



## **DR. BOB FIELD**

Cal Poly adjunct physics professor and research scholar in residence

Morro Bay State Park Museum of Natural History docent

Author of numerous unpublished works in the Cal Poly Digital Commons

Retired physicist specializing in advanced optical systems and components for aerospace applications

Email: [rfield@calpoly.edu](mailto:rfield@calpoly.edu)

Website: [web.calpoly.edu/~rfield](http://web.calpoly.edu/~rfield)

I earned my BS in physics in 1970 from Case Western Reserve University and my MS and PhD in physics from the University of Illinois in 1972 and 1978, respectively. My experimental solid state physics PhD thesis required me to design and build several state-of-the-art spectroscopic instruments to acquire the data necessary to determine the nature of several advanced materials. My twenty year career as an aerospace scientist emphasized the design and development of high energy laser optical systems and components, primarily for space-based, ground-based, airborne, and ocean-related military applications.

I worked at Rocketdyne for ten years on advanced laser projects doing systems analysis and designing high energy laser optical, electro-optical, and opto-mechanical systems. As a senior scientist at Schafer Corporation for ten years, I designed very low absorption optical coatings and evaluated advanced coating technologies for uncooled high energy laser optics, for large laser beam director primary mirrors, and for broadband and multi-band surveillance system optics. My optics experience ranges from the ultraviolet to the far infrared and includes hands-on design, construction, assembly and operation of advanced instrumentation and developing and exercising applied math models.

I retired in 1998 and applied my background in physics, optics, and systems analysis to my interests in natural science and natural history. I became a docent in the state parks, preparing and presenting PowerPoint programs at the Morro Bay State Park Natural History Museum.

I supervise natural science student projects at Cal Poly where I have volunteer appointments as an adjunct physics professor and a research scholar in residence. I maintain a website at [web.calpoly.edu/~rfield](http://web.calpoly.edu/~rfield) that includes numerous original educational articles and resources related to my science and natural history projects. I create posters for display at Cal Poly and at the Morro Bay State Park Natural History Museum. I have created and presented fifteen 90-minute slide shows on global natural science, presented occasionally at the Museum, Cal Poly, and other local venues. I have developed evolution walks in the Leaning Pine Arboretum, on the bluff in Montana de Oro State Park, at Pismo State Beach, in the Elfin Forest, and in the museum. My programs are aimed to challenge a general audience interested in natural history or high school and college students and educators. I am the author of numerous unpublished works which I am in the process of archiving in the Cal Poly Digital Commons.

### **PRIMARY RESEARCH EMPHASIS: GLOBAL EVOLUTION STUDIES**

I study the structure, composition, flows of energy and matter, and evolution of the Sun, solid Earth, hydrosphere, atmosphere, and biosphere. As an adjunct physics professor at Cal Poly since 2001, I have developed simple math models of complex systems and I have supervised fifteen student projects in physics and biology. I have analyzed solar evolution with a code donated by Los Alamos National Lab. I developed and taught an advanced physics course PHYS470 in Solar and Global Evolution. I have prepared and presented several colloquia and scholars talks on campus and I have worked with the library, Osher Institute, Central Coast Science Project, and Center for Excellence in Science and Mathematics. As a California state park docent since 1998, I devoted 5000 hours to developing and conducting informal science education programs for the general public and youth audiences, including fifteen animated PowerPoint slide shows, several temporary natural history museum poster displays, and four nature walks that highlight global evolutionary themes for the

museum and for general and youth audiences. I previously served on a Central Coast Natural History Association educational liaison committee and on the state park walk docent committee.

The structure and evolution of the OASES (oceans, atmosphere, solid Earth, and Sun) and the biosphere (molecules, cells, organisms, and ecosystems) depend on interactions of energy and matter. The origin, evolution, diversity, abundance, and distribution of life depend on the natural formation of complex materials and processes from simple building blocks when energy flows in the OASES and the biosphere. The Natural History of Planet Earth is the product of nearly five billion years of global evolutionary processes that followed the first nine billion years of cosmic evolution. I am developing indoor and outdoor science education programs for youth and for the adults that influence them by applying Dr. Sam Ham's principles of thematic interpretation to the greatest story rarely told: the remarkable four billion year sequence of physical and biological events that preceded the Cambrian Explosion. My current research interests include the following:

1. **Collaborate with students, volunteers, educators, and other professionals on global evolution projects.**
2. **Develop a global evolution website that highlights the five billion year natural history of planet Earth.**
3. **Develop "simple" math models of complex natural systems including the OASES and the biosphere.**
4. **Develop poster exhibits and programs based on global evolution themes.**

