

**Field Education, Geoscience  
Education and Broader Impacts:  
some context**

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# My Perspectives:

- **Geoscience education investigator**
  - Convening Team, Summit on the Future of Undergraduate Geoscience Education (1/10-12/14)
- **Past NSF-DUE Program Director**
  - Currently NSF-DUE funded to support PI's in proposal development/submission
- **Chair of a large geoscience dept. with a big field education program**
  - 150 Geology majors, ~40-50 in major courses and our summer field courses annually
- **Chair of the UNAVCO Education and Community Engagement Advisory Committee**
  - Helping UNAVCO-ECE in setting direction and supporting efforts in the GAGE project

**Geoscience education perspective: we're revisiting what we do in our Bachelor's degree programs...**

***Summit on the Future of Undergraduate Geoscience Education***

***Sponsored by***



**National Science Foundation**  
**WHERE DISCOVERIES BEGIN**

***Workshop: Jackson School of Geosciences  
University of Texas at Austin***

***January 10-12, 2014;***

***Ongoing townhalls and events for community input***

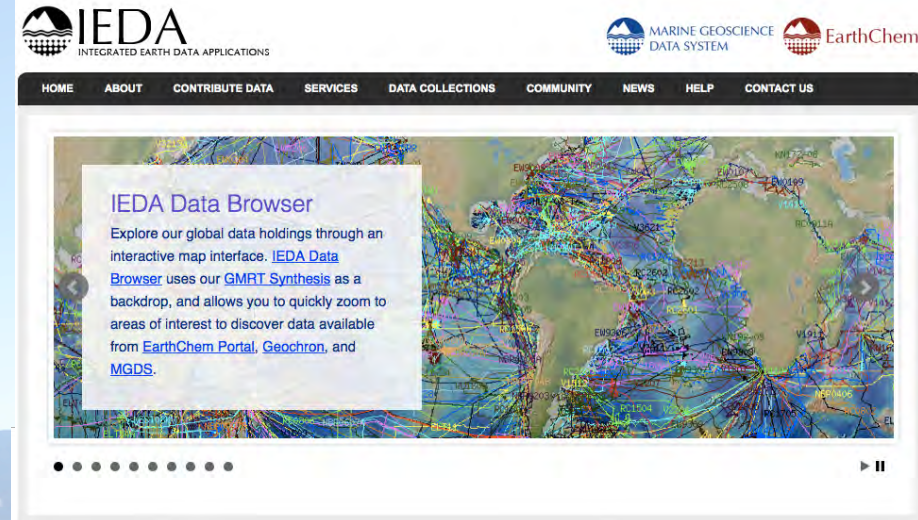
# ***Summit Report:***

<http://www.jsq.utexas.edu/events/future-of-geoscience-undergraduate-education/>

- **CONSENSUS VIEW: Our focus as educators should be on skills and competencies as learning outcomes, not courses or curricula**
  - **Universally accepted skills for scientists**
    - Critical thinking/problem solving
    - Communicating effectively to scientists & non-scientists
    - Understand and use scientific research methods
    - Have strong quantitative skills and ability to apply
    - Work well in interdisciplinary teams and across cultures
    - Ability to access and integrate information from different sources and to continue to learn

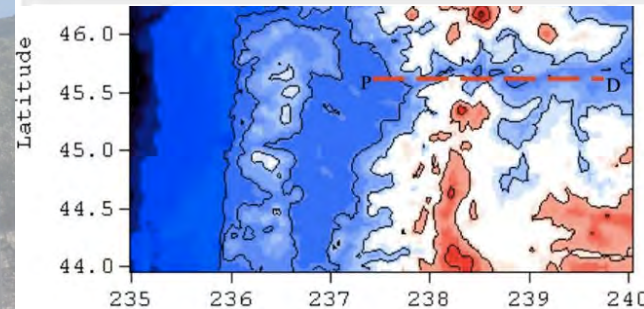
# Specific Skills for Geoscientists

- Work with uncertainty, non-uniqueness, incompleteness, ambiguity and indirect observations
- Problem solving re: spatial and temporal (i.e. 3D and 4D) interpretations
- **Integration of Earth system observations with experimentation and modeling**
- **Strong computational skills and the ability to manage and analyze large datasets**
- **Integrating data from different disciplines and applying systems thinking**
- **Have strong field skills and a working knowledge of GIS**
- **Be technologically able and versatile (i.e. Google Earth, tablets, smartphones, apps)**

