What's Up
Down There?

Name: Chris Davidson
Contact Information: chdavidson@weber.k12.ut.us
Course Name: 7th Grade Integrated Science

Core Curriculum Standard Fulfilled:

- Standard II: Students will understand the relationship between properties of matter and Earth's structure.

Core Curriculum Objective Fulfilled:

- Objective 2: Analyze how density affects Earth's structure.

Intended Learning Outcomes (ILOs) Fulfilled:

1. Use Science Process and Thinking Skills
   f. Distinguish between factual statements and inferences.
4. Communicate Effectively Using Science Language and Reasoning
   a. Provide relevant data to support their inferences and conclusions.
   f. Construct models to describe concepts and principles.

Time Needed To Complete Inquiry: 1-2 days

Inquiry: What is the research question to be scientifically investigated by the students?

- Based on observable evidence, what can you infer about the interior structure of the earth?

Will you use Structured Inquiry, Guided Inquiry, or Open Inquiry as the teaching method?

- This lesson will utilize guided inquiry.

Prior Knowledge Needed: What background knowledge and skills do the students need to be prepared for this inquiry? How will they obtain it?

- By the time this unit is taught, students will have already been presented with density, mass, volume and calculating density. Also students will already have done the layered separation lab.

Introduction: Tell how you will introduce the inquiry to your students to make it meaningful and relevant.

- Read newspaper article, see attachment

Materials / Resources Needed for the Investigation:

- Blank foldable, or sketch pad
- Colored pencils or markers
- Guided notes (I chart)

Procedures of the Investigation: Describe the actual investigation. What will the students do? If applicable, identify the independent and dependent variables, the constants, and the repeated trials.

PART I:

- Discuss early models of the Earth. Discuss why people thought it was flat, and how that has changed over time. Discuss Halley's idea of the Earth's interior being composed of concentric spheres (see attached news article). Ask the class: "Did Halley have any observable evidence to support this idea?"
- Pass out I-Chart and have students work on this during your class discussion, or students can work in a notebook.
- Ask students: "What kind of geologic events occur on the surface of our planet that may give us some indication of what it is like under the surface?"
- Develop a list on the board. If necessary, steer students to remembering about volcanoes, hot springs, geysers, etc.
- Students will then work in groups of 4 and come up with one model of the interior structure of the earth to draw within their group. They will also write a short paragraph providing evidence to support their model. Make sure the students understand that scientific understandings are based upon evidence and that they are beginning to develop a scientific understanding of the Earth's interior. Reciting prior knowledge of what they have seen in a textbook (or other source) will not work because they have no evidence to support that model.
- Ask students to write down any questions that come up during their group discussions.
- Groups will then present their models and evidence to the class. As a class discuss the merits of each model presented. Does the model show evidence

to support it? As a class come to a consensus. The model they should develop at this time should be an Earth with a solid crust (observable around us) and a hot, molten liquid interior (this is supportable by the fact that molten lava comes out of volcanoes and other geothermic events). At this point in time, students do not have any other observable evidence to support other models of Earth's interior structure.

- Students can also present any new questions that they came up with.

PART II:

- Then present the information that the AVERAGE density of the earth is 5.5 g/cm^3. Briefly explain Newton's Law of Gravity was used to calculate the mass of the Earth and the volume of a sphere is easy to calculate. These values were then used to calculate the AVERAGE density of the Earth.
- Then relate back to the "Calculating Densities" lab. Ask students: "Based on the data that you collected in the "Calculating Densities" lab, what can you infer about the densities of the interior and crust of the Earth now that you have this new information?"
- Students should infer that the interior of the earth has to be more dense than the crust because rocks (some of the most dense material in the crust) only have a density of about 2.5 – 3.0 g/cm^3.
- Have students add this new information to their model of the Earth in their sketch pad / foldable.

Data Collection: How will students collect and organize data (tabulation)?

- I-Chart
- Sketch pad / Foldable

Data Analysis: How will students be able to interpret the data (e.g., graphs), to reach consensus (if appropriate)? How will they draw conclusions?

Students will be using a valid scientific method quite different than what is traditionally presented in textbooks. They will be drawing conclusions based on evidence they can observe and information provided to them to develop a model of Earth's interior structure. They will reach consensus of acceptable models based on their ability to account for the evidences at hand.

Assessment: How will you know that your students have met the objective? Are there application extensions to this activity, interpretative test items, etc.?

- Formative assessment occurs as groups present and come to a consensus.

Optional activities:

Writing

- Describe an adventure to the center of the earth. Describe the different layers as you move through them.
  - What would you see along the way?
  - How would a machine be able to get you to the center of the earth?
  - Use some of the following vocabulary: generalize, conclude, hypothesis, theory, variable, measure, evidence, data, inference, infer, compare, predict, interpret, analyze, relate, calculate, observe, describe, classify, technology, experiment, investigation, tentative, assumption, atmosphere, atom, crust, density, diffusion, gas, liquid, models, mass, matter, molecule, particle, solid, temperature, heat energy, volume

Internet/Art

- Find 10 pictures of evidence that support the idea that the earth has a liquid layer. Make a poster or collage with those pictures.

History

- Research more about why people thought that the earth was flat. Why did this change? Were there any legends or stories of people sailing off the edge of the earth? What did early maps / models of the earth look like?

