Investigation Six – Chemical Change

Standard I Students will understand that water chemical and physical changes occur in matter.
Objective 3 Investigate evidence for changes in matter that occur during a chemical reaction.
Intended Learning Outcomes 1. Use science process and thinking skills. 2. Manifest scientific attitudes and interests. 3. Understand science concepts and principles. 4. Communicate effectively using science language and reasoning. 5. Demonstrate awareness of social and historical aspects of science.

Standard I

Objective 3

Background Information

A *chemical change* occurs when new kinds of matter are formed. The composition of the matter changes and the new kinds of matter have different properties from the old matter. Evidence of a *chemical change* may be the result of chemicals reacting with one another. A *gas* or a *solid* may be formed where the *products* are in a different state than the *reactants*. A change in temperature, pressure, or color may also be evidence of a *chemical change*. These changes are called indicators. Physical properties, such as the boiling point and the melting point, are often altered as matter undergoes a *chemical change* (e.g., a raw egg when cooked becomes a hard-boiled egg). All the materials for this activity can be obtained easily at a grocery store and nursery. *Jars or cups can easily be substituted for falcon tubes.* If both objective indicators (3a & 3e) are to be taught, the activity extension for this lesson plan must be completed. The red cabbage juice needs to be prepared within 24 to 36 hours of conducting the activity or it will go stale and may not work properly. Red cabbage juice can be made by placing four or five leaves of red cabbage in about one cup of water and boiling it for a few minutes. Then drain the juice.

Pre-Assessment/Invitation to Learn

Teacher Demonstration: Vinegar and Baking Soda

1. Have the students gather around a desk or table that has a funnel, scale, baking soda, vinegar, a pop bottle, and a balloon on it.
2. Weight the baking soda, vinegar, pop bottle, and balloon separately and record them on paper. Add the weights together to get the total weight.
3. Pour the vinegar into the pop bottle and put the baking soda into the balloon. Use a funnel for ease in pouring. Carefully put the balloon over the bottle opening so the baking soda doesn't go into the bottle. Let the balloon hang down over the side of the bottle.

Materials
- Funnel
- Baking soda
- Scale
- Vinegar
- Pop bottle
- Balloon

4. Ask the students to predict what will happen when the baking soda is mixed with vinegar inside the bottle.
5. Mix the two substance together by holding the balloon upright and letting the baking soda fall into the bottle of vinegar.
6. Have a discussion of the observations. *(The substances that were mixed together produced a chemical reaction, giving off a gas called CO_2 that inflated the balloon.)*
7. After the fizzing stops, record the collective weight of the bottle, balloon, gas and the new substance. Is it the same weight as the total weight recorded before? *(The weight of an object is always equal to the sum of its parts, regardless of how it is assembled.)*
8. Remove the balloon filled with the CO_2 gas and allow the gas to leave the balloon. Put the balloon back on the bottle. Ask the students how the weight of the items might now be affected. *(Students will hopefully be able to understand because a gas was given off that some of the weight is now distributed into the room and out of the items in the bottle.)*
9. Weigh the pop bottle, balloon, and contents one last time and record the weight. Compare all three weights. Have a discussion about each of the weights.

Materials
For each group of 3-5 students
- 50 ml falcon tube of milk
- 50 ml falcon tube of white vinegar
- 15 ml falcon tube of baking soda
- 15 ml falcon tube of cabbage juice (boiled red cabbage in H_20)
- 15 ml falcon tube of calcium chloride (road salt) (Prestone Highway Heat works well)
- 15 ml falcon tube of ammonium nitrate (plant fertilizer)
- 2 clear plastic cups
- "Chemical Reaction Lab Worksheet"
- Paper towels for cleanup

Note: The falcon tubes can easily be substituted by plastic cups if needed.

