Natural Inquirer Scientific Process Module

Unit 2, Lesson 3: Design the Experiment and Answer the Question

Objectives:

- Students will be able to read and explain information from a science article.
- Students will be able to describe at least two different methods for studying a scientific problem.
- Students will be able to design their own way to solve scientific problems.
- Students will be able to explain the importance of accurately recording information and making good observations.

Time Needed:

2 weeks

Materials (for each student or group of students):

- *Natural Inquirer* monographs or articles
- Compare & Contrast Methods Graphic Organizer
- Blank paper or notebook
- Writing utensil

Once a question or problem has been clearly defined, scientists must then design and implement data collection, analysis, and reporting of findings. This hands-on part of the scientific process is the part most often engaged in by students. But this part of the scientific process is just that: a part of the process. A successful science project should include all of the parts, even if they are truncated because of time or other constraints. However, data collection and analysis are the parts of the scientific process that are the most fun for students, educators, and scientists!

Some of the things scientists consider when designing data collection are:

1. How can I measure and record the quality that I am interested in?
2. How can I maintain consistency in data collection?
3. How can I account for outside influences, such as time of day or year, environmental variations, etc.?
4. How will I summarize and compare the data?

Scientists collect data through observation, asking questions (in social sciences), and the use of technology. Sometimes the scientific process involves setting up experiments and sometimes it involves observing and recording what happens naturally. The research presented in *Natural Inquirer* has examples of both experimental designs and non-experimental designs. Natural resource scientists sometimes use a laboratory to set up their experiments, but often experiments are set up in the outdoor environment.

It is important for scientific data to be accurately collected and recorded, and for scientists to maintain their honesty and integrity throughout the process of data collection and analysis.

Once data are collected and recorded, they are entered into a computer program for analysis. Analysis serves one or two purposes: to summarize and/or compare the data. It is important to emphasize that computer programs do not “do” the analysis. Scientists do the analysis using computers and other technologies as tools.

After the data have been summarized and/or compared, the findings must be presented for the review of other scientists (and eventually for the users of the findings, such as doctors, environmental managers, or the public). Scientists use charts, graphs, maps, figures, and text to present their findings. At a minimum, a research paper includes the sections presented in *Natural Inquirer* articles: Introduction, Method, Findings, and Discussion. We will cover “Discussion” in a subsequent lesson.

Methods

Prep

Familiarize yourself with the chosen *Natural Inquirer* monographs or articles. Make copies of the Compare & Contrast Methods Graphic Organizer.

Note: To limit the amount of materials, reuse the *Natural Inquirer* publications selected in Unit 1, Lesson 3.

Day One

Provide students the chosen *Natural Inquirer* monographs or articles. Students will not be reading the entirety of any article, but will instead focus on reading just the "Introduction" and the "Methods" of each article.

As students read the two sections from each article, direct them to complete the Compare & Contrast Graphic Organizer to the best of their ability. The graphic organizer has an example on it to show how students should be entering information.

Day Two

Provide time for students to complete the graphic organizer as discussed in the previous class. If some students are reading at a higher level, and other articles are available, encourage them to continue reading new articles and entering that information into the graphic organizer.

Once students are finished with the graphic organizer. Review the graphic organizer as a class. If students had time to do an additional article, ask those students to share what they read with the class. Their classmates should write the information about that article in their graphic organizer (even if they didn't read it).

Days Three-Four

Give students a few minutes to review the information in their graphic organizers. Hold a class discussion about the similarities and differences among methods used in the articles. List the similarities and differences on the board for all to see. This would be a good time to discuss qualitative versus quantitative research and how they relate to different types of research questions or problems. Point out any remaining similarities or differences that would be valuable for students to understand that were not covered by the class discussion.

After the class discussion, ask students to revisit the science problem or question that was used in Unit 2, Lesson 2. Using that problem or question, direct students to devise a way to test the problem or question. Alternatively, split the class into groups and provide each group with a problem or question that you have created. Have the groups devise a way to test the problem or question. Have students write down the methods they think will work best on a blank piece of paper or their notebook.

Day Five

Students, or the groups of students should then present their research question or problem and the methods they believe should be used to test it. If appropriate, open up the discussion to the class to see if other students have ideas on how to test the problems or questions presented.