### **RELATED PROFESSIONAL ACTIVITIES**

I have been an adjunct physics professor at Cal Poly since 2001. I have spent countless hours developing simple math models of complex systems and working with students and faculty in physics, biology, chemistry, and education. I have supervised fifteen student projects (four senior projects, eight summer research students, plus PHYS200, PHYS400, GEOL400, and BIOL400 special problems) in optics, atmospheric physics, optical oceanography, geophysics, solar astrophysics, and natural history. I developed and taught an advanced physics course PHYS470 Solar and Global Evolution that included analyses produced by a solar evolution code donated by Los Alamos National Lab as well as my simple math models of the oceans, atmosphere, and solid Earth.

I created the Ocean Science Quest tabloid newspaper posters currently on display in Fisher Hall as part of a larger six-week exhibit for the Kennedy Library in conjunction with an Osher Institute course that I taught in 2003. I have given three physics colloquia and I have conducted teacher workshops for the Central Coast Science Project (CCSP) and prepared proposals to advance the missions of the Center for Excellence in Science and Mathematics (CESAME) and the Center for Coastal Marine Science (CCMS). Recently, I recruited scientists and educators and prepared several proposals to develop informal science education programs. I created another poster display called "Darwin in the Garden" for the Kennedy Library and Fisher Hall and a walk in the Leaning Pine Arboretum for the Darwin Bicentennial. I have given numerous physics colloquia and several research scholars talks in the library. I am currently developing a global evolution website and related educational resources.

### **NATURAL SCIENCE AND NATURAL HISTORY PROGRAMS**

#### **Books and Courses**

Fall 2006: Solar and Global Evolution Physics 470 course slides etc

July 2008 – present: preparing a reference book entitled "Solar and Global Evolution: The First Five Billion Years"

#### **Faculty/Student Science Projects** – reports and associated files

2002: supervised Ann Marie Costello's senior project on Seasonal and Global Variations in Sunlight

2002: supervised Ben Tarr's senior project on Multi-Channel Optic Light Concentrator

2003: supervised Lode Tigulo's senior project on Solar Sea Transmission Graphs

2003: wrote white paper on "Interactions of Energy and Matter"

2003?: PHYS 200 project

Winter 2003: supervised GEOL 400 first solar geophysics student project

Summer 2004: supervised Art Evans' ASTR 400 solar astrophysics student project  
2004 and 2005: supervised three quarters of ASTR 200 and PHYS 200 physics student projects on the "Properties of the Sun"  
2005: supervised BIO 400 biology student project on transitions of life from sea to land  
Summer 2005: supervised three summer research projects on the "Properties of the Sun"  
Winter 2006: supervised Art Evans' GEOL 400 geophysics student project  
Summer 2006: supervised four summer research projects on the Properties of the Solid Earth  
2007: supervised BIO 200 biology student project on "Carbon in the Geobiosphere"  
2007: supervised BIO 200 biology student project on prokaryotes and photosynthesis  
2007: supervised Ryan Cunningham's senior project on the Thermal Structure of the Troposphere  
Winter 2009: supervised BIO 400 biology student project related to the "Darwin in the Garden" poster display and walk  
March 2009: Accepted Cal Poly request to archive my works in the Digital Commons and began preparation for archiving  
March 2009: Met with a curator at the California Academy of Sciences to discuss upgrading their "Timeline of Life on Earth" exhibit  
Spring 2009: Supervised microbiology student project to study molecular timescales of prokaryotes and eukaryotes

### **Traveling Poster Exhibits**

2000: Iridescent Shells and Feathers notebook display  
2001: Seasonal Change posters  
2001: Phases of the Moon interactive poster  
2001: All about Tides posters  
Fall 2003: created Kennedy Library tabloid newspaper poster display entitled "Ocean Science Quest" (displayed in Fisher Hall for five years)  
February 2009: Created a lavishly illustrated poster display entitled "Darwin in the Garden" for Kennedy library which is now in Fisher Hall

### **Natural Science Talks**

September 2001 and February 2002: presented science talks to junior high school teachers for the Central Coast Science Project"  
Fall 2003: Osher Institute short course "Ocean Science Quest", based on library-based tabloid newspaper poster display  
May 2004: biology colloquium on "The Sea Otter in the Kelp Forest" based on the Ocean Science Quest poster display  
July 2008: physics colloquium on the "Internal Structure and Evolution of the Sun"  
October 2008: physics colloquium on the "Internal Structure and Evolution of the Solid Earth"  
October 2007: Presented research scholar's talk on "Life on our Evolving Planet" in the Kennedy Library (and to Dean Wendt's Bio 100 class)  
October 2008: Presented research scholar's talk on "Carbon and Climate" in the Kennedy Library (and to Dean Wendt's Bio 100 class)  
February 2009: Presented Darwin Bicentennial physics colloquium on "Darwin: Geologist and Naturalist"  
October 2009: Presented research scholar's talk on "Darwin in the Garden" in the Kennedy Library  
November 2009: ASTR 301 guest lectures on the interior of the Sun and the Earth and the climate of Venus

**Natural History Talks** created primarily for the MBSPMNH Mind Walk lecture series and repeated many times in many venues including the Guadalupe Dunes Center, the Morro Coast Audubon Society, the Natural History Museum in Santa Maria, RAMS (Retired Active Men), the Villages retirement home residents, etc.

1998: "Sunsets and Twilight Arches"

1998: "Rainbows and Raindrops"

1998: "Moonlight and Shadows"

1999: "A Bird's Eye View" Winter Bird Festival  
1999 - 2008: "Iridescent Shells and Feathers"  
2000: "All about Tides"  
2001: "Celebrate the Seasons"  
2001: "Sunlight and Sea Life"  
2002: "Global Climate Change"  
2003: "The Violent Birth of Mother Earth"  
2004: "Father Sun's Fusion Factory"  
2005: "The Origin of Life"  
2006: "The Diversity of Life" MBSPMNH  
2007: "The Summer of Change" MBSPMNH  
2009: lectures at the Villages on "Celebrate the Seasons", "Darwin in the Garden", and "How High the Moon"

**Natural History Walks** created for specific venues and repeated several times

2005: Evolution of the Montana de Oro Bluff  
2005: Elfin Forest Solstice Walk  
2005: Exploring Evolution in the Museum of Natural History  
2006: Exploring Evolution at Pismo State Beach (once for YMCA ten year olds)  
October 2008: Exploring Evolution in the Elfin Forest  
February 2009: "Exploring Evolution in the Leaning Pine Arboretum"  
May 2009: Developed and led a field trip for seventh graders at Montana de Oro State Park entitled "Darwin on the Bluff"  
May 2009: Helped a state park docent develop a field trip for seventh graders at the Museum of Natural History entitled "Evolution of Plants"

### **Project Proposals**

2006: developed "The Natural History of Planet Earth" informal science education project proposal with CESAME  
2006: Global Evolution Education Project proposal  
2006: Evolution Workshop for State Park Docents project proposal

### **Natural Science and History Travels**

1980: California Coast  
1981: Hawaii, Kauai, Maui, Oahu?  
1982: Sequoia National Park  
1983: Mt. Rainier, Mt. Olympus, Issaquah, Victoria, and Vancouver  
1983: Maui  
1984: Sequoia National Park  
1985: Calgary and Canadian Rockies?  
1986: Chichen Itza, Uxmal, Yucatan, Cancun  
1987: Yosemite  
1988: Alaska – Denali, Glacier Bay  
1989: Kauai  
1990: Fort Ross, Drake's Bay, Mendocino, Oroville, Sacramento  
1991: New Zealand, Grand Canyon  
1992: Montreal, Quebec, Laurentians  
1993: England, Wales, Scotland, Death Valley  
1994: Anza Borrego; Maine reunion, Nova Scotia, Prince Edward Island  
1995:  
1996: Costa Rica - Rain Forest, Tamarindo Beach  
1996: France - Pantheon in Paris, etc.  
1997:

1998: Italy - Pantheon in Rome, Florence, Venice

1999: Greece -Parthenon in Athens, Santorini, Crete

2000: Ecuador - Galapagos Islands

2000: Peru - Cuzco and Machu Picchu

2001: Outer Banks NC, Tucson and Phoenix

2002: Spain – Madrid, Barcelona, Alhambra, Toledo

2003: Yellowstone, Grand Tetons, Yosemite, Bryce, Zion, Las Vegas

2004: Australia – The Greater Barrier Reef, tropical rain forest, Blue Mountains

2005:

2006: China – Beijing, Great Wall, Xian Terra Cotta Warriors, 3 Gorges Dam Yangtze River cruise, Canton, Li River, Hong Kong, Shanghai

2007: Maui

2008: Four Corners

2009: London and Maine reunion- Darwin's Down House