Letter from the Dean

We are excited to be launching new efforts to coordinate education and outreach under the umbrella of UA Science and Biosphere 2. On April 3, the former Flandrau Planetarium on the University of Arizona (UA) campus was reopened as UA Science: Flandrau. A Tucson tradition since 1972, I envision that Flandrau will now emerge as a vibrant hub for education and public outreach activities and a portal to the cutting-edge science being done at the University of Arizona.

This new partnership makes it possible for Flandrau to reopen to the public and showcase UA Science facilities ranging from Biosphere 2 in Oracle to SkyCenter’s 24-inch telescope at the summit of Mt. Lemmon and the Steward Observatory Mirror Lab on the UA campus.

Biosphere 2 is acting as the springboard for these efforts. Education and outreach content will be developed for use across facilities to improve connections and learning experiences both within the UA and in the local community. Universities must do all they can to transmit knowledge to the public and spark the imagination of youth about what their future could hold. This new endeavor will push that concept forward in a synergistic way—one designed to engage a multitude of stakeholders.

Joaquin Ruiz
Dean, College of Science
Executive Dean, Colleges of Letters, Arts and Science

Conference Center Gains Popularity

The Biosphere 2 Conference center is having a busy season. Since opening in 2007, we have hosted nearly 200 conferences and workshops.

The Conference Center caters to a diverse group of entities. Some stay for a night or two and some for a full week. The reviews keep getting better on this unique and beautiful facility and our friendly and attentive staff makes sure your experience is a special one.

The Conference Center rates are very competitive and we can accommodate over 100 individuals for overnight stays and up to about 180 in a single meeting space.

If you’re looking for a unique location for your next conference or workshop, come experience our "open spaces and open minds" facility just 30 minutes north of Tucson.

For more information and to view a full listing of upcoming and past conferences, please visit: www.b2science.org/institute/conf.html or call the Conference Center Manager Val Kelly at 520.838.6154.
Solar Mines Prototyped

In search of viable locations for large-scale solar deployment, Biosphere 2 has partnered with Solarmax Arizona to pilot a novel approach to mounting photovoltaic (PV) solar panels on steep, unstable, slopes. This is the first known installation of rigid PV modules mounted to geosynthetic membranes commonly used to cover mine tailings and landfills.

Nationwide approximately six million acres are utilized by the mining industry. Much of this land is simply used to build colossal piles of crushed waste rock. Conventional solar field mounting systems wouldn’t stand a chance on these 30-degree slopes of rock powder with high velocity, caustic dust blowing around.

However, mines’ existing electrical infrastructure, remote location, and vast expanse of already disturbed land, clear the common hurdles of transmission and NEPA permitting of most other solar sites.

Last fall, Biosphere 2 decided to experiment with novel mounting systems by using PV panels donated by the SOLON Corporation (Tucson, AZ) and an existing berm made of fill dirt as a model tailings pile.

The Solarmax prototypes utilize geosynthetic membranes that cover the entire slope creating a barrier between the PV system and the harsh properties of the tailings. The Biosphere 2 pilot mounts CIGS PV panels across two membranes using three different mounting systems. A standard ground mount system will act as the control for UA researchers to compare panel performance across the various mounting systems by monitoring variations in temperature and irradiance.

The demonstrated viability of PV mounted geosynthetic membranes opens the door for applications such as: commercial roofing, methane capture from landfills, evaporation reduction in water storage facilities, and pollution mitigation. This integrated services approach to solar energy could significantly help the bottom line of large-scale solar distribution in the U.S.

2010-2011 Science and Society Fellows Announced!

Initiated in 2008, The University of Arizona Biosphere 2 Science and Society Fellows Program was created for UA graduate students doing research in the areas of ecology, earth, and environmental sciences. The goals of the program are to increase the skills of the Fellows in communicating their research outside an academic setting through public outreach events, blogs, and displays; and to advance the understanding of scientific information and the scientific process by members of the general public. Research areas for the new fellows include researching information flow pathways in ant colonies, leaf venation and plant function, biodiversity, phenology, forest ecology, flooding and weather patterns of the Tucson basin, and understanding the disturbance patterns in the Pinñaleno Mountains.
A Pairing of Music and Stars

On Saturday, February 20, B2 visitors were treated to a series of events that combined the wonder and inspiration of the stars with the mesmerizing sounds of new music.

