Mixed Reactions

Topic
Chemical Reactions

Key Question
What are some of the ways you can tell if a chemical reaction has taken place?

Learning Goals
Students will:
1. conduct tests to check for a chemical reaction,
2. classify the tests based on whether or not a chemical reaction has taken place, and
3. identify the production of gas and change of temperature as evidence of a chemical reaction.

Guiding Documents
Project 2061 Benchmark
- *When a new material is made by combining two or more materials, it has properties that are different from the original materials. For that reason, a lot of different materials can be made from a small number of basic kinds of materials.*

NRC Standard
- *Substances react chemically in characteristic ways with other substances to form, new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metal is an example of such a group.*

*NCTM Standards 2000**
- *Collect data using observations, surveys, and experiments*
- *Recognize the differences in representing categorical and numerical data*

Math
Data analysis

Science
Physical science
chemical reactions

Integrated Processes
Observing
Comparing and contrasting
Classifying
Collecting and recording data
Interpreting data
Inferring

Materials
For the whole class:
clock or watch
hydrogen peroxide
calcium chloride (see *Management 7)*
baking soda
vinegar
sugar
salt
six buckets or tubs
six plastic trash cans (see *Management 4)*
paper towels
overhead transparency of *Evidence of a Chemical Reaction* page
station cards

For each group:
one clear plastic cup, 9-oz. (see *Management 5)*
one plastic spoon
one thermometer

For each student:
data sheet

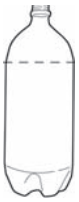
Background Information
A chemical reaction is another name for a chemical change. A chemical change is the process that takes place when one substance turns into another substance. For example, when an iron nail rusts, it undergoes a chemical change. The iron in the nail reacts with the oxygen in the air producing a new substance, iron oxide, which is rust.

A change in temperature is one piece of evidence the students can use to see if a chemical reaction has taken place. Reactions can be endothermic or exothermic. In an endothermic reaction, the temperature will decrease. In an exothermic reaction, the temperature will increase. A second piece of evidence that a chemical reaction has taken place is the production of a gas (bubbles). A third piece of evidence is the formation of a precipitate. A precipitate is a solid substance that forms within a liquid (or even in some gases). Other indications of a chemical reaction are production of light and change of color.

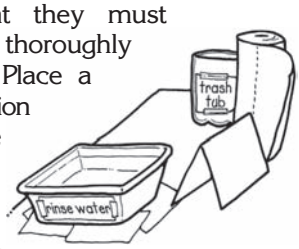
In this activity, students will examine six different reactions. They will identify whether a chemical reaction has taken place by looking specifically for temperature changes and the production of gas.

Management

1. Caution the students not to taste any of the substances at the stations. Tell the students it is not safe to mix unknown substances to test for reactions. The materials they will be testing are known not to produce harmful reactions.
2. Prepare the station cards. Make an overhead transparency of the *Evidence of a Chemical Reaction* sheet.
3. You can make a plastic trash can to use at each of the stations by cutting the top four inches off a two- or three-liter drink bottle.



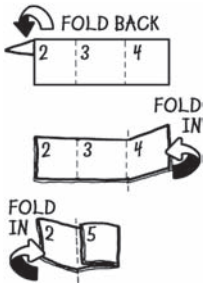
4. Tell the students that they must clean their equipment thoroughly between each station. Place a bucket or tub at each station with water in it so that the students can clean the cup, spoon, and thermometer.



5. You will need to attach the graduated scale slips to the sides of the 9-ounce clear cups. The strips need to be completely covered with clear tape so that they will be waterproof.
6. Student groups of four work best for this activity.
7. Calcium chloride can be purchased at hardware stores and grocery stores. It is used to thaw ice on sidewalks and driveways.

Procedure

1. Ask the *Key Question* and state the *Learning Goals*.
2. Tell the students that they will rotate through six stations. Explain that they will be observing how selected solids react to selected liquids. Discuss the indicators on the *Evidence of a Chemical Reaction* sheet.



3. Distribute a cup, spoon, and thermometer to each group. Also hand out a data sheet to each student. Show how to fold the data sheet to form a booklet.
4. Direct the students' attention to the bucket and plastic trash can at each station. Tell them at the end of each test, they are to pour the liquid that is in their cups into the plastic trash can and then they are to use the water in the bucket to rinse their cups, spoons, and thermometers. They are to dry the materials using the paper towels before moving to the next station.
5. Explain how the students will rotate through the stations. Tell the students they will have three minutes at each station. Point out that they must record their observations on the student data sheets. Tell the students that they will be making temperature recordings as well as written observations of what they see happening at each station. Inform them that even if no reaction takes place, that it is still an observation that will need to be recorded.
6. Distribute the temperature change graph. Tell students to record the initial temperature for each station. Have them create a scale for the graph based on the data collected and graph the temperature changes. Increases in temperature will be above the initial temperatures and decreases will be below. If no temperature change occurred, have students record that by writing "0" in the spaces provided to record temperature change.

