JSD 3D Learning Activity Template

Grade: 6th Grade	**Title:** Baking Soda and Vinegar—What Really Happens?

Utah Science with Engineering Education Standard (SEEd):

Standard 6.2.1: Develop models to show that molecules are made of different kinds, proportions, and quantities of atoms. Emphasize understanding that there are differences between atoms and molecules, and that certain combinations of atoms form specific molecules. Examples of simple molecules could include water (H_2O), atmospheric oxygen (O_2), and carbon dioxide (CO_2)

Key crosscutting concept(s) (CCC): Proportions and Quantities
Key science and engineering practice(s) (SEP): Develop Models

Materials: 16 oz. plastic soda bottle**;** funnel, 12-inch balloon**;** scale; small bowl, vinegar**;** baking soda**;** ml spoon**;** graduated cylinder; 4 different color of beads w/holes: blue for sodium (1), yellow for hydrogen (5), white for oxygen (5), and black for carbon (3); three 3-inch pipe cleaners; safety goggles

Time: 60 minutes

Teacher background, key content information and hints:

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. When chemical changes occur, the proportions and quantities change within the new products formed. Even though there are new products, the number of atoms has not changed during the reaction. The chemical make-up of baking soda: $NaHCO_3$ and vinegar: $HC_2H_3O_2$ make the new the products: . water: H_2O, carbon dioxide: CO_2, and sodium acetate (salt vinegar): $NaC_2H_3O_2$.

Prior knowledge that students need:

Students need to know that when a chemical change has occurred and new products are made, that the number of atoms stay the same from the beginning to the end. They need to know the definition of atoms and molecules.

Learning Activity Plan

These three aspects of a lesson should be identified in your learning activity.

Gathering: *(Obtain Information, Ask Questions/Define Problems, Plan & Carry Out Investigations, Use Models to Gather Data and Information, Use Mathematics/Computational Thinking.)*	***Reasoning:*** *(Evaluate Information, Analyze Data, Use Mathematics/Computational Thinking, Construct Explanations/Solve Problems, Develop Arguments from Evidence, Use Models to Predict & Develop Evidence.)*	***Communicating:*** *(Communicate Information, Argue from Evidence (written & oral), Use Models to Communicate).*

Phenomenon: When doing the baking soda and vinegar experiment, it starts out with two chemicals and at the end of the experiment there are three chemicals.

Learning Activity:

GATHERING

Instructional Points and Background

1. Tell the students that they will be doing an experiment today that they have seen before. It is the baking soda and vinegar experiment. This experiment will reinforce that new products are being formed and that matter is not being created or destroyed. The matter will only change form. Explain to them that the purpose of this experiment is to understand what is really going on with the new products being formed at the molecular level and that we will learn about their chemical formulas for each.
2. Let the students know that they will be recording what they see happening through observation. They will be writing it down, asking questions, and using models of what they see happening.
3. They will be using models to show what happened when the new products formed.
4. Review with them the difference indicators that show that a chemical reaction has happened for they will be watching for a number of these to happen.
    a. A new solid is formed.
    b. A new liquid is formed.
    c. Change of temperature (hot or cold).
    d. Light is given off.
    e. An unexpected gas is given off.
    f. An unexpected odor is given off.
    g. An unexpected color change.
    h. Combustion of material

The Experiment:

1. In a small bowl, pass out to each group of 2, 3, or 4 students 1 blue bead (sodium), 5 yellow beads (hydrogen), 3 black beads (carbon), and 5 white beads (oxygen) and the three 3-inch pipe cleaners (or any colors you would like to use). However, make sure they are all different.)
2. Tell the students at each bead represents an atom of that particular element. Many times when elements are put together they will bond to each other making a molecule though a chemical reaction. These molecules make up different substances depending on which elements bond to each other.
3. Discuss the chemical make-up of baking soda and vinegar by having them look it up or giving it to them.
    a. baking soda $NaHCO3$; vinegar: $HC2H3O2$
    b. On two pipe cleaners, have the students put the respective bead numbers and bead colors on each pipe cleaner representing baking soda and vinegar:
        i. baking soda pipe cleaner: 1 blue, 1 yellow, 1 black, 3 white
        ii. vinegar pipe cleaner: 1 yellow, 2 black, 3 yellow, 2 white
    c. Have the put them down while they do the experiment.
4. Have the students put on their safety goggles.

