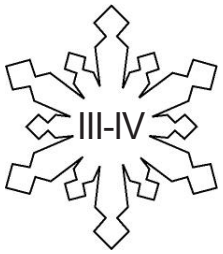
Convection and Wind

Levels



Grades 5-8

Overview:

During this project, students observe convection current by performing a lab experiment. As a result of this activity, students develop an understanding of the process of convection as it relates to wind.

Objectives:

The student will:

- draw or define convection;
- learn that convection current can occur in any fluid substance (air, gas, water, etc.);
- learn that hot air rises and cool air sinks; and
- learn that convection current occurs in Earth's atmosphere, causing wind.

GLEs Addressed:

Science

- [5-8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.
- [6] SA1.2 The student demonstrates an understanding of the processes of science by collaborating to design and conduct simple repeatable investigations.
- [7] SA1.2 The student demonstrates an understanding of the processes of science by collaborating to design and conduct simple repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.
- [8] SA1.2 The student demonstrates an understanding of the processes of science by collaborating to design and conduct repeatable investigations, in order to record, analyze (i.e., range, mean, media, mode), interpret data and present findings.

Whole Picture:

The term convection refers to the way molecules – in the form of liquid or gas (fluid) – move when *heated*. Convection is a direct result of the effects of gravity in relation to the density of the fluid. The colder the fluid, the more densely packed the molecules and the heavier it is.

Wind is a direct result of convection. When air close to Earth's surface is heated by solar energy it becomes less dense, and therefore rises. Immediately cooler, less-dense air sinks – rushing in to fill the space. The cooler air then heats, rises and the process continues.

The process is visible in a pot of water on a hot stovetop. The heated water expands (becoming lighter or more buoyant) and rises to the top. The cooler water sinks. The process repeats and a circulation cycle is visible. Fluid trapped in such a cycle is called a convection cell – a common weather phenomenon affecting both dry and moist air

Materials:

- Clear glass beaker that can be placed on a hot plate
- Hot plate
- Water
- Paper dots or confetti
- Safety goggles

Teacher Note: Some hot plates have heating elements on the outside of the plate. If that is the case, convection currents may be different than those shown in the diagram.

- STUDENT WORKSHEET: “Convection Hypothesis”
- STUDENT WORKSHEET: “Convection Data”
- STUDENT WORKSHEET: “Convection Conclusion”

Activity Procedure:

1. Explain a convection current occurs when temperature differences cause fluid material to move.
2. Discuss what Athabascan Elder Effie Kokrine said: “When the heat generates to the bottom of the ground and circulates to the top and all around, it gets warmer.” Effie’s quote describes convection. As the sun heats Earth, the air around Earth gets hotter. This hot air is less dense than the cold air above it, so the hot air rises. The cold air sinks toward Earth’s surface, where it warms. Meanwhile, the air that initially rose becomes cold again and sinks back to replace the newly warmed air. This cycle of moving warm and cold air is called convection. Convection creates wind, which is simply moving air.
3. Distribute the Student Worksheet: “Convection Hypothesis.” Ask students if they think convection can occur in water. Ask students to record their predictions in the hypothesis section of the worksheet. Explain students will perform an experiment to determine if convection occurs in water.
4. Divide students into groups and distribute supplies. If confetti is unavailable, ask students to use hole punches to create a mound of paper dots. Ask students to follow the instructions on the Convection Hypothesis Worksheet to perform the experiment.
5. Discuss student observations and results. Students should understand that as the water in the bottom of the beaker warmed and rose to the surface, the paper dots also began to rise. At the surface, the water cooled. Warm water rising from the bottom pushed cool water toward the edges of the beaker. At these cooler edges, the water began to sink again, carrying the paper dots with it. Any fluid substance (air, gas, water, etc.) can be heated and experience convection. Remind the students that “hot air rises” because it is less dense.
6. Distribute the Student Worksheets: “Convection Data” and “Convection Conclusion.” Discuss the similarities and differences between convection current in Earth’s atmosphere and the convection current illustrated by this water and beaker model. Ask students to complete the worksheets.

Answers to Student Worksheets:

Convection Hypothesis: Student responses will vary.