Connecting Learning

1. What evidence do you have as to whether or not a chemical reaction took place at each station?
2. How are the temperature changes you observed in these investigations different from those that would happen if you put something on the stove or in a refrigerator?
3. If you pour hydrogen peroxide on a cut and a white substance appears, what do you know has taken place? [a chemical reaction]
4. Why was it important to record what you observed at each station?
5. How did the thermometer help determine if a chemical reaction had taken place? [A change in temperature is an indication of a chemical reaction.]
6. Did some of the reactions have more than one thing happening that would tell you a chemical reaction has taken place? Explain. (Some will have both a temperature change and production of a gas.)

Evidence of Learning

1. Listen to student discussion during the *Connecting Learning* questions. Students should state evidence from the investigation in describing chemical reactions.
2. Check the student recording sheets to see that they accurately identify the stations that produced a chemical reaction and the evidence that it took place.
   - hydrogen peroxide and activated yeast—temperature change and gas produced
   - hydrogen peroxide and sugar—no reaction
   - water and calcium chloride—temperature change
   - water and baking soda—temperature change
   - vinegar and baking soda—temperature change and gas produced
   - vinegar and salt—no reaction

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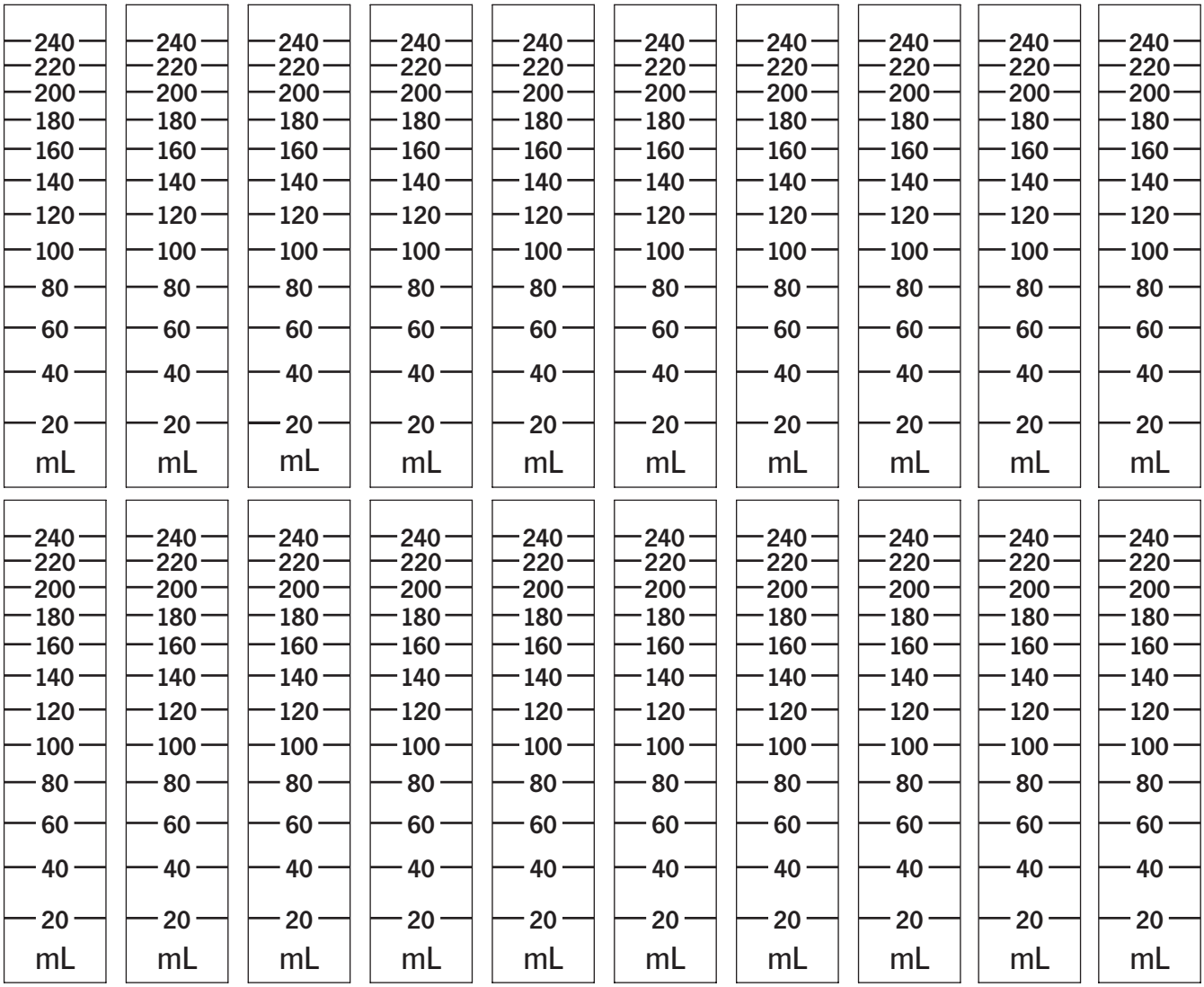
Graduated Scales

