1], D. CANTU[1], R.L. EVES[2], J.E. BOWNS[2], and R.L. MARTIN** ([1]Bryce Canyon Natural History Association, Bryce Canyon, UT, 84717; [2]Southern Utah University, 351 West Center Street, Cedar City, UT, 84720).

A positive field experience is essential to gaining basic skills in, and a working knowledge of, the biological and geological sciences. These skills, and this body of knowledge, are essential to understanding and teaching biology/ecology and geology in the K-12 setting. To help ensure that in-service science teachers in Garfield, Kane, and Washington counties, Utah, have access to this integral part of their continuing

education, the Bryce Canyon Natural History Association, in partnership with Southern Utah University scientists, conducts summer field experiences for K-12 educators during which they observe the rich, and diverse, natural history of the Colorado Plateaux, Basin and Range, and the Transition Zone.

It has long been accepted that field trips and field conferences are important components of scientific meetings, because they integrate scientific knowledge with the scientific method. Unfortunately, many K-12 educators, with limited training in lab-oriented sciences, are unfamiliar with the applied aspects of the various natural sciences. The basic purpose of this annual field seminar is to teach subject matter in a natural setting, so that K-12 educators are provided with a baseline background in field studies. This field seminar demonstrates the specifics of natural history by clarifying concepts and examples described in textbooks. Our field seminar occurs in an informal setting, which makes it a forum for frequent, spontaneous, discussion. One of the requirements for the seminar is the preparation and submission of science units in geology, ecology, and natural history. Teachers who participate also benefit from the opportunity to collect samples, take photographs, and to develop classroom exercises.

*Molecular Biogeographic Analysis of the Relationships between* Papilio indra *Sub-Species,* **JAMES PRICE, DEVONE BURTON, AMANDA BUTLER, KRISTI GOODWIN, BRAD GRAHAM, MELISA GRIFFITH, MICHELLE HOGG, REBEKAH MARTINEAU, BENJAMIN MCCUMBER, HARLEY MULLEN, PETER RAVEN, BRIAN STURGILL, DERREL WALKER, KIM WAGSTAFF, JOSEPH WRIGHT, and WAYNE WHALEY** (Department of Biology, Utah Valley State College, 800 West University Parkway, Orem, UT 84058; E-mail: pricejm@uvsc.edu).

Twelve subspecies of the Indra Swallowtail butterfly (*Papilio indra*) occupy a variety of ecological niches distributed throughout the western United States. The different populations display obvious morphological differences and physiological adaptations to their local environments and food plants. Our research has focused on molecular genetic analysis to determine the evolutionary divergences of subspecies groups. Specimens were collected from widespread locations. Mitochondrial DNA was extracted from the butterflies, the Cox I and Cox II genes were amplified by polymerase chain reaction, and their sequences were determined.

To date, we have identified 37 sequence polymorphisms in the *P. indra* Cox I and Cox II genes from 13 distinct populations. Each of the populations so far studied can be distinguished by its own unique set of polymorphisms and they can be grouped into subclades based on shared subsets of polymorphisms. In general, our results support the conclusion that each population is genetically distinct and that geographic proximity correlates with genetic similarity. We will present molecular phylogenies showing the relationships of the various populations and estimate the time since the specimens last shared a common maternal ancestor.

*Linking Plant Biochemical Diversity, Herbivore Culture, and Over-Grazing by Livestock: Have We Trained Herbivores to Over-Graze Rangelands?* **FREDERICK D. PROVENZA** (Dept. of Forest, Range, and Wildlife Sciences, Utah State Univ., Logan, UT 84322-5230; E-mail: stan@cc.usu.edu).

We often presume outcomes of herbivory on plant communities are inevitable, and in the case of livestock, that grazing leads inexorably to land degradation. These assumptions are based on the belief that populations of wild and domestic herbivores behave - select foods and habitats - predictably. This is untrue for two reasons. First, our emphasis on populations and means, rather than on individuals and variances, leads to mistaken notions concerning inevitability and predictability. Food and habitat preferences depend on differences in how individuals are built morphologically and how they function physiologically, and marked variation is common even among closely related conspecifics in needs for nutrients and abilities to cope with toxins. Second, preferences for foods and habitats are influenced by the biophysical and social context in which young animals are reared; as context changes, so do preferences. Importantly with livestock, different systems of management alter how young animals learn to forage. Rotational grazing at low stock densities encourages selectivity, whereas short-duration grazing at high stock densities increases diet and habitat breadth. Thus, historically, by focusing grazing management on moderate use of keystone plant species and areas, we may have trained generations of livestock to "eat the best and leave the rest" inadvertently accelerating a decline in biodiversity and an increase in the abundance of less desirable plant species. Undoubtedly, there are critical combinations and thresholds of herbivore knowledge and plant biochemical diversity above which biodiversity can be maintained and below which it can not.

*Stress Inducing Cross Protection to UV-B Radiation and Heat of* Metarhizium anisopliae *Conidia*, **DRAUZIO E.N. RANGEL**, **ANNE J. ANDERSON and DONALD W. ROBERTS** (Department of Biology, Utah State University, Logan, UT 84322; E-mail: drauzio@biology.usu.edu).

The fungus *Metarhizium anisopliae* is an important agent for biological control of insects and has been utilized with success for the control of spittlebug in sugar-cane fields in Brazil. However, solar ultraviolet radiation and heat are important obstacles for the use of *M. anisopliae* in agriculture. Several approaches have been developed to improve environmental survival of entomopathogenic fungi, including formulation of conidia with protective agents, selection of

isolates with more heat- and UV-tolerance, and genetic engineering to produce such desirable characteristics. Few studies, however, have examined improving stress tolerance in conidia by altering physiological conditions before conidiogenesis. Environmental stresses activate expression of genes encoding products that either protect the cells from the stress or participate in the repair of cellular damage. Therefore, it is possible that exposure of mycelium to one type of stress may lead to the acquisition of conidial tolerance against another stress. In this report, conidia of *M. anisopliae* were produced on mycelia which had been subjected to nutritive stress or heat shock and then the sensitivity of these conidia to UV-B radiation and heat was tested. Conidia produced under nutritive stress were ca. 50% more tolerant to UV-B radiation than conidia produced on rich medium, but tolerance to heat increased only ca. 20%. On the other hand, heat-shocked mycelium produced conidia that were ca. 50% more tolerant to heat but were only ca. 20% more tolerant to UV-B radiation. Thus, stress treatments improved conidial tolerance but not equally for responses to UV-B irradiation and heat responses.

*Geospatial Technology Applications for Agricultural Sustainability,* **V. PHILIP RASMUSSEN[1] and DENNIS L. WRIGHT[2]** ([1]NASA Geospatial Extension Program, [2]NASA Affiliated Research Center, Plants, Soils, Biometeorology Department, Utah State University, Logan, UT 84322; E-mail: philr@ext.usu.edu and dennisw@cc.usu.edu).

Geospatial technologies such as the Global Positioning System (GPS), Geographic Information Systems (GIS), and Remote Sensing (RS) are becoming more accurate, user friendly, and less expensive. Some of the most common geospatial tools for agriculture include, yield monitors, integrated GIS packages, and handheld GPS units. Land Managers are using these geospatial technologies to become more sustainable through data collection and analysis. Records of seeding and fertilizer rates, planting dates, and conservation tillage can be tied to a specific field in a GIS and may pulled up with on the hand-held computer within seconds. Imagery from satellite and aerial platforms may provide information to ascertain the best locations for conservation tillage. Direct seeding into no-till areas is difficult because a tractor operator can't see where he or she has planted; however, a GPS guidance system with auto steer can also guide a tractor with centimeter accuracy. The applications of geospatial technology for sustainable agriculture are limitless as bright-minded farmers, ranchers, and researchers continue to work together.

*Mobile Elements and Primate Genomic Evolution,* **DAVID A. RAY[1], PAULINE A. CALLINAN[1], ABDEL-HALIM SALEM[1,2], JINCHUAN XING[1], DALE J. HEDGES[1], LYNN B. JORDE[3] and MARK A. BATZER[1]** ([1]Department of Biological Sciences, Biological Computation and Visualization Center, Louisiana State University, 202 Life Sciences Building, Baton Rouge, Louisiana 70803; [2]Department of Anatomy, Faculty of Medicine, Suez Canal University, Ismailia, Egypt; [3]Department of Human Genetics, University of Utah Health Sciences Center, Salt Lake City, Utah 84112; E-mail: mbatzer@lsu.edu).

*Alu* elements belong to discrete subfamilies that can be differentiated from one another by diagnostic nucleotide substitutions. An analysis of several recently integrated *Alu* Y lineage subfamilies was undertaken to assess *Alu* element associated primate genomic diversity. Our screening of the *Alu* insertion loci resulted in the recovery of a number of "young" *Alu* elements with different distributions throughout the primate lineage. Many of the *Alu* elements recovered from the human genome were restricted to the human lineage, with some elements that were polymorphic for insertion presence/absence in diverse human populations. These loci have proven useful for elucidating human population relationships. Some of the other *Alu* elements recovered from the human lineage also resided at orthologous positions in non-human primate genomes. Sequence analysis demonstrated that these *Alu* elements were the products of gene conversion events of older pre-existing elements, independent parallel forward insertions of older elements in the same short genomic region, or authentic shared phylogenetic characters. The level of gene conversion between *Alu* elements suggests that it may have an influence on the single nucleotide polymorphism within *Alu* elements in the genome. We have also identified several genomic deletions associated with the retroposition and insertion of *Alu* Y lineage elements in primate genomes. This type of *Alu* retroposition mediated genomic deletion is a novel source of genetic variation within primates. The distribution of *Alu* elements throughout various primate genomes makes them useful tools for resolving non-human primate systematic relationships.

*Mobile Elements and Primate Phylogenetics,* **DAVID A. RAY[1], JINCHUAN XING[1], DALE J. HEDGES[1], MICHAEL A. HALL[1], MEREDITH E. LABORDE[1], BRIDGET A. ANDERS[1], BRITTANY R. WHITE[1], NADICA STOILOVA[1], JUSTIN D. FOWLKES[1], KATE E. LANDRY[1], LEONA G. CHEMNICK[2], OLIVER A. RYDER[2], and MARK A. BATZER[1]** ([1]Department of Biological Sciences, Biological Computation and Visualization Center, Louisiana State University, 202 Life Sciences Building, Baton Rouge, Louisiana 70803; [2]Center for Reproduction of Endangered Species, Zoological Society of San Diego, San Diego, California 92101; E-mail:daray@lsu.edu).

Short INterspersed Elements (SINEs) make very useful phylogenetic markers because the integration of a particular element at a location in the genome is irreversible and of

known polarity. These attributes make analysis of SINEs as phylogenetic characters an essentially homoplasy-free affair.

*Alu* elements are primate-specific SINEs that make up a large portion of the human genome and are also widespread in other primates. Using a combination wet-bench and computational approach we recovered 191 *Alu* insertions specific to the genomes of nine New World primates. We used these loci to investigate branching order and have produced a cladogram that supports a basal position for the Pitheciidae (titi and saki monkeys) and a sister relationship between the Atelidae (spider monkeys) and the Cebidae (marmosets, tamarins and owl monkeys). The data support these relationships with a homoplasy index of 0.00. In this study, we report the largest application of SINE elements to phylogenetic analysis to date and the results provide the most robust molecular phylogeny for Platyrrhine primates ever presented. This data set, in combination with a similar analysis of hominids and a forthcoming analysis of Old World monkey species, will provide one of the most comprehensive pictures of primate phylogenetics currently available.

*Pasja Yield Responses to Fertilizers Under Different Cultivation Methods in New Zealand*, **LEANNA REYNOLDS and ANDREA PEARSON** (Crop & Food Research, Hastings, 265 Lawn Rd, RD 2, New Zealand; E-mail: reynoldsl@crop.cri.nz).

Forage brassicas such as pasja are commonly grown in New Zealand as a summer supplementary feed for sheep and beef production. Pasja (*Brassica campestris X Brassica napus*), a Chinese cabbage x turnip hybrid, is characterized by rapid production of leaf, and little stem or bulb, and has the capacity to re-grow after grazing. Response of this crop to P fertilizer is poorly defined as most trials have been conducted on sites of moderate fertility. To refine nutrient inputs, five N and P fertilizer treatments were applied in a full Latin square design at two low fertility sites (Olsen P levels of 3 and 5 µg/ml). At the direct-drilled site (A) there was a strong positive yield response to N in the presence of P fertilizer. The yield response at site B was not significantly different between fertilized treatments; this may be due to the mineralization of soil organic matter after cultivation.

