New Online Resources for Teaching Introductory-Level Geoscience Courses

Carol Ormand, SERC*
Karin Kirk, SERC*
Heather Macdonald, College of William & Mary
Cathy Manduca, SERC*
Barb Tewksbury, Hamilton College

* Science Education Resource Center, Carleton College
The Pivotal Role of Introductory Courses

- Recruiting future geoscientists
- Providing experiences in science for preservice teachers
- Developing a science-literate public: future policy makers, business people, & other citizens

Image from the USGS
New Resource Collections

Cutting Edge: Teaching Introductory Geoscience in the 21st Century

- Course descriptions
- Teaching activities
- Workshop pages: presentations, discussion summaries, posters
- Misconception literature, “bookshelf”

Starting Point:

- The First Day of Class
- Just-in-Time Teaching (expanded)
- Experience-Based Environmental Projects
From **On the Cutting Edge**

Teaching Introductory Geoscience Courses in the 21st Century

Do you recall your first geoscience course? For many geoscience teachers, it was this first taste of plate tectonics, landforms, fossils or oceanography that suddenly made us realize we had found our calling. We hope that some of today’s new students who experience their first earth science courses will become inspired just like we did. Yet some students take a 100-level geology course because it seems to be the least-daunting way through their college’s science requirement. Thus, faculty of introductory courses have a big job on their hands, managing a wide range of students, taking them through the basics of earth science, and hopefully imparting some inspiration along the way.

This web module is for those who teach introductory earth science courses. Here you will find ideas for designing a new course, splicing up an existing course design, or adding innovative activities or teaching methods.

This website was launched in November 2007 in anticipation of a July 2008 workshop. In the months leading up to and following this summer’s workshop, a wide range of material will be added to this site.

Until then, here are a few resources to get you started.

- A collection of introductory-level geoscience courses, spanning a host of geoscience topics.
- The [Starting Point - Teaching Entry-Level Geoscience](http://serc.carleton.edu/MAGTeachworkshops/entrylevel/index.html), which contains 22 modules built around pedagogic approaches for introductory courses, plus dozens of example activities.


This workshop will be held July 14-17, 2008 on the campuses of Carleton College and St. Olaf College in Northfield, MN.
Themes Emerging from the Workshop

- Establishing learning goals is paramount to course design
  - Limit content to add depth
  - Use effective pedagogies

- Local data, case studies, or service learning add relevance

- Teach the process of science

- Address misconceptions

- Supplement the textbook
Course Descriptions

More than 200 courses
Examples

There are many different exciting approaches to teaching introductory geoscience courses.

Geology 101—Earth science and the educated voter

Instructor: Pete Stelling
MWF 3:00-3:50 a.m., SL 150

Monitoring the Florida River

How a class research project took over the labs of Earth Systems Science
Teaching Activities

More than 350 activities

Activities for Introductory Geoscience

Here you will find a wide range of activities for teaching introductory geoscience courses. You can refine your search by selecting the topic or resource type, or by typing in search terms into the search box in the box below.

Please share your own activities and we will add them to this collection.

Results 1 - 10 of 367 matches

What Should We Do About Global Warming? part of Starting Point: Teaching Entry Level Geoscience: Role Playing/Examples

Climate at Work part of Starting Point: Teaching Entry Level Geoscience: Role Playing/Examples

Weather Map Interpretation part of Starting Point: Teaching Entry Level Geoscience: Gallery

Mock Environmental Summit part of Starting Point: Teaching Entry Level Geoscience: Role Playing/Examples

Floodplains part of Starting Point: Teaching Entry Level Geoscience: Field Lab: Field Lab Examples

Earth System Topics

Atmosphere 71 matches
Biosphere 90 matches
Evolution 15 matches
Geology 62 matches
Human Dimensions 65 matches
Hydrology 74 matches
Oceans 41 matches
Solar System and Astronomy 22 matches
Sedimentology 37 matches
Sedimentary Geology 46 matches
Sedimentary Rocks 20 matches
Structural Geology 67 matches
Surface Processes 63 matches
Weather 80 matches
Weathering 85 matches

