

# Online Teaching Materials and More for Geoscience Faculty

Cathy Manduca, *Carleton College*, Dave Mogk, *Montana State University*, Barb Tewksbury, *Hamilton College*, Heather Macdonald, *College of William and Mary*  
NSF Grant # 0127141, 0226243, 0226199, 0304762, 0306708, 0333402

## Finding What You Need: Teach the Earth —A Portal for Faculty in their Role as Teachers

- Teaching Materials and Methods
- Course Design
- Integrating Research and Education
- Building Strong Departments

**Resources You Can Trust:  
Developed by Leaders in  
Geoscience Education and  
Your Faculty Colleagues**  
Teach the Earth provides access to resources developed by six NSF funded projects. All provide links to relevant reviewed literature including papers from the *Journal of Geoscience Education*. A major feature are examples of courses and activities developed by geoscience faculty.

[serc.carleton.edu](http://serc.carleton.edu)



**Teach the Earth**  
the SERC portal for Geoscience Faculty

Search the Site [ ] Go

**Find Teaching Activities** ▶  
[ ] Search

**Explore Topics and Themes** ▶

**Teaching**  
Using visualizations and datasets and models, interactive lectures, fields labs, quantitative literacy, petrology, structural geology, designing courses and much more....

**An Earth System Approach**  
An overview of this approach with teaching resources, bio-complexity, geology and human health.

**Integrating Research and Education**  
Using research results in geoscience courses, addressing NSF's broader impacts and bringing research on learning to the geosciences.

**Managing your Career**  
Future faculty, early career faculty, professional development resources.

**Developing Web Resource**  
Putting course materials online and making datasets accessible to educators.

**Departments**  
Building strong geoscience departments.

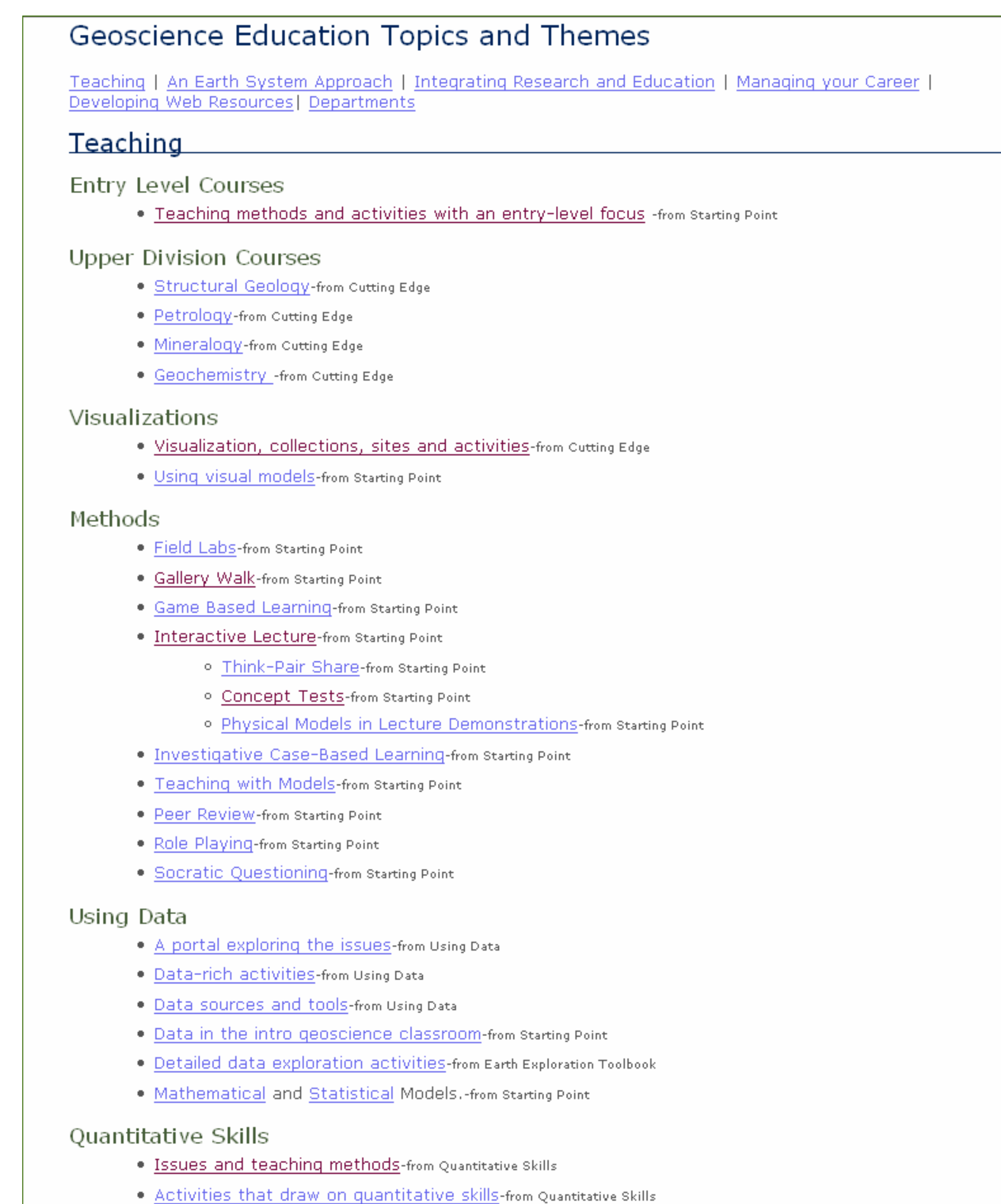
**News**  
**EarthScope in the Northern Rockies Workshop**  
September 16-19, 2005 at Montana State University in Bozeman, MT. The goals of this workshop include formulating an integrated research and education agenda to optimize the use of the Earthscope facility. Check the website for more information.