Convection Data:

Diagram 1: No Heat Source

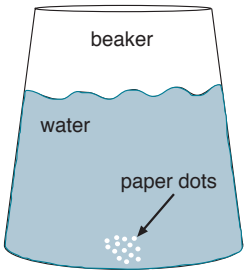
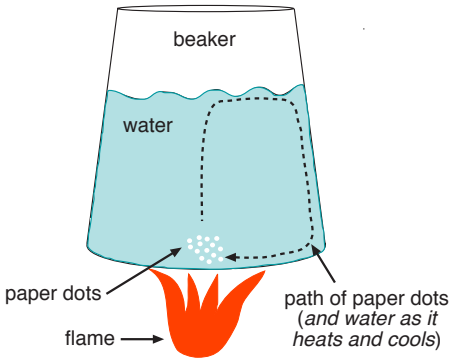


Diagram 2: Active Heat Source



Analysis of Data: 1. d 2. c

Convection Conclusion: Student responses will vary.

Further Questions: 1. c 2. a

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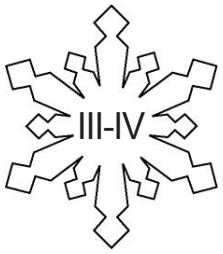
Levels



Convection Hypothesis

Student Worksheet (page 1 of 3)

Testable Question/Problem:

What will happen to paper dots submerged in a beaker of water if the water is heated?

Background Information/Observations:

As the sun heats Earth, the air around Earth gets hotter. This hot air is less dense than the cold air above it, so the hot air rises. The cold air sinks toward Earth's surface, where it warms. Meanwhile the air that initially rose becomes cold again and sinks back to replace the newly warmed air. This cycle of moving warm and cold air is called convection, and is what creates wind. Wind is simply moving air.

Hypothesis:

In the box, draw a diagram of what you think will happen to the paper dots when the beaker of water is placed on a hot plate and heated.

Experiment:

Materials:

- Clear glass beaker
- Hot plate
- Water
- Paper dots
- Safety goggles

Procedure:

1. Put on safety goggles.
2. Pour 250-300 ml of water into the beaker.
3. Sprinkle paper dots over the top of the water. If the dots do not sink, push them under the water with a pencil until they rest at the bottom of the beaker.
4. Observe the beaker of water. Complete Diagram 1: No Heat Source, in the Data section of this Lab Packet.
5. Turn on the hot plate and place the beaker of water on the burner. Heat the water slowly.
6. Observe the beaker of water as it heats for 10 minutes. Complete Diagram 2: Active Heat Source, in the Data section of this Lab Packet.

Name:_____

Convection Hypothesis

Student Worksheet (page 2 of 3)

Data:

In the boxes below, draw the beaker of water with the paper dots in it. Label the beaker, water, paper dots, heat source (if applicable), and the path of movement of the paper dots (if any).

Diagram 1: No Heat Source

Diagram 2: Active Heat Source

Analysis of Data:

1. Circle the correct answer. What are the differences between your observations for Diagram 1 and Diagram 2?

   a.) In Diagram 1 the paper dots remained still, while in Diagram 2 the paper dots moved.
   b.) In Diagram 1 the paper dots moved, while in Diagram 2 the paper dots remained still.
   c.) In Diagram 1 there was no heat source, while in Diagram 2 there was a heat source beneath the beaker.
   d.) Both a and c.

2. Circle the correct answer. What are the differences between your observations for Diagram 1 and Diagram 2?

   a.) As the water warmed, the paper dots floated to the surface and remained on top of the water.
   b.) As the water warmed, the paper dots remained motionless on the bottom of the beaker.
   c.) As the water warmed, the paper dots were carried by rising water to the surface, where the water cooled and began to sink again, carrying the paper dots with it back to the bottom of the beaker.
   d.) As the water warmed, the paper dots were shifted by hot water to the bottom edges of the beaker, where they remained, fluttering gently in the current.

Name:_____

Convection Hypothesis

Student Worksheet (page 3 of 3)

Conclusion:

1. Was your hypothesis proved or disproved? Use a complete sentence.

2. Briefly explain how you came to your conclusion.

Further Questions:

1. What did the path of paper dots in Diagram 2 represent?
   a. the movement of the water
   b. convection current
   c. both a and b
   d. none of the above

2. What powers convection current in the air surrounding Earth?
   a. the sun
   b. the moon
   c. other planets
   d. the atmosphere