Resource Type: Activities

32 matches General/Other
46 matches Field Lab
11 matches Gallery
22 matches Interactive/Java
37 matches Multimedia
20 matches Role Play
65 matches Simulation
37 matches Text
12 matches Video
Examples

Many of the teaching activities are capstone projects, synthesizing course material & concepts
Workshop website

Program: links to presentations

Teaching Critical Thinking

Mary M. Walczak
Associate Professor and Chair of Chemistry
Interim Director, Evaluation & Assessment
St. Olaf College

GEOL 613
Earth Science and the NYC Urban Environment
Workshop website

Workshop outcomes: summaries of discussion sessions on the impact of intro courses, teaching the process of science, and teaching large classes.
Using Notebooks to Support Student Learning
Physical Science Department
Mesa Community College, Mesa, AZ
Kaatje Kraft

Overview
• How can we best prepare our introductory students to be successful in our class and future endeavors?
• Science notebooks have been a way to record and process data for scientists for a very long time. How can we use them to help students understand science and their own experiences?
• Science notebooks in the classroom are more than just records of data and conclusions; they are opportunities for reflective inquiry, risk-taking, and ownership of learning.

A Sample Approach
• Students start by summarizing the lab data of each student group in a single document.
• Students are asked to answer the question, “What do you think the world would be like if you had to do it all over again?”
• Students share their goals and ideas with the class.
• Students discuss and reflect on the success of their lab experiments.

Student Population

A Sample Approach cont.
• Step 5: Students reflect on their learning
  • Use tech to support inquiry labs.
  • What would you do differently next time?
  • Use tech to support inquiry labs.
  • What would you do differently next time?

References & Acknowledgements

Workshop website
Poster session: downloadable poster files, with links to related courses & activities
From Starting Point

- First Day of Class
- Just-in-Time Teaching (recently expanded)
- Experience-Based Environmental Projects
From Starting Point

The First Day of Class

The First Day of Class
Compiled by Carol Ormand, SERC, Carleton College

Why is the first day important?

It’s the first day of class, and the room is buzzing with excitement and expectation, novelty and nerves, curiosity and uncertainty. In spite of how distracted they may seem, students are paying attention. They want to find out as much as possible about the course and they are curious about the instructor - will you be fair, interesting, easy to learn from?

The first day of a geoscience course or lab sets the tone for the entire term. This is your opportunity to stimulate excitement about the course, give students a sense of classroom dynamics, and establish course expectations.

What can you do the first day?

- **Engage students with the course content** in a substantive activity that *stimulates their interest* in the course and *demonstrates your expectations* for their class work. Involve the students in making observations, asking questions, testing hypotheses, solving problems - in short: doing science, even on the first day.

- **Motivate your students to want to learn more**. Make explicit connections between course content and students’ lives, present information about careers in geoscience, preview “coming attractions,” or stimulate their interest with a challenging task.

- **Establish a positive classroom climate**. Easing students’ anxiety facilitates their learning, and it’s never too soon to begin. “Icebreaker” activities can be very effective in fostering rapport and a comfortable learning environment.

- **Survey your students**. Finding out what your students want to learn in the course, surveying them about their current attitudes/beliefs toward geoscience, assessing their current knowledge (and misconceptions) about the subject matter, or having them complete a learning styles inventory can provide you with valuable information for your teaching.
First Impressions are Lasting Impressions

- Engage with course content
  - Introduce the first topic
  - Practice geoscience skills
- Motivate student learning
  - Connect the course to students’ lives
  - Challenge students to solve a problem
  - Highlight career opportunities
- Establish a positive classroom climate
- Survey your students: knowledge, attitude, learning styles...
1<sup>st</sup> Day of Class Activities

More than 50 activities
From Starting Point
Just-in-Time Teaching

"As you enter a classroom ask yourself this question: If there were no students in the room, could I do what I am planning to do? If your answer to the question is yes, don’t do it." - Gen. Ruben Cuéllar, Dean of The Faculty, United States Air Force Academy