**New Project - Microbial Life Educational Resources is live!**  
Come discover the connections between microbial life, the history of the earth and our dependence on micro-organisms.

Our **Tsunami Visualization Collection** was picked as the **Cool site of the day** on February 2nd. It includes animations and computer visualizations of the December 26, 2004 Indian Ocean Tsunami as well as other historical and hypothetical tsunamis.

**Contributing Projects**

- [Bringing Research on Learning to the Geosciences](#)
- [DLESE Community Services](#)
- [Integrating Research and Education](#)
- [Teaching Quantitative Skills in the Geosciences](#)



**Geoscience Education Topics and Themes**

[Teaching](#) | [An Earth System Approach](#) | [Integrating Research and Education](#) | [Managing your Career](#) | [Developing Web Resources](#) | [Departments](#)

**Teaching**

**Entry Level Courses**

- [Teaching methods and activities with an entry-level focus](#) -from Starting Point

**Upper Division Courses**

- [Structural Geology](#) -from Cutting Edge
- [Petrology](#) -from Cutting Edge
- [Mineralogy](#) -from Cutting Edge
- [Geochemistry](#) -from Cutting Edge

**Visualizations**

- [Visualization, collections, sites and activities](#) -from Cutting Edge
- [Using visual models](#) -from Starting Point

**Methods**

- [Field Labs](#) -from Starting Point
- [Gallery Walk](#) -from Starting Point
- [Game Based Learning](#) -from Starting Point
- [Interactive Lecture](#) -from Starting Point
  - [Think-Pair Share](#) -from Starting Point
  - [Concept Tests](#) -from Starting Point
  - [Physical Models in Lecture Demonstrations](#) -from Starting Point
- [Investigative Case-Based Learning](#) -from Starting Point
- [Teaching with Models](#) -from Starting Point
- [Peer Review](#) -from Starting Point
- [Role Playing](#) -from Starting Point
- [Socratic Questioning](#) -from Starting Point

