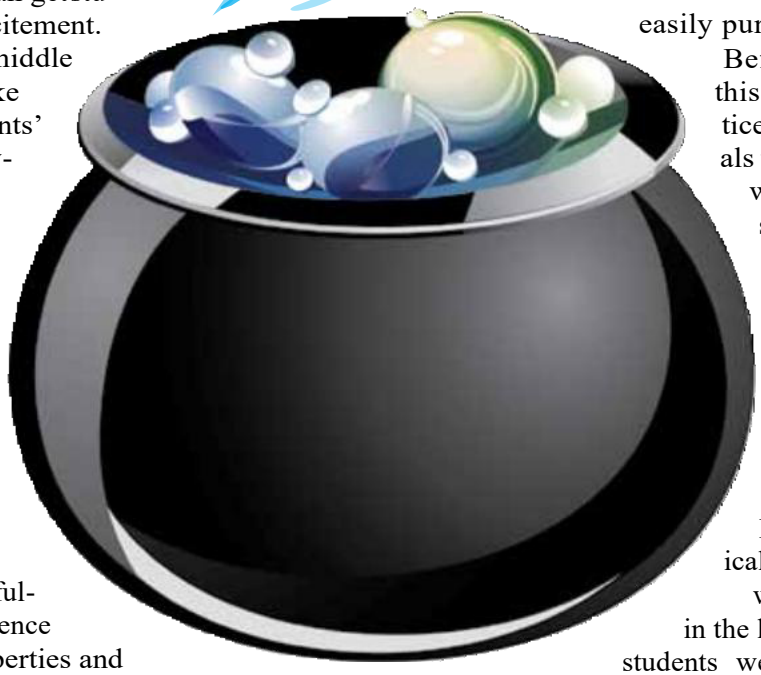
The Halloween lab

by Stacey Hoffman



There are certain school days when students are full of extra energy and less focused than we would like them to be. For example, the day before a break, days near the end of the school year, and holidays such as Halloween and Valentine's Day can get students buzzing with excitement. When I was teaching middle school, I decided to take advantage of my students' enthusiasm for Halloween to create the Halloween lab, which uses physical and chemical changes to teach students about changes of state, exothermic reactions, properties of solids and liquids, and chemical reactions while creating some Halloween "magic."

Performing this lab fulfills several national science standards, such as properties and changes of properties in matter, understanding about scientific inquiry, and chemical reactions (NRC 1996). While I don't grade the lab, I do check to see if students have answered the questions on their Activity Worksheet. The Halloween lab can be completed in one 42-minute class period, and I spend about 15 minutes the next class day reviewing the lab questions and reinforcing what students learned in class.

Students work in groups of two, and each student is given an Activity Worksheet to record observations. I set up the supplies for both parts of the lab at each lab station so that as students complete one part, they can move right on to the next without having to leave their table. All of the materials, except for those used for the teacher's demonstration, can be donated by students or easily purchased.

Before students conduct this lab in class, do a practice run with all the materials to make sure you know what the expected results will be and where the difficulties might be for students and make any needed modifications to procedures and amounts of materials needed.

Safety

Indirectly vented chemical splash goggles must be worn at all times while in the lab. In addition, have all students wear gloves and aprons and remind them that they may not taste or eat anything used in the science lab. Have either running water or containers of water available to immediately rinse the skin of anyone who inadvertently comes in contact with the peroxide. Review and enforce all safety procedures on the MSDS sheet and remind students to report any spills immediately so they can be wiped up. I also discuss how each item should be disposed of—what can go in the sink and what cannot.

Part 1: Make some oobleck

In this activity, students create a substance called oobleck, which is considered a "non-Newtonian" fluid, meaning that the viscosity of the fluid changes as pressure is applied to it. The materials are very simple, and if students are not 100% exact in the measurements, it does not greatly affect the re- sults. On each lab table there is a large plastic cup filled with cornstarch from which students mass the amount needed. Have students add more of ei- ther water or cornstarch to get the oobleck to the correct consistency (a peanut-butter-like viscos- ity), using a plastic spoon or popsicle stick to mix it up. Be sure students keep their hands over the lab area, or the oobleck will drip all over the floor (although it is quite easy to clean up by letting it dry and brushing it away with care not to breathe the dust).

Students are amazed at the viscosity changes in the oobleck, and they have a great time seeing what happens when they squeeze this substance or stab the surface with a finger. This force leads the fluid to behave like a solid rather than a liquid: As they squeeze it, the substance gets harder and sometimes even crumbly. As the pressure is released, the oobleck seems to magically turn into a liquid, oozing and dripping between their fingers. Students record all of their observations on the worksheet.

Although there are some students who have made oobleck at summer camps, this activity never ceases to be popular with the class, and students are astounded to hear that if I filled up a pool with oobleck, they could walk right across it (as long as they walked with even pressure and speed). There are several videos of "pool walking" on the internet.

Part 2: Get slimed

The purpose of this lab is to again show changes in physical properties as two liquids are combined to form a solid substance. The slime is an excel- lent example of a polymer and can be used as a springboard for discussion later in the year when talking about chemical bonding. Many students might have played with Silly Putty when they were younger; the slime is very similar in chemical composition to Silly Putty. Before they begin the activity, students predict what they think will happen when the two liquids are combined. After they are done making the slime, they practice observation skills by noting what they see, how the slime responds to pressure, etc.

Part 3: Fire burn and cauldron bubble

An excellent example of an exothermic decomposition reaction occurs during this teacher demonstration. I adapted this activity, often called "elephant toothpaste," and gave it a Halloween flair by refer- ring to it as the bubbling cauldron and modifying it to be made in a half-liter water bottle versus the traditional two-liter soda bottle that is seen in many videos online.

For safety reasons, I do not let students perform this activity, as it is not recommended that middle school students use 20% hydrogen peroxide. Ev- eryone present in the classroom, students and teachers, must wear indirectly vented chemical splash goggles and aprons during the demonstra- tion. The teacher must also wear gloves. Complete this part of the lab in a well-ventilated area, as the 20% hydrogen peroxide can be caustic to the eyes, nose, and throat. Tell students that this experi- ment should not be repeated at home and that this peroxide concentration (20%) is much higher than the 3% most people have at home and can be very damaging to human tissue.

The peroxide can be purchased at a beauty supply store for approximately $6 for one gallon, which is plenty for all of my classes. One jar of yeast, which also costs approximately $6, will be enough for all classes. The peroxide can be disposed of by run- ning water while pouring the peroxide down the drain of a sink.

Materials

- empty 20 oz. plastic bottle
- 130 mL 20% hydrogen peroxide solution
- 4 grams active yeast
- liquid dish detergent
- food coloring

Materials note: The amounts must be kept at this level to prevent the reaction from getting out of control and dangerous for students around it.

Teacher procedure

1. Fill a labeled graduated cylinder with 130 mL of hydrogen peroxide solution.

2. Add a few drops of dish detergent and a drop of food coloring to the graduated cylinder. Gently swish the bottle around to mix the ingredients. Set the bottle in the sink.
3. Add the yeast to the bottle and tell students to watch, paying attention especially to the top of the bottle. Ask them to describe what they see and smell.
4. If you desire, ask for a student volunteer to put on gloves, feel the bottle, and describe what he or she notices to the rest of the class.

The reaction

Hydrogen peroxide (H_2O_2) is a reactive molecule that readily decomposes or breaks down into water (H_2O) and oxygen and gives off heat in the process.

Activity WorkSheet: halloween Lab

What happens when you mix common everyday items together in different ways? Today you will find out! Every substance has specific chemical and physical properties that make it unique. The purpose of today's experiments is to show you how when two or more substances are combined, the properties of the substance(s) will often change. A physical or chemical reaction is taking place when this happens.

Safety precautions

Indirectly vented chemical splash goggles, gloves, and aprons must be worn at all times for all parts of these labs. Do not taste or eat anything used for this lab. Report any spills immediately. None of the materials or final products may be taken out of the lab.

