

LISELL

Lesson Starters

Controlling Variables in Experiments



Teacher Background

LISELL Inquiry Practice 2 - Controlling Variables

A variable is anything that can change. We can consider variables in a science experiment or in life more generally. The weather, the speed of a bike going down a hill, and the height of students in your class are all variables. In the LISELL project, we are particularly concerned with the role that variables play in the process of science inquiry. When students consider the practices of science inquiry, such as coordinating hypothesis, observation and evidence, or explaining cause and effect relationships, the only way they can be certain that they are correctly interpreting their observations and evidence is if they have adequately accounted for all possible variables.

Middle school students are often familiar with the term variables from math class, so it's important to clarify that the variables they think of as represented by letters such as x and y in math equations are different from the variables that we are talking about in science investigations.

In scientific experiments, we usually manipulate one variable and then attempt to determine the effect of this manipulation on another variable. Any other possible variables that could affect the process or outcome of the experiment need to be kept constant or controlled. **This attempt to prevent multiple variables from changing at the same time is what we mean by controlling variables.** The variable we intentionally change is called the *independent* (or manipulated) *variable*. The variable we want to observe to see how it changes is called the *dependent* (or responding) *variable*. The other potential variables that we wish to prevent from changing are called *controlled variables* or constants. **Variables should be stated as something that can be observed or measured.**

Consider the question: What is the effect of nitrogen fertilizer on the growth of bean plants? To design an experiment to answer this question, the *independent variable* would be fertilizers with different amounts of nitrogen (what we would manipulate). The *dependent variable* would be some measure of bean plant growth, such as plant height or number of beans (what change we would look for). We would try to *control* (or keep constant) all other possible *variables* that could influence bean plant growth, such as soil type, amount of sunlight, size of container, amount of

water, and other ingredients in the fertilizers. The only thing we would want to change for each plant would be the amount of nitrogen in the fertilizer (the *independent variable*). If all other possible variables are controlled, then we can logically conclude that any differences we see in bean plant growth are the result of different nitrogen levels in the fertilizers.

While the idea of controlling variables is not hard to understand, it can be difficult to do in practice because not all of the variables that can cause a change in an experiment are always obvious. Lesson starters that focus on identifying independent variables, dependent variables and constants in simple investigations are a good way for students to practice thinking, talking, and writing about controlling variables.

Students can practice identifying variables using pictures, diagrams or written descriptions of experiments as well as during actual investigations. This kind of focused discussion of concepts like variables is valuable for all students, but is particularly helpful for English language learners who are simultaneously developing their knowledge of the language and science. In the LISELL project, we want students to learn that controlling variables is a fundamental part of learning to do science, as well as a useful skill for making decisions in everyday life.

LISELL Lesson Starters Controlling Variables in Experiments

Preserving Apple Slices

Leticia wants to know how fast apple slices will turn brown after being soaked in different preservatives, such as lemon juice, fruit freshener, and Sprite.



Work with a partner to write the following:

- 1) What is the **independent variable** in Leticia's experiment?
(Remember that the independent variable is the variable that you change or manipulate)
- 2) What is the **dependent variable** in Leticia's experiment? (Remember that the dependent variable is the variable that changes in response to the independent variable)
- 3) List 2 other variables that Leticia will need to **control** in her experiment. (Remember that to control a variable means to keep it from changing)
- 4) Use **scientific language** to describe the experiment that Leticia could perform to answer her question.
Think about the way we express variables in science-your variables should be stated as something you could observe or measure.

LISELL Lesson Starters Controlling Variables in Experiments

Seeds for Birds

Maria has three types of food that she can put in her bird feeder: sunflower seeds, dried corn and peanuts. She wants to know which type of food will attract the most birds.



Work with a partner to write the following:

- 1) What is the **independent variable** in Maria's experiment?
(Remember that the independent variable is the variable that you change or manipulate)
- 2) What is the **dependent variable** in Maria's experiment? (Remember that the dependent variable is the variable that changes in response to the independent variable)
- 3) List 2 other variables that Maria will need to **control** in her experiment. (Remember that to control a variable means to keep it from changing)
- 4) Use **scientific language** to describe the experiment that Maria could perform to answer her question.
Remember that your variables should be stated as something you could observe or measure.

LISELL Lesson Starters Controlling Variables in Experiments

Baking Cookies

Freddy wants to know if the size of a cookie **determines** how long it needs to bake. He decides to do an experiment to find out.