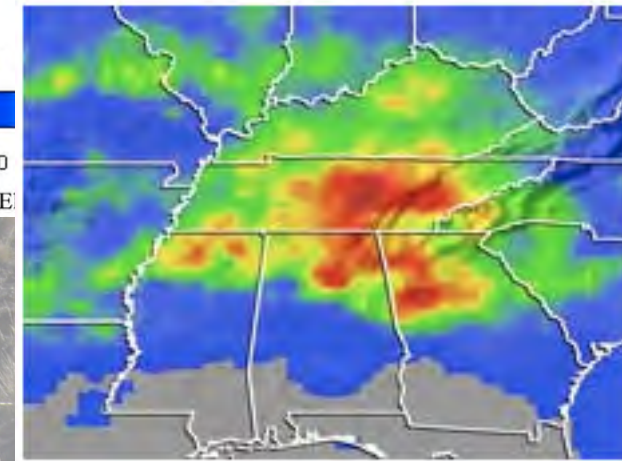


The screenshot shows the IEDA (Integrated Earth Data Applications) website. At the top, there are logos for IEDA, MARINE GEOSCIENCE DATA SYSTEM, and EarthChem. Below the logos is a navigation bar with links: HOME, ABOUT, CONTRIBUTE DATA, SERVICES, DATA COLLECTIONS, COMMUNITY, NEWS, HELP, CONTACT US. The main content area features a large map of the Pacific Northwest region with a semi-transparent text box overlaid. The text box contains the following text:

**IEDA Data Browser**  
Explore our global data holdings through an interactive map interface. [IEDA Data Browser](#) uses our [GMRT Synthesis](#) as a backdrop, and allows you to quickly zoom to areas of interest to discover data available from [EarthChem Portal](#), [Geochron](#), and [MGDS](#).