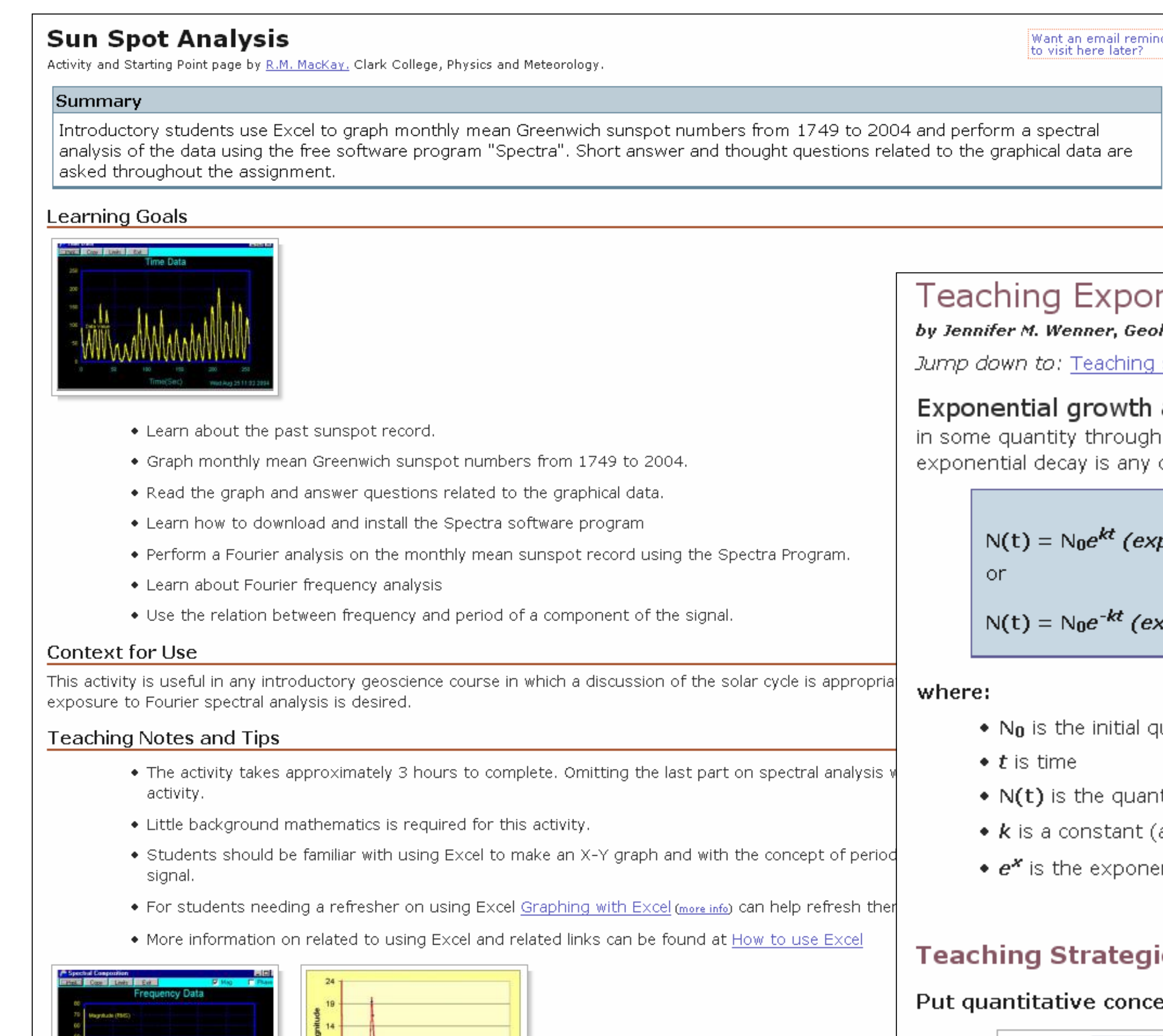
**Using Data**

- [A portal exploring the issues](#) -from Using Data
- [Data-rich activities](#) -from Using Data
- [Data sources and tools](#) -from Using Data
- [Data in the intro geoscience classroom](#) -from Starting Point
- [Detailed data exploration activities](#) -from Earth Exploration Toolbook
- [Mathematical and Statistical Models](#) -from Starting Point

**Quantitative Skills**

- [Issues and teaching methods](#) -from Quantitative Skills
- [Activities that draw on quantitative skills](#) -from Quantitative Skills

## Teaching Materials



**Sun Spot Analysis**  
Activity and Starting Point page by [B.M. Madras](#), Clark College, Physics and Meteorology.

Want an email reminder to visit here later?

**Summary**  
Introductory students use Excel to graph monthly mean Greenwich sunspot numbers from 1749 to 2004 and perform a spectral analysis of the data using the free software program "Spectra". Short answer and thought questions related to the graphical data are asked throughout the assignment.

**Learning Goals**

- Learn about the past sunspot record.
- Graph monthly mean Greenwich sunspot numbers from 1749 to 2004.
- Read the graph and answer questions related to the graphical data.
- Learn how to download and install the Spectra software program
- Perform a Fourier analysis on the monthly mean sunspot record using the Spectra Program.
- Learn about Fourier frequency analysis
- Use the relation between frequency and period of a component of the signal.

