Science Unit:	***Animals, Matter, and Mankind in the Environment***
Lesson # 1:	***States of Matter - Oobleck and Baking Soda Volcanoes***
Summary:	Students use “Oobleck” and a baking soda/vinegar “volcano” to explore the states of matter.
School Year:	2013/2014
Developed for:	Renfrew Elementary School, Vancouver School District
Developed by:	Sheila Thornton (scientist); Jessica Wersta-Duncan and Lucia Bildstein (teachers)
Grade level:	Presented to grade K/1/2; appropriate for grades K-4 with age appropriate modifications
Duration of lesson:	1 hour and 20 minutes
Notes:	This lesson allows the students to explore mixtures, so is best conducted in an art room

Objectives

Students will be able to:

1. Understand states of matter – solid, liquid and gas, and understand that all forms of matter take up space and have weight
2. Understand the change of state of matter (temperature and pressure)
3. Understand and define environment, using the concept of matter
4. Observe how animals function in their environment - adaptations

Background Information

Matter is everything around you. Matter is anything made of molecules. Matter is anything that has mass (weight) and takes up space. If you are new to the idea of mass, it is the amount of stuff in an object. Even though matter can be found all over the Universe, you only find it in a few forms. There are three common states in which matter exists - solid, liquid, and gas.

But what makes a state of matter? It's about the **physical state** of the molecules and atoms. Think about solids. They are often hard and brittle. Liquids are all fluid at room temperature. Gases are there, but you usually smell them before you can see them. You don't see them because their molecules are really far apart.

Changing States of Matter: Molecules can often move from one state to another and not change their basic parts. Water (H_2O) is an example. A water molecule is made up of two hydrogen (H) atoms and one oxygen (O) atom. It has the same molecular structure whether it is a gas, liquid, or solid. Although its physical state may change, its chemical state remains the same.

Materials

- Cornstarch
- Baking soda
- Vinegar
- Bins (dishwashing bins work well)
- Balloons with frozen water, water, and air
- Containers at least 2 cm deep
- Food colouring
- Beakers
- Baggies with water, rock, and air

Vocabulary

Vibration	A rapid back-and-forth movement
Frequency	The number of wavelengths per second – relates to the pitch of a sound
Amplitude	A measure of the height of a sound wave – relates to loudness of a sound
Molecule	The smallest unit of a substance that still has the properties of that substance
Liquid	A form of matter that is neither gas nor solid, and flows easily
Solid	A form of matter that has shape and can be measured in length, width and height
Gas	A form of matter that is neither liquid or solid, and conforms to the shape of a container
Environment	The area in which something exists or lives; the things and conditions around us
Adaptation	A change in an organism, over time, that better enables it to survive and multiply

In the Classroom

Introductory Discussion

1. What is matter? Ask students to describe/define matter.
    - Pass around zip lock bags with a) a rock, b) water, and c) air. Ask the students to describe each of the things inside the bag.
    - Pour the water into a cup and ask them to describe the "shape" of water.
    - Lead them to describe the shape, and identify that solids have a defined shape, liquids change shape easily, and gases have no shape of their own.

2. States of matter
    - Pass around sealed plastic bags or balloons of one type of matter – water – in three different states: one gaseous (water vapour from breath), one liquid (water) and one solid (ice cubes in a bag or frozen water balloon).
    - Ask the students what is in the bags/balloons, and how they think the water could change states. Ask what could you do to make matter change state. (Lead them to the concepts of pressure and temperature.)
    - Define molecules (smallest particle of something that still retains the characteristics). Explain how pressure and temperature can change the way molecules interact, but not change the molecule itself.

3. Physical demonstration of pressure and temperature
    - Ask children to demonstrate "high energy" molecules – gas, need lots of room to move. Ask them to hold hands and be "fluid" – can still move around. Ask them to put their hands by their sides and stand right next to each other, as close as possible – solid. Explain that high temperature adds energy (gas), and cooling takes it away (change state to solid).
    - Repeat, but with the teachers adding "pressure" to the gas, pushing the molecules closer together, and changing the state of the "matter" from gas to liquid to solid, by putting pressure on the molecules (students) and moving them closer together.