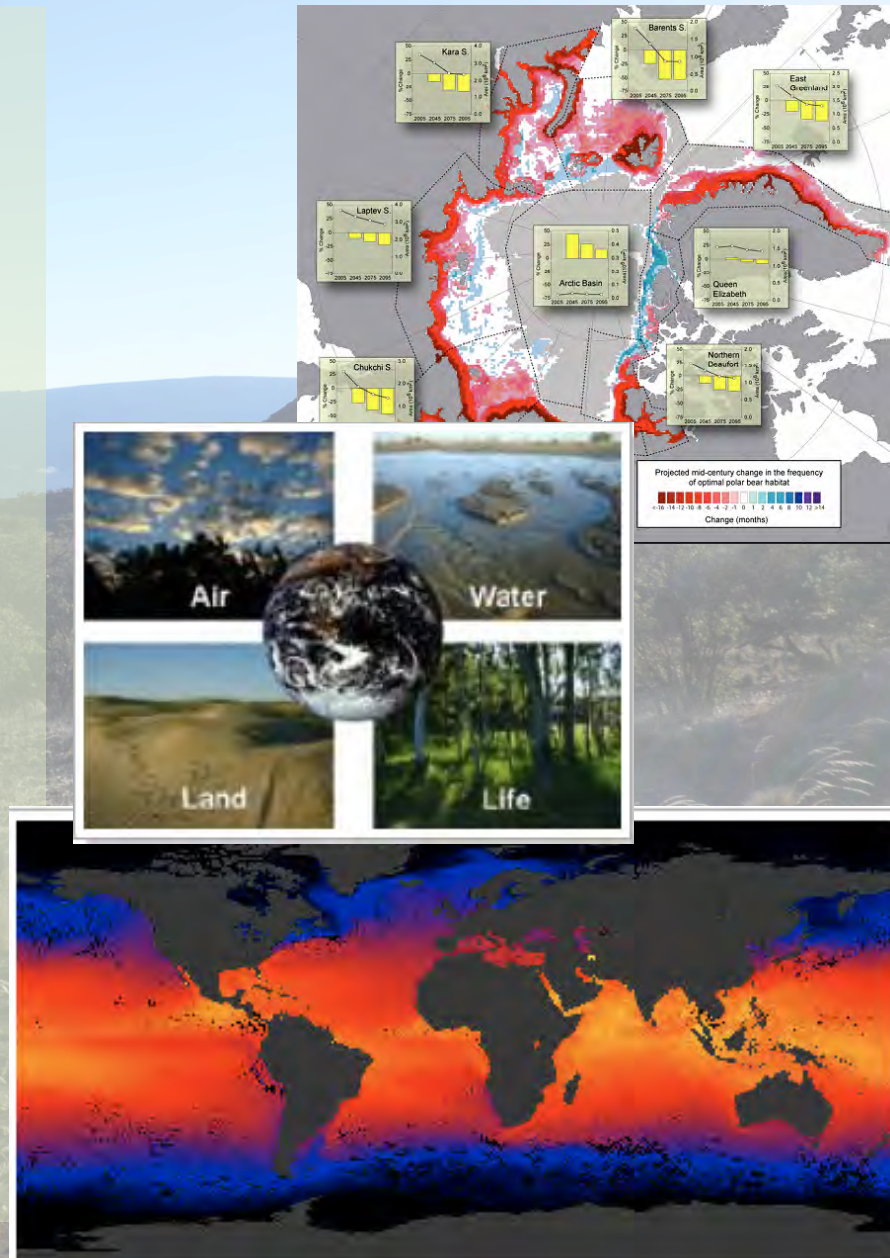


SW Washington/NW Oregon



# Geoscience Conceptual Fundamentals

- Earth as a complex dynamic system
  - linkages between the different systems (e.g., lithosphere, hydrosphere, atmosphere, biosphere etc.).
  - coupling between chemical, physical, biological and geological processes
- Deep time, including the origin and evolution of life and Earth; present day processes & future impacts
- **How Earth works, including surficial and tectonic processes; natural resources (including water and energy), natural hazards, climate change**
- **Understand societal relevance of geoscience topics and ethical dimensions**



# Geoscience Pedagogies

- Use proven active learning methods and pedagogy
  - Disseminate, encourage use & increase current knowledge base; illustrate benefits
  - Incorporate collaborative, integrative, interdisciplinary teamwork
  - Integrate research projects & experiences, problem solving projects, field experiences into curriculum
- Research as a high-impact pedagogy (prominent in Summit discussions and the report)

**SERC** the Science Education Resource Center at Carleton College

Engaging teaching activities  
Effective pedagogy  
Transformative workshops

Whether you're an undergraduate faculty member or a K-12 science teacher our suite of partner projects have materials you can use today. Connect with a community of peers as they share what really works in their classrooms.

Learn more about SERC >

Search All SERC-hosted projects...  
Activities, Workshops, People and more

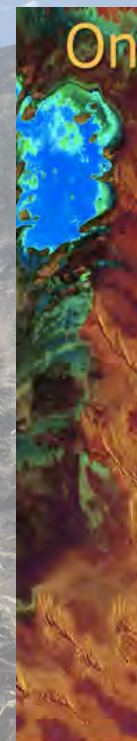
...or choose a starting point

**SERC Site Guides**  
How to Find What You Need at SERC

**Teach the Earth**  
Resources for Geoscience Educators

**Pedagogy in Action**  
Educators Sharing their Expertise

**K12 Portal**  
Resources for K12 Science Teachers



Dasht-e Kavir  
(Great Salt Desert), Iran

## On the Cutting Edge

An  Professional Development Program for Geoscience Faculty

[About](#)

### Managing Your Career

- [Preparing for an Academic Career](#)
- [Early Career Faculty](#)
- [Career Development](#)

### Enhancing Your Teaching

- [Affective Domain](#)
- [Assessment of Learning](#)
- [Classroom Observation Project](#)
- [Course Design](#)
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- [Service Learning](#)
- [Teaching in the Field](#)
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- [Teaching with Video](#)
- [Undergraduate Research](#)
- [Urban Students and Urban Issues](#)
- [Using Online Games and Environments](#)
- [Visualizations](#)
- [Web Design](#)

### Search the Site

Classroom activities, syllabi, images, animations and more.

