Throughout the guide teaching tips are in red.

Activity Description and Estimated Class Time

This three day activity allows students to observe the basic principles of the water cycle. On day one, students observe the effects of the water cycle and notice water condensing. During day two, teams of students are challenged to modify the set-up to move more water. On day 3, students determine the results of their designs, share results with the class, and consider connections to weather.

Objectives

Students will develop an understanding of the following ideas and content:

- Evaporation and condensation,
- Water vapor as an invisible gas,

Correlations to NC Science Standards

7.E.1.2 Explain how the cycling of water in and out of the atmosphere and atmospheric conditions relate to the weather patterns on earth.

Brief Science Background

Water evaporates into the air as a vapor. Most of us think of water vapor as tiny droplets of water, but surprisingly, water vapor is an invisible, odorless gas that is much lighter than the atmosphere as a whole. With regard to weather, this lightness is water vapor's most important quality. Because air containing it is lighter - less dense - than air alone, air containing water vapor floats upwards. It is called a low pressure air mass. However, as this air rises and cools, water vapor condenses out of the atmosphere to become water again. That water takes the form of tiny droplets that we see as clouds. Without water vapor, air left behind is more dense, and it falls toward earth. It is called a high pressure air mass. Low and high pressure air masses are important factors driving weather, wind, and precipitation. Low and high pressure air masses owe their existence to the cycling of water in and out of the atmosphere.

Part 1 – Water Moves

Materials

Materials for the whole class

- ice cube trays

Materials for teams of 4 students

- 1 sandwich bag
- 1 hinged deli container
- 1 oz. graduated cup
- 1 Clamp light with 100 watt bulb
- 1 ice cube

Preparation

1. For the first day, freeze a full ice tray, enough ice so each team of four has one cube. For the second day, some teams might want more than one cube, so you might need extra ice.

2. Set up 8 clamp lights around the room, each team of four will use one. Clamp lights should be about 1 foot above a flat surface and be able to point straight down.

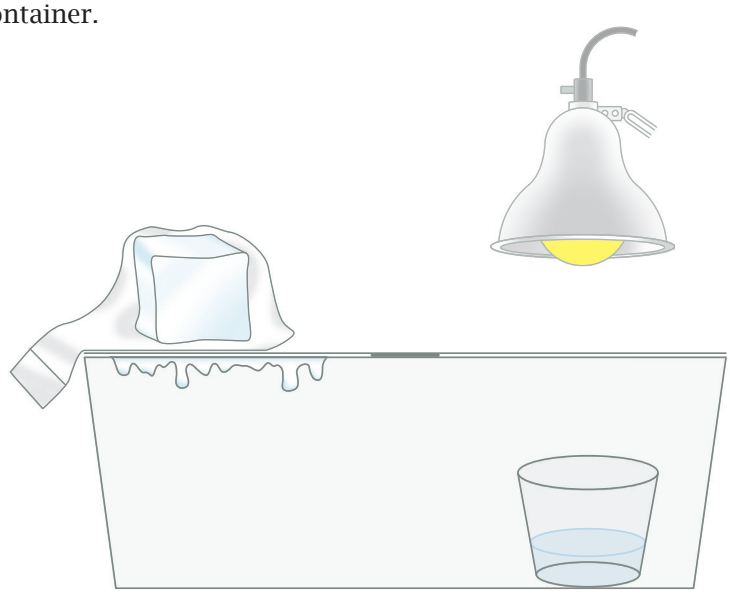
Procedure

Exploration – 5 minutes

1. Ask students to list places where there is water in our atmosphere.
2. Ask students to speculate how water moves in our atmosphere.
3. Explain that we will explore how water moves and factors that affect how water moves.

Activity – 40 minutes

1. Form teams of four students. Each team will prepare their set-up and place it under a clamp light for 10 minutes.
2. Each set up requires:
   - 1 oz. cup containing 10 mL of room temperature water
   - 1 ice cube sealed in a sandwich bag
   - 1 hinged deli container
3. As in the figure below, students should place the cup of water in the container on one end. Seal the lid and place the ice cube in the sandwich bag on the other end of the container.



4. After the set-up is complete, students should place the container under the clamp light with the cup of water directly below the bulb. The bulb should be about 8 inches above the container. Turn on the light and wait 10 minutes.
5. During this time, students can begin to read the information in the textbook about the cycling of water in our atmosphere.
6. After 10 minutes, ask teams to remove the ice. Ask student to discuss what they see.
   Students should notice water collected inside the lid directly below the ice cube.

7. Ask students to speculate where they think the water inside the container lid and under the ice cube came from and how it got there.

   If students are unsure about the water cycle and how water moves, allow time to complete the reading. Students should understand that heat from the light evaporated some of the water in the cup. The evaporated water became water vapor, a gas. The ice cooled some of the water vapor, making it became water again (condense). The condensed water collected directly below the ice cube.

8. During cleanup, have students dry and save the deli container and 1 oz. cup to be used for the next class.

9. Tell students that they will work in teams of four. Explain the challenge as follows: Using the set-up that we have just seen, and running it overnight, move the most water you can out of the cup and into the container. We will weigh the container without the cup before and after the experiment. After the experiment, the container's weight will include any water droplets that collect inside.

   The inside of the container must remain unchanged, just like the setup we have already seen. Teams can only change the outside of the container. Allow teams to use colored paper, aluminum foil, extra ice, insulation, etc.

   Allow teams time to plan. If they want to bring in items from home, discuss this with them and allow it if it seems reasonable.

Part 2 – The Challenge (50 minutes)

Materials

Materials for the whole class

- Digital scale
- 2 ice cube trays full of ice
- Black construction paper
- Aluminum foil

Materials for teams of 4 students

- 1 sandwich bag
- 1 hinged deli container
- 1 oz. graduated cup
- 1 Clamp light with 100 watt bulb (4 teams will share a light)
- 1 copy of SD-1

Preparation

1. Using the ice trays, prepare enough ice for each team. Some teams will want more ice. Depending on your ice supply, it might be necessary to limit each team to 5 cubes. If you have a bag of ice, you can let them have more.
2. Set up 2 clamp lights for each class. Each class has four containers under each light to remain overnight.

Procedure

1. Remind students of the challenge. “How much water can they move out of the cup?”
2. Inform the class that at the end of the class period, they will have their container set up under a clamp light. Four teams will share one clamp light. The containers will sit under the light overnight. The next day, each team will determine how much water moved out of their cup.
3. Hand each team a copy of SD-1. Provide each team an empty deli container and have them measure the mass and record it on SD-1.
4. Allow the class time to plan and design their water cycle setup. Let teams know that they have ice, black construction paper, and aluminum foil available. If they would like to use other items have them check with you to see if you can supply them.
5. Near the conclusion of the class period, be sure each team has their container set-up under a clamp light. Allow time for them to complete SD-1.
6. Have each team look at the other teams’ containers and lead a discussion comparing them. Ask teams to share the reasoning of their design.

Part 3 – The Results (30 minutes)

Materials

Materials for the Whole Class

- One copy of SD-2 per student
- SD-3 ready to project

1. Have each team retrieve their water cycle containers. Remind the students not to tip over the 1 oz. cup in the container.
2. Carefully open the deli container and remove the 1 oz. cup, close the lid and place on the digital scale. Record this value on SD-1.
3. Allow teams to share their results and discuss which designs worked the best and speculate about the results.

   Designs that work well absorb and trap more heat. For example, black paper under the container helps to absorb heat. Designs that work well also have a significant cold area that stays cold longer. This allows more water vapor to condense. For example, using more ice and insulating it with a towel can provide good conditions for condensation.
4. Ask each student to fill out SD-2 as best they can.

Wrap-Up

1. After students fill out SD-2, discuss their results.
2. Project SD-3, the answer key, to call attention to the areas where there is the most and least water vapor in the air. Explain that air that is full of water vapor is called a low pressure area, and it rises. Air from which water vapor has condensed contains less water vapor. It is called a high pressure area, and it falls toward the ground.

Support Document 1

Team members' names _____

1. Using the digital scale, record the mass of the empty deli container _____ g

2. Record the list of additional materials your team plans to use in this challenge:

_____

_____

_____

3. Sketch your set-up:

4. Explain what you think will happen and how the materials you chose will allow more water to move out of the cup and into the container.

Results:

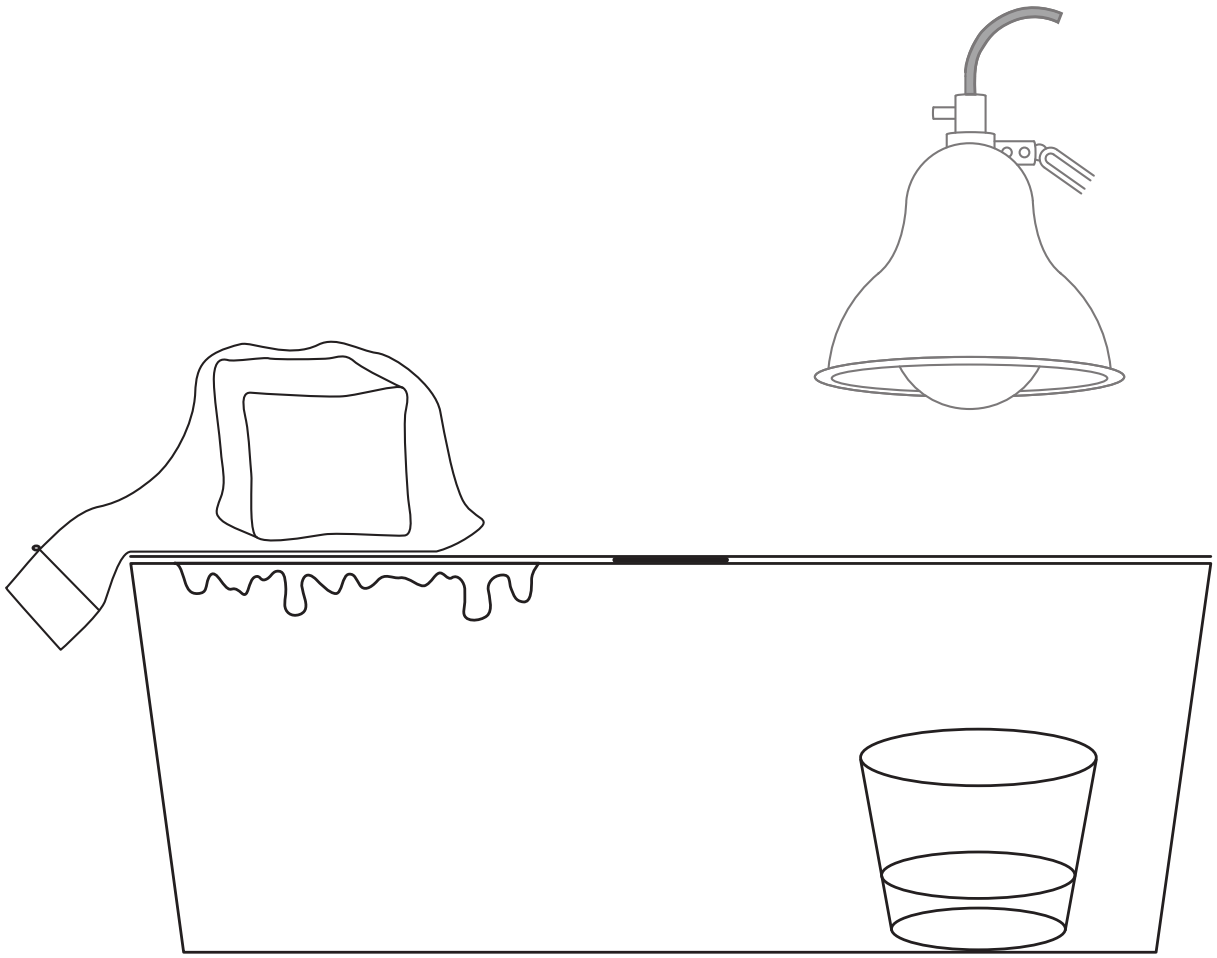
1. After your setup has run overnight, remove any materials around it. Taking care not to tip over the cup inside, open the container and remove the cup along with the water in it. Place the container along with the water collected inside the lid on the digital scale. Determine the mass:

   _____ g

2. How much water your team was able to move: _____ g

Support Document 2

Name _____



In the diagram above, consider that this is a model of water in the atmosphere, and label the following:

1. the sun,

2. the coldest air inside the container,

3. the boundary between the coldest and warmest air inside the container,

4. the places where there is the most and least water vapor in the air,

5. the direction of water vapor movement inside the container,

6. clouds or rain.

Using arrows, draw how you think air is moving inside the container. Include the area where air is falling and where air is rising.

Support Document 3

Answer Key