*Soil Nitrogen Dynamics Beneath Yellow Starthistle (*Centaurea solstitialis*) and Smooth Brome (*Bromus inermis*) Canopies: A Mechanism for Arrested Succession?* **JULIE P. RIEDER** (Utah State University, 5305 Old Main Hill, Logan, UT 84322; E-mail: jrieder@biology.usu.edu).

Traditional successional pathways predict that perennials should replace annual forbs. However, many non-native annual forbs, like yellow starthistle (*Centaurea solstitialis*, YST), are capable of creating monocultures that persist. One possible explanation is that elevated soil nitrogen allows non-native annuals to maintain their position on the landscape, while excluding perennials that are competitively superior under lower nutrient regimes (McLendon and Redente 1992; Perry et al. 2004). In this study, we examined the nitrogen dynamics of soil beneath YST and perennial grass (*Bromus inermis*) at our site in South Ogden, Utah. If nitrogen dynamics affect YST persistence, we would expect elevated levels of soil nitrogen beneath YST compared to grass (hypothesis I). More specifically, given the physical structure and phenology of YST, we predict a temporary pulse of soil nitrogen beneath YST soon after fall wet-up, and a subsequent draw down of that pool as YST seedlings establish (hypothesis II). To begin addressing these hypotheses, we measured ammonium and nitrate concentrations for a set of soil samples (initial, field incubated, final), three times during the growing season (spring, summer, fall wet-up), beneath two vegetation canopies (YST, n=8; grass, n=8). Our results support our hypotheses: 1) soil beneath YST is generally higher in nitrogen concentration, especially for nitrate, and; 2) soil beneath YST shows a larger pulse of soil nitrate soon after fall rains, that is subsequently drawn down during YST seedling establishment. These results are suggestive of a positive-feedback loop created by YST that helps maintain elevated soil nitrogen, arresting successional pathways.

*Geometrical effects on electromagnetic wave interaction with moist materials,* **DAVID A. ROBINSON[1], S. B. JONES[1], S.P. FRIEDMAN[2], M. BLONQUIST[1], and M.G. SCHAAP[3]** ([1]Department of Plants, Soils and Biometeorology, Utah State University, Logan UT; [2]Volcani Center (ARO), Bet Dagan, Israel; [3]GEB Jr. Salinity Lab USDA-ARS, Riverside, CA 92507; E-mail:darearthscience@yahoo.com).

Transport properties in soils, sediments and rocks are influenced by grain scale geometry. In particular, electromagnetic measurements of porous media are used to estimate water content. In this work we present results to isolate different effects of the geometrical arrangement of particles on the dielectric properties of media (electrical energy storage). We develop grain scale models to describe rigid porous media, from the scale of a single grain, to the whole sample. 2-phase media are considered at length and the importance of, grain to grain contact, particle size distribution, and particle shape are considered. As the scale increases we examine the effects of layering on wave propagation, this is important for field techniques such as ground penetrating radar and active microwave remote sensing. Our aim is not only to understand the impact of geometry on the determination of water content from electromagnetic measurements, but conversely to infer something about the geometrical arrangement of the material.

*Proteomic Analyses of Mature Barley Seeds among Recombinant Chromosome Substitution Lines Generated from a Cross between Barley spontaneum and Harrington barley,*

**D. ROCHE** (Utah State University, Logan, UT 84322; E-mail: droche@mendel.usu.edu).

Using two-dimensional electrophoresis we are in the process to characterized seed proteins of recombinant chromosome substitution lines (RCSLs) derived from a cross and backcrosses between *Hordeum vulgare* subsp vulgare (cv. Harrington as recurrent parent) and *H. vulgare* subsp spontaneum (as donor parent) (Matus et al, 2003). This RCLS mapping population gives us the opportunity to monitor the effects of chromosome substitution on the recurrent proteome of mature Harrington seeds. We found a significant number of polymorphic hydrophilic proteins between seed extracts of the recurrent and donor parental lines. From whole seed extracts of Harrington cv. and *H. vulgare* spontaneum, we resolved 287 hydrophilic protein spots in a narrow pH gradient (5.5-6.7). Only 92 of them are present in both lines indicating a large qualitative level of polymorphism. Among these 92 matched spots, normalized spot intensities for 17 and 18 of them further indicate a differential representation of three-fold decrease and three-fold increase, respectively. The quantitative data from Harrington whole seeds is used as reference gel (internal control) for the analyses of extracts from RCSLs. We will discuss prospects to expedite the comparison of barley seed proteomes with fluorescence (2D-DIGE) tools or Isotope Coded Affinity Tags (ICAT TM).

Matus I. et al., 2003. Genome 46:1010-1023

*What Can the Stable Oxygen Isotopic Composition in Tree Ring Cellulose Tell Us About the Past?* **JOHN S. RODEN** (Biology Department, Southern Oregon University, Ashland, OR 97520; E-mail: rodenj@sou.edu).

Stable oxygen isotopes in wood come from water and vary seasonally as well as annually. They may provide proxy information about water sources, relative humidity and climate cycles. Most climate change studies have been based on empirical correlations with measured or inferred meteorological information. Recently, mechanistic models have been developed to interpret and predict the isotopic composition of cellulose. These models help clarify what environmental information might be contained in historic cellulose records. Field-testing of these models is critical since the tremendous variability of environmental factors in natural habitats could obscure important signals. Two studies will be presented that test three models that predict the stable oxygen isotope content of cellulose under field conditions. All three models adequately accounted for field observations of riparian zone trees that had contrasting isotopic and environmental inputs. The models underestimated the oxygen isotopic content of cellulose along a transect of decreasing water status in Oregon. Both studies show that ambient humidity plays an important role in modifying the primary signal of meteoric water isotopic content in organic matter. Teasing out humidity information from tree ring records may be difficult due to the number of other factors involved. The use of dual isotope records (carbon and oxygen) allow for better interpretation of environmental information since each isotope provides different, though related, information regarding ecosystem water status.

*Seasonal Fluxes of Water Vapor and $CO_2$: Their Decoupling from the Atmosphere Above a Grassland Steppe of Northern Kazakhstan,* **NICANOR SALIENDRA[1], KANAT AKSHALOV[2], DOUGLAS JOHNSON[3], TAGIR GILMANOV[4] and EMILIO LACA[5]** ([1]Dept. of Forest, Range and Wildlife Sciences, Utah State University, Logan, UT 84322-6300, USA; [2]Baraev Research and Production Center for Grain Farming, Shortandy -1, Akmolinskaya Oblast 474070, KAZAKHSTAN; [3]USDA-ARS Forage and Range Research Laboratory, Utah State University, Logan, UT 84322-6300, USA; [4]Dept. of Biology and Microbiology, South Dakota State University, Brookings, SD 57007-0595, USA; [5]One Shields Avenue, Dept. of Agronomy and Range Science, University of California, Davis, CA 95616-8515, USA; E-mail: nick.saliendra@usu.edu).

Throughout four growing seasons (May-Oct in 1998-2001), we used the Bowen ratio-energy balance technique to measure the energy, water vapor, and carbon dioxide ($CO_2$) fluxes above a pristine grassland steppe in northern Kazakhstan. We selected the mid-day (1020 to 1400 h) measurements to quantify two decoupling coefficients ($\Omega$): 1) $\Omega_{gc\text{-}E}$, for canopy conductance ($g_c$) and transpiration ($E$), and 2) $\Omega_{E\text{-}Wf}$, for transpiration and absolute humidity of the air ($W_f$). We found that the water vapor and $CO_2$ fluxes above the grassland steppe site became increasingly decoupled as $W_f$ peaked during the period of most active vegetation growth. Seasonal patterns of micrometeorological variables were tightly linked with the relative changes in $W_f$ from the start to the end of the growing season, so that the prevailing $W_f$ was correlated to the contrasting seasonal trends of the two decoupling coefficients, $\Omega_{gc\text{-}E}$ ($r^2 = 0.59$) and $\Omega_{E\text{-}Wf}$ ($r^2 = -0.78$). Our results indicate that the small seasonal change (range: 0.85 to 0.93) of the decoupling coefficient for $E$ and $W_f$, $\Omega_{E\text{-}Wf}$, may have led to the observed increase in bulk air $W_f$ that resulted in the wide seasonal change (range: 0.38 to 0.60) of the decoupling coefficient for $g_c$ and $E$, $\Omega_{gc\text{-}E}$. Thus, the traditional decoupling coefficient, as quantified by $\Omega_{gc\text{-}E}$, represented the linkage between stomatal responses (as estimated by $g_c$) and $E$. We propose that the decoupling coefficient for $E$ and $W_f$ ($\Omega_{E\text{-}Wf}$) be used to quantify the seasonal changes of the linkage between transpiration and water status of the bulk air.

*Aggregation of 1,1'-diethyl-2,2'-cyanine Dye on Polyvinyl Sulfate: A Quantitative Study of the Kinetics of the Electron Transfer in the "J-Aggregates",* **HUSSEIN SAMHA** (Department of Physical Science, Southern Utah University, Cedar City, UT 84720; E-mail: samha@suu.edu).

Aggregates having photochemical properties have as an ultimate goal, a variety of potential applications including; energy antennas, charge storage and molecular electronic devices. The J-aggregation phenomenon of cyanine dyes makes these reagents commercially valuable in the photographic industry and in probing and sensing devices. In this presentation we report quantitative analysis for the kinetics of the electron transfer in the J-aggregates of 1,1`-diethyl-2,2`-cyanine iodide (PIC) formed on polyvinyl sulfate polymers (PVS). Using ultraviolet-visible (Uv-vis) spectroscopy, the change in optical properties of the cyanine dye from the monomers form in aqueous solution, to the adsorbed form on charged surfaces, is studied. Polyvinyl sulfate is used to provide charged surfaces where aggregates are formed. J-aggregate domains, characterized by a sharp and intense "red-shifted" (572 nm) absorption (compared to the monomer), are formed upon adding an aqueous solution of the polymer to the dye monomers in aqueous solutions. Data analysis indicates that the cyanine dye cations are embedded on 50% of the repeating units of the polymer added. Lifetime of 40 Pico-second for the excited state of the J-aggregate adsorbed on PVS is observed. 85% quenching of the emission of the J-aggregates embedded on PVS is achieved when methyl viologen is used as an electron acceptor. We calculated the quenching constant from the Stern-Volmer relation to be $1.8x10^{7}$ mL $mol^{-1}$ and an electron transfer rate of $7.5x10^{-7}$ mL $molecule^{-1}s^{-1}$.

*Earthworm Populations in Different Experimental Coffee Management Systems,* **YANIRIA SANCHEZ-DE LEON and JODI JOHNSON-MAYNARD** (Plant, Soil and Entomological Sciences, University of Idaho, Moscow, ID 83844-2339; E-mail: sanc0745@uidaho.edu).

Earthworm effects in agricultural soils include increased nutrient availability, changes in soil physical properties, and transport of microorganisms. Earthworm populations in coffee systems are relatively unknown. My study objective was to determine if earthworm populations were altered by coffee management systems in Turrialba, Costa Rica. I hypothesized that shade organic coffee management will have the highest earthworm diversity, density, and biomass due to high organic matter inputs. I studied two coffee management systems: sun and shade with *Erythrina poepiggiana*. I had three sub-treatments: high, medium conventional, and organic. In high conventional, fertilizer, pesticides, fungicides and herbicides were applied as in commercial fields. In medium conventional, fertilizer applications were half of the high conventional treatment and pesticides, fungicides and herbicides were periodically applied. In organic treatments, *Ricinus communis* was a second shade species. Organic fertilizers and biological insecticides were used. Selected herbaceous species were left in medium and organic treatments. I found two earthworm species, *Pontoscolex corethrurus* and *Metaphire californica* in shade treatments, but *M. californica* was absent from sun treatments. Density averages were 63, and 91 for high and medium conventional sun treatments. Density averages were 131, 186, and 265 for high, medium conventional and organic shade treatments. Fresh weight results followed the same pattern as density. These results show that earthworm diversity, density, and biomass were higher in shade organic management. Earthworm populations may be negatively affected in sun treatments due to low organic inputs, elimination of herbaceous cover, higher temperatures, and lower soil moisture than shade treatments.