### Workshop Schedule

### For STEM Educators

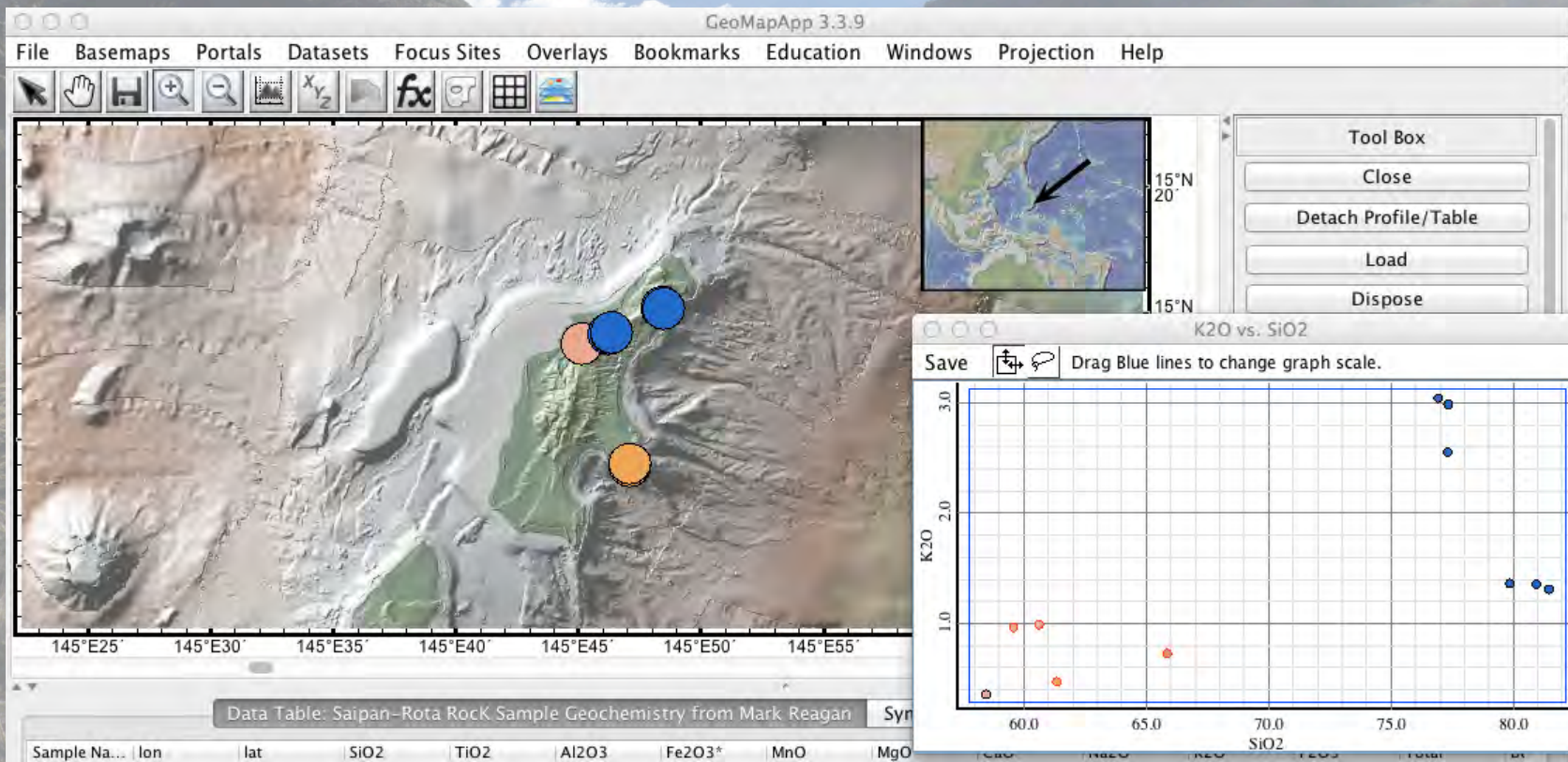
A guide to those *On the Cutting Edge* resources that apply beyond the geosciences

### Email List and Discussion Board Site Guide

Find the places in Cutting Edge and beyond where the community is talking.

