Directions, Students, and Science Projects—Oh My!

Jenny Sue Flannagan, WHRO

Overview

Topic: Designing science projects, writing directions, scientific method, and experiments. To get what you want out of a project, you have to *know* what you want out of a project. Students understand terms such as independent and dependent variable, but many students are so used to following lab directions that when they have to write their own, they can't. This lesson teaches students not only how to write quality directions to be used in a lab experiment, but it also gives students a chance to design their own experiments.

Length of Lesson

Approximately 90 minutes

Instructional Video/Technology

Challenge of the Unknown #6, Outcomes: How Do I Get There?

Learning Objectives

The student will be able to:
- write a clear and precise set of experimental procedures.
- plan and conduct investigations in which: hypothesis are stated in ways that identify the independent variable (manipulated) and dependent (responding) variables; the hypothesis is tested through repeated trials; constants and controls are identified; valid conclusions are made after analyzing data. (Va. SOL Science 6.1, LS 7.1, PS 8.1)

Materials

For the Teacher:
- overhead projector
- box of crackers with inner bag unopened
- a plastic knife
- plastic spoon
- paper plate
- a jar of jelly with the lid
- a jar of peanut butter with the lid
- teacher supplement: checklist for evaluating procedure (attached)
- 3 different brands of paper towels (1 ply, 2 ply, 3ply)
- 3 beakers
- water (10 ml, 20 ml, 30 ml)
- butcher's paper

For Students:
- pencil
- paper
- 3 different paper towels (1 ply, 2 ply, 3 ply)
- water (10ml, 20 ml, 30ml)

Pre-Viewing Activities

1. Cover a demonstration table with butcher's paper to serve as a protective barrier and have all utensils (knife, spoon) on a paper plate.

2. Tell your students to individually write the directions for making a peanut butter and jelly cracker sandwich on a piece of paper. Allow about five minutes before collecting their papers.

3. Ask for one volunteer to come up to demonstrate for the class how to make his/her sandwich. The student is to make the sandwich by precisely following their own directions, as you read them aloud. If a student does not describe opening the box, the inner bag, or the jar, they should sit down empty handed and hungry. Do not let students shift hands, put things down, or open their mouths unless the directions instruct them. Let 3-4 different students attempt to complete the task using their directions.

4. Ask: What have we learned? Lead discussion to conclusion that directions are important.

Focus for Viewing

Tell the students that the short video they are about to watch will show us another example of what can happen if we don't give clear-cut directions.

NOTE TO THE TEACHER
Pause vs. Stop

When using a video interactively with students, teachers need to decide when to use **PAUSE** and when to use **STOP**. **PAUSE** the video when the anticipated discussion or activity will take less than two minutes. **STOP** for longer periods. Pausing for too long at one time can cause video heads on the VCR to become clogged which may require cleaning to correct.

Viewing Activities

1. Focus: Explain to the students that they are to pay close attention to the video to discover the problem. **START** the video ***Challenge of the Unknown #6*** with the **SOUND OFF. STOP** the video when the painter puts his hand on his hip and the screen fades to black. Ask: What was the problem the painter was given? Do you think he understood the assignment? Have you ever been given a task and did not understand the assignment?

2. Focus: Let's see how the painter solved the owner's request. **RESUME** the video with the **SOUND OFF. STOP** the video when the sandwich shop owner comes out and sees the tiny painting of the sandwich on the billboard. Ask: Did the painter do what the owner wanted? How could the sandwich owner explain his ideas better?

3. Focus: Watch this next segment and look for the new directions given to the painter by the sandwich shop owner. **RESUME** the video with the **SOUND OFF. STOP** the video when the painter looks the sandwich from the top down. Ask: What do you think the information was that the painter received from sandwich shop owner? Why do you think he is confused?

4. Focus: What do you think the painter will paint this time? **RESUME** the video with the **SOUND OFF. STOP** the video when the owner comes out and see the sandwich painted from the top down view. Ask: How could he have cleared up his expectations with the painter? Do you think his directions were very clear? How could he have made his directions of what he wanted painted on the mural more clear? Lets see if we can write directions that can lead someone else through our science experiments.

Post Viewing Activities

1. Designing your own experiment. Tell students in order to write a procedure for a science experiment, you need to visualize the steps necessary to conduct the experiment, identify the necessary materials and equipment, and finally write a set of procedures for the experiment. Tell them their experiment will be to test different paper towels' absorption rate.

2. Prepare students for the writing phase by asking them some questions to get them thinking about their experiment. Ask students:
Question 1: What materials are readily available for

conducting an experiment on paper towels? (Different brands of paper towels)

Question 2: How does a paper towel act? (It soaks up water or other liquids)

Question 3: How can you change the set of paper towel materials to affect the action? (Change the brand of paper towel)

Question 4: How can you measure or describe the response of the paper towel to the change? (Measure the amount of the liquid soaked up by different brands of paper towels)

3. Have students go through their answers to their questions in their groups and fill out the experimental design table. (attached)

4. Once students have filled out their handout (Experimental Design Sheet "Paper Towel Lab"), they will be ready to write the procedure for the experiment. Have students visualize the steps they would follow to test different absorption rates of three different brands of paper towels. Sample steps would be:

1. Obtain three different brands of paper towels
2. Tear off one sheet of each brand
3. Measure out different amounts of liquid
4. Pour liquid on table surface
5. Use paper towel to pick up spill

5. Have students work in groups to go over their steps for how they would conduct the experiment. Students should try to duplicate the experiment from the directions. While they are performing the experiment, they should check the directions for the procedure to see if they left out any step.

Assessment

Have students use the rating criteria to evaluate their experimental design. (See teacher supplement). Give students the opportunity to write more procedures. Examples: ask students to write a detailed and precise procedure to test the various amounts of oil on the number of popcorn kernels, the affects of different amounts of fertilizer on plants, or the affects of different amount of sunlight given to plants.

Action Plan

1. Throughout class, students have worked to write procedures for experiments that will allow anyone to complete the experiment. Have students exchange their write-ups with students at a local high school to try the experiments and give students feedback.

2. Plan a field trip to a local college to allow students to shadow a scientist for a day.

3. Bring a scientist from the community to speak to students on the different types of research/experiments that are done by scientists in the real world.

Extensions

Social Science: Experiments are part of a scientist's life. Have students research the history of scientist and describe one of their most famous experiments. Use the ITV program ***Great Science Stories*** to inspire students. Students can use this program to examine not only the history of science but learn information about the person who made the discovery.

English: Grammar and sentence structure is important in an experimental design. Have students work with their English teacher to review and edit student's experimental design for mistakes.

Mathematics: Graphing is a key element in interpreting data in science. Students can work with their math teacher to decide when and what type of graph is appropriate depending on the type of data. Have students present their experiments to the class using their graphs created in math to compare and contrast data from their experiments.

Music: For scientist, procedures are how experiments are done. Allow students to study and research how musicians write their directions for composing music. Students can work with the music teacher to also investigate how music has been influenced by the times and whether there was a change in the directions for composing music.

Have a musician come in and talk about the "language of a musician" and how directions are written for music.

Art: Allow students the opportunity to draw their procedures instead of writing them.

Computer/Technology: Go online to get science fair ideas on the web. Check out the following Internet sites:

<www.discovery.com>
<www.istf.ucf.edu>
<www.ala.org>
<www.ipl.org/youth/projectguide/>