*Changes in Tropopause Height: A New"Fingerprint" of Human Effects on Climate,* **B. D. SANTER[1], T. M. L. WIGLEY[2], A. J. SIMMONS[3], P. KÅLLBERG[3], G. A. KELLY[3], S. UPPALA[3], C. AMMANN[2], J. S. BOYLE[1], W. BRÜGGEMANN[4], C. DOUTRIAUX[1], M. FIORINO[1], C. MEARS[5], G. A. MEEHL[2], R. SAUSEN[6], K. E. TAYLOR[1], W. M. WASHINGTON[2], M. F. WEHNER[7], and F. J. WENTZ[5]** ([1]Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Laboratory, Livermore, CA 94550; [2]National Center for Atmospheric Research, Boulder, CO 80303; [3]European Centre for Medium-Range Weather Forecasts, Shinfield Park, Reading, RG2 9AX, U.K.; [4]University of Birmingham, Edgbaston, Birmingham B15 2TT, U.K.; [5]Remote Sensing Systems, Santa Rosa, CA 95401; [6]Deutches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, D-82234 Wessling, Germany; [7]Lawrence Berkeley National Laboratory, Berkeley, CA 94720).

This talk reviews recent comparisons of tropopause height changes in climate models and reanalyses. A previous attempt to identify human effects on tropopause height (Santer et al. 2003. Science 301:479-483) relied on information from 'first-generation' reanalyses, such as NCEP-50 and ERA-15 (Kalnay et al. 1996. Bull. Amer. Meteor. Soc. 77:437-471; Gibson et al. 1997. *ECMWF Re-Analysis Project Report Series 1. ERA Description*). Climate data from these initial reanalyses have well-documented deficiencies, raising concerns regarding the robustness of earlier detection work that employed NCEP-50 and ERA-15 data. More recent work has addressed such concerns using information from the new 'second-generation' ERA-40 reanalysis (Simmons et al. 2000. ERA-40 Project Report Series No. l, Reading, U. K.). Over 1979-2001, tropopause height increases by nearly 200m in ERA-40, partly due to tropospheric warming. This estimated increase is relatively insensitive to details of the procedure used to calculate the height of the lapse-rate tropopause, such as the vertical and temporal resolution of input temperature data. The spatial pattern of tropopause height increase in ERA-40 is consistent with climate model predictions of the expected response to anthropogenic influences, significantly strengthening earlier detection results. Our results provide support for claims that human activities have warmed the

troposphere and cooled the lower stratosphere over the last several decades of the 20th century, and that these changes in atmospheric temperature have contributed to an overall increase in tropopause height.

*Automated Hardware Protocol Verification Using Symbolic Trajectory Evaluation*, **ROHIT SARASWAT and ANNETTE BUNKER** (Department of Electrical and Computer Engineering, Utah State University, Logan, UT 84321; E-mail: saraswat@cc.usu.edu).

Protocol Live Sequence Charts (PLSCs) represent the internetworking of processes or modules in a hardware system. To achieve automated verification, these PLSCs need to be translated into some temporal logic. In our current work, we are using Symbolic Trajectory Evaluation (STE) which is a new approach based on ternary symbolic simulation. The properties represented in the PLSCs can be described as STE Assertions of the form [characteristic A => Characteristic C] which express the constraints on the bounded length sequences. Our work translates data flow and timing information as captured in PLSCs into STE assertions. The Intel® Forte tool can automatically verify these assertions against hardware description language implementations of hardware communication protocols. A comparison would also be made with earlier translations of PLSCs into LTL to determine benefits and efficiency of this new approach.

*Raster-Based Spatial Evolutionary Game Dynamics,* **YUYA SASAKI** (Department of Environment and Society, Utah state University, Logan, UT 84322-5215; Email: slk1r@cc.usu.edu).

I present an extended version of the evolutionary game theory that involves the spatial heterogeneity of evolutionary dynamics and stability. Raster is used as the spatial data structure for its simplicity to let spatial interactions work. Moreover, the data is layered so that each raster layer holds the cell values of unique phenotype. Thus, the number of layers corresponds to that of the phenotypes defined in the game, and the interactions of games occur across layers as well as across cells. Unlike the standard evolutionary game theory, I incorporate the effects of the von-Neumann-neighboring cells in the fitness functions of all the phenotypes in the cell, which only slightly modify the differential equation of the standard evolutionary game dynamics (replicator equations). I call these modified equations the spatial replicator equations. While this model is intrinsically associated with analytical dynamic models, I rather adopt cellular automata as an implementation tool to make this model visually more intuitive. From some analyses and simulations, I argue that (i) the simplex of the game is invariant under the spatial replicator equations (ie. the norm of the frequency vector of each cell remains one). Then, I show that (ii) the evolutionarily stable state under the standard replicator equations is also stable under the spatial replicator equations. Additionally, (iii) the spatial evolutionary dynamics can have infinitely many evolutionarily stable states unlike the standard version. The famous "hawk-dove game" is used as an example.

*Supply-Side Fluctuations Viewed as Evolutionary Game Dynamics,* **YUYA SASAKI** (Department of Economics, Utah state University, Logan, UT 84322-3530; Email: slk1r@cc.usu.edu).

I present an alternative thesis of the supply-side fluctuations and the resultant aggregate labor dynamics, where the source of cyclical dynamics is defined as the response of evolutionary game drifts to exogenous shocks. First, payoff systems, replicator dynamics, and the momentary stability are defined and briefly analyzed. Payoffs are defined by a cardinal utility that accounts for the value of the real income relative to the cost of its associated hours of work. The firms' decisions of unemployment depend on the replicator differential equations that restrict prompt changes in their policies, so that the dynamics involve some inertia. This reflects the reality better since firms have only limited flexibilities in labor input decisions due to labor contracts, etc. Given this, the equilibrium under this dynamics is shown to be asymptotically stable. Second, I introduce exogenous shocks to the dynamics to make the asymptotic stability of the equilibrium only momentary, thus causing aggregate fluctuations. To make this concept clearer and visually more intuitive, I use computational simulations as well as analytical methods. Third, it is shown how the degree of recency-weighting in firms' expectations affects the magnitudes of the fluctuations. The implication of this model is that economic agents are likely to suffer from larger variations in income and unemployment as the inertia of the dynamics is decreased. Conversely, the model says that this variation can be mitigated by encouraging rigid expectations.

*Pygmy Rabbits (*Brachylagus idahoensis*): Methods of Detection, Habitat Preferences, and Distribution in Nevada,* **EVELINE S. SÉQUIN and PETER F. BRUSSARD** (Department of Biology, Program in Ecology, Evolution, and Conservation Biology, University of Nevada at Reno, Reno, NV 89557; E-mail: esequin@unr.nevada.edu).

This project is part of an ongoing study to determine the current distribution, status, and natural behaviors of the pygmy rabbit (*Brachylagus idahoensis*) in Nevada. Pygmy rabbits are the smallest North American leporid. They are extreme habitat specialists requiring dense, large sagebrush growing on deep, friable soils for food, shelter, cover from predation, and locations for their burrows. Degradation and reduction of this habitat type and a lack of information on their current status recently motivated a petition to list the pygmy rabbit as threatened or endangered under the U.S. Endangered Species Act.

GIS coverages of soil and vegetation were used to determine initial areas with potential pygmy rabbit habitat. However, pygmy rabbits were found to have additional microhabitat preferences, and ground surveys proved to be more time-effective in locating them. Different methods, including burrow, pellet, visual sighting, and camera surveys, were tested for their effectiveness in detecting current pygmy rabbit activity at a site. Camera surveys were the most effective and convincing for confirming current pygmy rabbit presence. Data collected to date indicate that pygmy rabbit populations are still reasonably well-distributed across Nevada.

*Comparison of Synthetic Aperture Radar (SAR) Data with NOAA AVHRR Derived NDVI in the Gaza-Negev-Sinai Border Regions*, **GUY SERBIN[1], GIL REVIVO[2] and DAN G. BLUMBERG[3]** ([1]Department of Plants, Soils and Biometeorology, Utah State University, Logan, UT 84322-4820, USA; [2]Simigon Distributed Training Solutions, 1 Sapir St., PO Box 12050, Herzliya 46733, Israel; and [3]Department of Geography and Environmental Planning, Ben Gurion University of the Negev, P.O. Box 653, Beer Sheva 84105, Israel; E-mail: gserbin@mendel.usu.edu).

Synthetic aperture radar (SAR) and NOAA AVHRR imagery of the Sinai-Gaza Strip-Negev border region exhibited noticeable differences across borders due to differing grazing and agricultural practices. Mean SAR backscatter coefficients ($\sigma^0$) were lowest in the Sinai-Negev Sand Sea on the Egyptian side and highest along the coastal plains due to farming and urbanization.Good correlations ($r^2 \approx 0.54$~$0.86$) were found between SIR-C and ERS-2 imagery and AVHRR derived NDVI for homogenous regions such as sand dunes and small farms in Sinai and the Gaza Strip. These correlations decreased when the large fields of the Israeli coastal plain were added due to random tilling directions and varying crop types. While NDVI varied seasonally, $\sigma^0$ did not, suggesting seasonal changes in chlorophyll content but not in bulk biomass or canopy architecture.The standard deviation (SD) of $\sigma^0$ was indicative of land use practices and homogeneity of land cover. The undisturbed Israeli side of the Sinai-Negev sand sea exhibited low SDs whereas the Egyptian side had higher SDs at all bands and polarizations due to grazing and interdunal farming. Coastal plain values show the opposite behavior as the large Israeli farms and higher building concentrations in the Gaza Strip resulted in greater SDs than for small Egyptian farms. C-band had lower SDs than L-band, as it was affected more by smaller reflective elements. The use of radar and NDVI data together in relatively homogenous regions may be a valuable tool for studies of desert vegetation and monitoring of land use and desertification processes.

*Influence of Reclamation Management Practices on Soil Bulk Density and Infiltration Rates,* **GYAMI SHRESTHA and PETER D. STAHL** (Department of Renewable Resources, University of Wyoming, Laramie, WY 82071-3354; E-mail: gyami@uwyo.edu).

The influence of reclamation and management practices on bulk density and water infiltration rates of soils at 5 surface coal mines in the Powder River Basin, the Green River Region and the Hanna Coal Field of Wyoming was evaluated in a study started in the summer of 2003. The reclamation and management practices considered were topsoil stockpiling vs. direct hauling, shrub mosaic seeding vs. grass seeding, hay mulching vs. stubble mulching and grazing vs. no grazing. Some of the management practice comparisons were found to have significantly different effects on the soil bulk density, which was measured across 3 depths up to 30 cm, and infiltration rate, expressed as hydraulic conductivity, while others did not. These effects were also significantly different when compared to adjacent undisturbed native sites.

*Changing the Culture at the University of Rhode Island: Assessing Readiness for Change,* **BARBARA SILVER[1], LISA HARLOW[2] and KATE WEBSTER[2]** ([1]University of Rhode Island, Kingston, RI 02881, E-mail: bis7289@postoffice.uri.edu; [2]Psychology Dept. University of Rhode Island, Kingston, RI 02881, E-mail: lahrlow@uri.edu, kweb7049@postoffice.uri.edu).

The ADVANCE program at URI involves a strong recruitment component, faculty development and support programs, all of which are well underway. Preliminary assessments of climate conditions and intervention strategies will be reviewed. These have been developed using two change models, the Transtheoretical Model for Change and Appreciative Inquiry, both of which will be discussed.

*Background Trace Element Concentrations in the Franciscan Complex, San Francisco, California,* **MEGAN SIMPSON and MATTHEW La FORCE** (Department of Geosciences, San Francisco State University, Ca 94132-4163; E-mail: laforce@sfsu.edu).

Background trace elements vary within the different geologic terranes of the Bay Area. In this study, we created a trace element distribution map of San Francisco. Accordingly, forty-five samples were randomly collected from chert, greenstone, sandstone and serpentinite outcrops from the Franciscan Complex around San Francisco. Samples were digested at low temperatures (110°C) using a mixture of hydrochloric, nitric, perchloric, and hydrofluoric acids and analyzed for chromium, cobalt, nickel and lead using inductively coupled plasma-atomic emission spectrometry. Trace element concentrations were: chromium (ranging from 12-2070 mg/kg), cobalt (<2-103 mg/kg), nickel (9-2240 mg/kg), and lead (<4-136 mg/kg). Chromium and nickel were concentrated in serpentinite and greenstone in the Presidio and Potrero Hill areas. The highest levels of lead were in chert in the Glen Park area. Cobalt concentrations were

greatest in serpentinite and greenstone in the north and east sections of San Francisco. Our study provides a necessary first step to understanding background trace element distributions in San Francisco and will assist future environmental clean-up programs.

*Using Geographic Information System (GIS) Software to Meet State and National Standards in Teaching Science and Geography,* **SANDRA SMITH** (Sequim Community School, Sequim School District, 503 N Sequim Avenue, Sequim, WA 98382; E-mail: sandrams@olypen.com).

National and state standards for teaching middle and high school science and geography include process objectives as well as content learning. Students are expected to learn to use basic tools and techniques of the science they are studying to answer questions about their environment, both physical and man-made. Geographic information systems (GIS) allow students to map their research findings and produce professional-looking products that can show relationships and changes over time and compared to other data from their cities, counties, and states. See what alternative high school students in an integrated science-math-geography course developed as part of service projects for local non-profit agencies: traffic and crime patterns, wildlife migration routes, threatened species locations, and river channel movements. Create mapping projects for your own secondary or college classroom, using relatively inexpensive software and hardware. Learn how to find local sources of maps, data, and aerial photos and use them with students to answer complex local social and natural science questions. Presenter has 33 years of teaching experience in grades 5 to community college.

*1,25-Dihydroxyvitamin D3 Stimulates Vesicular Transport within 10 sec in Polarized Intestinal Epithelial Cells,* **TREMAINE M. STERLING and ILKA NEMERE** (Department of Nutrition and Food Sciences and the Center for Integrated BioSystems, Utah State University, Logan UT 84322; E-mail: nemere@cc.usu.edu).

Controversy remains regarding whether the seco-steroid hormone $1,25(OH)_2D_3$ enhances calcium and phosphate movement across the intestinal epithelial cell by facilitated diffusion or a vesicular transport mechanism. In this study we investigated whether membrane trafficking, as judged by confocal microscopy, was sufficiently rapid in comparison to hormone-stimulated uptake of phosphate. Primary cultures of chick intestinal cells were established overnight either in petri dishes (uptake studies) or chambered coverslips (confocal microscopy). Addition of 130 pM $1,25(OH)_2D_3$ resulted in an apparent increase in $^{32}P$ uptake within 1 min, relative to controls, that was statistically significant from 3-10 min of incubation. Using the endocytic marker dye, FM1-43, confocal microscopy revealed a profound decrease in membrane-associated fluorescence (apical>basal) within 10 sec of hormone, a return of fluorescence at 15-65 sec, followed by another round of decreasing and increasing fluorescence. Between 3-9 min of incubation, fluorescence intensity increased 50% (apical region) and 20% (basal region) over control conditions. Others have interpreted such results as indicating intense vesicular recycling. An antibody (Ab 099) directed against a putative membrane receptor for $1,25(OH)_2D_3$ inhibited both $^{32}P$ uptake, and changes in fluorescence.

*Perenniality Traits in* Poa annua *L. Populations throughout Utah's Diverse Environments,* **ALEX N. STOY and PAUL G. JOHNSON** (Dept. of Plants, Soils, and Biometeorology, Utah State University, Old Main Hill, Logan, UT 84321; E-mail: alexstoy24@yahoo.com).

Annual bluegrass (*Poa annua*) is both a common weed and a desirable species in many golf turfs. It is undesirable because it disrupts turfgrass uniformity, is a prolific seed producer, dies out because of heat stress, and competes for space and nutrients (Hall and Carey, 1992). Yet *P. annua* can produce a high quality turf and tolerate extremely low mowing heights. The annual type, *P. annua* var. *annua*, is associated with less intensely managed areas such as golf course roughs, home lawns and warm, dry climates. *Poa annua* var. *reptans*, the perennial form, is associated with golf course greens and fairways, and cooler climates of temperate regions. *P. annua* var. *annua* reaches maturity quicker, has fewer leaves, nodes, tillers, adventitious roots, and produces a greater percentage of flowering tillers relative to the perennial form, *P. annua* var. *reptans* (Gibeault, 1971). Biological and morphological characteristics of *P. annua* are thought to be highly variable because of ecological pressures and turfgrass management regimes. The objective of this research is to characterize and evaluate the variation among sixty populations of *P. annua*, collected from fifteen golf courses throughout the state of Utah, by comparing them to their locations and management regimes. Comparisons include: 1. monitoring vegetative growth; 2. monitoring seed head production; 3. locations; and 4. management regimens. We will emphasize the use of the data to fine tune management programs and reduce waste in resources, especially nutrients that have pollution potential, and water, which is in short supply in many regions.

*A Rotary Dental Mill in* Paranthropus*?* **GORDON STRASENBURGH** (Society for Scientific Exploration, 2680 Everett St., North Bend OR 97459-2234).

The dental 'specialization' of *Paranthropus* has long been apparent, yet no model to account for the characteristic 'flat' wear pattern of the occlusals of robust molars and molarized premolars has been advanced. This robust signature, *versus* the dished molar occlusals of *Homo*, is one of five dental dichotomies between sibling clades. The two major components of a robust rotary dental mill model are: a)

temporals oriented from the vertical to the horizontal, another robust signature, the horizontal portions alternatively pulling the rami back and forth around a center of rotation inside the dental arch; and b) a modest reorientation of the mandibular condyles to serve as guides for reciprocating rotary mastication. If the robust mandible moved thusly, the robust molars would show some scratches parallel to the molar row (mesio-distal orientation) in addition to scratches perpendicular (bucco-lingual orientation). Grine and Kay (*Nature 333*:765, 1988) report just such a dichotomy in the orientation of scratches in molars of the two clades. In *Homo* nearly all the scratches are perpendicular, while in the robust about a quarter of the total are parallel. If one describes a circle tangent to the condyles of the Maka and Lake Natron mandibles, the center lies inside the incisors. The same procedure for *Homo* and Lucy places the center several inches outside the incisors. Further, the front teeth of *Homo* lock when occluded; those of *Paranthropus* do not (Wallace in Jolly, 1978). The robust rotary dental mill hypothesis accounts for these heretofore uncorrelated data and proposes an elegant, novel evolutionary adaptation.

*Long-term Mudpot Monitoring: An Ideal Project for Undergraduate Research,* **ANNE STURZ, CHARLES KOEHLER, THERESA COMPTON and JENNIFER PRICHARD** (Department of Marine Science, University of San Diego, 5998 Alcala Park, San Diego, CA 92110-2496; E-mail: asturz@sandiego.edu).

The Mud Pots Project is an on-going effort to establish baseline data delineating the chemical composition of fluids associated with mud pots and mud volcanoes located along the southeast shore of the Salton Sea. One objective of this study is to use fluid chemical composition and exit temperature to deduce the relationship between the mud pots and a deep-seated geothermal reservoir.

Our results indicate that exit temperature and chloride/bromide relative ratio show great site to site variation. This suggests there may be local spatial differences in the mixing ratio between high Cl/Br geothermal fluids and low Cl/Br near-surface groundwater. Our data also indicates that fluid mixing ratio changes at specific sites over time. We observe temperature and chemical variability that may be related to seasonal variation in irrigation and rainfall runoff volume. Superimposed on seasonal variability, our data show overall increase in Cl/Br at some locations and decrease in Cl/Br at other locations.

This project is ideal for undergraduate research because it illustrates how long-term sampling and analyses of simple parameters are particularly conducive to undergraduate research. Regular data collection over a long period of time by many individuals provides the opportunity to acquire meaningful information and gives the participants a sense of useful contribution. USD undergraduates regularly sampled mud pots and mud volcanoes since July 1991. To date, 28 students have participated in this project. Five of these students presented their results at conferences and used the project as the basis for Senior Seminar.

*Novel Homocysteine Bridged SOD-SAM Electrode,* **QINSHU SUN** (Department of Pharmacology and Pharmaceutical Chemistry, Jining Medical College, Jining, Shandong 272013, P. R. China; E-mail: qinshusun@yahoo.com).

Superoxide dismutase (SOD) has peroxidase activity in free radical mediated inflammatory disorders. We developed SOD-modified electrodes to study the electron transfer of SOD, in which SOD was oriented on gold electrodes via self-assembled monolayer of homocysteine (Hcy-SAM) by 1-ethyl-3-(3-dimethyaminopropyl) carbodiimide (EDC). Electrochemical behaviors characterized by cyclic voltammetry demonstrated a pair of well-defined electrochemical redox waves. SOD was found to be stably confined on Hcy-SAM with stable redox response suggesting permanent binding of SOD via the SAM bridge of Hcy to the electrode surface. The redox peak current increased with sweep rate as well as the unequal oxidation and reduction peaks showed a quasi-reversible electrochemical behavior. Therefore, homocysteine is an effective promoter for electron transfer by facilitating and speeding up the electron transfer of SOD. Hydrogen peroxide turnover by SOD weakened the electrochemical reversibility of SOD. The CV reduction peak current under -0.1 - 0.7 V sweep in pH 7.0 phosphate buffer was observed to decrease distinctly until disappear with the concentration of hydrogen peroxide increase, which indicated the decrease of SOD electron transfer by reduction of Cu complex moiety from Cu(II)SOD to Cu(I)SOD. Cu complex moiety was supposed to be the electroactive site of SOD with inherent enzymatic activity for dismutation of superoxide ion. The decrease of SOD electron transfer further weakens the bridge between SOD and Hcy-SAM.

*Stage of Maturity, Time of Sampling, and Method of Drying Effects on Forage Quality of Haybet Barley,* **L. M. M. SURBER**, **S. D. CASH**, **J. G. P. BOWMAN**, **L. BARNEY** (Montana State University, Bozeman, MT; E-mail: lmsurber@montana.edu).

Forage barley varieties are an increasingly important crop in Montana accounting for 15.2 % of the barley varieties grown. Approximately half of Montana grain hay production comes from barley. The objective of this research was to evaluate method of sample drying, stage of maturity and time of sampling effects on forage quality of Haybet barley. Haybet barley was grown under irrigated conditions in 2002 near Bozeman, MT. Forage clip samples (5 cm) were collected at the boot (B) and water early-milk stage (W) of maturity. At each stage of maturity samples were collected in the morning (AM) and evening (PM) of two consecutive days. Clip samples were divided into two aliquots that were either freeze-

dried (FD) with liquid nitrogen or oven dried (OD) at 60° C in a forced air oven. At each stage, time, and drying method three replicates were taken. Each sample (n = 48) was ground through a 5-mm screen and evaluated for in situ DM disappearance (ISDMD) at 48 h. A sub-sample was ground through a 1-mm screen and evaluated for DM, NDF, ADF, CP, and NO3-N. Stage of maturity affected (P less than 0.01) all forage quality parameters. Neutral detergent fiber was 4.8% greater (P less than 0.01) at W stage of maturity when compared to B stage of maturity (54.43 vs. 51.95%, respectively). Nitrate concentration was 45% lower (P less than 0.01) at the W stage of maturity when compared to B stage of maturity (0.140 vs. 0.253%, respectively), however it was unaffected (P greater than 0.10) by time of sampling or method of drying. Crude protein content was 53% lower (P less than 0.01) at W when compared to B stage of maturity (11.86 vs. 18.14%, respectively). Acid detergent fiber was 3.2% lower (P = 0.08) at PM than at AM (30.43 vs. 31.44%, respectively). In situ DMD tended to increase (P = 0.11) at PM compared to AM (76.45 vs. 75.21, respectively). Freeze drying decreased (P = 0.05) ADF content by 3.6% when compared to OD (30.36 vs. 31.51%, respectively). Freeze drying increased (P less than 0.01) ISDMD at 48 h, in contrast to OD (77.18 vs. 74.49%, respectively). Stage of maturity greatly affected forage quality of Haybet forage barley. Haybet cut in the evening tended to yield hay that was lower in ADF and higher in digestibility. Freeze or oven drying were equally effective methods of sample preparation for nitrate concentration determination.

*Nitrate Concentration of Cereal Forage Species at Three Stages of Maturity,* **L. M. M. SURBER**, **S. D. CASH**, **J. G. P. BOWMAN**, **and A. L. TODD** (Montana State University, Bozeman, MT; E-mail: lmsurber@montana.edu).

Cereal forages have become an increasingly economical source of winter feed for livestock producers, comprising 11% of all hay harvested in Montana. Livestock producers need to be concerned with nitrate concentrations when feeding annual cereal forages. Six cereal forage species (18 varieties) were grown in a randomized complete block design field trial (r = 4) under irrigated conditions in Bozeman, MT, and were used to test the effects of cereal forage species and stage of maturity on forage nitrate concentration. Plots were 1.52 x 6.10 m in length and spaced 0.46 m apart. Forage clip samples were collected at three stages of plant maturity; boot, anthesis and when the plots were harvested for hay (milk stage of maturity). A 0.15 m clip sample of one row was cut at stubble height and dried at 60° C for 48 h. Forage clip samples were ground to pass a 1-mm screen in a Wiley mill and evaluated for DM and nitrate-nitrogen (NO3-N). The range in NO3-N was from 0.01 to 0.55% (CV = 47.2%). There were significant (P less than 0.05) cereal forage species, stage of maturity and species x maturity interaction effects on NO3-N concentration. Nitrate-nitrogen concentration at the boot stage of maturity did not differ (P greater than 0.05) when compared to the anthesis stage of maturity (avg. 0.244 %). However, NO3-N concentration at harvest was 36 % lower than at anthesis (0.168 vs. 0.230 %). Barley forage NO3-N was similar (P greater than 0.05) when compared to emmer, triticale and wheat x spelt crosses (avg. 0.195 %) and lower (P less than 0.001) when compared to oat and spelt forage (0.186 vs. 0.341 and 0.258 %, respectively). Barley forage NO3-N concentration was highest (P less than 0.05) at the boot stage, intermediate at anthesis and lowest at harvest (0.230, 0.195 and 0.131%, respectively). Oat forage maintained high NO3-N concentrations at all growth stages (P greater than 0.05; avg. 0.341%). It appears that stage of maturity and cereal forage species greatly affect NO3-N concentration. Also, NO3-N concentrations of various cereal forage species respond differently at boot, anthesis and harvest. This implies that different harvest management must be implemented for oat when compared to other cereal forage species.