for 9-oz. cups

Tape graduated scale slip to the outside facing in.

Cover completely with tape.



Evidence of a Chemical Reaction

A change in temperature

Gas is produced

Light is produced

A change in color

A precipitate forms

Mixed Reactions

Key Question

How can you tell if a chemical reaction has taken place?

Learning Goals

Students will:

1. conduct tests to check for a chemical reaction,
2. classify the tests based on whether a chemical reaction has taken place, and
3. identify the production of a gas and a temperature change as evidence of a chemical reaction.

Temperature

before _____ °

after _____ °

ending _____ °

check one

☐ chemical change ☐ no chemical change

Observations

Hydrogen Peroxide and Sugar

Water and Calcium Chloride

Vinegar and Salt

Temperature

before _____ °

after _____ °

ending _____ °

check one

☐ chemical change ☐ no chemical change

Observations

Water and Baking Soda

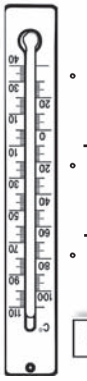
Vinegar and Baking Soda

Temperature

before _____ °

after _____ °

ending _____ °



check one

☐ chemical change ☐ no chemical change

Observations

Mixed Reactions

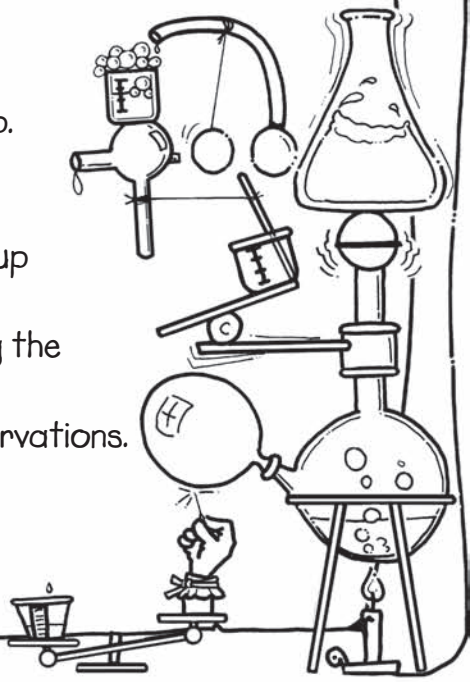
Graph the temperature change (if there was one) for each reaction. Be sure to write the beginning temperatures at each station in the spaces provided. Label the graph along the left side with the appropriate temperature increments based on your results.

Temperature Change:	+ ____ °C	+ ____ °C	+ ____ °C	+ ____ °C	+ ____ °C	+ ____ °C
Temperature Increase in °C						
0						
Beginning Temperature in °C	____ Station One	____ Station Two	____ Station Three	____ Station Four	____ Station Five	____ Station Six
0						
Temperature Decrease in °C						
Temperature Change:	− ____ °C	− ____ °C	− ____ °C	− ____ °C	− ____ °C	− ____ °C

