Pyrotechnic Gummy Bear

Fume Hood Demonstration

The Rundown

Time: 10 minutes
Content: Decomposition, combustion, chemical change, exothermic reactions
Safety Concerns: Moderate
Materials Availability: Potassium chlorate and a fume hood are necessary for this reaction. All other materials are common.

Didn't your chemistry teacher always tell you never to bring food or drink into lab? This is one of the major laboratory safety rules we emphasize at the beginning of each school year. So how can we as chemistry teachers get away with incorporating food (gummy bears) in a demonstration? Well, it is not for eating purposes. In fact, this demonstration emphasizes to students why they should NOT bring food into the lab. You never know what might happen to your reaction materials if a gummy bear or two falls into the mix!

Content Application

- Decomposition
- Combustion
- Exothermic Reactions

Enduring Understandings

- The production of light is evidence for a chemical change**.**
- Combustion reactions are exothermic reactions during which energy is released.

Chemistry

There are several different pieces of evidence that can be observed that indicate that a chemical change, or chemical reaction occurs. Some reactions involve changes in color, odor, or temperature, while others result in the production of a gas, precipitate, or light. All of these observations indicate that a chemical change is taking place.

There are also several different kinds of chemical reactions. In a **decomposition** reaction, a complex substance breaks down into multiple simpler substances. It typically involves the breakdown of a compound into two or more elements, or into an element and a compound.

Combustion reactions involve the reaction of a hydrocarbon compound with oxygen to produce carbon dioxide and water.

In this demonstration, a number of the previously mentioned observations can be made. Two reactions occur, one right after the other. The first reaction that takes place is the decomposition of potassium chlorate in the presence of heat. Metal chlorates tend to decompose into a metal chloride and oxygen gas. The reaction that takes place is as follows:

$$2KClO_3\ (s) \rightarrow KCl\ (s) + 3O_2\ (g)$$

In this reaction, the evidence for a chemical change is the production of oxygen gas. We know that it is produced because of the reaction that follows. Oxygen gas is necessary for any combustion reaction to occur. Through the addition of a gummy bear (sugar) to the decomposition products, the sugar reacts with the oxygen to produce carbon dioxide and water:

$$C_{12}H_{22}O_{11}\ (s) + 12\ O_2\ (g) \rightarrow 12\ CO_2\ (g) + 11\ H_2O\ (g)$$

In this second reaction, energy is released in the form of heat and bright light. As such it is considered to be an exothermic reaction.

Materials

1. Gummy Bear Candy (different colors)
2. Small amount (2 to 5 grams) of Potassium Chlorate
3. Large test tube
4. Ring Stand
5. Bunsen Burner or other heat source
6. Tongs

Safety

- Goggles and apron – This reaction is very vigorous and the test tube may explode.
- Reaction should be done in a fume hood since a small amount of chlorine gas is produced during the combustion portion of the demonstration.
- Do not point the opening of the test tube towards any individual as products may fly out as a result of the energy produced.

Procedure

Figure 1: Before

1. Set up a large test tube (tilted) over a heat source (Bunsen burner).
2. Add a small amount of potassium chlorate to the test tube.
3. Wait until the potassium chlorate starts to liquefy.
4. Using long tongs, drop the gummy bear into the test tube.
5. Stand back.

Figure 2: After

Disposal

- As it is very difficult to actually clean the large test tube following this reaction, the easiest way to dispose of the products is to throw the entire test tube into a glass waste container.

Student Participation and Follow-Up

Questions to ask:

1. What observations were made?
2. Was this a physical or a chemical change that occurred?
3. Predict the two reactions which took place and write equations for them (decomposition of a chlorate followed by combustion of sugar).
4. What else was produced other than new chemicals?
5. Was this an exothermic or endothermic reaction?

Follow-Up:

1. In order to compare and contrast this exothermic reaction with one that is endothermic, show the students a reaction between solid barium hydroxide and solid ammonium thiocyanate, which is a demo in this manual ("Endothermic Glue").