Investigation Four – Borax and Glue

Standard I
Students will understand that chemical and physical changes occur in matter.

Objective 1
Describe that matter is neither created nor destroyed even though it may undergo change.

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.
6. Understand the nature of science.

STANDARD I

Objective 1

Teacher Background

The suggested learning activity in this lesson will help students understand the relationship between the weight of reactants and the weight of the products involved in chemical reactions. This activity can be completed in about 40 minutes of class time.

Pre-Assessment/Invitation to Learn

Explain to the students what a chemical reaction is. Tell them that chemical reactions are happening around them every day. Most products we buy are the results of chemical reactions. Tell them that they will observe a chemical reaction and do one in groups. This demonstration is called "Vinegar and Cream."

1. Fill a clear plastic cup about ½ full of cream. Observe the cream and record its properties.
2. Pour about 15 ml of vinegar into another cup. Observe the vinegar and record its properties. The cream and the vinegar are the reactants in this activity.
3. Find the combined weight of the reactants by placing the cup of cream and the cup with the vinegar on the scale. Record the combined weight.
4. Pour the vinegar into the cram and stir once or twice. Pass it around for students to observe. Describe what you see and smell. (Make sure students understand that while it is safe to smell cram and vinegar, it is unsafe to smell or inhale some chemicals. Caution them never to smell unknown chemicals.) Is there evidence of a new substance being formed? Explain. (New substances formed from a chemical reaction are called products.)
5. Find the combined weight of the products by placing both cups on the scale. Record the weight. (Make sure students understand that it is necessary to weigh the empty cup because its weight was included when the vinegar was weighed.)

Materials

- 2 clear plastic cups
- Plastic spoon for stirring
- ½ cup heavy whipping cream
- 15 ml of vinegar
- Scale
- Graduated cylinder

Ask these questions:

- Did a chemical reaction take place when the vinegar and cream were mixed?
- What evidence suggests that a chemical reaction has taken place? (Formation of a solid after two liquids have been mixed.)
- Is it possible to get the cream and vinegar back after they have been mixed? (No) Why? (They have chemically changed into a completely different substance.)

Instructional Procedure

Materials
For each team of 3-5 students

- 15-20 ml sodium borate solution
- Scale
- 8-oz. paper cup
- Ruler
- Permanent felt-tipped marker
- Graduated cylinder
- Quart-sized plastic locking bag
- Bottle of white glue
- Student worksheet "Borax and Glue"
- Food coloring
- Water

Cooperative teams of 3-5 students should complete the following steps: Prior to this experiment mix one cup of Borax powder to two liters of water, shake well. (sodium borate solution.

1. Using a ruler and a permanent felt tipped marker, make a mark ½ inch from the bottom on the inside of the paper cup. Fill the cup to the mark with white glue. This will be about 25 ml.
2. Using a graduated cylinder, measure out 25 ml of water and add it to the glue in the cup. Add 1-5 drops of food coloring, if desired, and stir well.
3. Using a graduated cylinder, measure out 15-20 ml of sodium borate solution; pour it into the plastic locking bag and seal the bag.
4. Find the combined weight of the reactants by placing the bag with the sodium borate solution and the cup with the glue solution on the scale at the same time. Record the combined weight.
5. Pour the glue solution into the plastic bag with the sodium borate solution. The glue solution and sodium borate solution are the reactants. Seal the bag and knead the mixture for a few seconds. Make and record observations.
6. Remove the solid mass from the bag. As you remove the solid mass from the bag, hold the mass over the bag for a few seconds to allow any liquid to drip back into the bag.
7. Reseal the bag and set it aside. Work the mass with your hands until it forms a "Silly Putty"-type solid. Experiment with this material and record observations of its special properties. The solid material and the liquid left in the bag are the products of this chemical reaction.
8. Find the combined weight of the products by placing the bag with the remaining liquid, the "Silly Putty"-type solid, and the cup on the scale. *(Make sure students understand that it is necessary to weigh the cup because its weight was included when the glue was weighed.)* Record the weight.
9. Compare the combined weights of the reactants and the products. Record what you have learned.
10. Discuss with the students what they have discovered or learned.
11. Challenge students to write an equation that demonstrates what they have learned.

(weight of reactants + bag and cup = weight of products + bag and cup)

Curriculum Extensions

Science –

- With materials that were used to make "Silly Putty", change the proportions of the ingredients, or, substitute Borax with laundry detergent or glue with rubber cement. Allow the students to make hypotheses before they do the experiments. Have them write their experiments in their journals. Share them in class. (ILOs 1, 6)

Assessment Suggestions

- Ask the following questions for student understanding:
  - ✓ What evidence shows this is a chemical reaction? *(Formation of a solid-like material that is a completely new substance with different properties from the glue and borax solutions).*
  - ✓ Was the weight of the reactants equal to the weight of the products? *(The answer should be yes, but the students may have differences in their data. Have them compare their data and discuss why they may not agree. Some possibilities may be: Some of the liquid might have come off on hands while the "Silly Putty" was being worked; scales are inaccurate; mistakes might have occurred in taking or recording data; some "Silly Putty" may have stuck to their hands.)*

- Check students' journals and worksheets for accuracy and understanding.

Reference to Assessment Section:

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

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Name _____ Team _____ Date _____

Combined weight of reactants + (bag + cup) =

Observations of mixed reactants

Observations of "Silly Putty"- type solid

Combined weight of products + (bag + cup) _____

Write an equation about the relationship of the weight of the reactants to the weight of the products in this activity.

Write a statement about the relationship of the weight of the reactants to the weight of the products in this activity.