# Activity #29: **The Jet Stream**

**Did You Know?**
*Jet streams were discovered during World War II (1939-1945), when Allied and German pilots encountered them at high altitudes. The pilots noticed that their air speed was significantly affected when flying in or near these air currents.*

A jet stream is a band of fast-moving air currents that occur at high altitudes. Jet streams flow around the Northern and Southern Hemispheres. A jet stream's core of strongest winds measures about 60 miles (97 kilometers) wide, 1 mile (1.6 kilometers) thick, and about 3,000 miles (4,800 kilometers) long. The winds move at speeds greater than 65 miles (105 kilometers) per hour and may exceed 200 miles (320 kilometers) per hour. There are three main jet streams found in the upper troposphere, the layer of the atmosphere nearest the earth: (1) the polar jet, (2) the subtropical jet, and (3) the equatorial jet. These occur at altitudes of about 6 to 15 miles (10 to 24 kilometers) above the ground. The polar jet and the subtropical jet both flow from west to east and circle the earth in both hemispheres. Both weaken and move farther north (Northern Hemisphere) or south (Southern Hemisphere) during the summer. The equatorial jet, on the other hand, flows from east to west and does not circle the earth. It occurs only over Southeast Asia and Africa, and only in summer.

1. Commercial pilots take advantage of the jet stream on most west to east routes, when possible. (A pilot headed from Chicago to New York can save 15-20 minutes flying time and hundreds of gallons of fuel by slipping into the jet stream; a pilot flying from New York to London can save about 1 hour.) If you could take a west to east trip in the Northern Hemisphere on an airplane, where would you go?

2. Plan your west to east dream vacation! Locate the travel section in your Sunday newspaper. Find the chart giving lowest air fares. Pick a destination offering you the most for your money. Scan the travel advertisements and articles about that destination. Design your vacation itinerary.

| **DEPARTURE CITY (WEST):** | **DESTINATION CITY (EAST):** |
|---|---|
| **AIRLINE WITH LOWEST AIRFARE TO THAT DESTINATION:** | **AIRFARE:** |
| **ITINERARY:** | |

**Extension Activity:** Why do you think these fast-moving air currents were called "jet streams?" Look in today's newspaper for examples of other words that name items or objects in a similar manner. Find ten words and determine the relationship of each word-name to its definition.

# Activity #30: **Air Pressure**

**Did You Know?**
*The weight of the atmosphere (atmospheric pressure) is approximately 5,600 trillion short tons. Air pressure is greatest at sea level (14.7 lbs per square inch). It decreases the higher you go in the atmosphere.*

Because air has weight, it can exert pressure. The weight of the atmosphere, or the air over the whole earth, is constant, but it changes locally. The weight of the air over a given spot is called air pressure. Air pressure can be measured. An instrument called a barometer is used to measure air pressure. Barometers indicate air pressure in inches or millimeters of mercury or in units called bars and millibars. The bar is a unit of pressure in the metric system, and a millibar equals one one-thousandth of a bar. On a barometer, the average atmospheric pressure at sea level is 29.92 inches (760 millimeters) of mercury, or 1,013 millibars. Air pressure measurement is related to weather forecasting. The farther the pressure drops below the average 29.92 inches, the greater the likelihood of a storm. The farther the pressure rises above 29.92 inches, the greater the likelihood of fair weather.

1. Locate the weather page in today's newspaper. Can you find the barometer reading for today or yesterday? (It may be listed on the weather page under almanac information. However, some newspapers do not list barometer readings.) Keep track of the newspaper barometer readings for one week.

