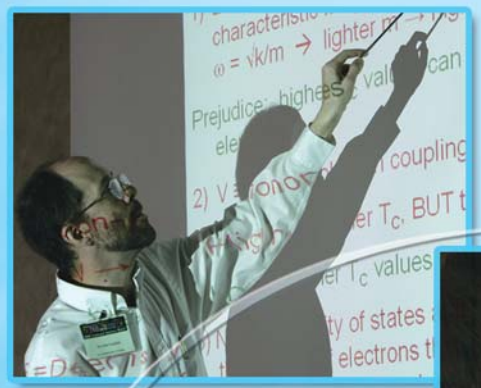
U.S. Department of Energy
National Science Bowl®

SCIENCE DAY PROGRAM

2009

May 2, 2009
Washington, D.C.



Pictured above (clockwise from top left): Dr. Paul Canfield talks about the physics behind discovering new compounds for novel materials. Dr. Wendy Gunther discusses using science in forensic pathology. High school teams work on solving problems during the Division Team Challenge.

SEMINARS BY TIMES AND LOCATIONS

ROOM	SEMINAR	PAGE
SEMINAR I: 9:00–10:15 a.m.		
Aiton Auditorium	*Harry Particle and the Chamber of Mesons* – Dr. Helio Takai	3
SEMINAR II: 10:30–11:45 a.m.		
Missouri Room	*Blood, Camera, Action* – Dr. David P. Baldwin	4
Ohio Room	*Physics is Phun* – Wayne Bird	5
America Room	*The Scientific Revolution* – Trevor Danos	6
Iowa Room	*Bacterial Organelles and Termite Hindguts* – Dr. Cheryl A. Kerfeld	7
Aiton Auditorium	*Big Numbers in Small Spaces* – Dr. Joel R. Stiles	8
Colorado Room	*Hands-On Activities:* *Work and Power, Go-Far Cars, Spaghetti Structures*	9
SEMINAR III: 1:15–2:30 p.m.		
Missouri Room	*Blood, Camera, Action* – Dr. David P. Baldwin	4
Ohio Room	*Physics is Phun* – Wayne Bird	5
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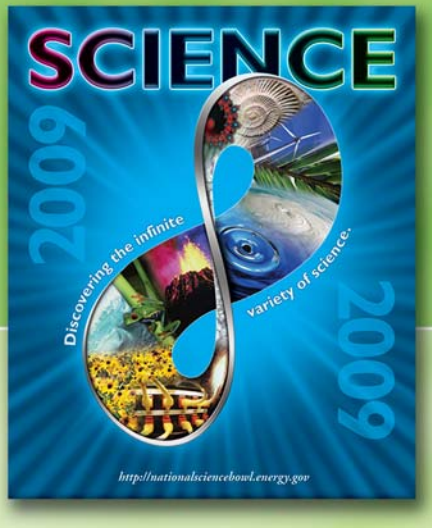
discovering science . . .



with Science Day Seminars!

Seminars –

All participants will enjoy the plenary session in the Aiton Auditorium for Seminar I. For Seminars II and III, students can choose to attend the session that interests them the most. Make sure to get to the sessions on time as the seats fill up fast! Most of the speakers are presenting during both sessions, so once all of the seats are filled in a room, participants will be asked to attend a different presentation for that seminar block.

Hands-On Activities –

Only students can participate in the Hands-On Activities in the Colorado Room for Seminars II and III. An entire team does not have to partake in the activities and students from different teams are invited to work collaboratively.

HARRY PARTICLE AND THE CHAMBER OF MESONS:

A Journey through Particle Physics

DR. HELIO TAKAI

Plenary Session
Aiton Auditorium

9:00–10:15 a.m.

The field of particle physics has history, intrigue, and goes places. Through the years, the development of particle physics led to the exploration of the frontiers of our knowledge and the structure of matter. From atoms to fundamental particles, we have evolved today to a place in time where we explore the basic building blocks of matter, fulfilling what was once dreamt by Greek philosophers. Particles are found everywhere, in nature and also in accelerators. Both give us hints of how the universe is evolving. Particle physics contributed extensively to the incredible technological development that we experienced in the past century, helping other sciences and society in general. We discuss briefly the history of particle physics, its place in physical sciences, and its connections to other fields of research. Fundamental science will be explored in the coming years in accelerator-based experiments and new opportunities are opening through the detection of naturally occurring ultra high energy cosmic rays.

