Pressure Systems & Wind

Recommended Grades:
K-5

Time Needed:
15-20 minutes

Description

- Students will learn how pressure systems drive wind.
- Guiding Question/Concept: What influences wind direction and strength

Learning Objectives

- Students will learn and be able to tell the difference between high and low pressure systems
- Students will be able to describe what makes the wind move
- Students will be able to determine wind direction and why it moves that direction

Materials

- 2 poles (or some other tall object that can be held - poles are not supplied with the map)

Preparation

- Find item to use as poles to represent the pressure system

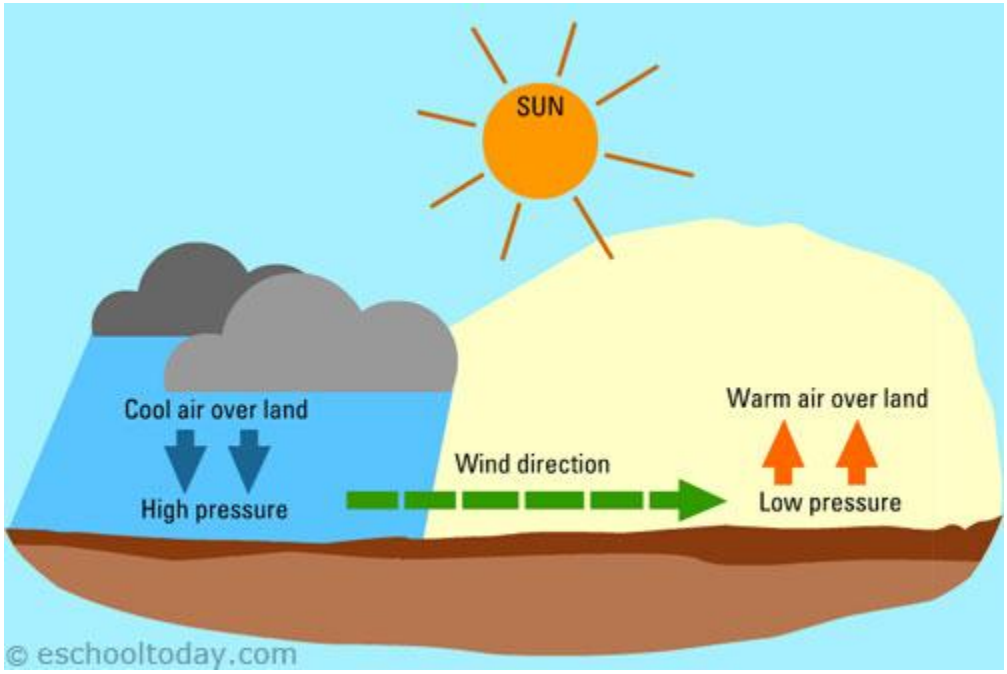
Rules: (e.g., have students remove shoes before walking on map)

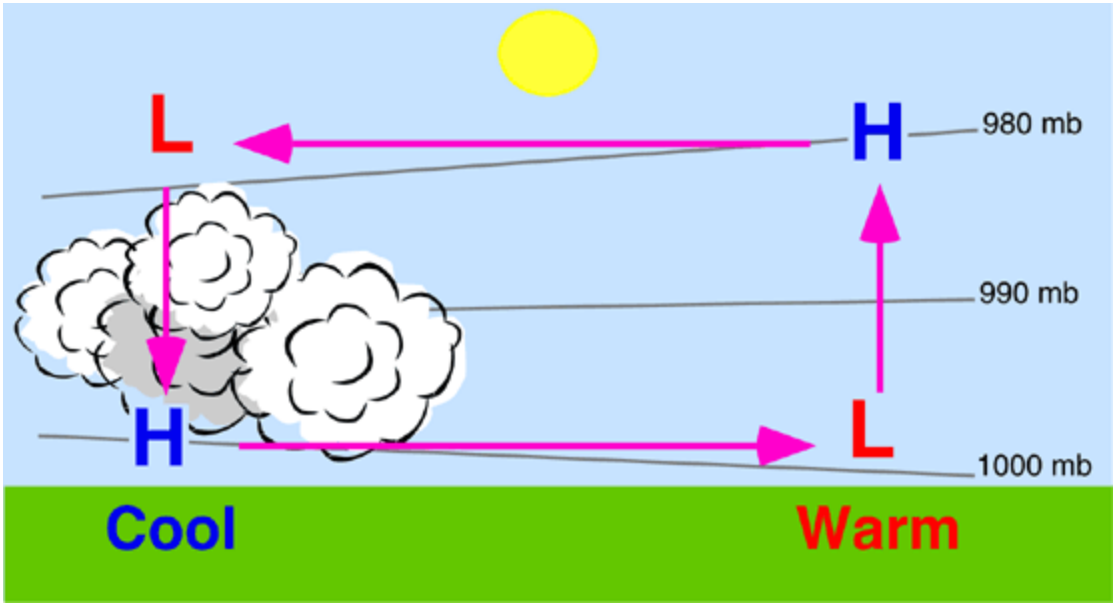
Directions

1. **Introduce atmospheric/air pressure**
    a. Say to the students: the air around us has weight that is pushing down on us, we just can't feel it. The weight of the atmosphere is measured through atmospheric, or air, pressure. Atmospheric/air pressure is the pressure, or weight, exerted by the atmosphere that is directed downwards toward earth's surface.
2. **Introduce high and low pressure systems**
    a. Ask the students what they think an area of high pressure means.

