Air Pressure

Lesson Concept Air pressure impacts temperature, wind, and contributes to general weather conditions.

Link In the previous lesson, students learned that winds are responsible for the movement of weather over the globe. In this lesson, students learn that density and air pressure (measured by a barometer) interact to impact the weather. In the next lesson, students will learn about severe weather that is characterized by wind, temperature and pressure.

Time 75 minutes (can be taught in sections)

Part I Engage through Explore #3 40 minutes

Part II Explore #4-Evaluate 35 minutes

Materials

Whole class

2 Pieces of clay or other soft material (see advance preparation)

Projector

Computer

R1 Pressure Pictures

R2 Guided Drawing

http://www.phschool.com/atschool/phsciexp/active_art/weather_fronts/

Per Group (4-6 students)

Quart sized Ziploc with 5 cotton balls

Quart sized Ziploc with 10 cotton balls

Individual

Science Notebook

Colored pencils

H1 Weather map with H and L and warm and cold fronts

Advance preparation

1. Prepare Ziploc bags with cotton balls.
2. Copy **R1** in color if possible.
3. Review **R2** (illustration of guided drawing example) prior to lesson.
4. Prepare two pieces of clay that are about 2 x 3 x1 inches.
5. Bookmark animation for easy access http://www.phschool.com/atschool/phsciexp/active_art/weather_fronts/

Procedure:

Engage ***(10 minutes) Density is the amount of matter in a given space.***

Teacher Note: The Engage connects with what students learned about density in Lesson 5.11, using bags of cotton balls.

1. Write the word density on the board and distribute cotton ball bags to each table group. Ask students to recall the density lesson: What is density? Which of these "models" is more dense? Why?
2. Have groups share their ideas; record their ideas on a T chart (with rows). Probe to have them describe how the balls are arranged.

Example T Chart

	Bag A (10 balls)	Bag B (5 balls)
Density	Balls are closer together Drawing with dots/balls close together More stuff in an area More dense	Balls are spread out Drawing with dots/balls further out Less stuff in an area Less dense

Explore #1 ***(10 minutes) Pressure is the ratio of the force over an area***

3. Explain that students will use what they know about density to connect to another idea called pressure. Write the word pressure on the board and ask students in partners to discuss what they think the word means.
4. Ask several students to share their ideas which might range from those who think pressure is when someone makes you do something, to those that think pressure is when you push on something.

5. Build on students' ideas that indicate pressure has to do with pushing and ask if any of those students can show what pressure looks like. Allow students to demonstrate their thinking.
6. Explain that scientists say that pressure is the ratio of the force over an area (the force spread over an area). Write this definition on the board. Explain that they will do two demonstrations to better understand this definition.
7. Show students **R1a** (a bed of nails) and **R1b** (a single nail). Ask students which would they would like to lay on and why. Remind them to think about the definition of pressure.
8. Discuss their ideas and then show **R1c** (man on bed of nails). Discuss the area in which the force is spread—in a bed of nails, the force is spread over a large area; in a single nail, the force in confined to a small area. Force over a larger area allows the main to lay in comfort!
9. Show students the two pieces of clay. Place one on the desk and press lightly with your 4 fingers spread apart. Show students the imprint. Repeat with the next piece of clay, but this time put your fingers together and press. Show students the imprint. Which one has more pressure? Why? Encourage students to use the definition of pressure in their answer.
10. Review the definition and the demonstrations. In the first example (bed of nails and 4 finger-spread) the force was spread over the area; in the second (single nail; 4 fingers-together) it was "concentrated" in a smaller area. Which would they call high pressure (the concentrated one)? Which would they label low pressure (spread over a larger area)?
11. Return to the T chart and add another row entitled pressure. Ask students, based on what they know about pressure, which bag would they describe as high pressure and why; which would they describe as low pressure and why?

Example T Chart

	Bag A (10 balls)	Bag B (5 balls)
Density	Balls are closer together Drawing with dots/balls close together More stuff in an area More dense	Balls are spread out Drawing with dots/balls further out Less stuff in an area Less dense
Pressure	The balls are close together-like the single nail or 4 fingers together so it is **high** pressure	The balls are further apart like the bed of nails or 4 finger spread so it is **low** pressure

Explore #2 (10 minutes) Pressure and density are related

12. Invite a group of 4 students up in front of the class and ask them to show what they would do if they were on the North Pole wearing what they currently have on. (Students should huddle together). Refer to the T chart. Which bag is most like the students? Why? Add their ideas to the T chart in a 3rd row entitled temperature.

13. Next, invite another group of 4 students in front of the class and ask them to show what they would do if they were on the equator. (Students should spread away from each other, allowing space between them). Refer to the T chart. Which bag is most like the students? Why? Add their ideas to the T chart.

Example T Chart

	Bag A (10 balls)	Bag B (5 balls)
Density	Balls are closer together Drawing with dots/balls close together More stuff in an area More dense	Balls are spread out Drawing with dots/balls further out Less stuff in an area Less dense
Pressure	The balls are close together-like the single nail or 4 fingers together so it is **high** pressure	The balls are further apart like the bed of nails or 4 finger spread so it is **low** pressure
Temperature	cold	warm

14. Ask students, in partners to review the T chart and synthesize what the characteristics of a high and low pressure are in terms of pressure, temperature and density.

Create another T chart, labeled High Pressure and Low Pressure, on the board and record students' ideas. An example of the chart might look like this:

High Pressure	Low Pressure
Force in a small area Cold High density	Force over a larger area Hot Low density

Explore #3/Explain (10 minutes) There are areas of high and low pressure based on temperature and density

15. Tell students that as a class they are going to complete a guided drawing in their science notebooks.
16. Ask students to think about the landscape of Santa Barbara/ Carpinteria and describe the different terrains. If necessary ask probing questions for them to mention mountains and the ocean.
17. Begin guided drawing on the board and ask students to record the drawing, as you draw, in their science notebooks.
18. Begin the drawing with cliffs on the right side and the beach/ ocean area on the left side. Then ask students to name the heat/ energy source in Santa Barbara/ Carpinteria. The students should say sun. Draw in sun on the left over the ocean.
19. Ask students where would the temperature be hotter: on the cliffs or on the beach? (cliffs). What would the air molecules look like above the cliffs? Why? (spread out because hot air rises).
20. Draw these molecules above the cliffs and label as “hot” and “spread out”
21. Ask if the molecules are spread out, would it be high or low density? High or low pressure? Label the cliff tops accordingly, low density and “L” for low pressure.
22. Repeat this procedure with the ocean area, guiding the students to draw the molecules in the air mass above the ocean closer together and labeling them cooler, high density, and “H” for high pressure.
23. Ask students to look at their drawings and determine which way the wind is blowing and why. Ask them to write their ideas in their notebook and then share with the class.

BREAK

Explore #4 (20 minutes) High and low pressure systems create weather fronts

24. Distribute **H1** (Weather Map) to students and ask them to find the High and Low areas. Where are they?
25. Ask students what they think will happen if the high and low pressure areas meet each other. Have students think-pair-share and then call on students to explain their answers. Illustrate student thinking if possible.
26. Explain that the pressure systems are moving air masses called ‘fronts.” When fronts meet one another they cause different types of weather.
27. Use http://www.phschool.com/atschool/phsciexp/active_art/weather_fronts/ for an animation of different types of fronts formed by the moving air masses. Show students the animation of a cold front and then ask these questions. 1. Why does the cold air go down? 2. What do you think happens to the warm air above it? (This air will cool quickly and together the cooled warm air and the cold air will produce rain.)

28. Have students draw the cold front at the bottom of the weather map handout using the information from the animation and the discussion.
29. Show students the animation of a warm front and then ask these questions. 1. Why does the warm air over the cold air? 2. What do you think happens to the warm air as it goes over the cold air? (This air will cool slowly and together the cooled warm air and the cold air will produce rain.)
30. Have students draw the warm front at the bottom of the weather map handout using the information from the animation and the discussion.
31. Both fronts can produce rain, ask students which front produces the most rain and why? (The cold front produces more rain because the warm air cools faster and in combination with the cold air, there is more of it)
32. Have students draw the fronts as you explain

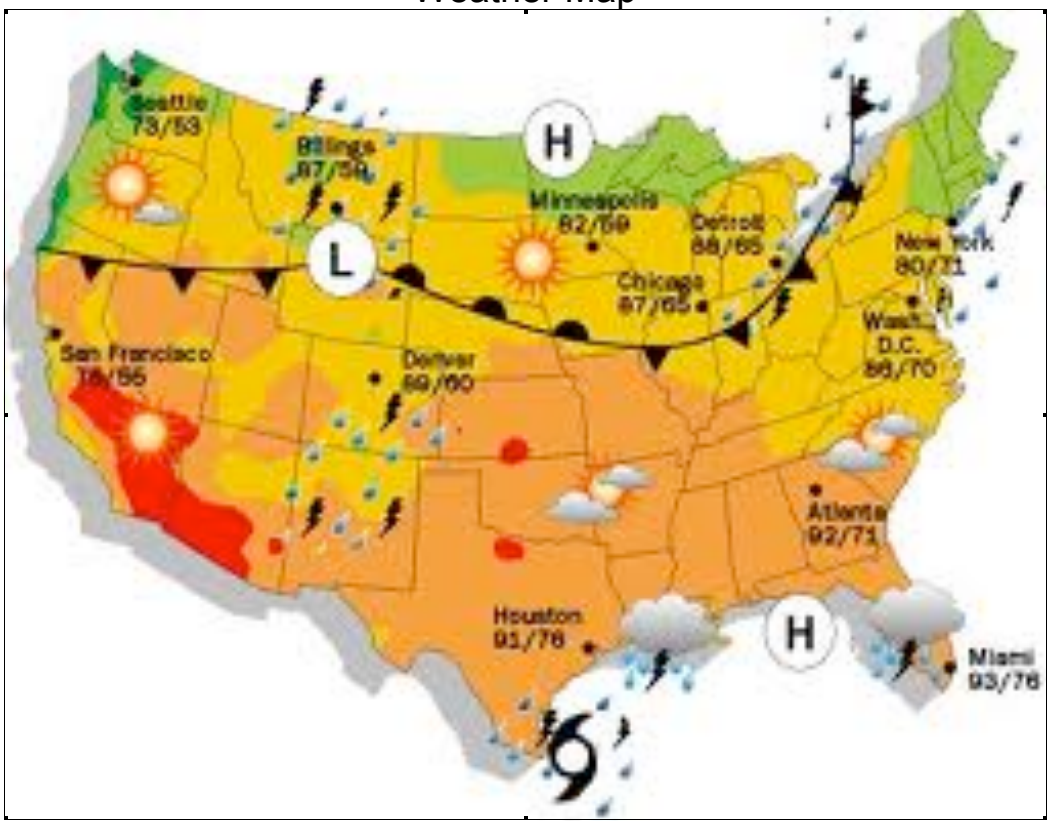
*Teachers Note: Air masses travel around the globe. When the air masses converge they form a front creating changes in temperature, wind, and precipitation**. Warm fronts** are when a low pressure and high pressure air masses meet and the low pressure air mass takes over the area, typically causing steady light rain. Because warm fronts move more slowly than cold fronts, the weather maybe rainy or foggy for several days. **Cold fronts** are when a high pressure cold air mass and a low pressure air mass meet and the high pressure air mass takes over the area, typically causing heavy rain, strong winds and severe thunderstorms. **Stationary fronts** are when a high pressure and low pressure air masses meet and neither moves forward, typically causing many types of weather.*

