On the Cutting Edge

Professional Development for Geoscience Faculty 2012-13

Teaching About Rates and Time: Challenges and Resources

Carol J. Ormand[1]*, Cathyrn Manduca[1], Steven Semken[2], Erica Crespi[3]
[1]Science Education Resource Center, Carleton College [2]School of Earth and Space Exploration, Arizona State University [3]School of Biological Sciences, Washington State University
* *cormand@carleton.edu*
ED43B-0729

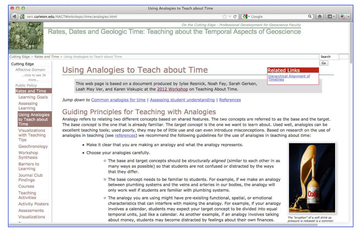
Geologic time is a fundamental concept in the geosciences. Determining the rates of geoscience processes and dates of key events is at the heart of much geoscience research. Further, intellectual grounding in the magnitudes of Deep Time may provide a foundation for understanding large magnitudes in other contexts, including astrophysics, evolutionary biology, and economics. Yet students struggle with many aspects of learning about geologic time, including lengths of time and rates of processes beyond human experience, proportional reasoning, uncertainty, unfamiliar processes, and unfamiliar terminology.

2012 Workshop: In February, 2012, we held a workshop on teaching about time. Geoscience faculty, education and cognitive science researchers, and faculty from other STEM disciplines discussed the cognitive challenges in learning temporal concepts and shared successful strategies for teaching about rates and time. Participants developed the following set of online resources for faculty who teach about rates and time in their courses.

http://serc.carleton.edu/NAGTWorkshops/time/index.html

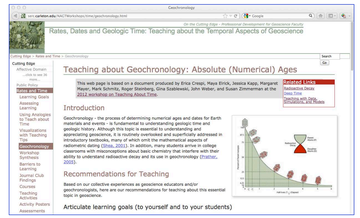
Using Analogies to Teach about Time

Used well, analogies can be excellent teaching tools. This page makes a set of research-based recommendations for using analogies to teach about time and also analyzes common analogies for their strengths and weaknesses as teaching tools. Recommendations include choosing analogies carefully, pointing out differences between the target and the analogy to prevent misconceptions, and making analogical mappings explicit.

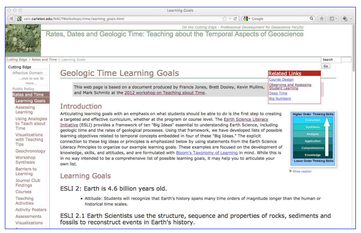


Teaching about Geochronology

Many students struggle with the chemistry and mathematics of radioactive decay and its use in geochronology. This page focuses on strategies to help students overcome those challenges, including teaching with analogies, building on familiar concepts, having students solve real problems, and reviewing the process of science as you teach about geochronology.

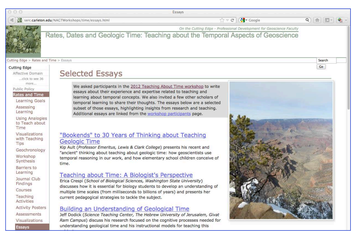


Geologic Time Learning Goals



Using the framework of the Earth Science Literacy Initiative, workshop participants developed lists of possible learning objectives related to temporal concepts embedded in four of the "Big Ideas" essential to understanding Earth Science. For example: "Students should be able to characterize geologic processes in terms of their rates and the span of time over which they operate." While this is in no way intended to be a comprehensive list of possible learning goals, reading these examples may help you to articulate your own list.

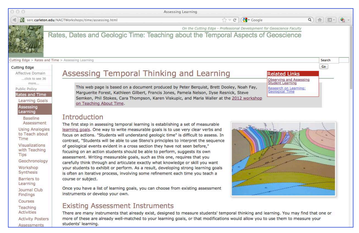
Essays



Workshop participants and a few other scholars shared their experience and expertise related to teaching and learning about temporal concepts in this collection of essays.

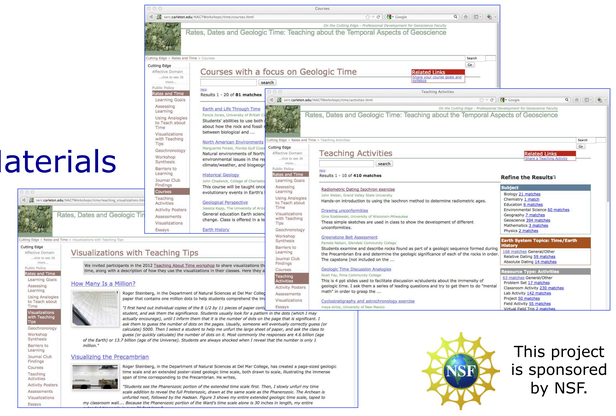
Assessing Temporal Thinking and Learning

This page links to several existing instruments designed to measure students' understanding of temporal concepts and also outlines a process for developing your own assessments, focusing on proven strategies: working backward from the specific, measurable learning outcomes you want to observe and using pedagogies such as concept maps, concept sketches, or ConcepTests.



Collections of Teaching Materials

Workshop participants contributed to SERC's online collections of courses, teaching activities, visualizations (with teaching tips), and assessments for teaching temporal concepts.



This project is sponsored by NSF.