Investigation 1.4: A Case Study – Sea Ice Research

Objectives:
Upon completion of this activity, students will:

- Know that the sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared radiation (heat), and ultraviolet radiation. That light interacts with matter by transmission (including refraction), absorption or scattering (including reflection).
- Know that energy, enters an ecosystem as sunlight. It is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
- Define, "What is sea ice?" and communicate its value/role in climate, ecosystems and in research.
- Recognize how the history of the earth's climate is studied via ice core research and that technology used to gather data enhances accuracy and allows for analyzing and quantifying results.
- Use the tools, including and techniques, of scientific inquiry, to gather, analyze and interpret data including, graphing, reasoning, drawing conclusions and communicating findings.
- Think critically and logically to make relationships between evidence and explanation, as well as communicate procedures and outcomes.
- Understand that science and technology are reciprocal. Science helps drive technology, as it addresses questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis.

Method(s):

- Teacher, using background as reading, facilitates a class discussion with some key points about sea ice.
- Whole class works cooperatively to complete a lab activity.
- Students write a lab report.

Background:
Note: Have available as a transparency, a handout, in student journal or online.

- What is sea ice?
- So what does sea ice have to do with climate change?
- What is the scientific method?
- What are the skills and abilities of scientific inquiry?
- The Science of Light

Materials:

- Diagrams: Light Spectrum, wavelength
  Illustration of reflection, refraction, absorption
  Nutrient Cycle and Energy Cycle
- If available, video "Secrets of Ice" from Natural Resources Canada
- Student Journal Pages – Sea Ice Research
- Materials for Lab, "Which Get Hotter: Light of Dark Surfaces?" (Download Whichgetshotter.PDF).
  Lab write-up, lamp with 100 watt bulb, black cup/can with insulated lid, white cup/can with insulated lid, two thermometers and ruler.
- Materials for optional activity, "Core Sampling"
  Bread, peanut butter, jelly, cream-cheese (or other spread-able substitutes), knife, clear plastic straws.
- Recommended/Optional: Lesson, graphs and questions for, "Interpreting Ice Core Data" at http://www.secretsoftheice.org/icecore/studies.html

Assessment:

Constructed Response – Students will communicate their knowledge and ability of scientific inquiry and associated concepts by completing a lab write-up.

Procedures:

1. Prior to class, prepare lab and demonstration materials.
2. Begin class by asking the class, "What is sea ice?" (See background.)
3. Sea ice is important for a variety of reasons. Not only is it an important factor in climate and climate change, but it is also an integral part of the arctic ecosystem. Sea ice contains the free-floating, aquatic plants (a primary trophic level of the arctic food chain). Through these plants, the sun's energy is converted, by the process of photosynthesis, from light energy to chemical energy that can be passed and utilized by animals in the nutrient cycle. The presence of sea ice means the presence of a food source for marine animals of the arctic.
4. Sea ice, as we mentioned earlier, is also an important factor in climate and climate change research. Next you will complete a lab activity which will help you to draw some conclusions about sea ice and climate change.
5. As a class, complete the lab, "Which Gets Hotter: Light or Dark Surfaces?" (Download Whichgetshotter.pdf). As you and student assistants complete steps of the lab, students should be writing corresponding entries in their journal. Assist students in identifying various steps and processes of scientific inquiry that are happening as you proceed. Make clear to students that if they are unclear about steps of scientific inquiry now is their chance to clarify. The next couple of classes, they will be completing similar lab write-ups and will need to understand these concepts to be prepared to ask the scientists the right questions to complete the lab write-up correctly.
6. After completion of the lab, ask students to extend their knowledge by inferring how this experiment simulates what might be happens in the Arctic ecosystem. (Energy, from the sun, enters the ecosystem and can be absorbed, reflected or refracted. Use diagrams of the energy cycle and light spectrum to illustrate this. Sea ice reflects sunlight. This reflection can be studied – Albedo research. Read the background information about Albedo.
7. If available, watch the video "Secrets of Ice" from Natural Resources Canada.
8. Read Background information about "Ice Core Research"

9. Optional activity, demonstrate core sampling technology. This can be done by building a sandwich with lots of thick layers (i.e. bread, peanut butter, bread, jelly, bread cream-cheese, bread, etc.) this is what will be sampled - ice. Then bend the sandwich showing how the layers of ice can be in various directions. Next, using a clear drinking straw, take a core sample of ice by pushing the straw through the layered sandwich. Show students the resulting "Core Sample". The layers are useful for dating as well as offering information about conditions at the time.
10. Recommended/Optional extension see below, "Interpreting Ice Core Data" extension activity.
11. Conclude the class, by having students summarize the importance of sea ice. Then lead a discussion about the ice albedo research that they will participate in during the next class. Where is Barrow anyway? Briefly talk about what they should expect on the virtual field trip and what will be expected of them.
12. Have students brainstorm (in their journal) and share questions that they have about ice albedo and research methods. What will they need to ask the scientists next class?

Extensions:

- Online or printed version, complete the lesson, graphs and questions for, "Interpreting Ice Core Data" at http://www.secretsoftheice.org/icecore/studies.html

Resources:

- Video "Secrets of Ice" from Natural Resources Canada (See resource section for contact info.)
- Hajo Eicken's website about sea ice. Excellent glossary, descriptions, photos, etc. www.arcticice.org