2. Using a barometer at home or at school, track the atmospheric pressure yourself! How do your readings match up against the newspaper readings? Did the barometer reading change very much from day to day? Explain. How did it help you forecast the weather to come? Next, convert the readings given in inches to millimeters or millibars (or visa versa: convert millimeters or millibars to inches).

| WEEK DAY | NEWSPAPER BAROMETER INFORMATION | DAILY BAROMETER READINGS | WEATHER TO COME | CONVERSION TO OTHER FORM OF MEASUREMENT |
|---|---|---|---|---|
| SUNDAY | | | | |
| MONDAY | | | | |
| TUESDAY | | | | |
| WEDNESDAY | | | | |
| THURSDAY | | | | |
| FRIDAY | | | | |
| SATURDAY | | | | |

**Extension Activity:** Perform a simple experiment to show how air has weight and can exert pressure. Wad or crumble a small piece of newspaper and put it in the bottom of a drinking glass. Put the drinking glass straight down into a tank of water. The newspaper will stay dry. This is because the air pressure is greater than the water pressure.

# Activity #31: **Air Masses & Pressure Systems**

**Did You Know?**
*If you stand with your back to the wind in the Northern Hemisphere, the nearest low pressure system will be on your left. In the Southern Hemisphere, it is on your right.*

Pressure systems are whirling masses of air, called highs or lows, that cover very large areas of land, often some 386,000 square miles (1,000,000 sq km). The highest or lowest pressure in the system is always at the center. Low pressure systems usually bring cloudy skies and often rain or snow. High pressure systems bring dry, gradually clearing weather or generally fair weather. Warm, moist air rises and is associated with low, or weaker, pressure areas. As this air rises, it cools and the water vapor in it condenses; this is how clouds are formed. Cool air sinks and compresses, causing high pressure. Rapidly falling air pressure means that a storm is coming. Rapidly rising air pressure means fair weather. (Differences in terrain, and in individual storms can cause exceptions to this general rule, however.)

1. Find the weather page in today's newspaper. Locate the national weather forecast map. Identify areas of high pressure (indicated by the symbol H) and areas of low pressure (indicated by the symbol L). Which pressure systems are more abundant, H or L?

2. Next, study the national forecast map for precipitation symbols. High pressure usually indicates dry weather, while low pressure usually indicates wet weather. Do you find that to be correct according to today's newspaper weather map? List the pressure areas from today's map on the chart below and describe any accompanying precipitation.

| HIGH PRESSURE AREAS (H) | PRECIPITATION PATTERNS | LOW PRESSURE AREAS (L) | PRECIPITATION PATTERNS |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Extension Activity:** Collect national weather forecast maps from the newspaper for several days or weeks. Then, arrange your maps in the correct sequence according to date. Make generalizations about the high and low pressure systems. Did these systems influence or determine weather outcome over the extended period of time? Explain.

# Activity #32: **Weather Fronts**

**Did You Know?** *The temperature can suddenly fall dozens of degrees when a front passes! Some historic temperature drops are as follows: from 55°F at 7:00 A.M. to 8°F at 7:15 A.M. in Rapid City, South Dakota (January 10, 1911); from 44°F to -56°F in 24 hours in Browning, Montana (January 23-24, 1916).*

A front is a transition between two temperature or air density zones. Fronts are formed by a contrast between ocean and land temperatures or by pressure differences in the upper wind flow. These factors cause cold air to sink and warm air to rise. In other words, they cause a front to develop. A simple wind shift can indicate a weak front; not all fronts are strong enough to bring dramatic shifts in weather. For a front to be strong, the difference in temperature between the cold front and the warm front must be a large one. Frontal weather can be unsettled or stormy. A front can be observed locally or located on a weather map by noting sharp temperature changes, drastic changes in humidity, shifts in wind direction, pressure changes, and changes in cloud and precipitation patterns. The four main types of fronts are the cold front, the warm front, the stationary front, and the occluded front (see page 40).

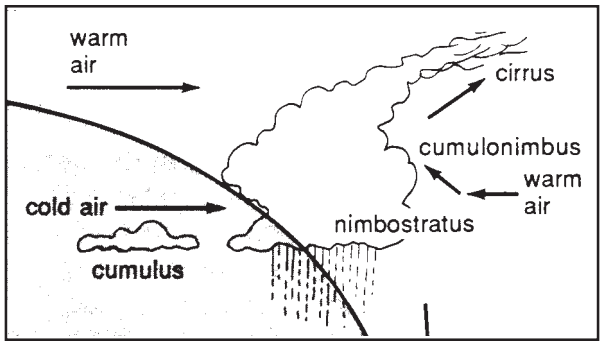
1. Find the weather page in today's newspaper. Locate the national weather forecast map. Identify the frontal systems illustrated on today's map. (Look for the specific symbols as given to you on page 40.)