In the B2 Exhibition Hall, pianist Ji-Young Kim’s performance of Alexina Louie’s “I Leap through the Sky with Stars” accompanied the extraordinary images of the night sky photographed by Dr. Richard Powell, UA Professor Emeritus and formerly Vice President for Research. An avid amateur astronomer, he presented an overview of the world above us entitled “Looking Beyond the Sky.”

The internationally recognized piano duo Gastesi-Bezerra performed Terry W. Owens’ mysteriously hypnotic musical of the story of Ariadne’s Crown as a prelude to a presentation on indigenous astronomy traditions by Dr. Jarita Holbrook, a past chair of the Cultural Astronomy & Storytelling Group for the United States and a research scientist at the University of Arizona.

The roar of a specially installed large digital organ filled not only the Habitat Plaza but all the spaces above and around it as organist-composer Matthew Whitehouse guided listeners on a musical journey through the mysterious sequence of events marking the birth of a star in his piece “NEBULAE.” Members of the audience matched sounds with pictures of the various stages of star formation in this opportunity to not only experience a new work, but to hear how a composer constructs a piece.

Visitors under the Dome were treated to the gentle echo of music by Eric Ryan Costenbader in the Lung; meanwhile the Desert rang with two performances of “Voyager” by Richard McCandless, a piece inspired by the two spacecraft launched by NASA in the mid-1970s. Finally, percussionist Stephen Tipping’s evocative sounds set the stage for thoughtful concluding remarks by astronomer Dr. Casey Meakin on man’s relationship with the Earth, the first Biosphere.

Funding of Arizona Center for STEM Teachers Continues

Arizona Center for STEM (science, technology, engineering and mathematics) Teachers (ACST) completed its first full year of operations with the conclusion of a short course on optics in October. Earlier this spring, after a full program review, Science Foundation Arizona (SFAz) signaled its approval of the work done by ACST by authorizing continued funding for the second of the three-year program. The SFAz funding is matched dollar for dollar by the Philecology Foundation.

“We are very pleased to be able to continue this exciting program,” said Pierre Meystre, Director of the B2 Institute and Principal Investigator on the grant, “especially when considering the challenging current financial situation of the State of Arizona and of SFAz.”

ACST is unique from most other teacher professional development programs in that an essential feature is the role played by veteran teachers in developing and enabling statewide teacher professional development.

“It is imperative that teachers gain the most up-to-date content knowledge in the science fields so that we can teach our students what they need to know to be successful in the 21st century. The ACST is unique in that it gives teachers not only current content knowledge, but also new ways of teaching those concepts. It’s been wonderful to be able to provide the resources, the unique facilities here at Biosphere 2, and the support of research and science professionals to our Arizona teachers. I am excited for the changes happening in STEM education, and for my fellow teachers and colleagues around the state of Arizona,” said Briana Gryzynger, first grade teacher and Chair, ACST Education Committee.

The next short course being offered by ACST will take place April 23-25 at Biosphere 2 on the topic of Earth Systems Synergy. Experts in a variety of fields from around the country will present sessions to 60 K-12 teachers from all over Arizona. “Our short course will help teachers examine new ways to inter-relate the study of the varying systems here on Earth, and to make integrated connections between the different science fields like Biology, Chemistry, and Earth Science,” stated Gryzynger.
Botanist Ty Taylor grew up in sub-arctic Fairbanks, Alaska, and so naturally developed an affinity for the tropics to avoid portions of the cold, dark winters. He began studying tropical biology in Costa Rica as an undergrad while at Evergreen State College in Olympia, Washington. After graduation he continued to study tropical plant systematics and to research epiphytes in the canopy in Costa Rica. He was invited to Biosphere 2 to conduct a survey of plants in the tropical rainforest.

Why Do We Need to Survey the Plants in the Rainforest?

Although a list and even maps exist of all of the species originally planted in Biosphere 2, many have died off over time. The basic purpose of the current survey was to find out what is left.

During the initial planting phases in 1991 and 1993, 366 plant species were introduced into the Biosphere 2 rainforest. Despite the 1993 restocking and additions, the total species count fell precipitously to 157 by 1996—a 58% loss. After that, species loss-rate decreased substantially despite management changes and drought experiments. There are currently 90 species in the rainforest—25% of the original count (see chart, top right).