What is Just-in-Time Teaching (JITT) - a combination of active learning and internet technology
Students in introductory courses read assigned material outside of class, respond to short questions online, then participate in discussion and collaborative exercises the following class period. The instructor’s in-class use of student responses to questions draws the students in, engaging them with the course material both outside of and in the classroom. Read an interview with Gregor Novak, a JITT pioneer; a detailed description of the JITT cycle of learning; a geoscience example WarmUp exercise; JITT learning goals; and a list of ways you could implement JITT in your courses.

Why use Just-in-Time Teaching - students think about and work through course material outside of class
Students are engaged with course content outside of and before coming to class, leading to increased student learning and motivation to learn. The exercises also allow instructors to assess student understanding of the course material. And instructors who use JITT also say they have more interesting conversations with students about the course material, both outside of and during class.

How to use Just-in-Time Teaching - WarmUp exercises with follow-up in-class discussions
Step-by-step guidance on implementing Just-In-Time Teaching in your classroom, from choosing the technology you’ll use to posting questions and collect student responses to finding or writing appropriate questions to incorporating students’ responses into your class.

Examples of JITT WarmUps for introductory courses
JiTT: What, Why and How, + References & Examples

WarmUps (web-based homework questions) are followed by interactive classroom sessions using students’ responses.
NEW: Expanded How to Use JiTT

- Logistics: technology & scheduling
- Finding and choosing WarmUp questions
- Constructing your own questions
- Reviewing student responses
- The class that follows
Experience-Based Environmental Projects

Created by Karin Kirk, Montana State University

Get your students involved in their own learning!

This module includes examples of projects, background information and teaching ideas to promote experiential environmental learning. These projects can get your students personally involved and invested, moving the learning experience from the classroom to their own lives.

Every student has an environmental impact.

All of our decisions and actions throughout the day affect our environment. What types of transportation do you use? Is your food locally-produced or shipped from another state or country? Does a product’s packaging influence your decision to buy it? Do you go through the day using energy and resources without considering the environmental impacts of each of your actions?

These questions can be explored with an experience-based approach. Experience-based environmental learning is an opportunity to learn through one’s own lifestyle and actions. In a sense, each student is their own laboratory. Experience-based environmental projects offer a way for students to apply classroom topics like energy use, global warming, water quality and land use to their own lives, and to realize that although these issues may be global or regional, they ultimately have roots at the individual level.

"It seems impossible to not produce garbage for even one day. At first it didn’t sound like a big deal, but after trying it for just this first day I realized just how much garbage I normally produce! It’s embarrassing!"

excerpt from a Lifestyle Project Journal, Skidmore College
The Lifestyle Project

Students make changes to their lifestyle to decrease their impact on the environment:

- Turn down the heat
- Create less waste
- Conserve electricity and water
- Leave the car at home
- Eat efficiently
- Other…
The Lifestyle Project

Students choose 3 categories, and are challenged to make greater changes each week for 3 weeks.

Kolb’s Cycle of Experiential Learning

Concrete Experience

Reflective Observation

Abstract Conceptualization

Active Experimentation

Image by Karin Kirk
For the Future

- Pre-AGU one-day workshop on Teaching Introductory Geoscience
- Pedagogic modules under development:
  - ConcepTests
  - Guided Discovery Problems
  - Jigsaws
  - Lecture Tutorials
  - Structured Academic Controversies
  - Teaching Large Classes
  - Teaching Metacognition
  - Teaching Problem-Solving Strategies
  - Teaching Urban Students
  - Teaching with Google Earth
http://serc.carleton.edu

On the Cutting Edge:
http://serc.carleton.edu/NAGTWorkshops/index.html

Teaching Introductory Geoscience Courses:
http://serc.carleton.edu/NAGTWorkshops/intro/index.html

Starting Point:
http://serc.carleton.edu/introgeo/index.html