

CLOUD FACTORY LESSON

DRIVING QUESTION: HOW CAN CLOUDS HELP US PREDICT THE WEATHER?

Recommended Grades: K – 6; Adaptations for 6 – 12.

<i>Classroom or Center Activities</i>	<i>Outside or Larger Space Activities</i>	<i>Technology-Based Activities</i>	<i>Stem-to-Go Take Home</i>	<i>Field Work and/or Natural Area Needed</i>
X	X	X	X	X

Materials: Cloud in a Cup: Ice, warm water, a quart freezer bag, blue food coloring. Front in a Cup: one cup of very cold water with blue food coloring mixed in, one cup of hot water with red food coloring mixed in, one empty cup. One dropping pipet.

Participant activity: 15 minutes for each activity.

Objectives:

1. Explain how clouds are part of the hydrosphere.
2. Describe the types of energy transfer: convection, conduction, and radiation.
3. Classify clouds and use observations to make weather predictions.
4. Model fronts and air masses.

STEM Skills

S: Classify clouds and make inferences about weather patterns.

T: Use interactive websites to identify clouds.

E: Build a model to explain how fronts form and air masses move.

M: Graph cloud cover and mood.

Teacher Tips: Cloud Factory

Plan ahead: It is helpful to have ice on hand as well as warm or hot water. Dropping pipets can be purchased from Carolina Biological Supply.

Total prep: < 5 minutes to make copies and assemble materials.

Safety: Make sure to mop up any water from the floor to mitigate a slip hazard.

Sensory Integration Issues: Participants who are color blind may need assistance with interpreting their observations.

Cost: Minimal, <\$2 per person.

What else do I need? Paper towels/rags.

Clean Up: Hands, equipment, and surfaces can be washed with soap and water.

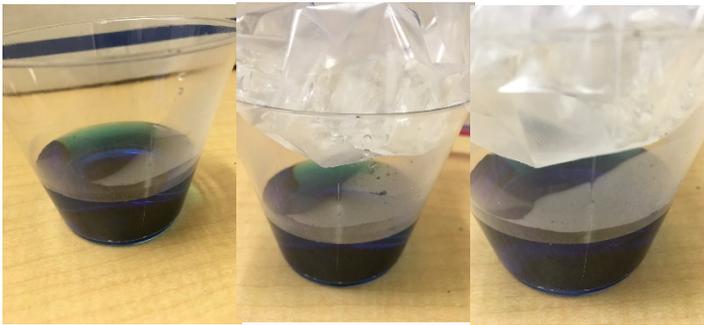
1. Print it out:

- a. Print out the Student Handouts
- b. STEM TO GO
- c. Cloud Identification Chart
- d. Fortune Teller/Cootie Catcher with Weather

2. Activate prior knowledge:

- a. Energy Hands: Use your knowledge of energy transfer to dance.
 1. Convection: Lock your fingers together and move your elbows in the wave like spaghetti circling up and falling down in boiling pot of water.
 2. Conduction: Make two fists and pop the sides of them together to make a popping sound. That's energy being transferred from one molecule to the other.
 3. Radiation: Spread your fingers out and wiggle them. Radiation is the only form of energy that can travel through space's vacuum.

3. Procedure:

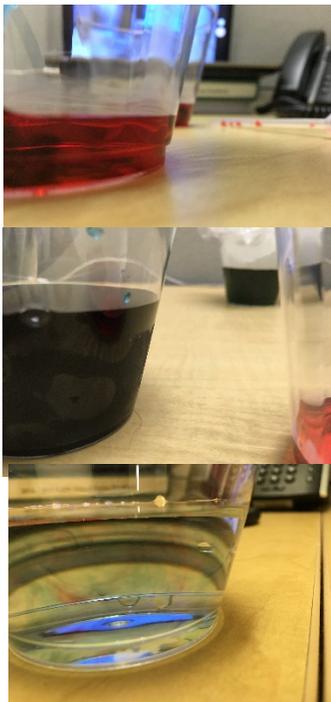


a. **Part 1: Cloud in a cup.**

- i. Fill a freezer bag with a handful of ice.
- ii. Heat approximately one third of a cup of water and pour it into a clear plastic cup and add several drops of blue food coloring to it.
- iii. Place the ice bag over the top of the cup of warm water.
- iv. Observe condensation against the side of the cup and let the cup sit undisturbed for five minutes.
- v. The "fog" should clear up. Then water droplets will form

along the boundary of the bottom of the bag of ice and the warm air inside the cup, water droplets will form. This represents a cloud with precipitation.

b. **Part 2: Front in a Cup:**



- i. Place approximately one third of a cup of ice water into a clear plastic cup. Add blue food coloring to it. In another cup, place approximately one third of a cup of hot water into a clear plastic cup. Add red food coloring.
- ii. In an empty cup, pour ½ inch of warm water with the red coloring. Using a dropping pipet, fill it with cold, blue water. Carefully drop the blue water along the side of the cup of red water. You should see the denser, cold blue water pushing the red warm water up and out of the way. This represents a fast moving cold front.
- c. In an empty cup, now pour ½ inch of cold water with blue food coloring. Using a dropping pipet, fill it with warm, red water. Carefully drop the red water along the side of the cup of the blue water. You should see a gentle curve with the warm water slowly rising into the blue and barely pushing it out of the way from the top down. This represents a warm front.
- d. Now take room temperature water. Add warm red and cold blue water to in concurrently. You should see the swirls stack with the blue on the bottom, the clear warm in the middle, and the red wedged on top of the other colors. This represents an occluded front.



4. Data Collection: Draw what you see in the cups.
5. Collaboration: How much does operator error/fine motor skills impact the ability to see the moving convection currents? Take turn trying the experiment so that everyone gets a chance.
6. Data Analysis: How important is convection to the distribution of heat? Which front moves the fastest? (Cold). Which front has the most chaotic convection? (occluded)
7. Resources and adaptations
 - a. For K – 6th, the cloud journal from STEM To Go can prompt observation skills that weather forecasting activities will reinforce.
 - b. For 7th grade and up, the interactive weather websites are very good reinforcement for the concepts of fronts.

STUDENT HANDOUT: CLOUD FACTORY

Part 1: Cloud in a Cup

The purpose of this activity is to model convection currents and condensation nuclei that create clouds.

Hypothesis: What happens when warm air and cold air meet?

Materials: For this activity you need:

Warm water with food coloring in it, a clear plastic cup, a quart size freezer bag of ice.

Procedure:

1. Place several drops of food coloring into to the warm water. Lay the ice on top of the cup's opening. **Draw your observations. Label evaporation, condensation, and precipitation in your drawing.**

Part 2: Front in a Cup

The purpose of this activity is to model convection currents that create frontal boundaries between air masses of different temperatures.

Hypothesis: If water and air are both fluids, then we can model convection currents and air masses using warm and cold water with food coloring.

Materials: For this activity, you need:

Three clear plastic cups, red and blue food coloring, hot water, cold water, and two dropping pipets.

1. Place approximately one third of a cup of ice water into a clear plastic cup. Add blue food coloring to it. In another cup, place approximately one third of a cup of hot water into a clear plastic cup. Add red food coloring.
2. In an empty cup, pour $\frac{1}{2}$ inch of warm water with the red coloring. Using a dropping pipet, fill it with cold, blue water. Carefully drop the blue water along the side of the cup of red water. You should see the denser, cold blue water pushing the red warm water up and out of the way. This represents a fast moving cold front. **Draw what you observe.**

- In an empty cup, now pour $\frac{1}{2}$ inch of cold water with blue food coloring. Using a dropping pipet, fill it with warm, red water. Carefully drop the red water along the side of the cup of the blue water. You should see a gentle curve with the warm water slowly rising into the blue and barely pushing it out of the way from the top down. This represents a warm front. **Draw what you observe.**
- Now take room temperature water. Add warm red and cold blue water to in concurrently. You should see the swirls stack with the blue on the bottom, the clear warm in the middle. This represents an occluded front. **Draw what you observe.**

Data Analysis:

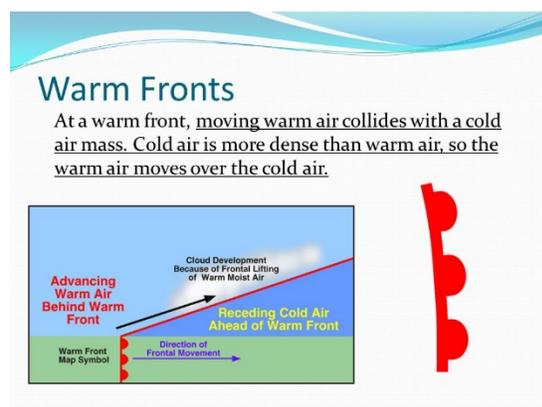
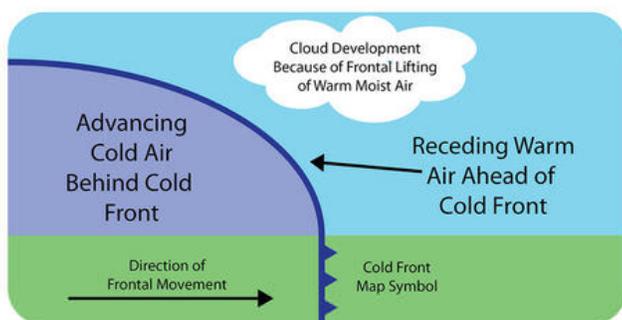
Cold Fronts: Cold fronts have fast moving weather, often with high winds and violent thunderstorms followed by cooler temperatures.

Warm Fronts: Warm fronts have slower moving air changes, with clouds or gentle rain followed by warmer temperatures.

Occluded Fronts: Occluded fronts have highly changeable weather, often with intermittent, sun, and changing temperatures.



The map symbol for a cold front is blue triangles that point in the direction the front is moving.



- Describe how the convection currents in water modeled the air masses and fronts.
- Which front has the potential for the strongest storms?

Think about it: What are the air temperatures like after the fronts move through?