The current species assemblage represents all major phylogenetic (evolutionary) groups. The ferns and cycads (ancient seed plants existing before the dinosaurs) experienced the most rapid initial decline and are now each only represented by one individual plant. The one remaining cycad, *Zamia fischeri*, happens to be an endangered species, according to the IUCN Red List of Threatened Species (see photo, right). This ancient species is known only from a small area in Mexico, and its population is currently diminishing.

Similar to many tropical forests, the Pea family (*Fabaceae*) is the most abundant and species-rich tree group. With early species die-offs, the canopy never fully developed to create a well-shaded understory. It appears that only two tree species are successfully “recruiting”, or contributing new individuals to the forest by viable seeds: one is a pea, *Leucaena sp.*; the other is in the family *Malvaceae, Pachira aquatica*.

The herbs are dominated by the viny, shade-tolerant family *Araeaceae* (particularly *Scindapsis aureus*) and the order of plants that specialize in growing quickly in light-gaps, the *Zingiberales* (e.g., ginger, banana, heliconia, and allies). There are two nuisance vines, morning glory and cissus (in the grape family *Vitaceae*), which without pruning grow to cover the space frame and actually prevent a substantial amount of light from hitting the leaves of other plants in the forest.

Under the tutelage of Matej Durcik, Taylor is using a Geographic Information System, Arc-GIS, to generate a 3D map of the rainforest, including all plants, instrumentation, and experiment locations. This synthesized visual interface promises to enhance tracking of research over time, and increase complementarity among research projects. For example, by mapping the locations...
of soil samples, future samples can be taken at the same places to monitor changes. If somebody wants to study contributions of fallen leaves to soil nutrient dynamics, they can see where nutrient analyses have been done before, and then choose a tree whose litterfall would have contributed to the nutrients of those previous samples (see figure, right).

The plant census allows researchers to create informed sample designs for any experiments in the rainforest. For example, some functional traits of plants, such as the emission of different volatile organic compounds (studies by Kolby Jardine), may be constrained to particular phylogenetic (evolutionary) groups, such as a particular order, family, or genus. By knowing where our plants occur on the phylogenetic tree, we can design our sampling plan to detect these patterns. Next on Taylor’s list is to take measurements of tree diameter and tree height, and to map the tree crowns and total canopy cover. These measurements will serve as a baseline for monitoring changes during an upcoming drought experiment.

Snow Days and SkyNights

Snow isn’t what comes to mind for visitors to Tucson, but the El Niño weather pattern this year has produced storms which dropped record amounts on the summits surrounding the city. Yet even under the 206 inches of snow that fell from December through March, SkyCenter, Biosphere 2’s partner on Mt. Lemmon, continued its SkyNights programs and managed to host a high school group of sixteen from Colorado for a four-day stay.

Over the winter months, SkyCenter has also been working with the University of Arizona Astronomy Club to reach out to the local community and school children in Houston, Texas. The Astronomy Club has held Star Parties at Sabino Canyon on the first Saturday of each month since October; these will continue through May. Astronomy Club students have a monthly question-and-answer session via Skype with the Houston elementary school students, who ask surprisingly detailed questions.

For more information about programs, visit the website, skycenter.arizona.edu or call 520-626-8122.
The workshop was hosted by the Smithsonian Institute’s National Museum of Natural History. The workshop brought together established and leading young scientists working in geology, geomorphology, biogeochemistry, hydrology, soil science, plant ecology, and microbiology. The goal of the workshop was to discuss hot topics that should be investigated within a 10-year research timeframe in the area of critical zone science, such as climate-biota effects on weathering; ecosystem-nutrient interactions; human impacts on weathering; interrelationships among chemical, biological and physical weathering; geochemical mechanisms of weathering through the micro- and macro-biota; and rates of biological soil turnover and mixing. This is the second workshop sponsored by NSF to bring together scientists working in Critical Zone Science. Participants focused on complex ecosystem interactions between landscapes and biota and their response to changing environment.