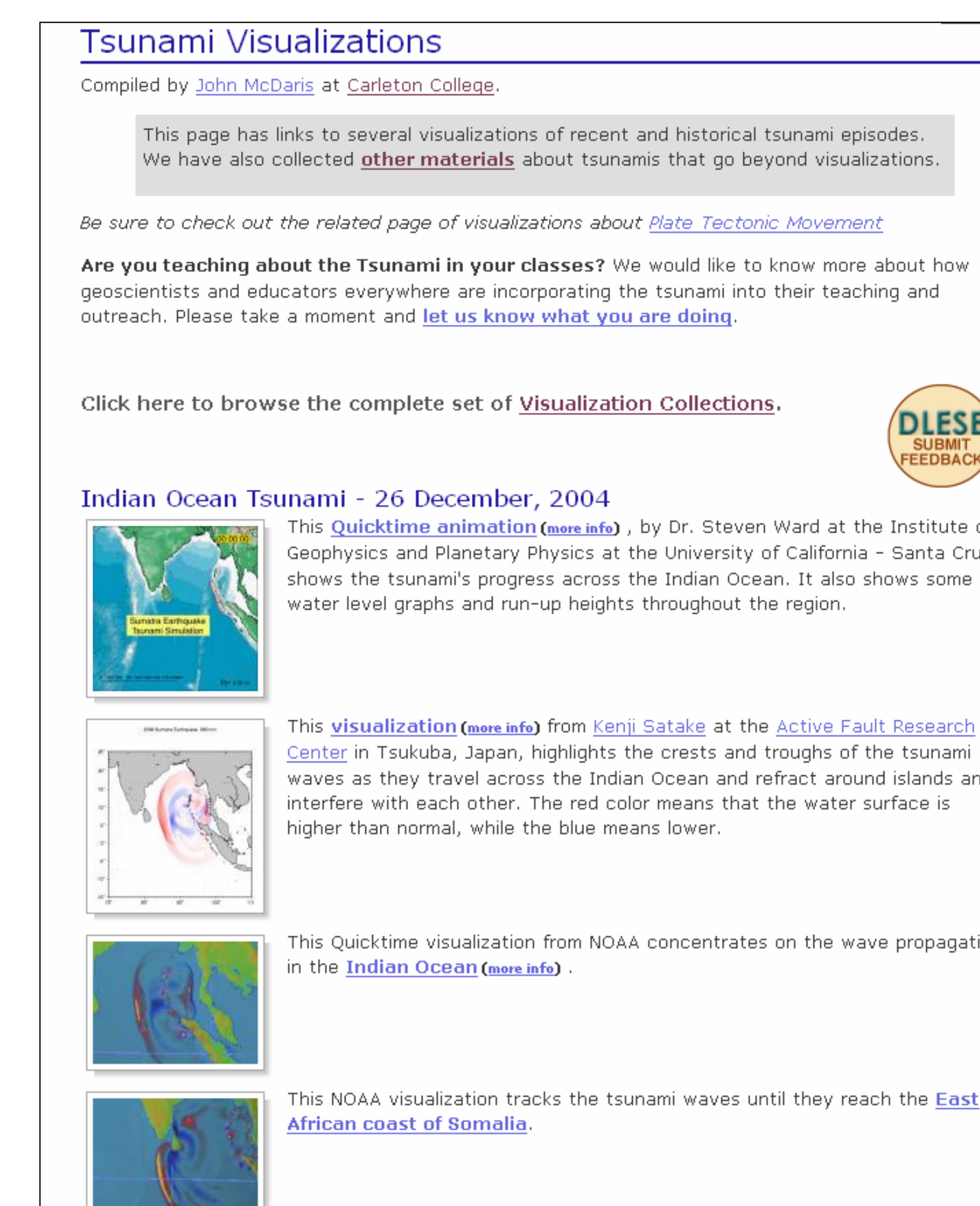
**Context for Use**  
This activity is useful in any introductory geoscience course in which a discussion of the solar cycle is appropriate. Exposure to Fourier spectral analysis is desired.