33. Use the weather map symbols from Lesson 5.9 for a cold and warm front and have students locate the fronts on H1.
34. Replay the animation again and discuss with students what they observed.

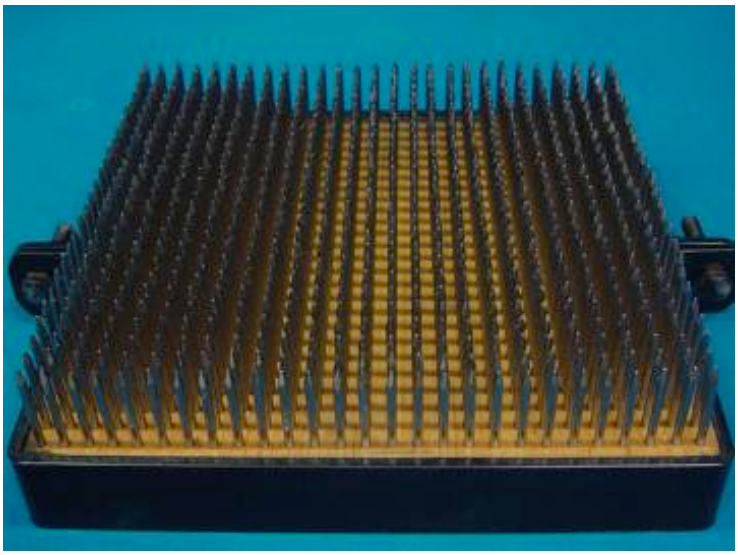
Explain/Evaluate (15 minutes) Air pressure impacts temperature, wind, and contributes to general weather conditions

35. Ask students (as individuals) to look at H1 and answer this prompt in their notebook: Based on what you have learned so far:
    a. What is the condition of the air around the Low pressure?
    b. What is the condition of the air around the High pressure
    c. What is the symbol for a cold front? What type of weather will occur along this front?
    d. What is the symbol for a hot front? What type of weather will occur along this front?
36. Weather can be confusing! On an exit slip, write one thing you are sure about weather and one thing that still confuses you.

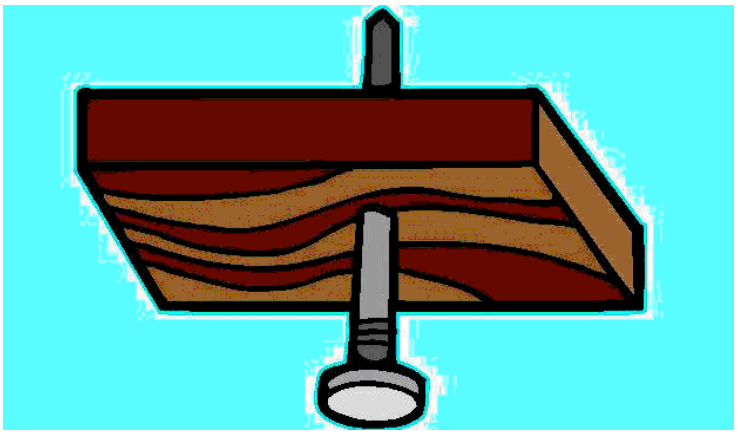
Weather Map



Cold Front	Warm Front



a. Bed of Nails



b. Single Nail

c. Man laying on bed of nails

Guided Drawing Illustration Example.