Dr. Helio Takai is a particle physicist at Brookhaven National Laboratory. He was born in Brazil and today lives on Long Island, New York. He has a Ph.D. in nuclear physics and is a member of the ATLAS experiment at the Large Hadron Collider at the European Organization for Nuclear Research in Geneva, Switzerland. He developed the concept for the MARIACHI project. In the MARIACHI experiment, scientists, teachers, and students come together to explore the ultimate frontier in astrophysics: ultra high energy cosmic rays and beyond. He is interested in particle physics, relativistic heavy ion physics, astrophysics, and education and outreach in physics. He is a science fiction enthusiast, having appeared in conventions, and enjoys demonstrating how simple the basic concepts of physics really are.

BLOOD, CAMERA, ACTION:

Investigating Bloodstain Pattern Generation Using High-speed Video

DR. DAVID P. BALDWIN

Missouri Room

10:30–11:45 a.m.
1:15–2:30 p.m.

In many violent crimes, bloodstain evidence is left at the scene. That evidence may be used to reconstruct some of the details of what occurred during and after the bloodletting event. Reconstructing those events may be difficult due to the lack of good substitute materials for human blood and living tissue and by the speed at which the blood is deposited on surfaces. Using high-speed digital photography, we have begun to illuminate some of the effects that occur during blood spatter events to aid in their interpretation.

Dr. David P. Baldwin is the director of the Midwest Forensics Resource Center at Ames Laboratory. The MFRC works in partnership with public crime laboratories to provide casework assistance, education, training, research, and technical innovation in management and infrastructure. He received a B.S. degree in chemistry from Lebanon Valley College and a Ph.D. degree in physical chemistry from the Massachusetts Institute of Technology. He was a postdoctoral associate at the Combustion Research Facility at Sandia National Laboratories in Livermore, California. As a program director at Ames Laboratory, his research has centered on the development of novel instrumentation and techniques for analytical measurements in environmental, forensic science, and nuclear nonproliferation applications. Key research areas include the development of compact robust spectrometers for field applications, multivariate statistical methods for spectral and spatial imaging, and laser ablation sampling methods. Dr. Baldwin is an Advisory Board Member of the Iowa Internet Crimes against Children Taskforce and Chair of the Scientific Working Group on Bloodstain Pattern Analysis (SWGSTAIN).

PHYSICS IS PHUN

(Translation – Really Weird Science)

WAYNE BIRD

Ohio Room

10:30–11:45 a.m.

1:15–2:30 p.m.

Thought you knew everything? You are right, you do. Now come find out ways to use and abuse that info. Join us for really strange examples of physics gone wrong. We will shrink wrap a couple of volunteers just before we mummify them. Find out how the Flaming Wheel of Death works. Watch as the Blob monster comes to life (suggestion, please watch the old Steve McQueen version before coming). Explore why your brain is trying to trick you ALL the time or "What you see is not what is there," when a wall of squares turns into a frog or was that a horse, no it was a horse frog, no, no it was two frogs, or was it two horses, AAAHHHHHHH. I broke my brain again. "Then all the kids brains were changed beyond imagination and they ascended to a higher plane of being" (I wonder how long it will be before the parents notice) and more. I told you this was WEIRD SCIENCE.

Wayne "Skip" Bird is presently the Treasurer/Observatory Director (building it now)/Night Sky Network Guru for the Westminster Astronomical Society, and outreach fanatic (definition of fanatic: someone who will not change his mind AND will not change the subject). He is also an Education Assistant for the American Astronomical Society and a teacher for astronomy and physics with the 21st Century Community Learning Center and South Carroll Covenant Keepers Home School Association. He is the world renowned author of "Night Flying Astronomy Bird" articles (OK, maybe world renowned is being a little modest), and the World's Greatest Dad — he has the button to prove it.

THE SCIENTIFIC REVOLUTION:

From Copernicus to Galileo to Newton, and Beyond

TREVOR DANOS

America Room

10:30–11:45 a.m.

1:15–2:30 p.m.

2009 is a remarkable year for science. We celebrate the 400th anniversary of Galileo's first use of the telescope, the 200th anniversary of the birth of Darwin (on the same day as Abraham Lincoln), the 150th anniversary of the publication of Darwin's 'On the Origin of Species' and the 40th anniversary of the Apollo 11 Moon landing. These anniversaries remind us that modern culture is a culture of science, though science and culture were not always like that. At one time, the word 'scientist' did not exist and science was more akin to magic. During the sixteenth and seventeenth centuries, in a period spanning a little over 150 years, Western knowledge acquired the characteristics of modern science. This was the period of the 'scientific revolution.' It is arguably one of the most important episodes in the history of science and one of the most interesting stages in human intellectual history. It has been described as the real origin of the modern world and of the modern mentality. Knowing about the lives and times of great scientists like Galileo and Newton can help us to have a better understanding about contemporary science and how we might solve some of our generation's scientific challenges.