**Teaching Notes and Tips**

- The activity takes approximately 3 hours to complete. Omitting the last part on spectral analysis of activity.
- Little background mathematics is required for this activity.
- Students should be familiar with using Excel to make an X-Y graph and with the concept of period of a signal.
- For students needing a refresher on using Excel [Graphing with Excel](#) ([see here](#)) can help refresh their skills.
- More information on related to using Excel and related links can be found at [How to Use Excel](#)

[serc.carleton.edu/introgeo/teachingwdata/examples/sunspots.html](http://serc.carleton.edu/introgeo/teachingwdata/examples/sunspots.html)

## Resources



**Tsunami Visualizations**  
Compiled by [John McDanis](#) at Carleton College.

This page has links to several visualizations of recent and historical tsunami episodes. We have also collected [other materials](#) about tsunamis that go beyond visualizations.

Be sure to check out the related page of visualizations about [Plate Tectonic Movement](#)

Are you teaching about the Tsunami in your classes? We would like to know more about how geoscientists and educators everywhere are incorporating the tsunami into their teaching and outreach. Please take a moment and [let us know what you are doing](#).

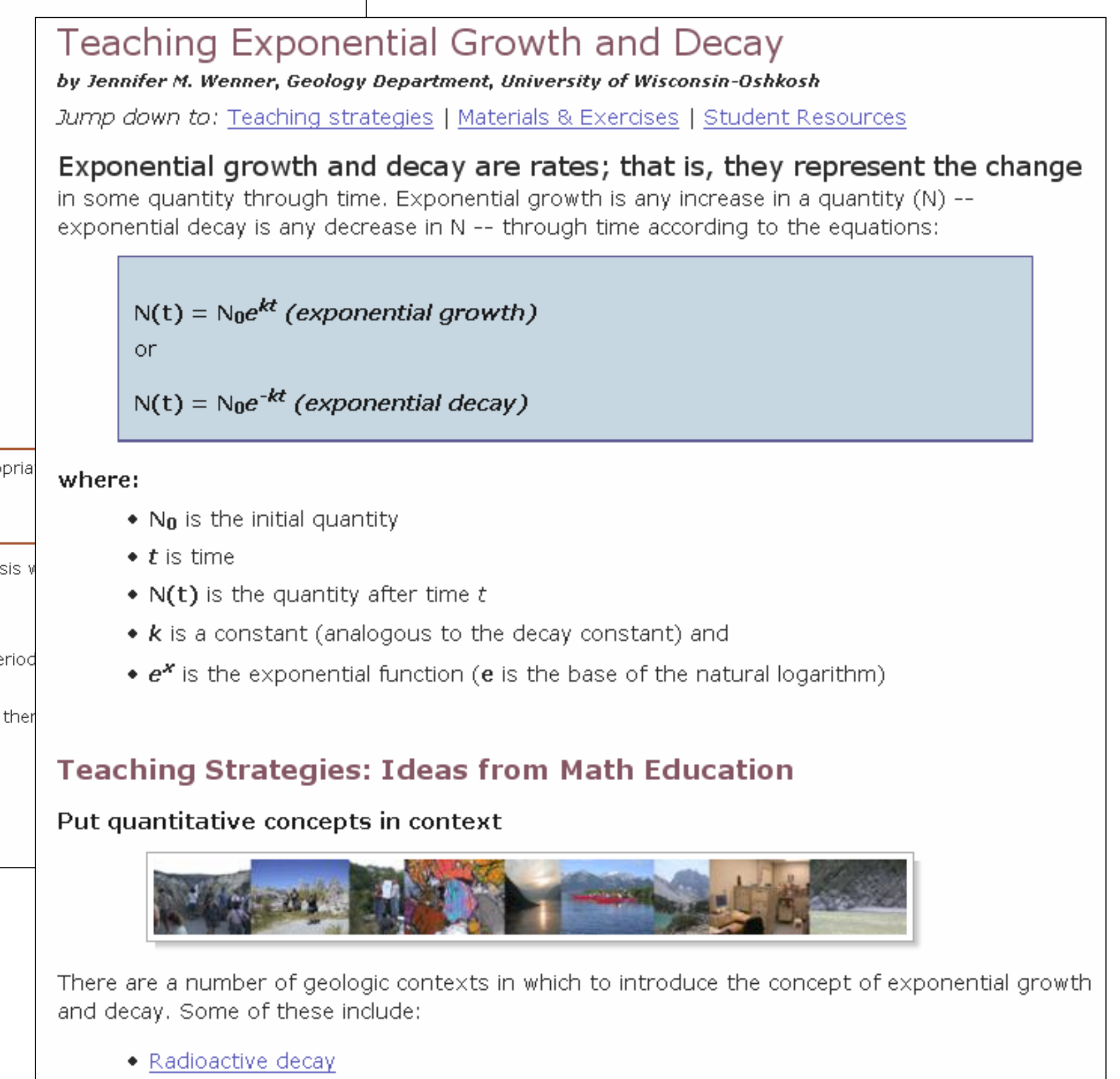
Click here to browse the complete set of [Visualization Collections](#).