Instructional Procedure

Student Investigations

1. Organize students in groups of three, four, or five.
2. Discuss the materials that will be given to each group. Explain that each of the *substances* are *reactants* (materials that can be mixed with other materials to create new *products*). Discuss the indicators that constitute a *chemical change* (materials may heat or cool, give off light, give off a gas, or change colors).
3. Explain that each group is going to conduct experiments where they are going to mix *substances* together. Discuss what a hypothesis is and why it is important for scientists to hypothesize (predict what will happen) as they conduct experiments. Explain that like real scientists, their group is going to experiment mixing the *substances* together. They are also going to develop hypotheses, record observations, and draw conclusions. As they complete these experiments they are going to record the results on a lab or journal sheet.
4. Discuss when *reactants* or *substances* are mixed together to create new *products* it is important that scientists use exactness in their measurements. Explain to students how to read the measurements on the falcon tubes. (Students, however, should know that the information gathered from these experiments will be somewhat accurate even if they don't measure with preciseness.)
5. Give each group the lab sheet. Explain how to complete the experiments. Model the first experiment with them. Have each group write a hypothesis on their lab sheet. Then have each group mix the *reactants* as the teacher demonstrates. Help groups record their observations and conclusions about the new *products* that are created.

6. Have each group complete the remaining experiments and record the results on the lab sheet.
7. When students finish the lab experiments, have them plan and conduct an experiment of their own. Have groups plan which *substances* or reactants they will use and the amounts of each *substance*. Have them make a hypothesis before testing the chemicals. Have them list their hypothesis, observations, and conclusion on their lab sheet. Ask students to identify the indicators that showed a *chemical reaction* or *change* occurred.
8. Clean up the activity by pouring liquids down the sink or into a bucket. Rinse out cups, milk tubes.
9. Debrief the activity by having individual groups share their results with the class. The results are:
    a. Vinegar & Milk – curdling of the milk (forming a precipitate)
    Indicator: Production of a solid.
    b. Baking Soda & Vinegar – fizzing (forming of CO_2 gas).
    Indicator: Production of a gas.
    c. Vinegar & Cabbage Juice – changes from purple to pink.
    Indicator: Change of temperature (cold).
    d. Milk & Ammonium Nitrate (fertilizer) – solution gets cold as granules dissolve.
    Indicator: Change of temperature (cold).
    e. Milk & Calcium Chloride (road salt) – solution gets hot as granules dissolve.
    Indicator: Change of temperature (hot).
10. Have students use the data they have collected to share with the class the *indicators* that resulted when the *chemical changes* occurred. Have students share their hypotheses and evaluate their results.

Curriculum Extensions

Science –

- Brainstorm with students about how bread is baked and formed. What are the ingredients used to make bread? Ask students to identify why yeast is an important ingredient in the process, and how we can determine that a *chemical reaction* has occurred during the bread-making process. (ILOs 2, 3)
- Suggest to students that you will offer bonus points to students who complete the following activity at home. Hypothesize with students what the results might be if no yeast were added to the other ingredients used to make bread. What would happen if you added twice the amount of yeast to the recipe? What might happen if you added five times the amount of yeast? (ILOs 2, 3)
- Have students make four small samples of bread at home under the direction of their parents. Discuss with students what a control group is, and explain that the normal recipe will be the control group. Help students to understand that a control group is needed to determine the changes in the variables in the other recipes. Have them make four small samples of bread: (1) one with the regular amount of yeast that their recipe calls for; (2) one with no yeast; (3) one with twice the amount of yeast from the control group; (4) one with five times the amount of yeast. (ILOs 1, 6)

- Encourage students to bring their bread samples to school to share with the rest of the class. Ask students to observe the bread samples and determine how they can tell if a *chemical reaction* occurred and what changes the variables caused in the bread. Using hand-held magnifying glasses will help students to see the size of the air pickets created by the gas producing yeast. Have them reflect on their original hypotheses and determine how accurate they were. (ILOs 1, 4)

Assessment Suggestions

Present the following scenarios either written or oral and have students identify the indicators that show a chemical reaction or change occurred.

Chemistry Lab Experiments on Planet Warnock

Alien scientists from a planet named Warnock located in another solar system are working in a lab to prepare food items to bring with them on their journey to visit Earth.

Note: This part of the plan could be enhanced by showing graphics of space aliens.

<u>Identify the indicators in the products below that show that a chemical change occurred.</u>

1. The scientists took 15 ml of zip and mixed it with 50 ml of quig. The mixture cooled down to 4 degrees C, turned into an elastic-type substance, and took on a shiny glue-like appearance. They named their new product jorg. It tasted delicious.

2. The scientists took a cube of rant and place drops of fap on the top of the cube. The cube started to dissolve. A large hole was carved into the cube of rant and changed colors. It gave off an undesirable smell and did not taste good. They decided not to take it on their trip.

