Pat McQuaid 11/23/2002
Environmental Education LAI 535

Lesson Outline

Statement of Topic/Concept to be developed

The nature of science

Description of Topic/Concept

The nature of science should be a fundamental component in any science class. The common misconception that should not be propagated however is that science is the process of using a prescribed "scientific method". The nature of science is not a rigid machine designed to collect facts about the world, but rather a collection of strategies used to *explain* and *predict* natural phenomena. It is important to note that natural phenomena are those that can be measured or observed directly or indirectly using current technologies, and anything that falls outside that range is currently not science.

Also central to the nature of science is that the explanations and theories that are a product of scientific endeavors be subject to potential falsification. Science seeks not to prove something "true" but rather to design tests to see if a hypothesis is refuted. Only after many such unsuccessful attempts at refutation, does a hypothesis gain support and acknowledgement.

Another key aspect of the nature of science is its tentative character. Even if a theory has withstood many attempts at refutation, a critical mass of inconsistent observations can lead to an eventual disregard for a theory when a more suitable one is put forth.

How lesson leads to topic understanding and environmental appreciation

This lesson challenges students to evaluate an idea that they all have some degree of experience with, namely the idea that the earth is flat. They will begin to notice differences between the qualities of explanations when they prepare to support both the spherical and flat earth model with observable evidence. Students will be lead to believe that anyone can generate an idea of how things are or work, but without substantial observable/measurable evidence to support your claim it remains a non-scientific position. Students should also note that when more observations and details are discovered there is often a switch to a more appropriate explanation of something.

Evaluating evidence and explanations is important for environmental issues mainly because business interests are now funding their own research to support their claims or in defense of environmental infractions. For instance, car manufactures have a substantial interest in debunking the link between fossil fuel consumption and global warming/air and water pollution/middle-east instability. It is the world citizen's duty to be skeptical and analytical when evaluating the different evidence put forth by different sources.

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MST Standards

Standard 1 – Analysis, Inquiry, and Design

1.The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

3.The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

Grade/Subject

High School Science

Skills/Knowledge prerequisites

none

Lesson Setting

Classroom

Lesson Preparation Plan

- **Objectives**

  Students will recognize how scientific explanations differ from non-scientific explanations.
  Students will recognize that scientific explanations can change, and why this happens.
  Students will recognize that some explanations are better than others, and why.

- **Implementation strategies**

  Students will be engaged in class discussion both as individuals and small teams of students. Discussion will be prompted by pre-existing student experiences and selected readings.

- **Required materials**

  Selected readings referenced at end of lesson
  Overhead/LCD projector
  Direction transparencies/slides

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Lesson Presentation

- **Pre-lesson instruction/activities**

  As students enter the room direct them to respond, in writing, to the first slide: *"What shape best describes the earth? Describe the evidence that supports your answer."*
  Collect all unique responses and summarize for class discussion.

- **Description of approach/strategies used**

  1. Begin discussion by helping students analyze their introductory responses. Classify written response as to:
     - whether they are related to question or not
     - whether they are direct or indirect evidence
     - whether they also support another view of earth's shape

     Show historic representations of the earth (Ethical Atheist reference)

  2. Have students read "The Flat-Earth/Round Earth Controversy" by Stanley Weinberg. Pairs of students will share evaluate the flat-earth evidence. Class discussion on what makes something un-scientific (unobservable, non-repeatable, no predictive power, not supported by observations)
  3. Compare to what makes something scientific (predictive, observable, repeatable). Make class list of characteristics.

  4. Student groups develop a list of the elements of something that is scientific (6-10 terms). Have each group provide a copy of its list for the teacher. Reassessment of class discussion.

  5. Students then generate similar list for things non-scientific. Students should have both lists side by side.

  6. Using scientific/non-scientific comparison lists, students will go back and evaluate the "The Flat-Earth/Round Earth Controversy" reading. This time they will comment on the relative scientific nature of each set of evidence.

  7. Students will read "The balanced Treatment for Flat-Earth Science and Spherical-Earth Science Act" and apply their scientific/non-scientific comparison lists.

- **Assessment strategies/tools**

  Students will be assessed on their discussion contributions both in small group and in whole class. Standard checklist rubric would be implemented as feedback to student.

  - ❑ *Student made positive contributions to discussion*
  - ❑ *Student showed value toward other student contributions (no put-downs)*
  - ❑ *Student kept written account of main ideas*

  Given a sample article from the references, students will point out the scientific character of the article and the non-scientific character. Students' evaluation would be judged by how closely it held to our scientific/non-scientific comparison lists. A letter grade would be assigned according to degree of correlations.

- **Suggested follow-up application**

  Provide a copy of William Carpenter's "One hundred proofs that the earth is not a globe" and have students pick 3 "proofs" to research and evaluate scientific character. Report findings to class in a 5-10 minute presentation.

Resources/References

http://www.talkorigins.org/faqs/flatearth.html Flat Earth Society flyer

http://www.lhup.edu/~dsimanek/fe-scidi.htm Flat Earth Society article

http://www.id.ucsb.edu/fscf/library/RUSSELL/FlatEarth.html Myth of Flat Earth

http://www.ethicalatheist.com/docs/flat_earth_myth.html Ethical Atheist
THE FLAT EARTH: A Detailed Study of Personal Bias and Historical Thinking.

http://www.geocities.com/lclane2/hundreda.html William Carpenter "One hundred proofs that the earth is not a globe"