4. Provide instructions for the cornstarch (suspension) and volcano (gas) experiments.
    - **Corn starch and water (oobleck) activity**: Have children describe the characteristics of the mixture, and decide whether it is a solid, liquid or gas (it's actually a suspension of a solid in a liquid, so it retains characteristics of both). Quicksand is another example of a suspension.
    - **Volcano** activity: – have the students create carbon dioxide "volcanoes" to demonstrate that gas takes up space and is "something" (tie this back to the "empty" bag of air to demonstrate that a gas is matter).

Science Activities

Activity 1: Oobleck

(Cornstarch suspension, with credit to Dr. Seuss' "Bartholemew and the Oobleck")

Purpose of Activity: Explain and demonstrate the properties of matter

Observations: The properties of a solid and a liquid will be observed separately. Students will record their observations as they mix the water and cornstarch together.

Prediction: What state will the mixture be when the cornstarch and water are mixed together?

Methods and Instructions:

1. Give each group a bowl or container, a box of cornstarch and a beaker of water (add food colouring if desired). Containers should be low sided but large enough to accommodate an open hand.
2. Add cornstarch into the container to a depth of 2-3 cm. Add small amounts of water to the cornstarch, mixing constantly. Students can use their hands to mix. Keep adding liquid until the mixture reaches the consistency of a milkshake or thick pancake batter.
3. Encourage students to question the state of the Oobleck and whether it is a liquid or solid.
4. Demonstrate that changes in pressure will alter the state or properties that the mixture exhibits:
    - Have the students pick up a handful of Oobleck and squeeze it – it will form a solid ball.
    - Release the pressure and the mixture will immediately exhibit properties of a liquid and will flow out of their hands.
    - Have the students slap or punch the Oobleck and observe that it exhibits properties of a solid
    - Then ask them to move their hand or finger slowly through the mixture and describe the state.
5. Challenge the students to come up with the fastest way to get Oobleck from one container to another. (Pouring is slow, but when you try to spoon it out it becomes a matter of chiseling. Have them observe the solid chunks turn back to a liquid on the spoon, then back to a solid as they go back under tension when they start to drip down.)

Activity 2: Volcanoes - the Mass of Gas

(May be performed as a demonstration if there are time constraints)

Purpose of Activity: Explain and demonstrate the properties of gas.

In this lab, the students will model a volcanic eruption in order to simulate the chemical changes that occur in an erupting volcano. The children will see a solid (baking soda) and liquid (vinegar) mixing to form a gas (carbon dioxide) and a liquid.

Lava is molten rock (a liquid) that flows on the earth's surface. Lava is formed inside the crust of the Earth by extreme heat; it erupts to form a volcano. During an eruption, many changes occur to the lava. First, as it cools, the lava changes state, from liquid to solid. Another change is the escape of gasses such as carbon dioxide, hydrogen sulfide, and water vapor, from the lava into the atmosphere.

Observations: Gas has mass and takes up space; these are the criteria that we use to define matter.

Prediction: When baking soda (sodium bicarbonate) and vinegar (acetic acid) are mixed together, carbon dioxide gas is produced. This gas takes up space, as observed by expansion of the balloon.

Methods and Instructions:

1. Give each group a flask, a balloon, a bottle of vinegar, and box of baking soda.
2. Fill a flask or bottle approximately 1/3 full with vinegar.
3. Using a funnel, half fill the balloon with baking soda (teachers/scientists should practice this to establish optimal quantities of reactants and prevent balloon "explosions").
4. Carefully attach the balloon to the top of the bottle or flask, without spilling any of the baking soda into the vinegar.
5. Tip the balloon up, releasing the baking soda into the vinegar; hold the balloon tight to the neck of the bottle or flask to prevent leakage.
6. Remove the balloons and tie them off to prevent inadvertent release.

Closure Discussion

1. What is in the balloon? Is it empty?
2. Where do you think the gas came from?
3. What caused the solid and liquid to change state into a gas?
4. Is Oobleck a solid or a liquid?
5. Can you think of an example in nature where something would have the properties of Oobleck? (quicksand).

Vocabulary for changes in state:
Gas to Liquid – **Condensation**
Liquid to Solid – **Freezing**
Solid to Liquid – **Melting**
Liquid to Gas - **Evaporation**