b. Say to the students: an area of high pressure means that the atmosphere is exerting a greater pressure, or weight, in one area than in another area. When this happens, it is called a high pressure system. A high pressure system is the term used to describe a weather system where the atmospheric pressure is greater than the surrounding area and is greater than the average air pressure at sea level- which is about 1013.25 milibars or about 14.7 pounds per square inch. In weather prediction, a high pressure system is also called an anticyclone. In an anticyclone, or high pressure system, the winds at the upper levels of the troposphere move down towards the surface and circulate clockwise. The troposphere is the layer of the atmosphere closest to earth's surface and this layer contains the winds and weather.
c. Ask the students what they think a low pressure system is.
d. Say to the students: a low pressure system is the term used to describe a weather system where the air pressure is less than the surrounding area and is less than the average air pressure at sea level. In weather prediction, a low pressure system is called a cyclone. In a cyclone, or low pressure system, the winds move upwards from the surface towards the upper levels of the troposphere and the winds circulate counter clockwise.

3. **Describe how the wind moves**
   a. Say to the students: wind moves according to the pressure systems. Wind travels from areas of high pressure to areas of low pressure in an effort to reach an equilibrium. (See diagram and draw/show one to students so they can see)





In the diagram, you can see that there are surface high and low pressure systems and upper air high and low pressure systems along with isobars, which are lines that join areas of equal pressure. The pressure systems are caused by differences in heating from the sun. Let's start at the surface low pressure system. This area in the diagram is receiving more heat from the sun, causing the air to warm up and rise, creating an area of low pressure. As this air rises, it cools and creates an upper area of high pressure. The upper level low (on the left side) is due to that area receiving less heat, or radiation, from the sun because there are clouds in that part of the atmosphere. This causes the Pressure Gradient Force- the force that puts the air in motion- and air in the upper level high pressure to travel towards the upper level low. Now because there are the clouds, the surface also does not receive much heating/energy from the sun, causing the air to be cool and to sink towards the ground. This creates areas of high pressure. Again, the pressure differences cause the Pressure Gradient Force, like in the upper air, and the air from the high pressure travels towards the low pressure at the surface.

Activity:

1. Set up the map and tell the students that they are the wind in this activity and that the first two rounds of this activity represent very basic wind movement, followed by a reenactment of the wind diagrams from above
2. Have two adults, or students if possible, each grab a pole, have them stand on opposite sides of the map, and establish which adult is the high pressure system and which is the low pressure system
3. Have the high pressure person start with holding their pole close to the ground to represent a weak high pressure system and explain this to the students
4. Have the low pressure person start with holding their pole up high to show a weak low pressure system and explain this to the students
5. Ask the students since they are representing the wind which way they think they should run/walk between the pressure systems (should say towards the low pressure)
    a. If the students are correct, explain that they will travel between the pressure systems slowly since they are both weak systems and wind speed increases with increasing pressure difference
    b. If students are incorrect, explain that they should travel from the high pressure system to low pressure system because the wind goes from areas of high pressure to areas of low pressure then explain that they will travel between the pressure systems slowly since they are both weak systems and wind speed increases with increasing pressure difference
6. Once all of the students are gathered around the person representing the area of low pressure, have them go back to where they started at the beginning of step 5.
7. Have the person holding the high pressure pole raise it up and the person with the low pressure system pole lower their pole down to signify the strengthening of the systems