Trevor Danos has degrees in economics and law from the University of Sydney. He has practiced as an attorney since 1981. His areas of specialization are project finance, aviation finance, and government procurement. Around 2000, after seeing the movie 'October Sky,' he was inspired to resume formal studies in physics and math and is now completing an undergraduate science degree. He is president of the Science Foundation for Physics at the University of Sydney. The Foundation, which is Australia's oldest science foundation, runs an international science school for senior high school students and workshops for science teachers, as well as funding research and hosting science outreach activities. Trevor is also deputy chair of the Human Research Ethics Committee at the University of Sydney. He sits on the selection committee for the New South Wales Scientist of the Year awards. His hobbies include reading (mainly science and U.S. Revolutionary and Civil War history) and walking his beagle.

BACTERIAL ORGANELLES AND TERMITE HINDGUTS:

Bioinformatic Explorations of Genomes and Metagenomes

DR. CHERYL A. KERFELD

Iowa Room

10:30–11:45 a.m.

1:15–2:30 p.m.

Genomics and bioinformatics have revolutionized life sciences research, enabling scientists to explore in new ways such remote environments as the interior of bacterial organelles and the digestive system of termites. The power of DNA sequencing and sequence comparison allows scientists to study many genes simultaneously to address a range of questions from the evolution of a single protein to the evolution of a species. Cheryl will describe two of the most exciting advances made possible by (meta)genomics research: the discovery of a diversity of bacterial organelles, which promise to be useful for removing carbon dioxide from the atmosphere, and metagenomics surveys of the termite hindgut. Characterizing the organisms living there will help scientist develop new ways to turn plants into biofuels based on the way the bacteria living in the termite gut turn a house into sawdust.

Cheryl Kerfeld is head of the Structural Genomics and Education Programs at the Department of Energy's Joint Genome Institute. She is also an adjunct professor in the Department of Plant and Microbial Biology at the University of California at Berkeley. As an undergraduate, Cheryl majored in biology and English at the University of Minnesota. After graduating, she spent a few years in career indecision at the University of Minnesota, working as a junior scientist in the Department of Microbiology while completing a Master's degree in English literature. Eventually, the study of bacteria won out over the study of Romantic poetry as a vocation and she moved to California to earn her Ph.D. in biology at UCLA. Despite being a professional scientist Cheryl remains active in writing and making art; her collaborative works have appeared in museum and media arts galleries.

BIG NUMBERS IN SMALL SPACES:

Using Supercomputers to Understand Atoms, Molecules, and How Cells Work

DR. JOEL R. STILES

Aiton Auditorium

10:30–11:45 a.m.

1:15–2:30 p.m.

One nanometer is one billionth of a meter, and yet a cubic nanometer is big enough to hold about 33 water molecules. A red blood cell is about seven microns (seven millionths of a meter) in diameter, and yet is big enough to hold about three trillion water molecules! All told, the human body contains about 7×10^{27} atoms, organized into water, fat, protein, and other molecules that operate over vast ranges of space and time, from Angstroms (one-tenth of a nanometer) to meters, and from femtoseconds (10^{-15} seconds) to days, weeks, or even years. How can supercomputers and 3-D computer visualization help us understand how molecules work in cells, how cells work in tissues, and how tissues work in the entire body? I will illustrate current issues and answers in state-of-the-art biomedical supercomputing, using research software focused on molecules and cells, as well as cutting-edge 3-D visualizations that blur the line between Hollywood-style "science fiction" and "science fact" as we presently know it.

Joel R. Stiles, M.D., Ph.D., is Director of the National Resource for Biomedical Supercomputing (NRBSC; www.nrbsc.org) at the Pittsburgh Supercomputing Center (PSC). He holds faculty appointments in the Department of Biology and Lane Center for Computational Biology at Carnegie Mellon University, as well as the Departments of Neuroscience and Computational Cell Biology at the University of Pittsburgh. Dr. Stiles is perhaps best described as a computational physiologist, with general research interests in cell and tissue modeling applied to personalized medicine, and current specific interests in synaptic and cellular microphysiology. His work includes creation and distribution of research and teaching software for spatially realistic simulations of cellular function, and has illustrated counter-intuitive structure-function relationships at the nerve-muscle synapse and in specific instances of neuromuscular disease. He is a principal co-author of MCell, a Monte Carlo simulator of cellular microphysiology, and is also the principal architect of DReAMM (Design, Render, and Animate MCell Models). Dr. Stiles also directs educational outreach activities from K-12 through graduate levels at the NRBSC and PSC.

HANDS-ON ACTIVITIES

(Students Only)

Colorado Room

10:30–11:45 a.m.

1:15–2:30 p.m.

Work and Power –

Build the best machine that operates solely on wind power you provide.

Go-Far Cars –

Predict how far a model car will go off a ramp at a given height.

Spaghetti Structures –

Build a sturdy structure out of uncooked spaghetti.

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