

EXPERIMENTING SKILLS

Understanding Variables

Malcolm used his grandmother's recipe to bake a loaf of bread.

Bread

Grandma's Favorite Bread

- 1 1/2 cups warm water
- 1 package dry yeast
- 1 teaspoon salt
- 2 tablespoons sugar
- 2 tablespoon melted butter
- 3 1/2 cups flour

Mix all of the ingredients together, and knead well. Cover the dough, and let it rise for 2 hours. Put the dough in a greased pan, and bake at 400° F for about 35 minutes.

Unfortunately, Malcolm's bread collapsed while it was cooking. "Shucks!" he thought, "What could have gone wrong?" What could Malcolm change the next time he makes the bread? Two examples are given for you.

He could add more salt.

He could take the bread out of the oven sooner.

Varying Your Variables

A **factor** is anything in an experiment that can influence its outcome. A **variable** is a factor in an experiment that can be changed. For example, because you can change the amount of salt in the bread recipe, the amount of salt is a variable.

Malcolm's grandmother suggested that he added too little flour or too much liquid. Therefore, Malcolm thought about changing one of the following three variables:

- the amount of water
- the amount of melted butter
- the amount of flour

Understanding Variables, continued

In science class, Malcolm learned to change only one variable at a time. Why is that important?

Scientists strive to perform controlled experiments. A **controlled experiment** tests only one factor at a time. In a controlled experiment, there is a control group and one or more experimental groups. All of the factors for the control group and the experimental groups are the same except for one. The one factor that differs is called the changed variable. Because the variable is the only factor that differs between the control group and the experimental group, scientists can be more certain that the changed variable is the cause of any differences that they observe in the outcome of the experiment.

Malcolm tried reducing the amount of water to 1 cup. Thus, he made the amount of water the changed variable. What factors did Malcolm control? (Hint: There are several of them! Refer to the recipe.)

As it happened, Malcolm chose the right variable to change. With less water, the bread came out perfect. He concluded that only 1 cup of water should be added.

Inputs and Outputs

The **outcome** describes the results of your experiment. For instance, when you bake bread, the outcome is the quality of the loaf of bread. Often an outcome is something that you have to measure. Following is an example.

Henry and Eliza conducted an experiment using plant fertilizer. They added different amounts of fertilizer to seven pots of bean sprouts. The pots were the same size and had the same type and amount of soil. They were given the same amount of seeds, light, and water. To find out how the fertilizer affected the growth of the sprouts, Henry and Eliza calculated the average height of the bean sprouts in each pot. Here are the factors in their experiment:

Changed variable: amount of fertilizer

Controlled factors: size of pots, amount of light, amount of water, amount of soil, number of seeds

Outcome: average height of bean sprouts



Understanding Variables, continued

Your Turn

Identify the changed variable, controlled factors, and outcomes in the following examples:

1. In a recent study, middle school students were given a math exam after various amounts of sleep. One group slept 8 hours or more, and the second group slept fewer than 8 hours. The students had similar skills in math. They ate the same meals the previous day. The study results showed that students who slept 8 hours or more scored better on the exam, while students who slept less than 8 hours scored worse.

Changed variable: _____

Controlled factors: _____

Outcome: _____

2. Our science club built a catapult out of craft sticks, glue, and a rubber band. We wanted to determine what size rubber band was best for launching a gumball across the classroom. If the rubber band was too small, the gumball wouldn't travel very far. If it was too big, it would be too loose to work well. We found that a rubber band with a circumference of 11 cm shoots the gumball the farthest.

Changed variable: _____

Controlled factors: _____

Outcome: _____

TROUBLESHOOTING
Remember that variables are things that can be changed. In each scenario, ask yourself what *could* have been done differently.

TRY THIS!
Make the bread recipe that appears on page 28. Remember to add only 1 cup of warm water!