Part 1: Make Some Oobleck

Materials

- 40 g cornstarch
- 27 mL water
- paper bowl
- spoon or popsicle stick
- triple beam balance

Procedure

1. Mass 40 g of cornstarch in the paper bowl (mass the bowl first, then add 40 grams).
2. List some of the physical properties of the cornstarch.
3. Do not stir but instead slowly mix in 27 mL of water to the bowl.
4. What are the physical properties of this substance, called oobleck?
5. Let each lab group member pick up a small amount of the oobleck and squeeze it. What happens?
6. Open your hand—now what does it do?
7. Slowly insert the popsicle stick. Does the oobleck stay in the liquid or solid state? Now try to quickly pull the stick back out again.
8. Describe the physical changes that occur as you apply more or less force to the oobleck.

Part 2: Get Slimed!

Materials

- water
- green food coloring
- 3 tablespoons white glue (~10 4 oz. bottles total for all classes)
- 10 g borax laundry booster (1 76 oz. box of borax, which costs ~$3, is sufficient for all classes)
- plastic bowls or large plastic cups
- plastic forks
- triple beam balance

Procedure

1. Mixture 1: Pour 120 mL of water into a bowl. Add 2 drops of green food coloring and 3 tablespoons of white glue to the bowl and mix together with the plastic fork.
2. Mixture 2: In a second bowl, mix 190 mL of warm water with 10 grams of borax laundry booster until the borax is entirely dissolved.
3. Slowly pour the glue mixture into the borax mixture, but do not mix them together. Swirl the glue mixture around in the borax mixture about five times.
4. Carefully take the glue mixture out of the bowl and knead it for about two minutes.
5. What are three physical characteristics of the slime?

Since this lab is done before students learn how to read equations, I included instructions for reading the equation on their worksheet.

The reaction releases oxygen gas that develops into huge bubbles, thanks to the dish soap, so the appearance is that of toothpaste oozing from a tube, hence the name "elephant toothpaste." Adding the food coloring gives an even more dramatic effect,

a. _____

_____

b. _____

_____

c. _____

_____

Part 3: Fire Burn and Cauldron Bubble (teacher demonstration only)

What's happening?

Hydrogen peroxide (H_2O_2) is a reactive molecule that readily decomposes or breaks down into water (H_2O) and oxygen and gives off heat in the process. When a reaction gives off heat, it is called an exothermic reaction.

$$2H_2O_2 \longrightarrow 2H_2O + O_2(g)$$

(Read the equation like this:
Hydrogen peroxide breaks down into
water and oxygen gas.)

In this demonstration, yeast is used as a catalyst (a substance that speeds up a reaction) so the decomposition (breaking down) reaction proceeds much more rapidly than normal.

Procedure

1. Record what happens when the teacher adds the yeast to the bottle.
2. What are some of the physical and chemical changes occurring?
3. Define the word *catalyst.*
4. What is an example of a catalyst you might use in your home?
5. Define exothermic reaction.

creating a bubbling Halloween "cauldron."

While the demonstration is taking place, we discuss as a class what is happening—the yeast begins to make a "bread" smell that many students are familiar with, and we talk about the role of yeast in bread, and the difference between endothermic and exothermic reactions. When we review after the experiment, either at the end of class or the next day, I ask students if they have ever heard of a catalyst. Most respond that they do not know what a catalyst is, and that they have not used one. Then I ask, "How many of you or your parents have ever used OxiClean or any other 'oxy' cleaning product?" Most hands go up, and I tell them that they have used a catalyst: The substance in these products is a catalyst that works to speed up laundry clean- ing by breaking down certain compounds, such as grass and food stains, so the laundry is cleaner. In our classroom demonstration, yeast is a *catalyst* (a substance that speeds up a reaction) so the *decomposition* (breaking down) reaction proceeds much more rapidly than normal.

conclusion

This is an exciting lab that students have asked me to repeat at the end of the year, and I have had many students go home and try to make oobleck in their own kitchen. One of the benefits of this lab is that the supplies are inexpensive and easy to find. The simple design allows the study of physical and chemical properties in a manner that keeps stu- dents engaged and learning on a day where their minds might otherwise be wandering. Performing this lab also helps students to improve their obser- vation skills and increases their ability to work in cooperative groups. Students learn about changes of state, exothermic reactions, chemical reactions, and properties of liquids and solids in a very en- gaging lesson. n

Reference

National Research Council (NRC). 1996. *National science education standards.* Washington, DC: National Academies Press.

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