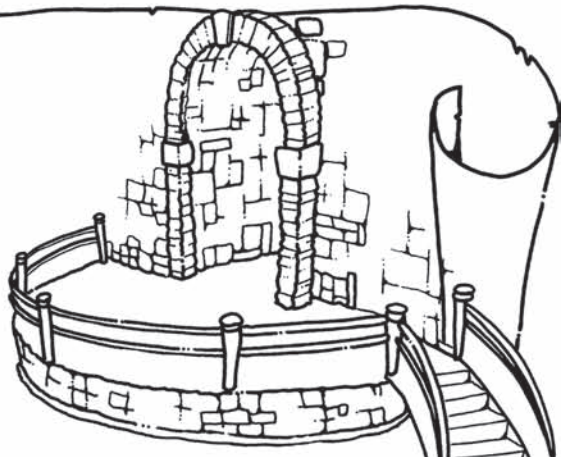
Hydrogen Peroxide and Activated Yeast

Procedure

1. Pour 40mL of hydrogen peroxide into your cup.
2. Find and record the initial temperature of the hydrogen peroxide.
3. Add one spoonful of activated yeast to the cup and stir.
4. Find and record the temperature after adding the activated yeast.
5. Observe for three minutes and record any observations.
6. Find and record the ending temperature.
7. Clean your equipment and area.



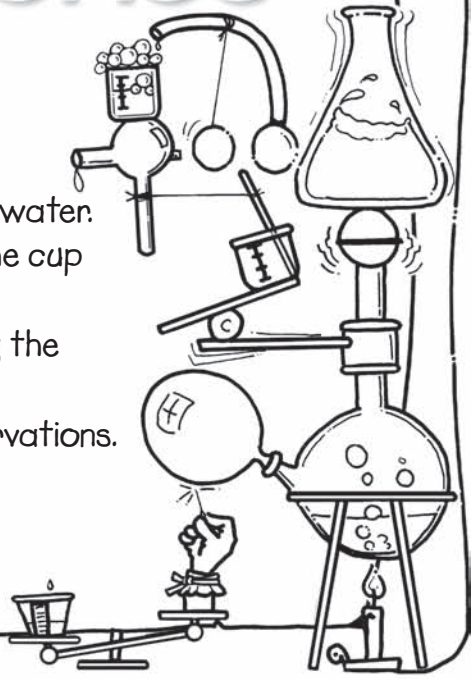
Hydrogen Peroxide and Sugar



Procedure

1. Pour 40mL of hydrogen peroxide into your cup.
2. Find and record the initial temperature of the hydrogen peroxide.
3. Add one spoonful of sugar to the cup and stir.
4. Find and record the temperature after adding the sugar.
5. Observe for three minutes and record any observations.
6. Find and record the ending temperature.
7. Clean your equipment and area.

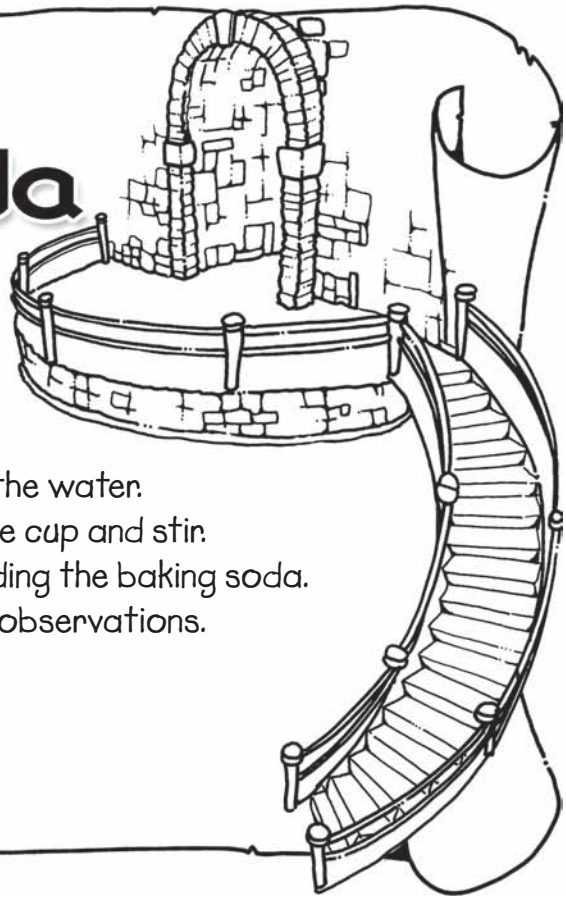
Water and Calcium Chloride



Procedure

1. Pour 40mL of water into your cup.
2. Find and record the initial temperature of the water.
3. Add one spoonful of the calcium chloride to the cup and stir.
4. Find and record the temperature after adding the calcium chloride.
5. Observe for three minutes and record any observations.
6. Find and record the ending temperature.
7. Clean your equipment and area.