*PINB is the Limiting Factor in the Reduction of Grain Softness in Wheat!* **C. G. SWAN**, **F. MEYER**, **A. HOGG**, **J. M. MARTIN**, **and M. J. GIROUX** (Montana State University, Bozeman, MT; E-mail: cswan@montana.edu).

Wheat endosperm texture directly affects end-use and milling qualities. Hardness (Ha), a single locus on chromosome 5D, is known to determine endosperm texture in wheat and contains the puroindoline A (pina) and B (pinb) genes. Absence or alterations in either of the puroindolines results in a hard seed phenotype, while seed softness results from the presence of both pina-D1a and pinb-D1a. Furthermore, recent studies suggest that grain hardness is correlated with the presence of both functional PINA and PINB, not total puroindoline content. The objectives of this study were to investigate which puroindoline (a or b) limits grain softness in soft wheats. To accomplish this, six transgenic pin a/b isolines in the hard wheat 'Hi-line' background were crossed with the soft wheat''Heron'. Resulting F2 derived F3 progeny were segregating for the pin transgene, as well as the wild-type and mutated Ha locus. Grain hardness, total puroindoline expression, and friabilin expression were evaluated for homozygous sergeants from each cross. In soft wheats, such as Heron, PINA and PINB are not characteristically present in a 1:1 ratio. It is typical that PINA is found in greater abundance then PINB. Among our progeny lines, we found that the addition of PINB in soft wheats reduces grain hardness more then the addition of PINA, signifying that PINB limits grain softness. Continued decreases in grain hardness were seen in lines having increasingly greater PIN expression indicating that the lower limit of wheat grain hardness has not yet been reached.

*Changes in Root Biomass and Intrinsic Permeability of Degraded Meadow Soils,* **HILLARY J. TALBOTT and PAUL A. McDANIEL** (Division of Soil Science & Land

Resources, University of Idaho, Moscow, ID 84844-2339; E-mail: talb0338@uidaho.edu).

Many Meadows on the east slopes of the Cascade Mountains of Washington have been degraded by heavy grazing by elk herds and cattle. This has left many of them in a degraded state. In 1992, a grazing exclusion and fertilization study was initiated on four meadows in the Eastern Cascades to test rehabilitation strategies. This study uses these existing meadow exclosures to observe how physical and hydrologic properties of compacted, degraded meadow soils may recover over time under different grazing and fertilization regimes. Intact soil cores were used to determine bulk density, porosity, root biomass, and soil water characteristic. Permeability was measured in situ. Measurements were taken in three different grazing regimes in both fertilized and unfertilized plots. Initial results indicate that both permeability and root biomass are highly spatially variable. Variability appears to be due, in part, to extensive gopher activity in these meadows. Permeability was not significantly different across grazing and fertilizer treatments at a $p<0.05$ level but was greater in the non-fertilized plots at a $p<0.1$ level. Root biomass was significantly greater ($p<0.05$) in the elk-only grazing treatment but was not significantly affected by fertilizer treatment. The elk-only grazing treatment may provide enough grazing to stimulate root growth of grasses without stressing the plants. Increases in root biomass did not correspond with greater permeability. These preliminary results suggest that restricting cattle from degraded meadows increases root biomass, which could lead to faster meadow recovery.

*Adolescent Development and Environments,* **DENISE E. TAYLOR and RANDALL M. JONES** (Family, Consumer, and Human Development Department, Utah State University, Logan, UT 84322; E-mail denisetaylor@cc.usu.edu).

Scarr and McCartney (1983) provide a framework for understanding developmental processes by way of genetic and environmental influence. The active selection of environments is referred to as niche-picking and niche-building, and is considered to be "...the most powerful connection between people and their environments..." (p. 427). To the extent that the immediate environment offers persons, symbols, and objects, the actualization of genetic potential will be influenced (Bronfenbrenner & Ceci, 1994). Parents provide opportunity structures, and adolescents make choices; gendered behaviors and reinforcement of them are often evident in these choices.

The purpose of this study was to explore opportunity structures and adolescent choices within the confines of their bedrooms (the adolescent bedroom is an environment where adolescents have the greatest control over design). Results from our survey of 234 8th and 9th grade students revealed that gender differences and preferences were most evident in decorations where girls were more likely than boys to report jewelry, pictures, make-up and/or hair accessories; whereas boys more often indicated athletic or sporting equipment and items that they had built. In general, girls' bedrooms contained a greater range of items than did boys' bedrooms. In addition, girls' bedrooms contained both feminine and masculine items; while boys bedrooms almost exclusively contained masculine items. Collectively, decorations and furniture were most useful in discriminating boy and girl bedrooms. Girls' rooms were characterized by [having/wanting] jewelry, dolls, make-up tables with mirrors, and pictures of siblings; whereas boy bedrooms were more likely to contain [request] a sofa and chair set. Findings from the study suggest that "have" and "want" bedroom design preferences of adolescents are strongly related to gender. Further, gendered choices among adolescents appear to be influenced by both biological and social factors.

*Response of Dry Bean Cultivars and Landraces to Seven Cropping Ssystems in Southern Idaho,* **H. TERAN[1], D. WESTERMANN[2], R. ALLEN[1], R. PARROTT[3], K. MULBERRY[3], J. SMITH[4], M. DENNIS[1], R. HAYES[1], C. G. MUNOZ[1], S. P. SINGH[1]** ([1]Univ. of Idaho, [2]USDA-ARS, Kimberly, ID, [3]Organic bean grower, [4]Bean grower; E-mail: hteran@kimberly.uidaho.edu).

Knowing the performance of dry bean cultivars and landraces under different cropping systems is essential for measuring gains from selection and developing high yielding cultivars for sustainable organic and conventional farming systems. Our objective was to evaluate for yield, 100-seed weight, and days to maturity four great northern, seven pinto, and five red cultivars and landraces in seven cropping systems in southern Idaho. Three on-agricultural experiment station cropping systems, namely conventional (EFC), continuous bean cropping (ECB), and drought-stressed (EDT), and four on-farm cropping systems, namely conventional (OFC), low fertility soil (OLF), organic drought-stressed (OGD), and organic irrigated (OGI) in the Magic Valley in southern Idaho in 2003. A randomized complete block design with four replicates was used, and each plot consisted of four or eight rows, 25 or 50 ft long. The effects of cropping systems were highly significant (P

*Lipid Peroxides Generated by the Ozonation of Biological Fluids are Effectively Neutralized by Phytochemicals with Antioxidant Capacity*, **DAVID P. TOMER, LEE D. MCLEMAN, SEIGA OHMINE, S. BRIANT STRINGHAM, CHRIS TRIMBLE, NICHOLAS J. BUCHKOVICH, KIM L. O'NEILL, and BYRON K. MURRAY** (Department of Microbiology and Molecular Biology, Brigham Young University, 775 WIDB, Provo, UT 84602; E-mail: davidtomer@hotmail.com).

Biological fluids frequently contain pathogens which render them impractical for use in laboratory applications. To disinfect such fluids, our laboratory has employed ozone, and while ozone effectively decreases the infectivity of pathogens, cytotoxic byproducts such as lipid peroxides remain. As ozone generates free radicals, we hypothesized that the addition of antioxidants would decrease the concentration of the ozone-generated lipid peroxides. We measured several phytochemicals for antioxidant activity with the ORAC (Oxygen Radical Absorbance Capacity) assay, and then investigated whether the antioxidants with higher ORAC values would neutralize lipid peroxides found in ozonated biological fluids. Minimum Essential Medium, supplemented with 2% bovine calf serum (BCS), was exposed for 45 minutes to an oxygen-ozone mixture containing 1200 ppm by volume (ppmv) of ozone. Following ozone exposure, phytochemicals with significant antioxidant activity were added to the ozonated fluid, and the concentration of malondialdehyde (MDA), a byproduct of fatty acid oxidation, was measured spectrophotometrically. Ozonated fluid without added antioxidants and non-ozonated fluid were tested as controls. For ozonated fluid without antioxidants, MDA was 9.2 μM, and with the added antioxidants, MDA decreased to 4.8 μM (pine bark extract), 3.3 μM (MegaNatural Gold grape seed extract), 1.1 μM (Pycnogenol), and 0.2 μM (green tea polyphenols). MDA for non-ozonated fluid was 0 μM. These data suggest that some phytochemicals can neutralize ozone-generated lipid peroxides, and that a correlation exists between their antioxidant activity and the degree of MDA inhibition.

*Measurement of MDA Levels as a Marker of Lipid Peroxidation in Serum,* **CHRIS TRIMBLE, LEE D. MCLEMAN, SEIGA OHMINE, S. BRIANT STRINGHAM, DAVID P. TOMER, KIM L. O'NEILL and BYRON K. MURRAY** (Department of Microbiology and Molecular Biology, Brigham Young University, 775 WIDB, Provo, UT 84602; E-mail: trimble@byu.edu).

Lipid peroxidation is the oxidative deterioration of polyunsaturated lipids by free radical chain reactions. Free radical generators, including reactive oxygen species (ROS), induce the peroxidation of lipids and fatty acids to short chain aldehydes, ketones and other oxygenated compounds. Malondialdehyde (MDA), an abundant product of lipids can serve as a quantifiable marker for overall lipid peroxidation levels. In the acid-catalyzed reaction of 1-methyl-2-phenylindole and MDA, a stable chromophore is formed, which can be detected and quantified with a light absorbance assay set at 586nm. For this study, we desired to examine parameters of lipid peroxidation in serum by quantifying levels of MDA. Ozone was selected as the ROS because of previous studies suggesting that ozone-generated lipid peroxides may inactivate pathogens in biological fluids. We exposed serum to ozone for different periods of time and at different concentrations, and we hypothesized that longer time intervals and higher concentrations of ozone would increase the levels of lipid peroxides proportionately. Our results showed a 15-fold increase in serum lipid peroxidation levels following exposure to an oxygen-ozone mixture 4800 ppmv for 30 minutes. Furthermore, a two-fold increase in lipid peroxidation was detected when the serum was treated at a concentration of 4000 ppmv ozone, as compared to 3000 ppmv ozone. Our results suggest that the lipid peroxidation levels in serum are positively correlated with the time periods and concentrations of ozone exposure, thus establishing basic parameters of ozone exposure as a possible therapeutic.

*Inhibition of CXCR4/SDF-1α Mediated Angiogenesis by Tannic and Ellagic Acid in Breast Cancer Cells,* **D.D. TWITCHELL, K.T. MEIER, B.K. MURRAY, and K.L. O'NEILL** (Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT 84602; E-mail: twitch@email.byu.edu).

Cancer cells, like all others, need nutrients and oxygen from the blood in order to survive and proliferate. Angiogenesis is the formation and stabilization of new capillaries, enabling the cells to grow. Both CXC chemokine receptor-4 (CXCR4) and its ligand- stromal cell-derived factor-1α (CXCL 12) are involved in the regulation of vascular endothelial growth factor (VEGF) and matrix metalloproteinases (MMP), suggesting their importance in angiogenesis. Our hypothesis was that tannic and ellagic acid may reduce the vascularization caused by breast cancer cell lines by interfering with the binding of CXCR4 and CXCL 12. Specific concentrations of either tannic or ellagic acid and SDF-1α were added to the chorioallantoic membrane (CAM) of chick embryos. We were able to quantify the angiogenesis with the aide of a new computer program, developed in our lab, which counts branching points and the total length of new blood vessels. When CXCR4 and SDF-1α bind, VEGF is secreted into the blood, giving us a possible way to show that tannic and ellagic acid inhibit their binding.

*Plant Layout Design with Heuristics,* **ZSOLT UGRAY and KARINA HAUSER** (Business Information Systems Department, Utah State University, 3515 Old Main Hill, Logan, UT 84322-3515; E-mail: Zsolt.Ugray@usu.edu and KHauser@b202.usu.edu).