The workshop participants produced a manuscript titled “Thirteen Hypotheses to Test How Biology, Weathering and Erosion Interact within the Critical Zone” that formulates the questions that Critical Zone Science needs to address in the next decade. The manuscript has been submitted for publication to *Geobiology*. The manuscript states the need for well-designed physical experiments and coupled numerical models that integrate biogeochemical and hydrological processes, and presents the new experiments being set up at Biosphere 2 as example of the type of research that needs to be done.

The workshop was attended by representatives of multiple funding agencies including NSF, NASA, USDA, DOE, US Geological Survey, and the National Academies to facilitate interaction between scientists and research funding administrators and discuss directions of future research. NSF program directors for the ecosystem science, hydrologic science, education and human resources, long term-ecological research and ecosystem sciences (responsible for NEON sites), and the geobiology and low-temperature geochemistry programs were present at the meeting.
Creative Science Writing Intern Chosen

Biosphere 2 announced the selection of its second Biosphere 2 (B2) Creative Science Writing Intern, Glen Grunberger. Glen is a first-year student in the UA graduate Creative Writing program and comes to the program after—mostly—practicing law for 20 years. In the 1990s he became one of Texas’s first full-time environmental crimes prosecutors, and in the spring of 2000 was named by Texas Attorney General (now U.S. Senator) John Cornyn as one of four pioneers of environmental crimes prosecution in Texas. Glen did not attend the ceremony to receive that honor, however, because by that time he was living San Miguel de Allende, Mexico where he had moved to pursue his writing. He lived in Mexico for two years where he also studied Spanish and acted in English-speaking community theater. Over the past ten years, he has maintained a significant pro-bono and reduced-rate caseload in areas as diverse as immigration, criminal, and family law and continues to serve as attorney and agent for a nonprofit corporation dedicated to preservation of Native American spiritual ways. This past summer, he moved from Texas to Tucson with his wife Sara, who teaches biology at Cholla High School, and their dog, Maya, who teaches them both how to be human. Glen has already been exploring B2 and interviewing scientists and staff—we cannot wait to see how Biosphere 2 inspires his creative writing! Follow Glen’s progress at his blog: http://b2mfawriting.blogspot.com.

The B2 Creative Science Writing Internship is for UA Creative Writing MFA students in poetry, fiction, and creative nonfiction. The goals of the program are to: (1) increase the intern’s knowledge of the scientific process and research conducted at B2; (2) improve the student’s research skills, as well as her/his skills in constructing engaging forms and narratives for the presentation of scientific research; and (3) disseminate understanding of science and B2 to a wider audience. The program is run during the spring and fall semesters and is administered by faculty from B2 (Dr. Mitchell Pavao-Zuckerman) and the UA Creative Writing Program (Fenton Johnson and Alison Demming).
Katerina Dontsova Featured in Earth Magazine

Assistant Research Professor, Katerina Dontsova will be featured in Earth Magazine in an article titled “Down to Earth” with Katerina Dontsova. The article discusses the Earth Surface Experimental Facility (ESEF) that is being constructed at Biosphere 2, and the opportunities for research and unique challenges that it presents. The article is scheduled to appear in the June 2010 issue!

In March, she was interviewed by Brian Johnson of the Earth magazine, a publication of the American Geological Institute. He also asked about her personal experiences working at Biosphere 2 and about a career path of soil scientist.

How You Can Help

Biosphere 2’s cutting-edge work depends on people who care about our environment and the science that helps us make informed choices. We hope you will consider becoming involved in any of the following ways.

1. Learn more about the many research projects taking place under the dome. You can see some of our ongoing research through our live webcam.

2. Take a tour of Biosphere 2. We are open every day from 9:00 to 4:00 except Thanksgiving and Christmas. Tours last approximately one hour and take you through the human habitat area where Biospherians lived and through each of the biomes. You will also have a chance to meet and talk with research scientists working onsite.

3. Become a member. There are many different levels of membership that provide benefits for you and support our work.

4. Attend a Science Saturday for a hands-on experience in science! Learn about bird species in the Southwest through an on-site birding tour, gain a new appreciation for insects and handle live ones, or participate in physics activities and demonstrations that show how water moves through urban environments.

5. Make a donation. Any gift is appreciated and can be designated to the Biosphere 2 activity or research project that matters most to you.

For more information on any of the above, visit our website: www.B2science.org.