8. Ask the students since they are representing the wind which way they think they should run/walk between the pressure systems (should say from high pressure to low pressure)
    a. If the students are correct, explain that they will travel between the pressure systems faster than before since both systems are stronger and wind speed increases with increasing pressure difference
    b. If students are incorrect, explain that they should travel from the high pressure system to low pressure system because the wind goes from areas of high pressure to areas of low pressure, then explain that they will travel between the pressure systems faster than before since both systems are stronger and wind speed increases with increasing pressure difference
9. Explain that now the students are going to recreate the wind diagram from earlier and for this activity, the surface systems will be weak and the upper level systems are strong. Have the people holding the poles reset to the weak systems.
10. Have the kids start in a location between the two pressure systems and have them travel towards the area of low pressure, again at a slower pace since these are two weak systems.
11. Have them pause and ask what happens to the air at an area of low pressure (should say the air rises)
    a. If they do not say the right answer review with them that the air rises
12. To illustrate the rising air, have the students start jumping and explain that with each jump, they climb higher up in the troposphere
13. As the kids are jumping, have the person with the low pressure pole gradually start rising their pole to the strong high pressure position and the person with the high pressure pole gradually lower theirs to the strong low pressure position and explain to the kids that the surface low is gradually turning into an upper level high as they ascend and the surface high pressure is gradually turning into an upper level low. Also explain that the systems are now stronger systems.
14. When the students stop jumping, ask them which way they should travel and how fast (should say towards the low pressure and faster than before because the systems are stronger)
    a. If they do not say the right answer explain the right answer
15. Have the kids travel toward the low pressure at a faster pace than before. When they get to the area of low pressure, have them pause and say that there are now dense clouds and ask if any remember the situation from earlier- does the air rise or sink? (should say sink)
    a. If they don't say the air sinks, explain that the air sinks
16. Have the students crouch down to represent the air descending back towards the surface. While the students are crouching, have the people holding the poles gradually return their poles to the starting position.
17. Ask the students which way they should travel and how fast (should say towards the low pressure and slower than the last trip)
    a. If they don't get the answer right, explain the right answer
18. Have the students go back towards the low pressure at a slower pace than step 14 and explain that they have now completed the cycle and in nature, the cycle would restart again because the air is constantly in a state of motion.

If 3rd Grade:

Have the kids make weather tables of local conditions during particular seasons, looking specifically at the wind direction. Ask the students which way the semi-permanent pressure systems (pressure systems that stay relatively consistent throughout specific seasons) are positioned for that season. Keep in mind that wind direction describes which direction the wind is blowing from, not towards. For example, a southwesterly wind blows from southwest to northeast. After each student has their hypothesis, explain the location of the semipermanent systems- during summer, there's a strong low pressure system near Greenland, which causes the southwesterly winds across much of Kentucky because the winds are going up towards the low pressure system. (Note: the Kentucky Mesonet can be a helpful resource when making the tables, at the website, under the data tab, hover over summary and choose monthly)

If 5th grade:
Ask the students where they think the surface high and low pressure systems can form or strengthen. Explain that for surface systems formed or strengthened over continents, mountains can often be the cause or part of the cause. The orographic effect is used to describe the interaction between mountains and the atmosphere. As air approaches a mountain, it is pushed up the windward side of a mountain, causing it to cool. Because the air is cooling, it becomes saturated from the water molecules that were already in the air. This forms clouds and precipitation as the air is on its way up the mountain. This leads to the areas on the windward side of the mountain to receive more precipitation than the areas on the leeward side. On the leeward side, the areas are typically drier than the windward side because the air that gets over the mountain is dry and it descends back down, warming up as it goes. When a pre-existing low pressure system moves across a mountain, the compression and then decompression of the air helps the system to gain more strength. This strengthening can even lead to tornadoes and other severe weather in Tornado Alley/Midwest region!

Key Vocabulary

- Anticyclone- a high pressure system; air circulates clockwise and travels downward towards the surface
- High pressure system- a weather system with a higher pressure than the surrounding areas
- Cyclone- a low pressure system; air circulates counterclockwise and travels upwards towards higher up in the atmosphere
- Low pressure system- a weather system with a lower pressure than the surrounding areas
- Atmospheric pressure/Air pressure- the pressure exerted by the atmosphere at sea level
- Barometer- an instrument used to measure atmospheric pressure
- Barometric pressure- atmospheric pressure measured by a barometer
- Millibar- a unit to measure air pressure
- Troposphere- the layer of the atmosphere that contains the winds and weather
- Pressure Gradient Force- the force that puts the air in motion; occurs by differences in atmospheric pressure
- (5th grade) Leeward side (of a mountain): Is typically the eastern side of a mountain; it is the side that is protected from harsh winds and weather conditions
- (5th grade) Windward side (of a mountain): Is typically the western side of a mountain; it is exposed to harsh winds and weather conditions
- (5th grade) Saturation: Occurs when air has reached full capacity of water vapor- the air can no longer hold any more water vapor (example is when you are looking at the forecast and it says there is 100% humidity) and precipitation starts to fall
- (5th grade) Orographic effect: Air is pushed up the windward side of a mountain, causing it to cool and become saturated. This leads to the areas on the windward side of the mountain to receive more precipitation than the areas on the leeward side. On the leeward side, the areas are typically drier than the windward side because the air that gets over the mountain descends back down, warming up as it goes. This prevents the formation of clouds and precipitation and makes the leeward side significantly drier and warmer than the windward side

Connections to the Curriculum

- 3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. (have data table ready for activity, specifically wind direction)
- 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.