Carefully designed plant layouts can result in significant reduction in lead time for parts needed on the plant floor. Additionally, substantial savings can be achieved from minimizing the inventory held for continuous operation of the plant. We are looking at cross-docking that is widely used logistic technique to transfer incoming shipments to outgoing shipments. One goal is to achieve zero (or close to zero) holding time during the transfer process. Another goal is to minimize the distance over which supply materials have to

be transferred on the plant floor. We show how this latter problem can be treated as a Quadratic Assignment Problem (QAP). Several heuristic approaches, such as Tabu Search (TS) and Genetic Algorithm (GA) are investigated. We compare the performance of the different approaches and validate the use of these algorithms. Our data originates from a large plant in the automotive industry. We show computational results to the actual floor plan design.

*Two-Stage Algorithm for Global Optimization,* **ZSOLT UGRAY[1] and LEON LASDON[2]** ([1]Business Information Systems Department, Utah State University, 3515 Old Main Hill, Logan, UT 84322-3515; [2]MSIS Department, The University of Texas at Austin, Austin, TX 78712-1175; E-mail: Zsolt.Ugray@usu.edu and Lasdon@mail.utexas.edu).

We have developed a two-stage, multi-start global solver (MSNLP) for solving non-convex non-linear programs (NLPs). The algorithm uses one of several fast heuristics in the first stage to generate candidate solutions. In the second stage, a local solver is called from many, but not all candidate starting points. We demonstrate the use of two 'filters' to select a few promising starting points from a large set of candidates. As a solver within the GAMS algebraic modeling system, MSNLP can call any one of the available GAMS NLP solvers, and can therefore solve very large problems. We discuss the underlying logic of the method and describe experiments comparing several procedures (including random search and scatter search) for generating trial starting points for the NLP local solver. We also present computational results on a large set of test problems.

*Selenium in the Environment,* **GEORGE F. VANCE** (Wyoming Reclamation Ecology Center and Department of Renewable Resources, University of Wyoming, Laramie, WY 82071; E-mail: gfv@uwyo.edu).

Selenium (Se) is recognized for its environmental impact to soils, plants, and waters in native and disturbed ecosystems in western and now eastern States. Selenium is of interest and concern because of its natural occurrence and potential toxicity to aquatic organisms, wildlife and livestock. This presentation will address issues related to Se analysis and levels in soils, plants, waters, and wildlife. Information presented will be based on several Se-related research projects conducted by the author that examined analytical methods for Se analysis, methods of sampling, Se analytical procedures for soil, overburden, backfill, vegetation, and water, identification of Se levels in native and disturbed environments, and organism Se concentrations.

*Use of Plants and Fish Wastes for Ameliorating Hazards Associated with Coal Bed Methane Waters,* **GEORGE F. VANCE, JOHN G. WOIWODE, ROGER M. HYBNER, KEVIN FITZSIMMONS and GIRISHA K. GANJEGUNTE** (Department of Renewable Resources, University of Wyoming, Laramie, WY 82071; E-mail: gfv@uwyo.edu).

An important source of natural gas is coalbed methane (CBM). Unlike traditional natural gas production, CBM is recovered by pumping water from coal seams to reduce hydrostatic pressure that retains the methane. In parts of the Powder River Basin, WY, coal seams are primary aquifers for agricultural and domestic uses. Some CBM water is used by farmers and ranchers for livestock watering, irrigation, and other purposes. However, much of the CBM discharge water is disposed of on lands. When these waters have high sodium adsorption ratios (SARs), and are applied on fine textured soils (i.e., clay loams), there is the potential to cause soil dispersion and harmful salt build-up. The result is an inability for the land to support desirable vegetation due to land degradation; worst case - land cannot support any vegetation whatsoever! The primary objective of this research was to determine if there is a significant uptake in sodium (Na) by plants after irrigation with high SAR CBM discharge water. A secondary objective was to determine if significantly improved growth occurs in plants with addition of nutrients from soil-applied fertilizer and/or water amended with fish wastes.

*Introduction,* **FREDERIC H. WAGNER** (Ecology Center and College of Natural Resources, Utah State University, Logan, UT 84322-5200).

Inferences on global climate change in recent years have been based in part on widely published time series of air temperatures: weather-station measurements for various regions, and for the entire globe over the past ~150 years; trends over the past 1,000 years based on a variety of proxies and modeling efforts; and trends over the past 160,000 years based on ice cores from the Greenland and Antarctic ice sheets. The first three papers in this symposium present evidence from recent research on temperature trends shown by bore holes in the earth, air temperatures shown by ice cores from a western U. S. glacier, and tree rings. The next three papers present evidence that the temperature increases are forced by human emissions of greenhouse gases, especially $CO_2$. The authors discuss other variables affecting temperatures that must be taken into account when inferring anthropogenic forcing from the measured trends. Global circulations models (GCMs) project much larger temperature increases during the 21$^{st}$ century than those of the 20$^{th}$, based on predicted increases in $CO_2$ emissions. Environmental effects during the 20$^{th}$ century are thus a limited portent of environmental changes likely to occur in the 21$^{st}$, and the first six papers in the second half of the symposium report recent research showing the wide range of environmental effects that occurred during the 1900s throughout western U. S. These include especially the effects on hydrologies of the water-short West, and on diverse western ecosystems. The final paper discusses factors that must be

considered, from a scientist's perspective, in devising policies to address the global-warming problem.

*Complementation of the Pina (Null) Allele with the Wild Type Pina Sequence Restores a Soft Phenotype in Transgenic Wheat,* **H. WANJUGI[1], M. J. GIROUX[1], J. M. MARTIN[1], and A. BLECHL[2]** ([1]Montana State University, Bozeman, MT and [2]ARS Crop Improvement and Utilization Research Unit; E-mail: hwanjugi@montana.edu).

Wheat (*Triticum aestivum* L.) grain hardness is a major determinant of milling and wheat end- product quality. The trait is controlled by the Hardness (Ha) locus located on the short arm of chromosome 5D (5DS). This locus contains the puroindoline A (pina) and the puroindoline B (pinb) genes. Hard textured wheats contain a mutant pinb allele or are devoid of pina (null) (pina-D1b), while soft wheats carry the pina-D1a and pinb-D1a alleles. Our objective was to determine the effect of complementing the pina-D1b allele in hard wheat cultivar 'Bobwhite' (pina-D1b/pinb-D1a) by expression of the pina-D1a sequence in transformed wheat plants. Immature embryos from cultivar 'Bobwhite' were bombarded with a DNA construct containing the pina-D1a sequence under control of the wheat glutenin regulatory sequences to obtain''BWA' lines with added pinA. Southern blot and PCR screening confirmed the presence of the pina-D1a transgene in six independent transgenic lines. Northern blot and triton X-114 protein extraction confirmed the stable expression of the transgene at the RNA and protein level. Grain kernel hardness was determined on transformed plants. High expression of wild type PINA in transgenic wheat seeds resulted in seeds having a soft chalky appearance and greatly decreased kernel hardness. These findings indicate that the absence of pina in hard wheats carrying the pina-D1b allele is causative to a hard phenotype. Further, pina expression and presence influences friabilin association with starch therefore regulating grain texture phenotype.

*Additive Response to Combined Cancer Therapies in Six Lymphoid Cell Lines,* **BRACKEN M. WEBB, MICHAEL R. PHILLIPS, BYRON K. MURRAY, and KIM L. O'NEILL** (Department of Microbiology, Brigham Young University, Provo, UT 84604; E-mail: brackdawg@hotmail.com).

Cancer treatment techniques are being developed which combine hyperthermia and chemotherapy as a means of inducing apoptosis in cancer cells. The combination of these treatments induces higher levels of apoptosis than by employing one of the treatments alone. In this study, we examined the percentages of apoptosis in six lymphoid cell lines: BJAB, Raji, HL-60, WTK-1, TK-6, and YAC-1. Apoptosis was induced by hyperthermia, doxorubicin (DOX), and a combination of the two. After 24 hours the cell lines were assayed using flow cytometry and Annexin-V to detect apoptosis. Our findings suggest that the success produced by the combination of a physical and chemical treatment is due to an additive affect of the mechanisms, which may function independently. Each cell line showed a differing sensitivity to hyperthermia and DOX. A comparison made between two WIL-2-derived cell lines that differ in their expression of p53 supports the suggestion of an additive response. TK-6 cells express a wild-type p53, while WTK-1 cells express a mutant p53. When the cells were exposed to hyperthermia alone, both showed similar apoptotic percentages. However, when the WTK-1 cells were exposed to DOX alone, 4.5% of the cells underwent apoptosis; in contrast, the TK-6 cell line showed a 35.9% level of apoptosis. Interestingly, the cells with a wild-type p53 are more susceptible to treatment with DOX; however, the additive effect of these two mechanisms is the same as when they are administered concurrently. The data from other cells lines examined also supports the conclusion of an additive response.

*Douglass' "Cycle Problem" and the Scientific Community's Reception of the New Science of Dendrochronology*, **GEORGE E. WEBB** (Department of History, Tennessee Tech University, Cookeville, TN 38505; E-mail: gwebb@tntech.edu).

Although the most dramatic applications of dendrochronology have been in the discipline of archaeology, A. E. Douglass believed throughout his life that the new science's greatest value lay in its potential contribution to the long-term prediction of climate. Toward that end, he sought to establish a direct link between solar activity and climatic fluctuation, soon focusing his attention on cyclical variations in the phenomena under study. Although the sunspot cycle of approximately eleven years provided an accepted periodicity, his data from the tree ring record proved more complex. Indeed, these data suggested that a large number of cycle values could be found in the dendrochronological record, raising questions from his scientific colleagues. More damaging to Douglass's efforts, the cycles could not be described in acceptably rigorous mathematical terms, leading Douglass to call his periodicities "cyclics" instead of "cycles," a literary sleight-of-hand that won few converts. Despite his best efforts to convince his colleagues of the reality of his tree ring variations, through publications and presentations at professional meetings, the scientific community remained unconvinced of the cyclical nature of the climatic variations evident in the tree ring record. An examination of Douglass's campaign to establish the reality of climatic cycles reveals intriguing characteristics of his scientific world view and his colleagues' reception of the new science of dendrochronology.

*Contributions of A. E. Douglass to Astronomy, the Development of Dendrochronology and the Institutional Growth of Science in the American Southwest*, **GEORGE E. WEBB** (Department of History, Tennessee Tech University, Cookeville, TN 38505; E-mail: gwebb@tntech.edu).

Born in 1867 in Windsor, Vermont, Andrew Ellicott Douglass (1867-1962) is best known for his contributions to the science of dendrochronology. After an undergraduate career at Trinity College in Hartford, Connecticut, Douglass joined the staff of the Harvard College Observatory in 1889, a post he held until early 1894. He next joined the newly-created Lowell Observatory, surveying various potential sites in the American Southwest and coordinating the construction of the facility in Flagstaff, Arizona Territory. Over the next seven years, Douglass served as Percival Lowell's chief assistant, often supervising other astronomers during Lowell's long absences. Douglass was dismissed in 1901 after he disagreed with Lowell's imaginative theories of intelligent Martian life. He spent the next five years in Flagstaff, before securing a faculty position at the University of Arizona in 1906. In addition to founding an astronomy program and observatory on campus, Douglass pursued his long-term goal of establishing a clear link between solar activity and climatic conditions. Recognizing that tree rings in the arid Southwest could serve as sensitive indicators of climatic conditions, especially rainfall, Douglass attempted to chart past climate by a systematic analysis of the variation in tree ring widths. He found evidence of cyclic variations that he hoped would convince colleagues of the value of his new science. Although he was unable to accomplish his goal of a precise, predictive theory of cyclical solar and climatic variation, his science of dendrochronology found significant use in both climatic studies and, more dramatically, the dating of archaeological ruins.

*Alkaloids and Old Lace: Pollen Toxins Exclude Generalist Pollinators from Death Camas (*Toxicoscordion [=Zigadenus] paniculatum*) (*Melanthiaceae*),* **MELISSA WEBER[1], MORGAN G. YOST[1], JAMES H. CANE[1,2], and DALE R. GARDNER[3]** ([1]Biology Department, Utah State University, Logan, UT 84321-5310; [2]USDA – ARS, Bee Biology & Systematics Laboratory, Logan, UT 84322-5310; [3]USDA – ARS, Poisonous Plant Research Lab, Logan, UT 84322-5310; E-mail: mweber@cc.usu.edu).

