The BeAM Project

This document contains a brief background/description, BeAM project objectives, and important dates. Please see the BeAM page on Sakai for detailed instructions & rubrics for each part of the BeAM project.

"The most common misunderstanding about science is that scientists seek and find truth. They don't—they make and test models."

-Neil Gershenfield, Physics Professor and Director of the Center for Bits and Atoms at MIT (2011)

Background:

In this course, you are learning to utilize some aspects of the scientific method. Specifically, you are making observations and/or collecting and analyzing data so that you can draw conclusions about the natural world. We typically work within the classroom using models, because Earth systems are often too large or too complex to test directly.

People often think of models as simplified representations of "real" things—for example, a globe is a model of the Earth. However, in science the idea of a model goes further that just making a simple representation. The model is often an experimental tool, and the results of testing a model allow us to make hypotheses, or predictions, about what will happen in the "real world." The better the model is, the better the data fits with observations of the natural world.

Some examples:

-A globe is a model illustrating the Earth. It's size and shape, and the distribution geographic features, are based on observations of the natural world

-The equation, $Fg=m_1m_2/r^2$ is a model illustrating how the mass of two objects and the distance between the two objects describes the force of gravity between them.

-A geologic cross-section made using cores is an example of modeling the Earth's subsurface

-The predicted path of the 2017 solar eclipse was a model, utilizing information such as the orbits of Earth and the Sun, as well as topographic information from the Earth and Moon. Read this article for more: https://www.space.com/37128-how-to-predict-eclipse-2017-path.html

Project Description:

The purpose of this project is to help you with the first few steps of the scientific process- the parts that have been done for you in most of our laboratory exercises. Here's what you'll do:

1. **Develop a scientific research question** having to do with one of the "big ideas" in Geoscience.
   ** Big ideas can be found in video form here:*
   https://www.youtube.com/playlist?list=PLEo276NPbrpX5Js3Q6H4Fw-_ht7RNSbwm
2. **Formulate an experiment** to come up with an answer to your research question.
   **Note that this experiment needs to be something that a middle or high school teacher could use in his or her class to teach about the "big idea" you chose- so the scope of your question and experiment needs to be relatively narrow.*
3. **Design a physical, numerical, or computer model** that will be used as part of the experiment. You should **work in the BeAM lab** to help create your model.
4. P**erform your experiment**, or, if you are unable to perform it in full, generate hypothetical data that you might have collected if your hypothesis was supported, and if it were not supported by the experiment.
5. W**rite a lesson plan** to outline how a teacher could use this model/experiment in the classroom

Course Learning Objective Addressed:

- Students will apply the scientific method, including the formulation of scientific questions and the use of multiple working hypotheses, to solve problems concerning Earth processes

Specific Learning Objectives for BEAM Project

- Students will design an experiment to test research question they develop about one of the "big ideas" in geoscience
- Students will be able to define **and** create a scientific model to generate or test hypotheses in their experiment
- Students will interpret the data collected in their experiment (or give possible interpretations of the data) to determine which hypothesis is best supported

Important Dates

- Feb. 02, **1%** points: *Part 1*- Complete BeAM Makerspace orientation by 5pm
- Feb. 16, **1%** points: *Part 2*- Complete BeAM preferences survey by 5pm
- Mar. 5,6, or 7, **2.5%** points: *Part 3*- Complete BeAM project proposal by the end of class
- Mar. 26, 27, or 28, **2.5%**: Part 3.5- Complete peer critiques by beginning of class
- Apr. 6, **2.5%**: Complete BeAM model design by 5pm
- Apr. 16,17, or 18, **10%**: Complete your BeAM lesson and experiment, and present to class

Readings/More information:

Scientific Models:
https://scienceornot.net/2012/01/17/science-uses-models-to-explain-aspects-of-the-real-world/
https://blogs.agu.org/magmacumlaude/2011/03/02/geologic-models/
https://pubs.usgs.gov/sir/2012/5159/SIR12-5159.pdf

Ideas for making (3D, physical) models and experiments:

**remember: making it is not enough! It must be useful as a hypothesis or aid in your lesson /experiment!*

- topographic maps (with or without vertical exaggeration)
  - http://touchterrain.geol.iastate.edu/
  - **Experimental idea**: Predict the shape of an ocean that could form at the site of the current East African Rift Zone. More details: https://geology.com/articles/east-africa-rift.shtml
- Mineral crystal systems
  - https://serc.carleton.edu/NAGTWorkshops/data_models/3Dprinting/3d_models_serc.html
  - **Experimental idea**: Simulate the process of gneiss formation using 3D printed crystals of minerals commonly found in gneiss
- Fossils
  - https://serc.carleton.edu/NAGTWorkshops/data_models/3Dprinting/3d_models_serc.html
  - https://sketchfab.com/tags/fossil
  - **Experimental idea**: Compare how the size of trilobites changes over time
- Create a 3D model of the Moon's surface
  - http://jthatch.com/Moon2STL/
  - https://nasa3d.arc.nasa.gov/search/moon/3dprint
  - **Experimental Idea**: Compare the minimum and maximum elevation changes on Mars to Earth, and differentiate between the mechanisms responsible for creating them
- Create a 3D model of Mars' surface
  - https://nasa3d.arc.nasa.gov/search/mars
  - **Experimental Idea:** Model the terrain Mark Watney traverses in "The Martian," and determine what created the landscape features he had to negotiate