Pure Substances and Mixtures	Grade 7: Matter and Energy

Lesson Plan

Safety Notes: Ask for help when using an oven.

Description

Students will learn the difference between a pure substance and a mixture by experimenting with household items.

Materials

Baking Powder Experiment

- Little bowls or a big tray
- Baking soda
- Cream of tartar
- Corn starch
- Baking powder
- Little spoons
- Vinegar
- Water
- Iodine (drugstore)
- pH indicator (red cabbage juice or Butterfly Peaflower tea) *See below on how to make at home
- Toothpicks

Healthy Yummy Baking Powder Experiment

- 2 Ripe bananas
- ¼ Cup milk (Alt.: Any non-dairy milk)
- ½ Cup peanut butter (Alt.: WowButter)
- 1 ½ Cups oats
- ⅓ Cup crushed walnuts (Alt.: shredded coconut)
- ½ Cup chocolate chips
- 2 tsp ground cinnamon
- 1 tsp baking powder
- Large bowl
- Oven
- Baking sheet
- Fork and spoon
- Measuring cups and spoons

Science Background

Particle Theory Background

Matter is any substance that has mass and takes up space. All matter is made up of many small particles called atoms, and they are in a continual state of motion. How much these particles move is determined by the amount of energy they have and their relationship to other particles. Matter exists in various states or phases, the most common of which include solids, liquids, and gases. Other states of matter can exist under highly specialized conditions, such as plasma and Bose-Einstein condensate.

Pure Substance

A pure substance is something that has a constant composition (homogeneous); the properties of the substance remain the same regardless of the size. In other words, the substance cannot be broken

down any further. The pure substance will be in the form of a gas, liquid or solid. For example, sugar ($C_{12}H_{22}O_{11}$) is a pure substance because regardless of the size of the sugar crystal its molecular composition remains the same; pure water (H_2O) is also a pure substance for the same reason. This does not mean that it cannot become a mixture, if sugar is mixed with salt or sand it becomes a mixture, just like if salt is added to water, it becomes salt water.

Mixture

A mixture occurs when two or more pure substances are combined. A mixture can either be homogeneous or heterogeneous. An example of a homogeneous mixture would be sugar water. When sugar is added to water, it dissolves completely throughout the water. When two substances mix so that one part of the mixture (e.g. the top of the cup) has the same composition (make-up) as a different part of the mixture (e.g. the bottom of the cup). Homogeneous mixtures can also be called a solution. A solution can be a mixture of any different state of matter (e.g. gas and liquid (soda or pop), liquid and solid (juice), solid and solid (brass), etc.). An example of a heterogeneous mixture is sand and water. When sand is added to water it does not dissolve but sinks to the bottom, unless stirred. Therefore the composition of the mixture is not consistent or the same throughout. A heterogeneous mixture can be a mixture of any different state of matter (e.g. solid and solid (mixed nuts), liquid and solid (cereal with milk), liquid and liquid (balsamic vinaigrette), etc.).

Activity Procedure

Baking Powder Experiment

1. Use a spoon to place a small amount of each dry powder (baking soda, cream of tartar, corn starch, baking powder) in different small containers and label them.
   (Be sure to wash your spoon when using different substances to avoid cross-contamination)
   Tip: If you have a paint palette you can also use it instead of small containers; or you can use a piece of parchment paper and mix them on there (if choosing this option, it is easiest to draw a 4x4 table on the parchment paper that matches the 4x4 table in your worksheet)
2. Pour a small amount of water onto each powder and stir it with your toothpick. Record your observations on the table that is in the worksheet.
3. Test each powder again using a different liquid. For example, prepare the four powders and test them using vinegar, being sure to stir and record your observations. Continue until you have used all 4 different liquids (water, vinegar, iodine, pH indicator) and have recorded all observations. If you do not have one that is okay, use only what you can find at your house.
   Note: Iodine works best as a solution and can also stain so be careful when using it.
4. Reflect on how you could use household liquids to identify an unknown white powder.

How to make pH indicator

- **Red Cabbage**
  1. Cut up about a cup of red cabbage (ask for assistance) and place in a cup or jar.
  2. Pour boiling water over top of cabbage so that it is completely covered.
  3. Wait at least 10min until the colour has leached out of the cabbage and into the water.
  4. Strain the cabbage pH indicator liquid into a container (all cabbage pieces should be removed) and use in the experiment
- **Butterfly Pea Flower Tea**
  1. Steep tea bag in boiling/hot water for about 10min
  2. Remove Tea bag and use in experiment

Healthy Yummy Baking Powder Experiment!

1. Preheat the oven to 375ºF (Ask an adult for help)
2. Measure out all the dry ingredients (oats, Walnuts (or coconut), chocolate chips, cinnamon, and baking powder) and add them to your large bowl. Mix together.
3. Peel the bananas and mash them with a fork in a separate bowl. Add the mashed banana to your bowl of dry ingredients.
4. Measure out peanut butter (or WowButter) and milk (or milk alternative) and add it to your bowl of ingredients.
5. Mix all the ingredients together to make cookie dough.
6. Prepare the baking sheet using parchment paper or any non-stick baking pan, and add enough cookie dough to fill the baking sheet (1 large spoonful of dough for each cookie). Press down on each cookie with a fork.
7. Cook in the oven for 10-12 minutes or until the edges are slightly browned.
8. Remove from the oven and let cool for 10 minutes.
9. Enjoy the healthy and delicious cookies.

Debrief

Baking Powder Experiment

It is important to recognize that different substances, even though they may look similar (like the ones in this experiment), have different compositions and will react differently with other substances. Baking powder is actually a mixture of the three other pure substances (baking soda, cream of tartar, and cornstarch). Individually, each substance has purpose for cooking in the kitchen, therefore we want to make sure we use the correct substance in our recipes. Baking Powder can easily be identified in this experiment because all of the liquids are water-based and therefore it has a reaction for all them. Knowing how to differentiate them becomes very important, especially if they are accidentally left in unmarked containers!

Healthy Yummy Baking Powder Experiment!

You will find that Baking Powder is a common ingredient in a lot of different cookie, cake, or brownie recipes. This is because the pure substances in all play a part in making them fluffy! The baking soda is a base, whereas the cream of tartar is an acid; when an acid mixes with a base they react and create a gas (like vinegar and baking soda volcanoes). However, a liquid needs to be added to the baking powder to activate this reaction, which is why we can store it in our cupboards for so long! When the gas is released in something being cooked it gets trapped in the batter (the other ingredients in the cake or cookie) which makes it fluffy! The cornstarch in the baking powder just helps the batter expand and then helps it keep its shape after it is done cooking.

Pure Substances and Mixtures — Grade 7: Matter and Energy

1. Can you identify the following as a pure substance or a mixture?

Salt: _____
Water: _____
Salt water: _____
Sugar: _____
Cookie dough: _____
Milk: _____

2. Follow the experiment and write down your observations.

	Water	Vinegar	Iodine	pH Indicator
Baking Soda				
Cornstarch				
Cream of Tartar				
Baking Powder				

3. What is baking powder made of?

4. From your observations, what is a pure substance and what is a mixture?

Baking Soda: _____
Cornstarch: _____
Cream of Tartar: _____
Baking Powder : _____

What's in Baking Powder — Grade 7: Energy and Matter

1. Can you identify the following as a pure substance or a mixture?

Salt :	Pure substance
Water:	Pure substance
Salt water:	Mixture
Sugar:	Pure substance
Cookie dough:	Mixture
Milk:	Mixture

2. Follow the experiment and write down your observations.

	Water	Vinegar	Iodine	pH Indicator
Baking Soda	No reaction	Bubbles	No reaction	Turns blue-green
Cornstarch	No reaction	No reaction	Turns black	Turns pink-ish
Cream of Tartar	No reaction	No reaction	No reaction	Same colour
Baking Powder	Bubbles	Bubbles	Turns black, bubbles	Turns blue-green, bubbles

3. What is baking powder made of?

   Baking soda, cream of tartar and cornstarch

4. From your observations, what is a pure substance and what is a mixture?

Baking Soda:	Pure substance
Cornstarch:	Pure substance
Cream of Tartar:	Pure substance
Baking Powder:	Mixture