JSD 3D Learning Activity Template

Grade: 6th	**Title: Making a Cloud in a Bottle**

Utah Science with Engineering Education Standard (SEEd): 6.3.2 Investigate the interactions between air masses that cause changes in weather conditions.

Key crosscutting concept(s) (CCC): Cause and Effect
Key science and engineering practice(s) (SEP): Earth Science

Materials: 2-liter bottle, ball needle, meat thermometer, #4 rubber stopper with the ball needle and meat thermometer pushed through it, ball pump, 1-cup warm water, talc (baby powder), funnel, flashlight, goggle for each student

Time: two 45-minute periods

Teacher background, key content information and hints: Air pressure change in an area plays a key role for the causes of change in weather conditions. High-pressure area means that the barometer reading is above 30.00 inches (30.25, 30.30, 30.35, 3.40 and so on). A low-pressure area means that the barometer reading is below 30.00 (29.90, 29.80, 29.70 and so on). During a high pressure, the air is circling clockwise pushing the air down toward the earth. During a low pressure, the air is circling counter-clockwise pulling the air upward away from the earth.

These high-pressure and low-pressure areas are known as air masses. When a low-pressure area, or storm front as it is known, comes in toward a high-pressure area and meet, the barometer will begin to drop. This meeting of air masses cause strong winds, colder temperatures, possible precipitation, changes in wind direction, and clouds of all types. It is the change of air pressure that causes these changes to happen.

It is best to take good data during the time the low-pressure area is coming toward and meets a high-pressure area, during the time a low-pressure area is present (the high pressure is pushed away), and during the time the low-pressure area leaves and the high-pressure area returns. You will see huge changes in the wind direction, the wind speed, the types of clouds, air temperatures, precipitation, and types of precipitation. Be sure to take the air pressure reading at the same time for you will begin to see the causes and effects that air pressure change has on the weather conditions to eventually begin to be able to predict a storm is coming.

One of the investigations you can do is “Making a Cloud in A Bottle” where you can see a high-pressure air mass (inside the two-liter bottle) meet a low-pressure air mass (outside the bottle) and how the meeting of the two masses causes a “strong wind”, cold air, cloud, and wind direction. There is no precipitation at this time, but the water vapor in the bottle cause water droplets found in the cloud.

When beginning you will see that there is water vapor in the bottle because it is condensing on the inside of the bottle wall. As the air is being pumped into the bottle, a high pressure is formed. When looking at the thermometer, it will actually increase 5 to 10 degrees inside the bottle. When the cork (rubber stopper) is released, high pressure from the bottle releases into the lower pressure open air causing wind and wind direction. Put the cork on top of the bottle and the thermometer will read about 10 to 20 degrees less which is temperature change. When high pressure moves rapidly into low pressure, energy is release and leaves cold air in the bottle. This cold air causes the water vapor in the bottle to condense into water forming a cloud.

Prior knowledge that students need: Students need to know the water cycle, cold air mass (low pressure), warm air mass (high pressure), and different weather instruments and what they measure.

Learning Activity Plan

These three aspects of a lesson should be identified in your learning activity.		
Gathering: To investigate this meeting of the two air masses, the students use a model to do a lab experiment "Making a cloud in a bottle". They will do the experiment, form questions, observe what happened, and gather information.	***Reasoning:*** Students will evaluate what they observed, analyze data, and use their knowledge about the water cycle to construct explanations of what caused the phenomenon to happen. They will develop models to present their argument.	***Communicating:*** Students will communicate their information from their observations and data and by using their model.

Phenomenon: When a low-pressure cold front air mass meets a high pressure warm air mass, clouds form and possibly produces rain.

Learning Activity:

Procedure: Part I

1. Tell the students that today we are going to learn what happens when a low-pressure air mass meets a high-pressure air mass.
2. Review what high pressure and low-pressure air masses are, and why high-pressure moves into low-pressure area.
3. The students will be put in groups of two or three.
4. Give each group 1 of each of the equipment needed: two-liter bottle, hand ball pump with the rubber stopper attached with the ball needle and meat thermometer in it, 1 cup of warm water in measuring cup, little baggie of talcum powder, funnel, and flashlight, goggle for each student.
5. Give them instructions as to what the procedure is. They are to write down what everything they observe during the experiment.
    a. Put warm water in the two-liter bottle.
    b. Put a small amount of talcum powder into the bottle for dust.
    c. One student is to hold the cork on the bottle while another student pumps air into the bottle.
    d. Watch the thermometer reading as air is being pumped into the bottle.
    e. When there is a lot of air pressure in the bottle, the student holding the cork pulls it off rapidly so that that is a small explosion of air coming out of the bottle.
    f. One student holds the flashlight to see if something formed in the bottle.
    g. Take the temperature of the bottle inside after the experiment.
    h. Have the students practice this a few times until they do it perfectly.

Procedure: Part II

1. When the students are done with their experimentation, they are to analyze their observations and data as to why a cloud formed in the bottle. These are things they should have observed.
    a. Water vapor was in the bottle before air was pumped into the bottle.
    b. As a higher air pressure was put into the bottle, the temperature increased.
    c. When the high pressure was released to a low pressure in the bottle, the temperature decreased.
    d. When cold air formed in the bottle changed the water vapor to change to water droplets forming a cloud.
    e. The release of the high pressure caused wind and wind direction.