**Indian Ocean Tsunami - 26 December, 2004**

- This [Quicktime animation](#) ([see info](#)), by Dr. Steven Ward at the Institute of Geophysics and Planetary Physics at the University of California - Santa Cruz, shows the tsunami's progress across the Indian Ocean. It also shows some water level graphs and run-up heights throughout the region.
- This [visualization](#) ([see info](#)) from [Kenji Satake](#) at the [Active Fault Research Center](#) in Tsukuba, Japan, highlights the crests and troughs of the tsunami waves as they travel across the Indian Ocean and refract around islands and interfere with each other. The red color means that the water surface is higher than normal, while the blue means lower.
- This Quicktime visualization from NOAA concentrates on the wave propagation in the [Indian Ocean](#) ([see info](#)).
- This NOAA visualization tracks the tsunami waves until they reach the [East African coast of Somalia](#).

[serc.carleton.edu/NAGTWorkshops/visualization/collections/tsunami.html](http://serc.carleton.edu/NAGTWorkshops/visualization/collections/tsunami.html)

## Methods



**Teaching Exponential Growth and Decay**  
by [Jennifer M. Wenner](#), Geology Department, University of Wisconsin-Oshkosh

Jump down to: [Teaching strategies](#) | [Materials & Exercises](#) | [Student Resources](#)

**Exponential growth and decay are rates; that is, they represent the change in some quantity through time. Exponential growth is any increase in a quantity (N) -- exponential decay is any decrease in N -- through time according to the equations:**

$$N(t) = N_0 e^{kt} \text{ (exponential growth)}$$

or


$$N(t) = N_0 e^{-kt} \text{ (exponential decay)}$$

**where:**

- $N_0$  is the initial quantity
- $t$  is time
- $N(t)$  is the quantity after time  $t$
- $k$  is a constant (analogous to the decay constant) and
- $e^x$  is the exponential function ( $e$  is the base of the natural logarithm)