5. In groups of two, three, or four, the students are given the equipment they need to do the baking soda and vinegar experiment: 16 oz. plastic soda bottle**,** funnel, 12-inch balloon**,** ml spoon**;** graduated cylinder.
6. Write the directions on the board of what you want them to do for the experiment. Go through them before they actually do the experiment.
   (directions)
   a. Put the end of a funnel in the opening of the balloon
   b. Measure out 10 ml of baking soda and put it in the funnel so the baking soda will go into the balloon.
   c. Measure out 25 ml of vinegar into a graduated cylinder.
   d. With a funnel, pour the vinegar into the 16 oz. plastic soda bottle.
   e. Carefully put the mouth of the balloon over the mouth of the soda bottle without letting the baking soda get into the bottle.
   f. Weigh the bottle with the vinegar in it with the balloon on top.
   g. When ready, lift up the balloon so the baking soda goes into the bottle. Shake the balloon so it all falls into the bottle. Shake the bottle so that the baking soda mixes well with the vinegar.
   h. When the experiment is over, weigh the whole bottle with the balloon again.
7. Have the student write down what they see happening during the experiment.
   (answers)
   a. It fizzed
   b. The balloon filled with a gas
   c. There is a solid at the bottom
   d. There is a liquid above the solid
   e. It is cold on the bottom.
8. Have the students write three or four questions they may have about the experiment.
   (possible questions)
   a. How did the chemicals to change to other chemicals?
   b. What caused the chemicals to change?
   c. What caused it to get cold?
   d. What caused it to fizz?
   e. What caused a gas to form from a liquid and a solid mixing?
   f. Why did the weight stay the same?
9. Discuss what the phenomenon is.
   (The two chemicals baking soda and vinegar changed into three new products unlike those of baking soda and vinegar.)

REASONING

1. Have a discussion of the three substances that were made of what they consist of.
   (answers)
   a. a gas (an airlike fluid substance which expands freely to fill any space available, irrespective of its quantity; a state of matter that has no definite volume or shape)
   b. a liquid (a substance that flows freely but is of constant volume, having a consistency like that of water or oil; a state of matter that has a definite volume but not a definite shape)
   c. a solid (firm and stable in shape; not liquid or fluid; a state of matter that has a definite shape and volume such as a rock)

2. Discuss with the student that the only elements that these can be are made are the elements from baking soda and vinegar. Have the students push the beads off the pipe cleaners into the bowl. Have them write what this represents.
   (answer)
   a. This represents that when the two chemicals were put together that it caused a chemical reaction and the bonding between the atoms all broke apart from each other.
3. Discuss what the molecules did after that to make the three substances.
   (answers)
   a. After the atoms broke apart from each other, they quickly found other atoms to bond with and made the three new substances.
4. Have the student find out by research what the substances are and the new chemical make-up of each one.
   (answers)
   a. Water is the liquid (H2O)
   b. The gas is carbon dioxide (CO2.)
   c. The solid is sodium acetate (NaC2H3O2) called salt vinegar.
5. Have the students make the new substances on the three pipe cleaners with the beads that are in the container.
   (answers)
   a. Water is the liquid (H2O)
   b. The gas is carbon dioxide (CO2.)
   c. The solid is sodium acetate (NaC2H3O2) called salt vinegar.
6. Using computational thinking have the students figure out how many atoms they start with and how many they will end with.
   (answer)
   a. The two substances begin with a total of 14 atoms and the total of the three substance in the end finish with 14 atoms.
7. Have the students make a model by drawing a picture of what happened in the experiment.
8. Have the students develop an argument with evidence of their own thinking of what happened.

COMMUNICATING

1. Have the students show the model they made and communicate their findings.
2. Have the make an argument how they were able to figure out what the new substances were and their chemical make-ups.

Assessment of student learning

Short description of the evidence the teacher is willing to accept that a student is proficient with the performance expectations.

This may be a rubric, narrative, or other set of descriptors that are useful for distinguishing proficient from non-proficient performances.

1. The students know that baking soda and vinegar are made up of certain atoms (elements).
2. The students know that when atoms connect to each other they bond and make molecules forming new products.
3. The students are able to explain that atoms breaking apart is caused by a chemical reaction.
4. The students are able to explain that after a chemical reaction, atoms will bond together making new products.
5. The students can explain the models that they made.

Name _____

Student Sheet

Title: Baking Soda and Vinegar—What Really Happens?

Introduction:
You are going to do the baking soda and vinegar experiment. You will be given directions on how to do it. You will be looking for data of what you observe to write down at the completion of the experiment. You will be given the chemical make-up of baking soda and vinegar. With a little research you will need to find out what the new products are and the make-up of the new products. You will need to explain your findings through drawing a model and designing an argument.

Materials:
16 oz. plastic soda bottle**,** funnel**,** balloon**,** scale**,** vinegar**,** baking soda**,** ml spoon**,** graduated cylinder, four different colors of beads (blue for sodium (1), yellow for hydrogen (5), white for oxygen (5), and black for carbon (3), three 3-inch pipe cleaners, goggles.

Part 1: Gathering Information

1. Let's make a list of the indicators of a chemical reaction.

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2. Baking is made up of NaHCO3—build it with your beads on a pipe cleaner.
    a. 1 sodium atom (blue bead), 1 hydrogen atom (yellow bead), 1 carbon atom (black bead), and 3 oxygen atoms (white beads).

3. Vinegar is made up of HC2H3O2—build it with your beads on a pipe cleaner.
    a. 1 hydrogen atom (yellow bead), 2 carbon atoms (black beads), 3 hydrogen atoms (yellow beads), 2 oxygen atoms (white beads)
4. Put the beads down for a while.
5. Put on your safety goggles.
6. In your group you have all the equipment to do the baking soda and vinegar experiment along with these directions.
    a. Put the end of a funnel in the opening of the balloon
    b. Measure out 10 ml of baking soda and put it in the funnel so the baking soda will go into the balloon.
    c. Measure out 25 ml of vinegar into a graduated cylinder.
    d. With a funnel, pour the vinegar into the 16 oz. plastic soda bottle.
    e. Carefully put the mouth of the balloon over the mouth of the soda bottle without letting the baking soda get into the bottle.
    f. Weigh the bottle with the vinegar in it with the balloon on top. _____
    g. When ready, lift up the balloon so the baking soda goes into the bottle. Shake the balloon so it all falls into the bottle. Shake the bottle so that the baking soda mixes well with the vinegar.
    h. Weigh the whole bottle with the balloon on top. _____

7. Record the observations on your data sheet. (Observation is with all your five senses.)

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8. Write down any question that you may have.

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9. What is the phenomenon?

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Part 2: Reasoning

1. What are the three states of matter that you see in the bottle and the balloon?

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2. In your groups, write the definitions of these three states of matter.

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3. Since the bead models they made of the vinegar and baking are no longer there, push the beads into the small bowl where there are all separate from each other. Write down what this represents.

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4. In your own writing, explain what do you think happened of how the two substances turned into three new substances.

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5. Through research find out what the names of the new substances are and how they are made up chemically.

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6. Make the new substances with the beads on the three pipe cleaners.

7. Using computational thinking, what do you see that confirms the law of conservation when you made the new substances?

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8. Draw a model of the experiment showing what happened.

9. Make an argument to tell what your model means.

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10. Communicate to the class your findings using the model as evidence to argue your findings.

Name _____

Reflection on the Baking Soda and Vinegar Experiment

1. What are the small building particles of all substances made up of called?

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2. What happens when these small building particles connect to each other and what are they called?

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3. What is a chemical reaction?

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4. After a chemical reaction, what do the small building particles usually do?

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5. Explain in your own words how new products are made.

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6. How do you know that new substances made from a chemical reactions would contain the same building particles as the original substances combined?

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7. How did the models you made help you in understanding what happened in the experiment?

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8. Describe in a paragraph what you learned in this activity.

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Reflection on the Baking Soda and Vinegar Experiment
Answers

1. What are the small building particles of all substances made up of called?

They are called atoms.

2. What happens when these small building particles connect to each other and what are they called?

They are called molecules. Sometimes when substances are put together the atoms bond to each other to make new substances.

3. What is a chemical reaction?

These are changes that take place when two or more substances interact to form new substances.

4. After a chemical reaction, what do the small building particles usually do?

The atoms bond to each other making new substances.

5. Explain in your own words how new products are made.

When two substances come together, they react with each other and break apart the bonds between those atoms that make up the substances. The atoms find new atoms to bond with making new molecules that make new products unlike the original substances.

6. How do you know that new substances made from a chemical reactions would contain the same building particles as the original substances combined?

The weight stays the same which means that from the two former substances, all the atoms that were present then have only rearranged themselves where all the atoms find their place in the new arrangement of atoms.

7. How did the model you made help you in understanding what happened in the experiment?

The model shows the progression of the experiment from the molecule make-up of two substances to the new molecule make-up of three substances where all the atoms from the two substances were used to make the three substances.

8. Describe in a paragraph what you learned in this activity.

Answers will vary.