Procedure: Part III

1. Have the students make a model by drawing a picture of the experiment showing what caused water vapor to change to a cloud. Have the student form their arguments.

Assessment of student learning

1. When the students are done with their experimentation, they are to analyze their observations and data as to why a cloud formed in the bottle. These are things they should have observed.
    a. Water vapor was in the bottle before air was pumped into the bottle.
    b. As a higher air pressure was put into the bottle, the temperature increased.
    c. When the high pressure was released to a low pressure in the bottle, the temperature decreased.
    d. When cold air formed in the bottle changed the water vapor to change to water droplets forming a cloud.
    e. The release of the high pressure caused wind and wind direction.
2. The students are make a model by drawing a picture of the experiment showing what caused water vapor to change to a cloud. Have the student form their arguments.

Student Sheet

Title: What Happens When a Low-Pressure Area Meets a High Pressure Area?

Introduction: Air pressure change in an area plays a key role for the causes of change in weather conditions. High-pressure area means that the barometer reading is above 30.00 inches (30.25, 30.30, 30.35, 3.40 and so on). A low-pressure area means that the barometer reading is below 30.00 (29.90, 29.80, 29.70 and so on). During a high pressure, the air is circling clockwise pushing the air down toward the earth. During a low pressure, the air is circling counter-clockwise pulling the air upward away from the earth.

These high-pressure and low-pressure areas are known as air masses. When a low-pressure area, or storm front as it is known, comes in toward a high-pressure area and meet, the barometer will begin to drop. This meeting of air masses causes strong winds, colder temperatures, possible precipitation, changes in wind direction, and clouds of all types. It is the change of air pressure that causes these changes to happen.

While doing this experiment, you are to write down your observations and as much data as you can. Then you are going to analyze your data. You are to explain why as to what formed in the bottle by using your knowledge of the water cycle and high pressure to low pressure change.

Materials: 2-liter bottle, ball needle, meat thermometer, #4 rubber stopper with the ball needle and meat thermometer pushed through it, ball pump, 1-cup warm water, talc (baby powder), funnel, flashlight.

Procedures:

Part I

1. Put warm water in the two-liter bottle.
2. Put a small amount of talcum powder into the bottle for dust.
3. One student is to hold the cork on the bottle while another student pumps air into the bottle, and the third is to put the light so it shines into the bottle.
4. Watch the thermometer reading as air is being pumped into the bottle.
5. When there is a lot of air pressure in the bottle, the student holding the cork pulls it off rapidly so that that is a small explosion of air coming out of the bottle.
6. Hold the flashlight to see if something formed in the bottle.
7. Take the temperature of the bottle inside after the experiment.
8. Repeat this experiment three for four times and gather data to verify.

Analysis:

1. You are to analyze their observations and data as to why a cloud formed in the bottle. Remember the water cycle and high what happens when a high pressure moves into a low pressure. Write down everything you saw happen and explain why they happened.
2. Make a model by drawing a picture of why the cloud formed in the bottle.

Data tables or graphs:

1. Make a graph of your data gathered.
2. Make a table of what you found out.

Conclusion:

1. Report what you found out by using your data, graphs, tables, and model.

Name _____

Air Pressure Change Experiment

Supplies: 2-liter bottle, ball pump, ball needle in a rubber stopper, funnel, pitcher, talc powder, flashlight, goggles

Directions:

1. Get into groups of three. One student pumps, one student holds the rubber stopper on the bottle, and one student shines the flashlight.
2. Put on your goggles.
3. Put a cup of very warm water into your two-liter bottle.
4. Put some talc powder into the 2-liter bottle.
5. One student puts the rubber stopper on the bottle opening and holds on to it tightly on the bottle.
6. One student pumps about 30 pumps into the bottle.
7. When 30 pumps have been put into the bottle, the student holding the rubber stopper deliberately pulls off the rubber stopper. There should be a small explosion of air coming from the escaping air.
8. When done, the student hold the flashlight shines the light inside the bottle to see what happened in the bottle.
9. Do this so everyone has a turn to pump, hold the rubber stopper, and shine the light.
10. When you are done, discuss these questions.
11. When answering them, think about:
    a. Air pressure change
    b. The water cycle.

Questions:

1. What did you discover that happened inside the bottle when the rubber stopper was pulled off the bottle? (This is the phenomenon.)

_____

2. Thinking about the water cycle, what was inside the bottle besides air before you started to pump air into the bottle?

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3. Thinking about the water cycle, how did the answer to number 2 get into the bottle?

_____

4. Thinking about the water cycle, what generally causes clouds to form?

_____

5. What kind of air pressure was in the bottle before you started pumping air into the bottle?

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6. What kind of air pressure was in the bottle right before the rubber stopper was pulled off the bottle?

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7. What kind of air pressure was in the bottle after the rubber stopper was pulled off the bottle?

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8. What must the temperature of air had been after the rubber stopper was pulled off to cause the phenomenon?

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9. What caused the phenomenon to happen in the bottle?

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10. What will usually cause clouds to form?

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