Many plants produce toxins to which specialist herbivores – typically insects – have evolved counter-adaptations, sometimes resulting in a co-evolutionary arms race. Although many non-social bee species are likewise taxonomic host specialists, the pollination guilds at their floral hosts frequently include diverse floral generalists as well, even on plants that are otherwise chemically defended. In this study, we show that pollen and nectar of foothills death camas (*Toxicoscordion* [=*Zigadenus*] *paniculatum*) contains zygacine, the alkaloid responsible for this plant's notorious mammalian toxicity. Adults and larvae of the generalist solitary bee, *Osmia lignaria* (Megachilidae) were paralyzed and soon after died when fed biologically relevant doses of zygacine. Such lethality probably explains the absence of this and 50+ other native bee species from this potential host. The sole pollinating bee, *Andrena astragali*, is known to use only death camas pollen to feed itself and its progeny. Thus, pollen and nectar toxins exclude generalist pollinators from foraging at death camas, despite the necessity of pollinators for seed set. The evolutionary ramifications for poisoning potential mutualists are discussed.

*Using Genomics in the Food Industry,* **BART WEIMER** (Center for Integrated BioSystems, Utah State University, Logan, UT 84322-4700; E-mail bcweimer@cc.usu.edu).

Genomics an area of systems biology is becoming wide spread in many applications. The use of genomics and functional genomics is standard tool that is providing new insights into cellular processes. The use of these tools in agriculture is also becoming common. The Lactic Acid Bacteria Genome Consortium has sequenced 11 microbes important in fermented food production. Subsequently, the sequence from these genomes was used to produce gene expression arrays. Use of gene expression arrays from complex sample types is difficult in some cases, but provides data to optimize processes, especially in food processing and production. For example, determination of the gene expression pattern allows one to deduce the cellular metabolism during food fermentations and provides an understanding of gene regulation in specific foods or environments. These data provide insights into the metabolic pathways and cellular responses that are important in fermentation processes. Additionally, these results yield information about the genes involved in survival mechanisms and stress responses to acid, temperature variation, osmotic shock, and oxidation. Another application of these arrays is the determination of strain variation genetic drift of these traits for process optimization. Use of these data can guide investigation and optimization of metabolism that lead to flavor production as well. Examples and discussion of these topics will be presented, with specific attention to gene expression analysis.

*Problem Solving Dynamics of Stomatal Networks*, **JEVIN WEST, SUSANNA MESSINGER, DAVID PEAK, and KEITH MOTT** (Biology Department and Physics Department, Utah State University, Logan UT 84322; E-mail: jwest@biology.usu.edu).

Is the adaptive response to environmental stimuli of a biological system lacking a central nervous system a result of a formal computation? If so, these biological systems must conform to a different set of computational rules than those associated with central processing. To explore this idea, we examined the dynamics of stomatal patchiness in leaves. Stomata—tiny pores on the surface of a leaf—are biological processing units that a plant uses to solve an optimization problem-maximize $CO_2$ assimilation and minimize $H_2O$ loss. Under some conditions, groups of stomata coordinate in both space and time producing motile patches that can be visualized

with chlorophyll fluorescence. These patches suggest that stomata are nonautonomous and that they form a network presumably engaged in the optimization task. In this study, we show that stomatal dynamics are statistically and qualitatively comparable to the problem-solving dynamics of cellular computing systems, characterized by emergent collective behavior.

*Current Status of Nuclear Transfer in Animal Agriculture – Successes and Challenges*, **KENNETH L. WHITE** (Animal, Dairy and Veterinary Sciences Department, Center for Integrated Biosystems, Utah State University, Logan, UT 84322-4815; kwhite@cc.usu.edu).

Nuclear transfer has been used to produce mammalian offspring in sheep, cattle, pigs, mice, rabbits, goats, cats, mules, the horse and most recently deer. Live animals have been produced from somatic (non-reproductive) cells from adult, fetal and embryonic cell lines. Recently, our laboratory reported the first successful births of an equine specie, three identical cloned mules produced from the transfer of fetal somatic cell nuclei into enucleated horse oocytes and carried full-term in the reproductive tract of a female horse (mare; Science 301:1063). All of these animals developed normally and the births were unassisted and each animal appears developmentally normal and healthy based on several physiological parameters monitored since birth. Significant gestational losses during all three trimesters are report in all species studied. Metabolic problems have been manifested immediately after birth in some nuclear transfer offspring. However, the majority of nuclear transfer animals produced and surviving the first weeks of life appear developmentally normal in the majority of the domestic animal species studied. Further, progress is being made in the production efficiency and subsequent survival of nuclear transfer animals. This presentation will review the current state-of-the-art in this research area as well as the potential applications and impact of the technology in animals and man.

*Forage Quality of Spring Cereal Forage Varieties in Montana,* **D. M. WICHMAN[1], S. D. CASH[2], P. F. HENSLEIGH[2], K. D. KEPHART[3], M. P. WESTCOTT[4], D. L. JOHNSON[5], P. F. LAMB[6], and M. KNOX[4]** ([1]Central Agricultural Research Center, MAES, Montana State University, Bozeman, MT; [2]Montana State University, Bozeman, MT; [3]SARC, Montana State University, Bozeman, MT; [4]WARC, Montana State Univeristy, Bozeman, MT; [5]NWARC, Montana St. University, Bozeman, MT; [6]NARC, Montana State University, Bozeman, MT; E-mail: dwichman@montana.edu).

The quality of forage produced by spring cereal varieties is of increasing importance due to increasing use of cereal grains for hay. Traditionally, cereal forages were viewed as being inferior in forage yield potential and in forage quality. Often cereal forages were valued similar to cereal straw. Research has shown properly managed cereal forages can produced high yields of good quality forage. Several spring barley varieties along with varieties of oats, emmer, spelt, and a spelt x wheat line have been evaluated for yield potential and quality in Montana. Differing maturity dates and harvest dates make quality comparisons difficult and imprecise. Acid detergent fiber and Neutral detergent fiber values range from 20% to 35% and 29% to 60%, respectively, when harvest prior to soft dough. Protein and relative feed values ranged from 8.0% to 15.9% and 85% to 158%, respectively.

*Climate-change Implications of U. S. U. Lidar Observations of the Mesophere*, **VINCENT B. WICKWAR, JOSHUA P. HERRON, and TROY A. WYNN** (Center for Atmospheric and Space Sciences, Utah State University, Logan, UT 84322-4405).

A Rayleigh-scatter lidar has been operated at the Atmospheric Lidar Observatory (ALO) at Utah State University (41.7° N) since August 1993. It provides accurate and precise temperature profiles between 45 and 90 km above the earth's surface, essentially from the stratopause, throughout the mesosphere, to the mesopause. Model calculations indicate that a build up of greenhouse gases should lead to significant cooling in much of this region. This should be manifest directly by temperatures decreasing over time. The ALO mesospheric data set, one of the longest in the world, might be able to show this trend. It is also predicted that cooling in the upper mesosphere at 80-85 km should lead to the occurrence of more noctilucent clouds (NLCs), alternately called polar mesospheric clouds, and to their occurrence equatorward of the polar regions. The dense ALO data set, with observations on most clear nights when the lidar is working properly, might detect NLCs. Prior to 1999, no reliable reports of NLC observations existed at latitudes below 50°. However in June of that year, we saw NLCs visually and with the ALO lidar, and upon reexamination, with the lidar in 1995. Any long-term temperature trend has to be reliably separated from the effects of periodic events such as the 11-year solar cycle and the annual and semiannual cycles, and from the effects of episodic events such as volcanic eruptions. We will discuss the long-term and NLC observations, and their interpretation in terms of climate change.

*Policies to Combat Global Warming,* **TOM M. L. WIGLEY** (National Center for Atmospheric Research, Boulder, CO 80307).

The primary basis for policies to respond to anthropogenic climate change is Article 2 of the U. N. Framework Convention on Climate Change, which states: "The ultimate objective of this Convention…(is to achieve)…stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." In principle, achieving this goal would stabilize the climate system within the limits of natural

variability. Article 2 and the concept of concentration stabilization, however, raise a number of questions:

- What is meant by 'dangerous interference'?
- What are the emissions requirements to achieve concentration stabilization?
- What is the role of $CO_2$ relative to the other greenhouse gases?
- How important are the other direct or indirect climate-forcing agents that are not specified directly in the Convention or its spin-off, the Kyoto Protocol (aerosols, reactive gases, etc.)?
- What should the stabilization target(s) be to avoid dangerous interference?
- Given that $CO_2$ is the most important greenhouse gas, what concentration pathway should we choose to reach $CO_2$ stabilization?
- How do we account for the multiple uncertainties involved?

This presentation will address these issues, using, where possible, a probabilistic approach.

*Placental Abnormalities Caused by Somatic Cell Nuclear Transfer,* **QUINTON A. WINGER** (Animal, Dairy and Veterinary Sciences Department, Center for Integrated Biosystems, Utah State University, Logan, UT 84322-4815; E-mail: qwinger@cc.usu.edu).

The number of different species cloned from somatic cell nuclear transfer continues to increase. However, the potential application of cloning in agriculture and for the advancement of medicine is still negatively effected by the low efficiency of the cloning process. A study investigating the rate of pregnancy loss in clones between days 30-90 determined an abortion rate of 82% of viable nuclear transfer fetuses during this period. This high rate is a consequence of abnormal placental development. During these first 90 days of development the cow fetus establishes a fetal-maternal connection through the formation of placentomes. In a large number of clones, placentome development is not normal and results in a placenta with reduced numbers of enlarged placentomes. This abnormality is highlighted by the fact that in cloned placentomes binucleate cells are detected at almost three fold higher levels in clones than in control placenta. This study investigates the possibility that these abnormalities are the result of aberrant gene expression caused by the incomplete reprogramming of somatic cells to a totipotent state. Genetic reprogramming of the somatic cell is necessary for embryonic development. The role of the insulin-like growth factor (IGF) family, and specifically IGF-II, a known imprinted gene with a proven role in the development of the placenta, will be the focus of this work. Research investigating the abnormal placental development is necessary to improve the efficiency of somatic cell nuclear transfer.

*Conditional Gene Targeting Strategies to Determine the Role of Transcription Factor AP-2γ during Pre- and Peri-Implantation Mouse Development,* **QUINTON A. WINGER[1,2] and TREVOR WILLIAMS[2]** ([1]Utah State University, Dept of Animal, Dairy and Veterinary Sciences, Logan, UT, 84322; [2]University of Colorado Health Sciences Center, Dept of Craniofacial Biology and Cellular & Developmental Biology, Denver, CO, 80262; E-mail: qwinger@cc.usu.edu).

Reproduction in all eutherian mammals is critically dependent on implantation and extraembryonic tissue formation. Several genes play key roles in regulating these two developmental processes. Embryos lacking AP-2γ die at around 7.5dpc due to aberrant extraembryonic lineages. This early lethal phenotype led us to investigate mRNA expression during preimplantation development and in cultured trophectoderm stem (TS) cells. AP-2α, AP-2γ and AP-2ε transcripts are present in the blastocyst and in TS cells. To further study AP-2γ we wanted to investigate the effect of the mutation in trophoblast cells and in the embryo. However, the embryos die and TS cells mutant for AP-2γ would not grow. Therefore, we needed a technique that would leave the AP-2γ expression intact and allow for conditional gene mutations. To accomplish this we have used the Cre/*loxP* recombination system and have generated a conditional AP-2γ allele in which the DNA binding domain has been flanked by *loxP* sites. We have analyzed our floxed allele in combination with several established Cre recombinase expressing strains. The ZP3-Cre is expressed in maturing oocytes and allows us to investigate maternal effect. TNAP-Cre is expressed in the primordial germ cells and the labyrinthine region of the placenta and allows the investigation of placenta defects. MORE-Cre is expressed in the epiblast and generates adult mice that lack AP-2γ, thus providing a system that can be used to study multiple processes both during development and in the adult. These specific conditional gene knock-outs have allowed us to characterize the important role of AP-2γ in the mouse.

*Estimating the Ages of* Alu *Insertions,* **DAVID J. WITHERSPOON, W. SCOTT WATKINS, MARK A. BATZER and LYNN B. JORDE** (Department of Human Genetics, Eccles Institute of Human Genetics, 15 North 2030 East, University of Utah, Salt Lake City, UT 84112; E-mail: david.witherspoon@utah.edu).