3. The aliens from the planet Warnock took 50 ml of zap that weighed 50 grams and mixed it with 50 ml of lorn that also weighed 50 grams. The solution didn't mix well together. It started to fizz and bubble. The colors didn't mix well together. When they measured the new product, its volume was 100 ml and the weight was 98 grams. They named the new product tig and decided to mix it with the fluids They would drink on their way to Earth.

4. The scientists took a bar of tuz and placed it into a container with 1 liter of brig.

   At first, the two substances didn't appear to mix well together. After 1 minute The bar of tuz started to melt. The container heated up and was hot to the touch. They named the new product wophi. The aliens took the mixture and placed it in a freezer. When they took it out of the freezer the substances of the product (tuz and brig) had separated. They kept the container at room temperature, and the tuz and brig soon melted together again. They turned the lights off to go home and the entire room filled with light coming from the wophi. They decided not to eat the wophi on their journey to Earth, but to use it instead as a night-light to help them see aboard their spacecraft in the dark.

Answer to the Assessment Scenarios

1. The scientists took 15 ml of zip and mixed it with 50 ml of quig. The mixture cooled down to 4 degrees C, turned into an elastic-type substance, and took on a shiny glue-like appearance. They named their new product jorg. It tasted delicious.
   The product absorbed heat by turning cold.

2. The scientists took a cube of rant and placed drops of fap on the top of the cube. The cube started to dissolve. A large hole was carved into the cube of rant and changed colors. It gave off an undesirable smell and did not taste good. They decided not to take it on their trip.
   The product changed color.

3. The aliens from the planet Warnock took 50 ml of zap that weighted 50 grams and mixed it with 50 ml of lorn that also weighed 50 grams. The solution didn't mix well together. It started to fizz and give off bubbles. The colors didn't mix well together. When they measured the new product, its volume was 100 ml and the weight was 98 grams. They named the new product tig and decided to mix it with their fluids they would drink on their way to Earth.
   A gas was given off as the two reactants were mixed together.

   (The teacher could reinforce Objective 3, indicator b, from this question. Help students to understand that the measured weight of a remaining product is less than its reactants when a gas is produced.)

4. The scientists took a bar of tuz and placed it into a container with 1 liter of brig. At first, the two substances didn't appear to mix well together. After 1 minute the bar of tuz started to melt. The container heated up and was hot to the touch. They named the new product wophi. The aliens took the mixture and placed it in a freezer. When they took it out of the freezer the substances of the product (tuz and brig) had separated. They kept the container at room temperature and soon the entire room filled with light coming from the wophi. They decided not to eat the wophi on their journey to Earth, but to use it instead as a night-light to help them see aboard their spacecraft in the dark.
   Heat and light were given off.

Reference to Assessment Section

Unit Test	Multiple Choice	Constructed Response	Performance Test
1	4, 7, 8, 10, 12	1, 4	Plop, Plop, Fizz, Fizz Chemical Change Log
2	7, 8, 9, 10	2, 3, 4	Chemical or Physical

Chemical Reactions Lab (worksheet)

1. 10 ml of Vinegar and 10 ml of Milk

   Hypothesis:

   Test: Mix Chemicals

   Observations:

   Conclusions:

2. 5 ml of Baking Soda and 10 ml of Vinegar

   Hypothesis:

   Test: Mix Chemicals

   Observations:

   Conclusions:

3. 10 ml of Vinegar and 5 ml of Cabbage Juice

   Hypothesis:

   Test: Mix Chemicals

   Observations:

   Conclusions:

4. 10 ml of Milk and 10 ml of Ammonium Nitrate (fertilizer)

   Hypothesis:

   Test: Mix Chemicals

   Observations:

   Conclusions:

5. 10 ml of Milk and 5 ml of Calcium Chloride (road salt)

    Hypothesis:

    Test: Mix Chemicals

    Observations:

    Conclusions:

Extension Experiment:
If you finish the lab experiments early, plan and conduct an experiment of your own. Plan which substances or reactants you will use and the amounts of each substance. Make a hypothesis, test the chemicals, and list your observation and conclusion. What indicators showed that a chemical reaction or change occurred?

1. Substance or Reactants (and their amounts)

    Hypothesis:

    Test: Mix Chemicals

    Observations:

    Conclusions: