



Household Chemistry

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Topic

Identifying physical and chemical reactions



Time

2 hours, with some observations overnight



Safety

Please click on the safety icon to view the safety precautions. Adult supervision is required. Keep alcohol and nail polish remover away from flames. Be careful when using bleach. Clean up all spills immediately. Do not drink or eat any of the substances used in this experiment. Wash all utensils thoroughly after using. Dispose of all products safely and in the proper way.

Materials

3 tbs vinegar	2 tsp salt substitute
various glasses, bowls, and containers	food coloring
water	1 tsp baking soda (sodium bicarbonate)
one Styrofoam™ and one plastic cup	6-cm 2 6-cm piece of blue denim
three tea bags	Alka-Seltzer™ (or other effervescent tablet)
disposable aluminum pie plate (Make sure there are no holes in it.)	nail polish remover with acetone
2 tbs lemon juice	¼ cup rubbing alcohol
1 tsp sugar	zip-lock sandwich bag
clear plastic soda bottle with cap	1 cup household bleach
3 tsp table salt	
1 cup vegetable oil	

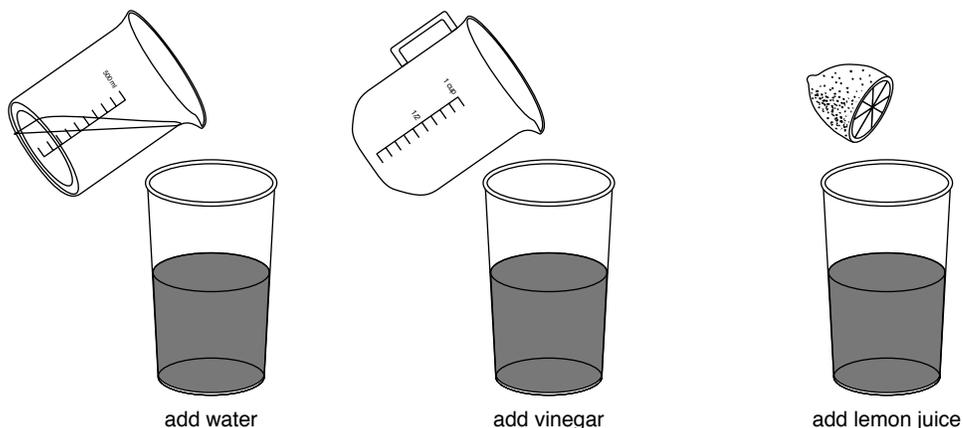
Procedure

In a *physical reaction*, the molecules or atoms of the substance remain unchanged. The substance may change shape or go through a change of state (from liquid to gas, solid to liquid, etc.), but it is still the same substance. If two or more substances are combined through a physical reaction, they can always be separated again by another physical reaction. No new substance is formed during a physical reaction.

In a chemical reaction, the individual molecules of the substances involved are changed, and a new substance is formed. You can usually recognize a chemical reaction by a color change or the formation of a precipitate (a new solid substance) or bubbles in a liquid (a new gas) or if a flame appears. Record all your observations on the data table.

DATA TABLE							
Procedure	Changes state	Changes color	Changes shape	Forms mixture	Releases energy (heat, light, or fire)	Releases gas	Substances can be separated
1A							
1B							
2							
3							
4							
5							
6A							
6B							
6C							
7							
8							
9							
10							

1. Place 1 tsp baking soda (sodium bicarbonate) in each of two separate glasses.
 - a. Add 1 tbs vinegar (acetic acid) to one of the glasses. Observe and record your results.
 - b. Add 1 tbs water to the other glass. Observe and record your results.
2. Place $\frac{1}{2}$ cup water in a glass. Add to this $\frac{1}{4}$ cup rubbing alcohol and stir. Observe and record results. Flush the contents down the toilet when finished.
3. Take the soda bottle and fill it halfway with water. Add 2 or 3 drops of food coloring, and mix well. Add vegetable oil until the bottle is three-quarters full. Cap the bottle tightly and shake well. After shaking, allow the bottle to sit. Observe and record results.
4. Fill a small bowl with $\frac{1}{8}$ cup of hot tap water. In this, dissolve 1 tsp table sugar (sucrose) by stirring for at least 2 min. Observe and record. Allow this mixture to sit for a day or two until the water evaporates. Observe and record results.
5. Fill a small bowl with $\frac{1}{8}$ cup hot tap water. In this, dissolve 1 tsp table salt (sodium chloride) by stirring for at least 2 min. Observe and record. Allow this mixture to sit for a day or two until the water evaporates. Observe and record results.
6.
 - a. Make 3 cups of strong tea. Measure out 1 cup each into three separate glasses or other clear containers (see the figure).
 - b. Add water to 1 cup of tea. Observe and record results.
 - c. Add vinegar to 1 cup of tea. Observe and record results.
 - d. Add lemon juice to 1 cup of tea. Observe and record results.



7. Crush an effervescent tablet, and place the crushed tablet in a glass of water. Observe and record results.
8. Place a Styrofoam™ cup in an aluminum pie plate. Pour some of the nail polish remover into the cup. Observe and record results.
9. Place 2 tsp salt substitute in a zip-lock sandwich bag, add $\frac{1}{2}$ cup water, and close the bag. Shake the bag to dissolve the “salt,” and feel the bag. Record your observations.
10. Pour bleach into a disposable plastic cup. Cut a piece of blue denim 6 cm \times 6 cm, and place this in the bleach. Allow to sit for 10 min. Dispose of the bleach by flushing it down the toilet. Rinse the denim under running water, and allow to dry overnight. Observe and record your observations.
11. Look over your data table and the definitions of physical and chemical reactions given at the beginning of the procedure section. Use this information to answer the two following questions: (1) Which of the procedures involved chemical reactions? Explain. (2) Which of the procedures involved physical reactions? Explain.

What's Going On

The following steps involved chemical reactions:

Step 1A: Vinegar and baking soda combine to form a gas (carbon dioxide).

Steps 6B and 6C: Vinegar and lemon juice are both acidic substances. Tea has the ability to act as an indicator. Adding either of the above to the tea changes its color, which indicates the presence of an acid.

Step 7: The effervescent tablet contains sodium bicarbonate and tartaric acid. In dry form, these chemicals are nonreactive; however, when they are dissolved in water, they react with each other, and carbon dioxide is released.

Step 10: The bleach reacts with the dye in the denim and renders it colorless, by oxidation.

The following procedures involved physical reactions:

Step 1B: The baking soda gets wet and partially dissolves in the water.

Step 2: The alcohol dissolves in the water.

Step 3: The oil and water separate; oil and water do not mix. The oil is less dense than the water and floats on top.

Step 4: The sugar dissolves in the water. When the water evaporates, sugar crystals are left in the bowl.

Step 5: The salt dissolves in the water. When the water evaporates, salt crystals are left in the bowl.

Step 6A: The water dilutes the tea. This is the control for purposes of comparison.

Step 8: What happens to the Styrofoam™ cup may seem like a chemical reaction because of the bubbles you see indicating the presence of a gas. This is misleading. What you are observing is actually a physical reaction. Styrofoam™ is a substance made of little pockets of plastic that are filled with air. When you pour nail polish remover into the cup, the plastic begins to dissolve in it. This releases the air that fills out the plastic and accounts for the gas you see being given off.

Step 9: The salt substitute dissolves in the water. You may have noticed that as the “salt” dissolved in the water, the bag got colder. This is because the dissolving “salt” takes energy from the water to help it dissolve.

Connections

Chemistry isn't just for chemists. As a matter of fact, many household activities involve simple applications of chemistry. In chemistry, two types of change or reaction are studied, *chemical* and *physical*. A chemical reaction is one in which the substances involved are transformed or combine to form a completely different substance. Chemical reactions often involve transformations of energy, producing light, heat, and, sometimes, even fire. In a *physical reaction*, although a change takes place, such as boiling, melting, or freezing, no new substance is formed. In this experiment you explored the chemistry around your house.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say “be careful with hot liquids” or “don’t cut yourself with the knife” does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don’t use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES