Lesson Title	States of Matter
Length of Lesson	50 minutes
Created By	Hannah Brackin
Subject	Physical Science, Chemistry
Grade Level	8th
State Standards	2a, 1d
DOK Level	DOK 1, DOK 3
DOK Application	Report, Measure, Recall, Revise, Construct, Hypothesize, Investigate
National Standards	5-8: B: Physical Science
Graduate Research Element	

Student Learning Goal:

State Standards:

2(a): Identify patterns found in chemical symbols, formulas, reactions, and equations that apply to the law of conservation of mass. (DOK 1)
1(d): Analyze evidence that is used to form explanations and draw conclusions (DOK 3)

National Standards: B: Physical Science:

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; metals are an example of such a group.

Students will have to recall previous knowledge and understanding on the format of the periodic table and chemical reactions. The teacher will cover the states of matter and phase changes. The students will then perform an experiment in which they will measure and combine several chemicals to make a solid (bouncy ball) and two liquid chemicals to make a non-Newtonian fluid (slime). They will be asked to hypothesize what phase their product will be in and then construct a lab report summarizing their observations and results.

Materials Needed (supplies, hand-outs, resources):

Dry ice, water, and a large container to place then in (not glass). Polyvinyl alcohol, borax, water, solo cups (clear with lid if possible) pipets, beakers, food coloring (optional) graduated cylinders, Popsicle sticks, gloves, 95% Ethanol, and sodium silicate

Lesson Performance Task/Assessment:

Students will be given chemicals and asked to hypothesize what phase the product of the reaction will be in. Then they will combine the chemicals and make observations explaining what phase their product is in. At the end of the experiment the students will be asked to write a lab report explaining the experiment and results.

Lesson Relevance to Performance Task and Students:

The students will be able use previous knowledge on chemical reactions to preform two reactions by themselves. They will classify their products using what they have learned about phases and phase changes.

Anticipatory Set/Capture Interest:

Students are more familiar with the solid, liquid, and gas states of matter. However, many do not know much about plasma and so at the beginning of class a video about plasma will be shown.

http://www.neok12.com/php/watch.php?v=zX645353667e6d7a03795d51&t=States-of-Matter

Guided Practice:

Students will be provided with a review of physical science covered in 7th grade and have an introduction to their physical science unit. Everything on Earth can be explained in terms of 4 states (phases) of matter-- solid, liquid, gas, and plasma.

<u>What are the properties of a solid?</u>
A substance in a solid phase is relatively rigid, has a definite volume and shape. The atoms or molecules that comprise a solid are packed close together and are not compressible. Because all solids have some thermal energy, its atoms do vibrate. However, this movement is very small and very rapid, and cannot be observed under ordinary conditions.

<u>What are the properties of a Liquid?</u>
Liquids have a definite volume, but are able to change their shape by flowing. Liquids are similar to solids in that the particles touch. However the particles are able to move around. Since particles are able to touch, the densities of liquid will be close to that of a solid. Since the liquid molecules can move, they will take the shape of their container.

- Viscosity --The resistance of a liquid to flow is called its viscosity

- Surface Tension -- The result of attraction between molecules of a liquid, which causes the surface of the liquid to act as a thin elastic film under tension. Surface tension causes water to form spherical drops.
- Vapor Pressure -- The pressure that a solid or liquid exerts when it is in equilibrium with its vapor at a given temperature.
- Boiling Point -- when vapor pressure = atmospheric pressure.

What are the properties of a Gas?

Gases have no definite volume or shape. If unconstrained gases will spread out indefinitely. If confined they will take the shape of their container. This is because gas particle have enough energy to overcome attractive forces. Each of the particles is well separated resulting in a very low density.

What are the properties of Plasma?

Plasma consists of a collection of free moving electrons and ions—atoms that have lost electrons. Although plasma is the most common state of matter in the universe, it is not that common on earth. Plasmas are found in fluorescent bulbs, neon lights, and in some display screens.

Finally, the teacher will cover phase changes. These are caused by changes in pressure or temperature of matter. Melting, freezing, evaporation, condensation, sublimation, and deposition are phase changes that occur.

At the beginning of the activity, the teacher will demonstrate a phase change by placing dry ice into water. The solid will sublimate into a gas. Each student will have to identify the phase change and make their own observations and record them.

Then each student will be given the materials to make a bouncy ball. Students will be asked what phase do we expect to have after combining these materials? They will measure and combine the chemicals and describe what happened. They will be asked to measure 20 mL of sodium silicate solution and pour it into a beaker. Next they will measure 5 mL of borax solution. Add the borax to the sodium silicate solution and stir until a solid forms. The students should be wearing gloves and can remove the solid and form it into a ball in their hands (gently).

Next, they will be given the chemicals to make slime. Students will be given a plastic cup, lid, and dropper. They will measure 50mL of the PVA solution in a beaker and place it in their cup. They will have the option of choosing a color. The teacher will place two drops of food coloring in each student's PVA solution. They will stir well. Next, they will take a graduated cylinder and measure 5mL of the Borax solution. At this point the teacher will ask what the students expect to get as a product from combining two liquids. They will fill in their data sheet with what they expect. After they have recorded their hypothesis, they will add the borax solution to the PVA solution and stir

until they have made slime. They will be asked to make observations and decide whether it is a solid or liquid. They will write down a defense to back up their choice. Once the students are done writing the teacher will hold a debate with the students to decide which phase is the correct answer. The teacher will explain that the slime is both because it is considered a non-Newtonian fluid. Other examples that they may be more familiar with are toothpaste, ketchup, and caramel.

Independent Practice:

The students will combine chemicals and have to classify them as a state of matter based on the observations that they make.

Each student will construct a lab report summarizing the experiment and their individual results.

Remediation and/or Enrichment:

Remediation:

Individual IEP. Do not allow students to measure the chemicals out by themselves (have the solution in the cup already).

Enrichment:

The students could be asked if they have encountered any other substances that could be classified as a non-Newtonian fluid (silly putty). Another example can be found by adding water to cornstarch (nicknamed oobleck).

Check(s) for Understanding:

The student will have to work alone to decide whether the slime is a solid or liquid and form an argument to why they have made that decision.

A classroom discussion will be held for the students to debate among themselves to come to a common conclusion.

What characteristics classify a solid as a solid and a liquid as a liquid?

Is it possible for a substance to be more than one state of matter?

Each student will have to complete a lab report describing the experiment and the results.

Closure:

The teacher will explain that slime is a non-Newtonian fluid and is both a liquid and a solid.

Students will have to formulate their own conclusion and defend them on a data sheet.

Once students have completed their data sheet, the class will hold a discussion on whether the slime is a solid or a liquid.

Possible Alternate Subject Integrations:

Geosciences: This lesson could be used to introduce students to non-Newtonian fluids and the relation to earth flows.

Teacher Notes:

For detailed slime experiment:
http://www.west.net/~science/slime.htm

For detailed bouncy ball experiment:
Mississippi State University Department of Chemistry CH 4521 Lab Manual