# Technology and Geoscience education

- **A critical element: working with and collecting data**
  - Taking advantage of informatics resources as well as real data collection opportunities to give students “practice” in investigating geologic questions.
  - Developing technical skills associated with the use of cutting-edge instrumentation.





# The NSF perspective:

- **National Academies : Rising above the Gathering Storm: Rapidly Approaching Category 5 (2010)**
  - Acute risks to American competitiveness, arising from shortcomings re: education
- **PCAST: “Engage to Excel...” (2012)**
  - Calls for widespread adoptions of validated, effective educational practices
    - **Undergraduate Research: a high-impact educational practice**
  - **Replacing traditional lab courses with discovery-based research courses**
- **AGI: Status of the Geoscience Workforce 2014**
  - Predicted need for 135,000 additional geoscience-trained graduates by 2022.

# Innovations in Undergraduate STEM Education (IUSE)

- **NSF-wide initiative, responding to PCAST and other national reports, to address national needs in STEM education**
  - Separate IUSE solicitations in EHR and in GEO (TBA...)
  - Targets “formal” education: what we do in our courses and curricula.
  - Objectives:
    - **Improve STEM Learning & Learning Environments:** Improve the knowledge base for defining, identifying, and innovating effective undergraduate STEM education teaching and learning.
    - **Broaden Participation & Institutional Capacity for STEM Learning:** Increase the number and diversity of undergraduate students recruited and retained in STEM education and career pathways.
    - **Build the Professional STEM Workforce for Tomorrow:** Improve the preparation of undergraduate students so they can succeed as productive members of the future STEM workforce and be engaged as members of a STEM-literate society.

# Innovations in Undergraduate STEM Education (IUSE)

- **Improving STEM Learning & Learning Environments:** Improve the knowledge base for defining, identifying, and innovating effective undergraduate STEM education teaching and learning.
  - Support for improvements/enhancements to geoscience courses, from introductory to “capstone” (i.e., field camps).
  - Support both to develop innovative materials/courses/curricula (Engaged Student Learning) and to foster their testing and adoption (Institutional and Community Transformation)
  - Support to acquire instrumentation for education (for institutions or facilities working with institutions...)

# NSF's New Review Criteria:

1. **What is the potential for the proposed activity to:**
  - a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
  - b. Benefit society or advance desired societal outcomes?**
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. **Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?**
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. **Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?**

# Broader Impacts and Education:

- **STEM education, especially at the undergraduate level, IS a national priority, so activities that foster education in the context of research (i.e., undergraduate research, building research activities/findings into courses/curricula) are Broader Impacts**
  - **But there needs to be a clear plan for it, with measurable outcomes/benefits (student learning/retention/recruitment, etc.)**
  - **And there needs to be investment in it, both in the proposed project (funds to do it and to spread the word about it) and at your institution (sustainability)**

# **A Chair's Perspective: USF School of Geosciences Field Education efforts.**

- **2014 Field camps: Five two-week sections for ~40 students**
  - A “modern” field camp encompassing varied topics:
    - Hydrogeology (FL)
    - Coastal Processes (FL)
    - Geologic Mapping (Utah-Idaho)
    - Geophysics (Idaho)
      - Makes use of GPS technologies
    - Volcanology (Idaho)
      - Has made use of TLS in the past...
- **Undergraduate and graduate-level academic year courses in geophysics and geodynamics/geodesy with extended field trips (...among others...)**
- **Major challenge– transport and especially maintenance/operation of Univ. field instrumentation and equipment, especially with tightening Univ. budgets!**

# UNAVCO Education and Community Engagement Advisory Committee

- **Both a voice for the UNAVCO PI community and a “sounding board” for UNAVCO ECE re: proposed activities**
  - **GAGE Project: Education and community outreach funds in direct costs for the first time!**
    - But the dollars are small in the context of GAGE and UNAVCO
  - **The gist of ECE-AC advice, which ECE has followed:**
    - **Work from and with your PI community – support and facilitate their initiatives**
    - **Leverage GAGE dollars from other sources (NSF IUSE, REU, etc) with buy-in from UNAVCO PI’s.**

**This workshop will help define how UNAVCO can support field education for its PI community, and can even (maybe) aid in finding the resources for all your ambitions (with a little out-of-box thinking...)**