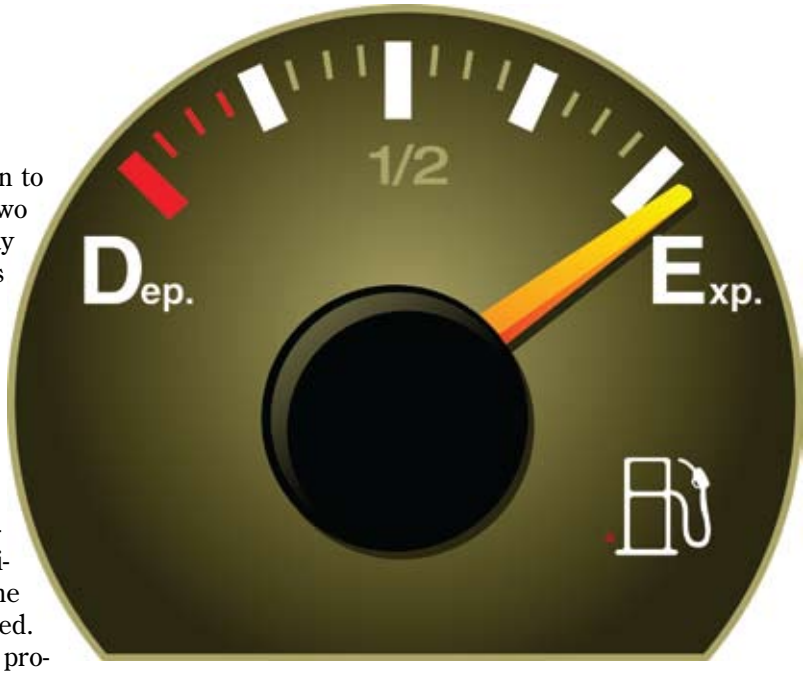
The Great Fakesperiment



Whenever science fair time rolls around, I mention to my students that the projects are assigned for two reasons: to be proud and to have fun. The best way for a student to be proud of a science fair project is to truly understand what it entails. For a middle school student, this does not mean describing the stoichiometry of a baking soda–vinegar reaction. It means making sense of the experimental process. A student who understands how to conduct an experiment knows that large amounts of evidence are gathered through multiple trials. It means determining the best tool for making measurements. A student who understands the experimental process can explain what is changing in the experiment and what will be measured and recorded. However, an understanding of the experimental process does not happen with one science fair project experience alone.

Weeks before the words "science fair" are uttered in my classroom, students complete a series of short experiments to reinforce their understanding of variables—what to change and what to measure. The favorite is always shooting rubber bands. Students work in teams of two or three, deciding if they would rather shoot wide and skinny rubber bands using a constant launch stretch, or shoot rubber bands of constant widths using varying launch stretches. As a class, they determine that, for either choice, a simple and useful result to measure is the distance the rubber band flies. After arming them with rubber bands, rulers, and meter sticks, we all put on goggles, stand back, and let the rubber bands fly.

This year, after finishing the rubber band lab, I decided to assess whether my students had mastered one concept within the experimental process—independent and dependent variables. Results of the informal assessment surprised me and led to the "Great Fakesperiment" activity. Despite having completed three lab activities especially designed to teach them the role of variables in experimentation, most students could only make the distinction between independent and dependent variables when given a lot of prompting. Even calling the independent variable the "experimental variable" only helped a few students. The rest were confused.

I created an activity in which students would be exposed to several experiments during a single class. The Great Fakesperiment was based on 10 fictitious experiment examples. These examples included a brief description of what the experiment was about, asked students to identify the independent or dependent variable, and listed possible answers (see Figure 1). I scattered the examples around the room and distributed a note card to each student. Students were directed to answer each of the questions and then show me their note card. When a student had answered all 10 questions, I quickly reviewed the answers and marked the incorrect ones. Then I directed the student to attempt the incorrect ones again. Any student who had correctly answered all of the questions was enlisted as a "fakesperiment consultant" to those students who were making further attempts.

The Great Fakesperiment activity ended with students partnering to create their own fake experiment in which they identified the independent and dependent variables. I displayed their examples so that we could refer to them later on. The activity, in addition to the previous lab activities, allowed students to deepen their understanding of variables and to think critically about how scientists choose what to change and what to measure as they design more complex experiments. These could be used for formative and summative assessments, as well.

Lisa Schunk *(lisa.schunk@gmail.com)* was most recently a middle school science teacher at The Congressional School of Virginia in Falls Church, Virginia.

FIGURE 1 The Great Fakesperiment classroom stations

Station #1: Cars get better gas mileage when their tires are properly inflated. Sayeema wanted to test if this was true, so she filled the gasoline tank in her car, inflated the tires to the car maker's suggested pressure, drove her car, and then calculated the miles per gallon. The next time she filled the car's tank with gasoline, she reduced the pressure of air in her tires. Once again she drove the car over the same roads and calculated the miles per gallon. She tried the process again with tires that were inflated a little more than the suggested pressure.

What is the experimental variable?

(A) gas mileage
(B) tire inflation pressure
(C) type of gasoline used
(D) roads where the car was driven

Station #2: Music may help people relax. Darius got two groups of people together. He took everybody's pulse and blood pressure. Then he allowed one group to listen to soothing music while the other group sat in silence. After the song was over, he measured everyone's pulse and blood pressure again.

What is the dependent variable?

(A) sitting in music or silence
(B) pulse and blood pressure
(C) type of music
(D) Darius

Station #3: Preservatives such as salt help keep food fresh. Imaan made 18 loaves of bread using the same recipe and baking method. In nine of them, she used no salt. In the other nine, she used salt. After the loaves were baked, she placed each of the loaves in a plastic bag and left them close together on the counter in her kitchen. Each day she looked at them to see if any mold had started to grow.

What is the dependent variable?

(A) location of bread on the counter
(B) amount of salt used in the bread
(C) mold growth on the bread in the bags
(D) number of loaves of bread

Station #4: Baking soda is an ingredient in chocolate chip cookies, but not much of it is used in the recipe compared to other ingredients such as flour. James did not think the small amount could be important to the taste of the cookies. He made four batches of cookies using the same recipe. One batch had no baking soda, one had half the amount called for in the recipe, one had the required amount, and one had double the amount called for. After making the cookies, he had 25 people do a taste test and rate the cookies from delicious to disgusting.

What is the experimental variable?

(A) amount of baking soda put into the cookies
(B) number of batches of cookies he baked
(C) cookie taste
(D) amount of flour used in the cookies

Station #5: Emily made four paper helicopters. Each was made out of a different kind of paper. She flew each one several times in the hallway and recorded how long each stayed in the air.

What is the experimental variable?

(A) flight time
(B) number of helicopters
(C) type of paper
(D) hallway

Station #6: Ethan filled 10 cups of the same size with equal amounts of water. He divided the cups into five groups of two cups each. The groups were placed in five different locations around his house. After two weeks, he measured the remaining water to determine how much had evaporated, by measuring how much water remained in each cup.

What is the dependent variable?

(A) location of cups
(B) amount of time they were left in locations
(C) amount of evaporated water
(D) size of cups

Station #7: Whether paint is oil-based or water-based could determine how long it takes to dry. Liliana found two pieces of the same kind of pine wood and painted one with oil-based blue paint and the other with water-based blue paint. Then she timed how long it took for each piece to dry.

What is the dependent variable?

(A) color of paint
(B) oil-based or water-based paint
(C) drying time
(D) kind of wood

FIGURE 1 The Great Fakesperiment classroom stations *(continued)*

Station #8: Caffeine may make people more alert. Devin tested 100 people by using their scores in the same video game. Fifty of the people drank a can of regular Brand X caffeinated soda half an hour before they played the game. The other 50 drank a similar amount of Brand X caffeine-free soda before playing. He recorded each person's score on the game.

What is the experimental variable?

(A) amount of caffeine in the soda
(B) video game score
(C) amount of playing time
(D) number of people

Station #9: Richelle made an air-pressure device that could launch potatoes. She added air to the device using her bicycle tire pump. For 10 launches, she used 10 pumps of air. For another 10 launches, she used 20 pumps of air. For the final 10 launches, she used 30 pumps of air. After launching a potato, she carefully measured how far it traveled.

What is the dependent variable?

(A) number of pumps
(B) distance the potato traveled
(C) size of the potato
(D) kind of pump used

Station #10: Malcolm had always heard that plants grow better if you talk to them. He purchased 10 of the same kind of plant, measured the height of each one, and made two groups of plants that he kept in similar conditions. He talked to one group for a half an hour each day but did not talk to the other group. After three weeks, he measured and recorded the height of each plant again.

What is the experimental variable?

(A) talking or not talking to plants
(B) amount of plant growth
(C) number of plant groups
(D) kind of plants

Making a leap toward concrete inferences

There are many ways to help students answer questions about the natural world. Some questions can be answered by simply finding the answer online or in a book; other questions lend themselves toward investigating phenomena in a systematic way. As we train students to become inquirers, we help them to build a toolbox of skills to answer their science questions. The tools in this toolbox are known as *science process skills*—the specific skills that students need to learn through science experience and practice over and over again so that they can call upon the correct tool for the job when trying to answer their questions about the natural world.

Making inferences is a vital skill for any scientist. We make inferences all the time in our daily lives. As people walk by you on the street, you might make inferences about their age based upon how quickly they are moving, what clothing they're wearing, or the color of their hair. We take our observations and put together a conclusion based on past experiences. We might say, "I've observed that my grandmother has a dress like that and has a similar hairstyle, so that person must be the same age as my grandmother." The same thing happens in the natural world. We might see two squirrels running around and making noise and think, "Their