Classroom Management

For this lesson plan to be successful a good classroom management plan needs to be in place. Here are a few simple tips for ensuring a successful, positive learning experience:

- Break students into groups of four.
- Explain to students that this is science, and we use data to make inferences. Not everyone's model will be the same, and your model will change as you get new information.
- In their groups of four, students will come to a consensus of a model of Earth's interior structure based on the evidence at hand.
- Each group will be presenting their model with evidence that helped shape their drawing to the class
- As a class, the merits of each model presented will be discussed in its ability to use the data at hand. This is an important time to use formative assessment in assessing student understanding.
- Use some sort of foldable, or sketch pad that students will be able to draw subsequent models of the Earth on.
- Establish a signal to get everyone's attention quickly.
- Have clear goals, objectives and expectations on the board and review them prior to the activity or lesson.
- Your students should already know your discipline procedure. Enforce it!
- Make sure students understand that it may take a few minutes for you to come around to help everyone. Be a problem solver!
- Teach the 3 **A**'s:
    - **A**sk yourself, **A**sk your neighbor, then **A**sk the teacher.
- Don't forget the positive praise. Stop class and direct everyone's attention to a group or a student who is doing a good job if you think it will benefit everyone.
- Use formative assessment to guide your instruction along the way.
- Listen to what students are discussing.
- Look for comprehension (thumbs up, thumbs down, or daily quizzes).
- Take some time at the end of class to reflect and discuss what students learned.
- Have fun!

Newspaper article link:

Believers seek doorway into Earth's interior realm

Richard Foot
CanWest News Service

www.canada.com

Wednesday, May 30, 2007

An American scientist and a small band of believers are planning a journey to the Canadian Arctic for what they call "the greatest geological expedition in history."

Are they searching for Arctic oil reserves? Documenting evidence of climate change?

Not quite. They're looking for a fog-shrouded hole in the Arctic Ocean that leads - they claim - to the centre of the Earth, where an unknown civilization is lurking inside the hollow core of the planet.

This time next year, Kentucky-based physicist and futurist Brooks Agnew hopes to board the commercially owned Russian icebreaker Yamal in the port of Murmansk, and to sail into the polar sea just beyond Canada's Arctic islands.

"Everest has been climbed a hundred times," Agnew says. "The Titanic has been scanned from stem to stern. (But) this is the first and only expedition to the North Pole opening ever attempted."

Agnew is the latest in a long line of people to peddle the nutty, yet persistent, theory that humans live on the surface of a hollow planet, in which two undiscovered openings, near the North and South poles, connect the outer Earth with an interior realm.

In the 17th century, English astronomer and mathematician Sir Edmond Halley, who calculated the orbit of Halley's Comet, advanced hollow-Earth theories, as did German scientist Athanasius Kircher.

The theory gained traction in the United States in the 19th century when John Symmes, a St. Louis trader, published a wildly popular article announcing that "the Earth is hollow and habitable within; containing a number of solid concentric spheres, one within the other, and that it is open at the poles. . ."

Symmes spent years spreading his theories and, in the 1820s, even petitioned the U.S. Congress - unsuccessfully - for money to find the North Pole opening and to colonize the Earth's core.

Soon afterwards, French author Jules Verne had fun with the notion in his book Journey to the Centre of the Earth, which in turn inspired a 1959 Hollywood movie.

More recently the myth has experienced a slight revival, thanks in part to a 2006 book, by American author David Standish, titled Hollow Earth: The long and curious history of imagining strange lands, fantastical creatures, advanced civilizations, and marvelous machines below the Earth's surface.

A year before the book was published, a Utah adventure guide named Steve Currey also tried to cash in on the hollow-Earth legend, by organizing an expedition to locate the North polar opening.

Currey made a living organizing rafting trips to the world's wildest rivers. He knew how to hype exotic destinations and recruit would-be explorers on trips of a lifetime.

It's not clear whether Currey was a true hollow-Earth believer, or if he could simply see a good business opportunity. Whatever his beliefs, Currey somehow pinpointed the Arctic portal at 84.4 degrees north and 41 degrees east, roughly 400 kilometres northwest of Ellesmere Island.

The North Pole inner Earth expedition was scheduled for the summer of 2006, with spaces offered to anyone with $20,000 US to spare.

"There are no guarantees that this expedition will reach inner Earth," Currey cautioned on his website. "The expedition will make a good-faith effort to locate the North Polar opening and enter therein, but worst-case scenario is that we visit the geographic North Pole, explore the region, and continue on . . ."

When Currey died suddenly of brain cancer last summer, Brooks Agnew stepped in to take his place. The trip was postponed to 2008.

While he insists the journey has a genuine scientific purpose, Agnew also says the expedition will include several experts in meditation, mythology and UFOs, as well as a team of documentary filmmakers.

Randy Freeman, a Yellowknife writer commenting in the current issue of Up Here magazine, warns that "besides heaps of throwaway cash, prospective cruisers should bring along enough gullibility to swallow an outlandish theory that, despite centuries of scorn, refuses to die."

But Agnew is unfazed by such criticism, promising a grand polar adventure, no matter what the outcome.

If the polar opening isn't there, the voyage "will still make an outstanding documentary," he promises.

"But if we do find something, this will be the greatest geological discovery in the history of the world."

CLOSE WINDOW