Activity: Procedure Pictures

FOR THE TEACHER

Summary
In this activity students are put into groups of 2 – 3 and are then charged with developing a procedure to investigate a provided “fact or fiction” statement. The twist to this task is that they are not allowed to use words; their entire procedure must be represented in pictures. This idea is based on the recent “Can You Picture That?” article by Julie Damico in the February 2014 edition of The Science Teacher magazine.

Grade Level
High school

Objectives
By the end of this activity, students should be able to
- identify relevant, independent, dependent, and control variables for a research question.
- plan/organize the steps necessary to conduct a simple investigation.

Chemistry Topics
- Experimental design
- Laboratory procedures
- Scientific questioning

Time
Teacher Preparation: 15 minutes
Lesson: 1-2 class periods

Materials
- Poster size pieces of paper
- Markers and pens

Safety
- No specific safety precautions need to be observed for this activity.

Teacher Notes
- I use this activity at the beginning of the year with my accelerated chemistry students. This comes after a couple of days discussing the basic components of performing research to answer a question/solve a problem. Topics that we discuss/review prior to doing this activity include independent/dependent/control variables, how to phrase a scientific question, and proper data sampling (i.e. don’t just do it once!).
- Some suggested “fact or fiction” statements include:
  - Adding salt to water when cooking spaghetti makes the water boil faster.
  - Eating sugar makes little kids hyperactive.
  - A watched pot never boils.
  - Ice is more slippery when it’s warmer.
The grass is always greener on the other side of the fence.
- Hair grows faster in the summer than the winter.
- An apple a day keeps the doctor away.
- Hot water freezes faster than cold water.
- If an egg floats on water then it is bad.
- Mixing more Mentos into Diet Coke makes a bigger reaction.

- The final step of this will almost certainly need to be done as a next-day follow-up if you are teaching in a typical 1-hour class period.

**Cross-Disciplinary Extensions**

**Connect to Math**
- This does involve representing numbers (trials and measurement values) in a graphical method. A follow-up to this activity could include writing out a procedure for the statement and deciding what would be the best way to represent collected data (i.e. what graph format would give the best way to represent and interpret the collected data).

**Connect to Reading**
- Students will be reading their statement and coming up with a way to translate that into another format (graphical).

**Connect to Writing**
- At the end of this activity students do some short writing on how the poster could be improved. They are expected to provide justification for their suggestions.
- This activity can lead directly in to having students write out and perform an actual investigation (which is actually what I do following this activity).

**Connect to Social Studies**
- Discussions around historical discoveries and how people made them could ensue after performing this activity. The discussion should focus on pointing out how the inventor, scientist, or researcher used the scientific or engineering process to gain their understanding/breakthrough. Possible examples could include Edison’s **invention of the light bulb** and the **discovery of radioactivity** by Becquerel and Marie Curie.

**FOR THE STUDENT**

**Lesson**

**Experimental Design: Procedure Pictures**

**Background**
An important part of studying chemistry (and science in general) is being able to organize and carry out an experiment. No matter what question or problem a researcher is trying to answer or solve, they must be able to set up a process that will give valid answers. In addition the process must be easily understood and potentially reproduced by others. During this activity your goal is to create an experimental procedure that can determine whether a given statement is fact or fiction. There is one twist to this - your procedure must be drawn out in pictures with no words involved!
**Prelab Questions**  
Define the terms: independent variable, dependent variable, and control variable.

**Objective**  
Develop a procedure using only pictures that can be used to scientifically determine whether a given statement is valid.

**Materials**  
- Large piece of construction paper  
- Pens, markers, etc. for drawing

**Procedure**  
1. With your lab partner, obtain a large piece of construction paper and a few pens or markers.  
2. Once ready, your teacher will give you a “fact or fiction” statement. Do not share the contents of this statement with any other group!  
3. You will have approximately 20 – 25 minutes to accomplish the following:  
   a. Use the paper and pens/markers to draw a picture (or series of pictures) to represent the steps involved in determining the validity of your statement. *You may not use any words or letters on your poster, but numbers are permitted.*  
   b. Your poster should be designed so that another person can figure out the question you’re researching as well as the process that you’re planning on using to research that question.  
4. Keep in mind the following key ideas when making your drawing(s):  
   - What are the independent, dependent, and relevant control variables?  
   - What measurements need to be made?  
   - What equipment is needed?  
   - What sequence of steps need to be performed?  
   - How many trials/samples need to be performed or tested?  
5. Find a location in the classroom to display your poster. Number it on the front (use the number on this statement given to you by the teacher). Put your names on the back of the poster.

**Observations**  
Once everyone’s posters are put up you will be given a list of possible statements. View each of the posters and write the poster number next to the statement that you think it corresponds with. You are not to talk while doing this! Turn in the list to your teacher once you believe that you have identified each of the statements.

**Analysis**  
Team up with your lab partner and pick a poster other than the one that you drew. The teacher will give you the actual statement that goes with the poster. Now that you know what the poster is trying to present answer the following questions:  
1. Was the statement actually something that can be validly answered in a scientific experiment? Provide reasoning to justify your answer.
2. How well did this poster communicate the question and procedure? Provide reasoning to justify your answer.

3. List any information that was missing from this poster or that could be improved. Provide a drawing on a separate sheet to represent at least one of these improvements.

4. Once completed, give your suggestions to the creators of that poster. Once you have received your own poster read through the suggestions, discuss them with your partner, and turn everything in to the teacher.