*Alu* elements are small (300 bp) repeated sequences that are created by retrotransposition events catalyzed by L1 retroelements. *Alu*s, numbering over one million, make up about 10% of the human genome. New *Alu* insertions are estimated to be created at a rate of 1 per 200 births. It has been hypothesized that the frequency and distribution of *Alu*s are affected by natural selection, and that *Alu*s, polymorphic or fixed, influence the local recombination rate. We set out to test these hypotheses using population genetic data and

analyses. Our sample consists of over 350 individuals from populations in Africa, Asia, and Europe. To date, we have genotyped 100 polymorphic *Alu* insertions in these individuals. For a sample of six *Alu*s that are not near any known expressed genes, we have genotyped 6 to 10 common SNPs within 20 kb of each insertion. These SNPs were ascertained on a representative subset of the worldwide population sample. Linkage disequilibrium analyses indicate that the polymorphic *Alu*s do not detectably suppress or enhance recombination. To test for selection, we compare the extent of linkage disequilibrium (LD) around each *Alu* insertion to its frequency in the population. Low-frequency *Alu* insertions are presumably more recent, and LD should extend further around them, while LD around higher-frequency, presumably older *Alu* insertions should not extend as far. Deviations from this expectation would indicate selection for or against *Alu* insertions; the lack of such a deviation would confirm their utility as neutral markers.

*EM-38 Calibration for Salinity Assessment in the Arkansas Valley*, **JAMES WITTLER** (Colorado State University, Soil and Crop Science Department, Ft. Collins, CO 80526; E-mail: james.wittler@colostate.edu).

The objective of this study was to develop a regional calibration between electrical conductivity (EC) values measured with the EM-38 probe (Geonics, Inc.) and saturated paste electrical conductivities ($EC_e$). The study region is located in the lower Arkansas River Basin, CO and is centered about Granada, CO. As soil $EC_e$ measurements are highly correlated to soil paste electrical conductivities ($EC_p$) (Rhoades et al., 1989), soil EC measurements were taken using a soil cup (SIW Kit, Hach Company, Inc.). At each randomly selected field site, an EM-38 reading was taken, followed by soil samples from the surface, 12", 24", 36", and 48" depths from the center, left, and right of the EM reading position. The field sites chosen have EC measurements ranging from one to eighteen dS/m and are also varied in texture and soil moisture content. Regression analysis of soil $EC_e$ against EM-38 values yielded an $r^2$ of 0.50. Multiple regression analysis, using particle size and moisture content as additional variables, improves the $r^2$ to 0.60.

*Change in XTH Activities, Cell Wall Extensibility and Hypocotyl Elongation of Soybean Seedlings at Low Water Potential,* **Y. WU[1], B. R. JEONG[2], S. C. FRY[3], and J. S. BOYER[2]** ([1]Utah State University, [2]University of Delaware, [3]University of Edinburgh; E-mail: yajun.wu@usu.edu).

In dark-grown soybean (Glycine max L. Merr.) seedlings, exposing the roots to water deficient vermiculite (water potential = -0.36 MPa) inhibited stem (hypocotyl) elongation. The inhibition was associated with decreased extensibility of the cell walls in the elongation region. A detailed spatial analysis showed xyloglucan endotransglycosylase hydrolase (XTH) activity on the basis of unit cell wall dry weight was decreased in the elongation region after seedlings were transplanted to low water potential. The decrease in XTH activity was at least partially due to an accumulation of cell wall mass. Since cell number was only slightly altered, wall mass had increased per cell and probably led to increased wall thickness and decreased cell wall extensibility. Alternatively, an increase in cell wall mass may represent a mechanism of regulating protein activity in cell walls, XTH in this case, and therefore cell wall extensibility. Stem elongation was partially recovered after seedlings were grown in low water potential vermiculate for about 80 h. The partial recovery of stem elongation was associated with a partial recovery of cell wall extensibility and an enhancement of XTH activity in the stem elongation zone. Our results indicate XTH may play an important role in regulating cell wall extensibility and thus cell elongation in soybean hypocotyls. Our results also showed an imperfect correlation of spatial elongation and XTH activity along the stems.

*Topographic Stratification of Soil Carbon and Nitrogen on a Palouse Hillslope*, **ALLYSON YOUNG and JODI JOHNSON-MAYNARD** (Soil and Land Resources, University of Idaho, Moscow, ID 83844-2339; E-mail: youn4170@uidaho.edu).

Significant soil variability found in topographically complex terrain may justify the costs associated with site-specific management of agro-ecosystems. Our objective was to predict soil-landscape relationships within a toposequence using hillslope characteristics and soil organic carbon and nitrogen measurements. A farmed hillslope was segmented into slope breaks represented by distinct summit, shoulder, backslope, footslope, and toeslope units. Soil samples were collected at three depth increments from eleven regularly-spaced transects that passed through the five units on both north- and south-facing aspects. The samples were analyzed for (total) organic carbon and nitrogen content. These values were interpolated using kriging methods in order to produce surface maps illustrating the pattern of carbon and nitrogen distribution. Total C concentrations ranged from between 0.43 and 3.87 %. Total N values ranged from 0.023 to 0.25 % across the study site. Lower values of total carbon and nitrogen were found on the south facing aspect and on divergent landscape positions while higher values were found on convergent units and on the north side of the hillslope. This trend was apparent at all three depths. The distribution of soil carbon and nitrogen was defined by readily recognizable landscape features, which can be managed within a precision agriculture framework.

*Salinity Tolerance of Four Ornamental Herbaceous Perennials*, **NICKOLEE ZOLLINGER** (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT 84322).

Although salinity is becoming an increasing concern for landscape plants in many areas of the West, few studies have

been carried out to evaluate salinity responses of ornamental herbaceous perennial plants. The objective of my research is to evaluate tolerance of several native and traditionally grown ornamental herbaceous perennials to soil salinity. I investigated growth, visual responses, and gas exchange (photosynthesis, conductance, and transpiration) of *Penstemon* (Palmer's penstemon), *Lavandula angustifolia* (Lavender), (James buckwheat), and *Echinacea purpurea* (Purple coneflower) at salinity levels of 0, 2, 5, and 8 dS/m. The study was carried out in a greenhouse under natural photoperiod and irradiance during an 8-week period. *E. purpurea* showed the lowest tolerance to salinity, as evidenced by substantial margin burn and growth reduction at all salinity levels. Growth and visual quality for *E. jamesii* were not significantly affected at the 2 dS/m level, but both were drastically reduced for the 5 and 8 dS/m treatments. *L. angustifolia* and *P. palmeri* showed very little margin burn and growth reduction at salinity levels up to 5 dS/m. However, for both species, a salinity level of 5 dS/m significantly lowered photosynthesis, conductance, and transpiration compared to the lower salinity levels.

*Drought Tolerance of Ornamental Herbaceous Perennials,* **NICKOLEE ZOLLINGER** (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT 84322).

Drought tolerance of herbaceous ornamental perennials for use in low water landscapes is not well defined. This study was carried out to investigate the responses of eight native and traditionally used perennial flower species to different levels of drought. 1-, 2-, and 3-week irrigation intervals were compared for *Coreopsis grandiflora* 'Early Sunrise' (Tickseed), *Echinacea purpurea* (Purple coneflower), *Gaillardia aristata* (Blanketflower), *Lavandula angustifolia* (Lavender), *Leucanthemum* x *superbum* 'Alaska' (Shasta daisy), *Penstemon barbatus praecox nanus* 'Rondo' (Penstemon), *Oenothera macrocarpa* 'Silverblade' (Evening primrose), and *Penstemon* x *mexicali* 'Red Rocks' (Red Rocks Penstemon) growing in a 10-gallon pot-in-pot system with confined root zones. In the summer of 2003, growth, gas exchange (photosynthesis, conductance, and transpiration), predawn water potential, and visual appearance (wilt, margin burn, and plant density) were measured over the growing season. Very few differences were seen in the treatments during the 2003 growing season due to initial variability in plant size. However, some visual differences were noted among the larger plants in the study, particularly for the *Leucanthemum* x *superbum* 'Alaska', which were badly wilted after 3 weeks without water. The study will continue through the 2004 growing season.

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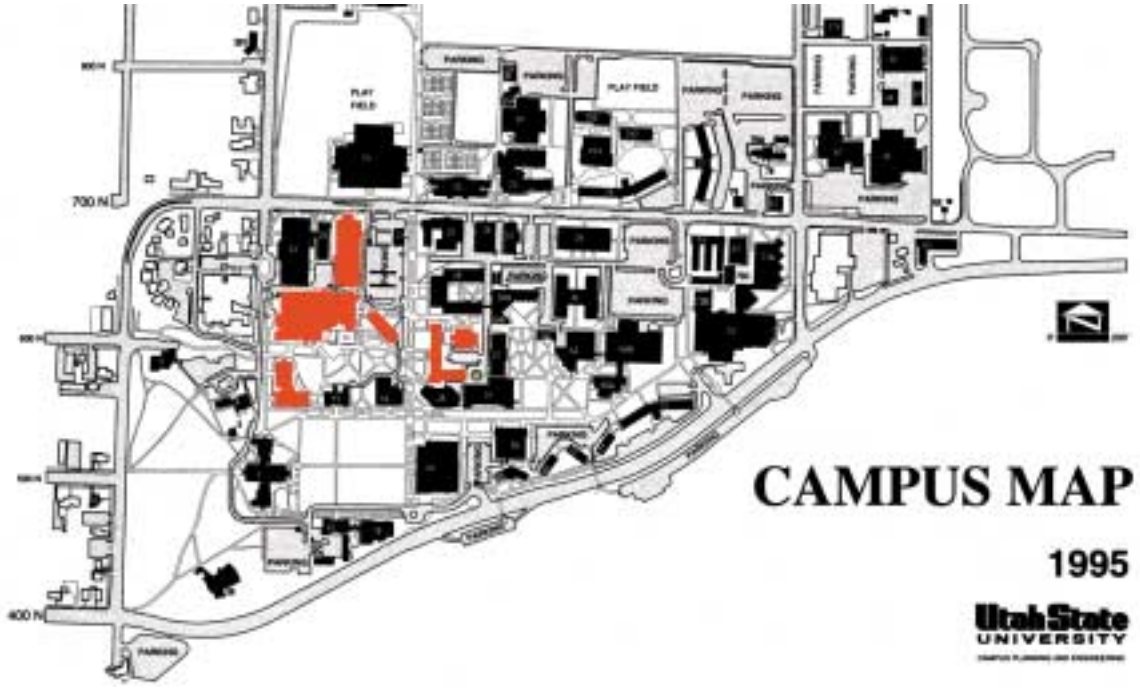
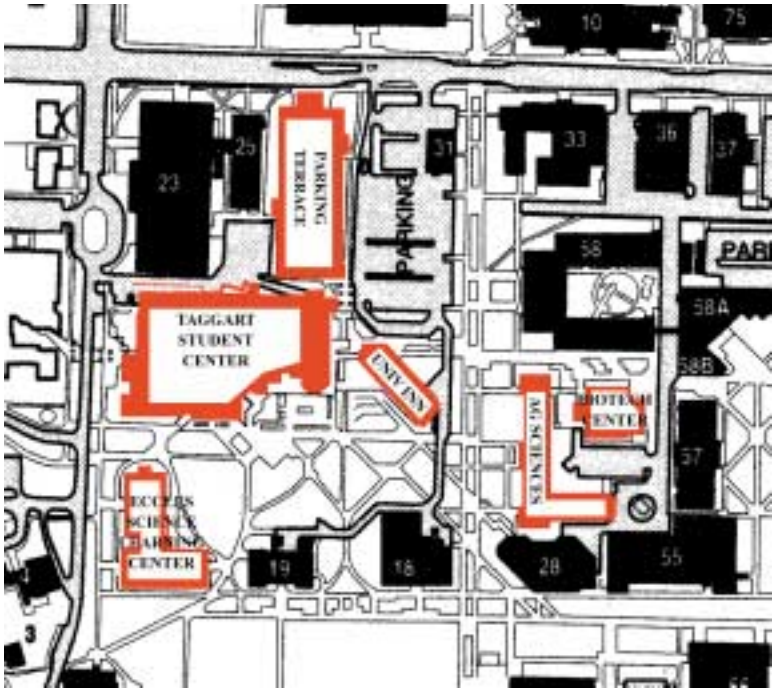



Utah State University map of upper campus. The campus is accessed from Highway 89 by turning left at 6th East (signal), then right at 6th North and left at 7th East (signal). The road winds to the right, becoming 7th North. The Parking Terrace in on the right about 1/2 block past the signal (8th East). Meeting buildings are colored in red. See map below for detail.




Detailed map of meeting buildings (highlighted in red). The Parking Terrace is at the top and is accessed from 7th North. Registration is in the Eccles Science Learning Center (lower left on map). Meeting rooms are in the Taggart Student Center, University Inn, Taggart Science Learning Center, and Agricultural Sciences (Ag Sciences). The Biotech Center is behind the Agricultural Sciences Building (lower right on the map).