Water and Baking Soda

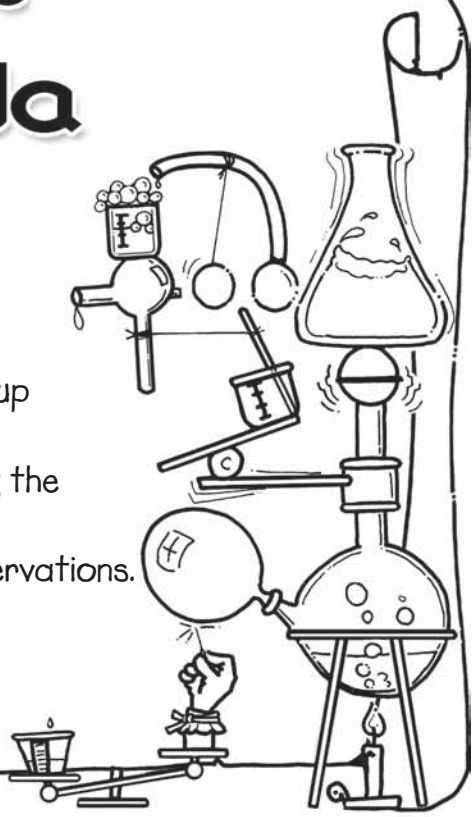


Procedure

1. Pour 40mL of water into your cup.
2. Find and record the initial temperature of the water.
3. Add one spoonful of the baking soda to the cup and stir.
4. Find and record the temperature after adding the baking soda.
5. Observe for three minutes and record any observations.
6. Find and record the ending temperature.
7. Clean your equipment and area.

5 STATION

Vinegar and Baking Soda

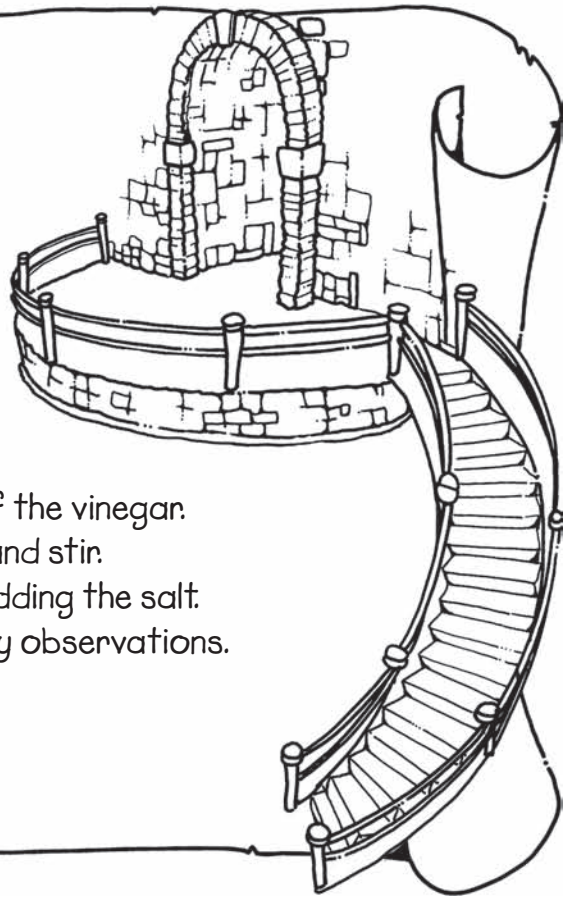


Procedure

1. Pour 40mL of vinegar into your cup.
2. Find and record the initial temperature of the vinegar.
3. Add one spoonful of the baking soda to the cup and stir.
4. Find and record the temperature after adding the baking soda.
5. Observe for three minutes and record any observations.
6. Find and record the ending temperature.
7. Clean your equipment and area.

6 STATION

Vinegar and Salt



Procedure

1. Pour in 40mL of vinegar into your cup.
2. Find and record the initial temperature of the vinegar.
3. Add one spoonful of the salt to the cup and stir.
4. Find and record the temperature after adding the salt.
5. Observe for three minutes and record any observations.
6. Find and record the ending temperature.
7. Clean your equipment and area.

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Connecting Learning

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2. How are the temperature changes you observed in these investigations different than if you put something on the stove or in a refrigerator?

3. If you pour hydrogen peroxide on a cut and a white substance appears, what do you know has taken place?

4. Why was it important to record what you observed at each station?

5. How did the thermometer help determine if a chemical reaction had taken place?

6. Did some of the reactions have more than one thing happening that would tell you a chemical reaction has taken place? Explain.

7. What are you wondering now?