Work with a partner to write the following:

- 1) What is the **independent variable** in Freddy's experiment?
(Remember that the independent variable is the variable that you change or manipulate)
- 2) What is the **dependent variable** in Freddy's experiment?
(Remember that the dependent variable is the variable that changes in response to the independent variable)
- 3) List 2 other variables that Freddy will need to **control** in his experiment. (Remember that to control a variable means to keep it from changing)
- 4) Use **scientific language** to describe the experiment that Freddy could perform to answer his question.
Remember that your variables should be stated as something you could observe or measure.

LISELL Lesson Starters Controlling Variables in Experiments

Evaporating Water

Juan has three fish bowls of different shapes. He is going on vacation and needs to **decide** which fish bowl to leave his fish in. He wants to know if the water in the fish bowls will evaporate at different **rates**.



Work with a partner to write the following:

- 1) What is the **independent variable** in Juan's experiment? (Remember that the independent variable is the variable that you change or manipulate)
- 2) What is the **dependent variable** in Juan's experiment? (Remember that the dependent variable is the variable that changes in response to the independent variable)
- 3) List 2 other variables that Juan will need to **control** in his experiment. (Remember that to control a variable means to keep it from changing)
- 4) Use **scientific language** to describe the experiment that Juan could perform to answer her question.

Remember that your variables should be stated as something you could observe or measure.

LISELL Lesson Starters

Controlling Variables in Experiments

Exercise

It is well known that regular exercise and healthy fitness **practices** can help you live longer. Some scientists think that regular exercise may have other **benefits** for young people. For example, a recent study of nearly 2 million students in Texas schools found that students who scored high on a cardiovascular fitness test were more likely to have better school attendance, to do better **academically**, and to have fewer disciplinary referrals than students who scored low on the fitness test. In other words, there are both short-term and long-term benefits to getting regular exercise as a young person and then sticking with it.



Work with a partner to write the following:

- 1) What was the **independent variable** in the experiment on students in Texas? (Remember that the independent variable is the variable that you change or manipulate)
- 2) What were the three **dependent variables** in the experiment on students in Texas? (Remember that the dependent variable is the variable that changes in response to the independent variable)
- 3) List 2 other variables that the scientists should try to **control** in this experiment. (Remember that to control a variable means to keep it from changing)

Remember that your variables should be stated as something you could observe or measure.

LISELL Lesson Starters Controlling Variables in Experiments

Bottled Water versus Tap Water

Throughout the world, bottled water has become **increasingly** popular in recent years. People see many **benefits**. Besides being convenient, many people think bottled water is purer, safer, and better tasting than tap water from the sink. These ideas may largely be a result of advertising, which shows that bottled water comes from crystal clear mountain springs or the run-off of pure glacial water.

A group called the Natural **Resources** Defense Council (NRDC) decided to **conduct** an experiment to see if bottled water sold in the United States is actually purer and better tasting than tap water in this country. In a four-year study, the NRDC tested the chemistry of over 103 different brands of bottled water. They also conducted blind taste tests to see if people could tell the difference between bottled water and tap water.



Work with a partner to write the following:

- 1) What was the **independent variable** in the experiment on comparing water samples?
- 2) What were the two **dependent variables** in the experiment on comparing water samples?
- 3) List 2 other variables that the scientists would have tried to **control** in this experiment.

LISELL Lesson Starters Controlling Variables in Experiments

Chlorinated Water

Using chlorine to kill microbes has a long history, both in swimming pools and in drinking water (the amount of chlorine added to drinking water is **significantly** lower than the amount added to swimming pools). It was more than 100 years ago, in 1908, that chlorine was first added to a city's drinking water to destroy germs. The city was Jersey City, New Jersey, and the person responsible for this **innovation** was a scientist named Harriette Chick. Dr. Chick was the first woman scientist to work at England's famous Lister **Institute**, where **research** is done on the causes, prevention, and treatment of diseases. Harriette Chick did experiments on the **factors** that **affect** how disinfectants, such as chlorine, kill germs. Thus, she was able to determine how much chlorine would be needed to add to water under certain conditions to make it safe to drink (or to swim in).



Work with a partner to write the following:

- 1) What was the **independent variable** in Dr. Chick's experiments on disinfecting water with chlorine?
- 2) What was the **dependent variable** in Dr. Chick's experiments on disinfecting water with chlorine?
- 3) List 2 other variables that Dr. Chick would have tried to **control** during her experiments.

Remember that your variables should be stated as something you could observe or measure.