

DID YOU KNOW YOU WERE A SCIENTIST?

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Science...It's Everywhere!

What is science? Contrary to popular belief, science is not a collection of facts and figures. Science is a way of doing things. Specifically, it is a way of gaining knowledge about things we don't know yet, and organizing that knowledge into theories. So science is a *method* of gaining new knowledge, and that new knowledge is the *product* of science. There are scientific explanations for many of the things in our everyday lives.

Here are a few activities to illustrate how the knowledge gained through science is at work in everyday life.

Activity One: That's Quite a Reaction!

For this activity you will use a one-liter plastic soda pop bottle, vinegar, baking soda, measuring spoons, a balloon, and some tape.

Put about one teaspoon of baking soda into the bottle. Measure out three tablespoons of vinegar. Have the balloon handy and ready to attach to the mouth of the bottle. Add the vinegar and immediately attach the balloon. Secure the balloon with tape if necessary. Observe what happens!

You will notice fizzing and bubbling when the vinegar is added to the baking soda. Enough gas may be produced to inflate the balloon. What is happening? You are observing a chemical reaction between vinegar (acetic acid) and baking soda (sodium bicarbonate). In a chemical reaction, the two substances in the reaction are changed into other substances. In this case, carbon dioxide gas is produced by this reaction, which causes the fizzing, the bubbling, and the balloon's inflation.

Activity Two: All Baking Products Are Not Created Equal

In this activity you will use baking soda, baking powder, two cups, and some water.

Put some baking soda into one cup and some baking powder into the other cup. Add some water to each cup. Observe what happens!

You will observe that nothing in particular happens when the water is added to the baking soda. It should form a white paste. When water is added to the baking powder, however, the mixture fizzes and bubbles. Why?

Baking *soda* is sodium bicarbonate, while baking *powder* is a mixture of sodium bicarbonate and a powdered acid. Adding water activates these powders and allows the sodium bicarbonate to react with the acid. What is the product of such a chemical reaction? (See Activity One.) When sodium bicarbonate reacts with an acid, carbon dioxide gas is produced. This gas is useful when it makes a cake or bread rise during baking! Using baking powder as an ingredient makes this happen. Using baking soda alone, however, will not be effective in this way.

Activity Three: All Things Change

Activities One and Two illustrate chemical reactions, or *chemical changes*. In a chemical change, the substances that are reacting are changed into different substances. That is, they have a different chemical composition after the reaction than they did before the reaction.

Many of the changes that occur in the world around us are chemical changes. Some, however, are *physical* changes. In a physical change, there is no change in the chemical composition of the substances involved in the change. For example, cutting fabric is a physical change. The fabric is the same chemically before and after the change. Only the shape changes. On the other hand, adding vinegar to baking soda is a chemical change. A new chemical substance (carbon dioxide) is formed in this reaction.

Discuss whether the following changes are chemical or physical changes:

- * Toasting bread until it is burned.
- * Boiling water.
- * Baking a loaf of bread.
- * Slicing a loaf of bread.
- * Burning a candle.
- * Tarnish forming on silverware.
- * Using vinegar to clean hard water stains.
- * Piecing a quilt.
- * Growing a vegetable garden.

(Answers: Toasting bread, baking bread, burning a candle, tarnish forming on silverware, and using vinegar to clean hard water stains are all chemical changes. Boiling water, slicing bread, and piecing a quilt are physical changes. Growing a vegetable garden is a tricky one! The plants change physically as they grow by water moving into and enlarging their cells and by the division of their cells. However, there are lots of chemical changes taking place in plants as they carry out photosynthesis to make "food" and respiration to metabolize it.)

How Are You a Scientist?

Do you ever think of yourself as a scientist? We tend to think of chemists, physicists, biologists, and other laboratory researchers when we hear the word "scientist." Actually, anyone who uses the scientific method can be a scientist, and we all do that whether we know it or not.

The scientific method is the way scientists *do* science. It's really very simple. The first step is to ask a *question*. (Sometimes this is the hardest part!) This is usually a question about how some part of the world works. For instance, "what will happen if...?" After the question has been identified, the scientist makes an educated guess (a *hypothesis*) about what the answer to that question will be. Next comes the experiment to *test* the hypothesis. This is where you find out if your educated guess was correct or not. If it wasn't, that's okay. Scientists learn as much from incorrect hypotheses as they do from correct ones. After the experiment has been performed, scientists draw some sort of *conclusion* related to the question.

Some examples of using the scientific method in daily life are following a new recipe, making changes to a recipe for the first time, using a new product for the first time, and so on. Can you think of others?

What About Technology?

Technology is a term that is often used in conjunction with science. Many people lump science and technology together, but they are not exactly the same thing. While science is the process of gaining new knowledge, technology is the process of *using* scientific knowledge, along with tools and skills, to meet human needs. Like science, technology is a way of doing things. Just as there is a scientific method, there is also a technological method. Inventors and engineers are examples of people who use the technological method.

The technological method starts with *designing* a solution to a human need. Inventors and engineers do this when they design new products, or new models of existing products, to meet new human needs (hence the phrase "necessity is the mother of invention"). The next step is to *produce* the product according to the design. After producing the new product, technologists *test* the product to make sure it works as they hoped it would. Depending on the results of the test, the technologists may then *revise* the design to make it better. From there, the process starts all over again.

Some examples of using the technological method in daily life include designing and making a new quilt, changing a recipe because you do not have one of the ingredients, making an item of clothing from a pattern, assembling a product labeled "some assembly required," and so on.

Notice that not all of the above examples utilize all of the technological method. Sometimes part of it has been done for you. When you assemble a product according to the instructions in the box, the design has already been carried out. You do the producing and the testing. When you design and make a new quilt, you may test it in various ways, but whether you revise it may depend on how much time you have.

Science and technology are two different processes, but they go hand in hand. Science provides the knowledge that technology uses to meet human needs. On the other hand, technology often provides new tools and processes that make the work of scientists easier. Whether we realize it or not, science and technology are everywhere, and we are a part of them!

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