**Teaching Strategies: Ideas from Math Education**

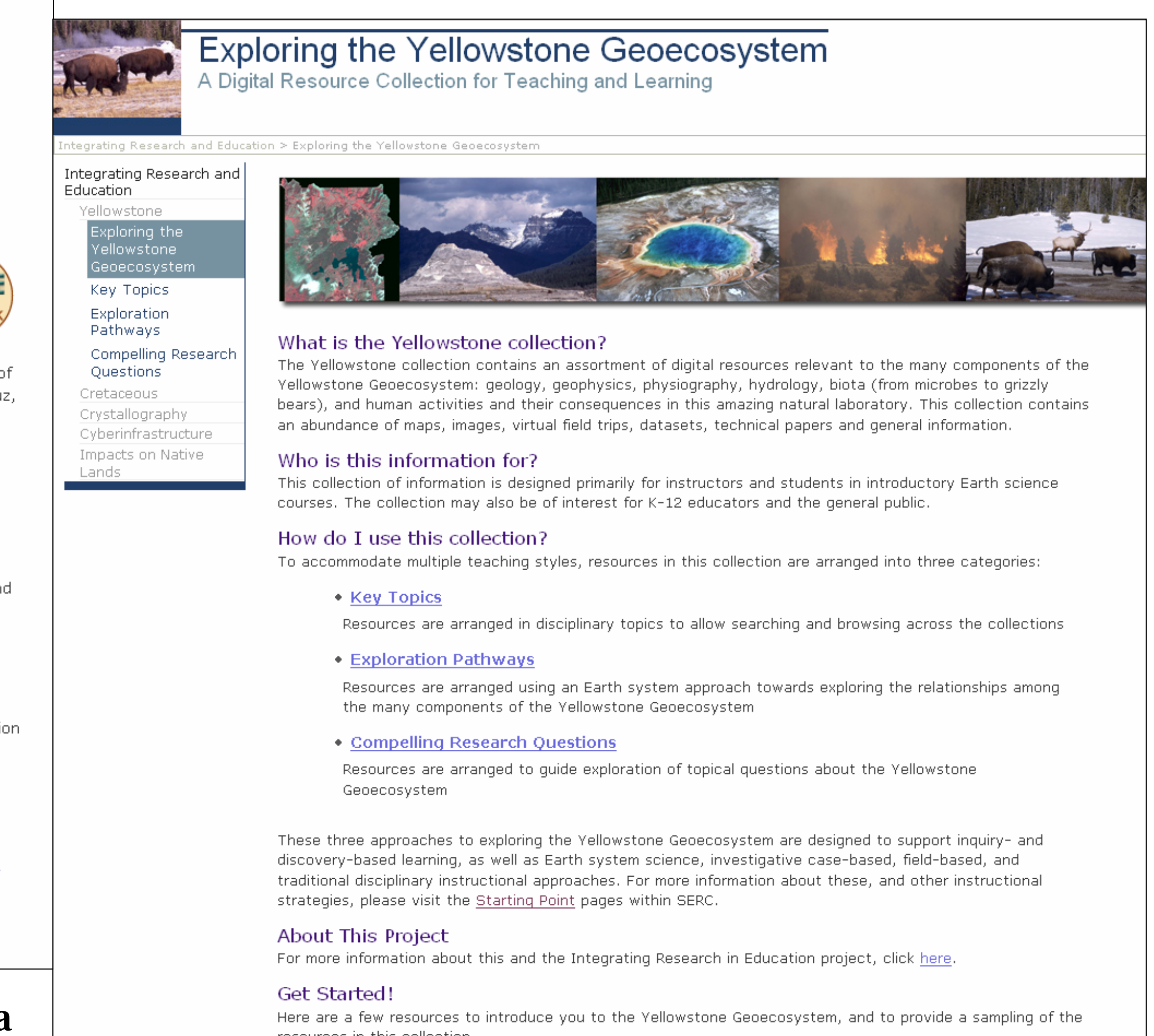
Put quantitative concepts in context



There are a number of geologic contexts in which to introduce the concept of exponential growth and decay. Some of these include:

- [Radioactive decay](#)

[serc.carleton.edu/quantskills/methods/quantlit/expGandD.html](http://serc.carleton.edu/quantskills/methods/quantlit/expGandD.html)



**Exploring the Yellowstone Geocosystem**  
A Digital Resource Collection for Teaching and Learning

Integrating Research and Education > Exploring the Yellowstone Geocosystem

Yellowstone  
Exploring the Yellowstone Geocosystem  
Key Topics  
Exploration Pathways  
Compelling Research Questions  
Cretaceous  
Crystallography  
Cultural Infrastructure  
Impacts on Native Lands

**What is the Yellowstone collection?**  
The Yellowstone collection contains an assortment of digital resources relevant to the many components of the Yellowstone Geocosystem: geology, geophysics, physiography, hydrology, biota (from microbes to grizzly bears), and human activities and their consequences in this amazing natural laboratory. This collection contains an abundance of maps, images, virtual field trips, datasets, technical papers and general information.

**Who is this information for?**  
This collection of information is designed primarily for instructors and students in introductory Earth science courses. The collection may also be of interest for K-12 educators and the general public.

**How do I use this collection?**  
To accommodate multiple teaching styles, resources in this collection are arranged into three categories:

- **Key Topics**  
Resources are arranged in disciplinary topics to allow searching and browsing across the collections
- **Exploration Pathways**  
Resources are arranged using an Earth system approach towards exploring the relationships among the many components of the Yellowstone Geocosystem
- **Compelling Research Questions**  
Resources are arranged to guide exploration of topical questions about the Yellowstone Geocosystem

These three approaches to exploring the Yellowstone Geocosystem are designed to support inquiry- and discovery-based learning, as well as Earth system science, investigative case-based, field-based, and traditional disciplinary instructional approaches. For more information about these, and other instructional strategies, please visit the [Starting Point](#) pages within SERC.

**About This Project**  
For more information about this and the Integrating Research in Education project, click [here](#).

**Get Started!**  
Here are a few resources to introduce you to the Yellowstone Geocosystem, and to provide a sampling of the resources in this collection.

[serc.carleton.edu/research\\_education/yellowstone/index.html](http://serc.carleton.edu/research_education/yellowstone/index.html)