2. How many frontal systems do you see? What does today's map tell you about the weather? Collect national weather forecast maps from the newspaper for several days. Then, arrange your maps in the correct sequence according to date. Speculate about the weather to come. Make a three-day forecast prediction based on the information given to you in this lesson, and on pages 40 and 41.

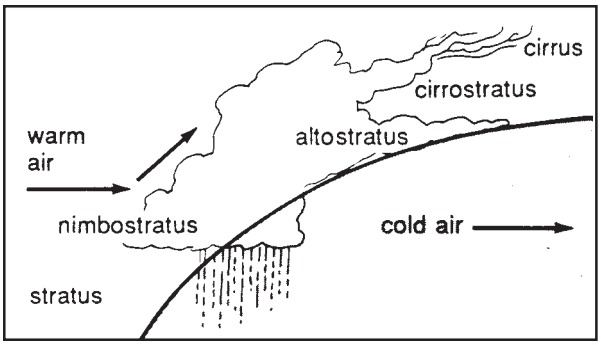
| THREE-DAY FORECAST | FRONTAL SYSTEMS | WINDS; TEMPERATURE; PRESSURE; CLOUDS; PRECIPITATION; HUMIDITY? |
|---|---|---|
| **DAY #1** | | |
| **DAY #2** | | |
| **DAY #3** | | |

**Extension Activity:** Experience the feeling of a warm and cold front by doing the following. First, stand in front of a radiator or heater for five to ten minutes. Then, stand in front of an opened refrigerator or air conditioner for five to ten minutes. The warm radiator heats the air around it. The refrigerator cools the air around it. Air masses work the same way. Air that lingers above a region without moving forms an air mass with the temperature and moisture of the area. When an air mass moves on, it influences the weather of the area it passes over. When cold and warm air masses meet, they don't mix. Instead, they form a zone that is generally hundreds of miles long. That zone is called a front.

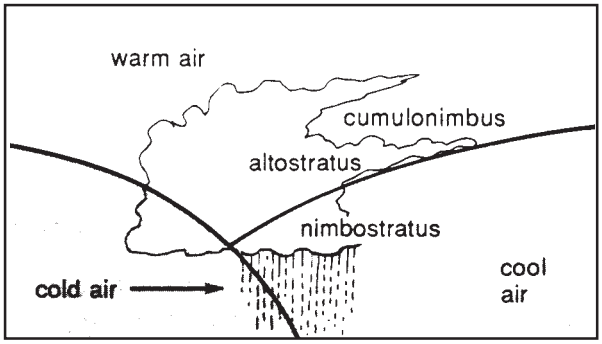
# Activity #32: **Weather Fronts**




**COLD FRONT**




**WARM FRONT**




**OCCLUDED FRONT**

**COLD FRONT:** In a cold front, the cold air cuts under the warm air, forcing the warm air to rise. Cold fronts often produce short periods of heavy precipitation. Colder weather usually follows the passage of a cold front. In the Northern Hemisphere, cold fronts usually lie in a northeast to southwest direction and move toward the east or the southeast. Cold fronts travel about 20 miles an hour, but faster in the winter than in the summer.

**WARM FRONT:** In a warm front, warm air overrides the cold air. Warm fronts often produce light, steady precipitation. Warmer weather usually follows the passage of a warm front. In the Northern Hemisphere, warm fronts usually occur on the east side of low-pressure cells and are usually followed by cold fronts as the prevailing westerlies move the low toward the east. Warm fronts travel about 15 miles per hour.

**STATIONARY FRONT:** When warm air and cold air meet but move very little, the front is a stationary one. The weather is usually moderate and continues for several days.

**OCCLUDED FRONT:** The weather of occluded fronts is similar to that of cold or warm fronts but less extreme. Occluded fronts occur because cold fronts travel faster than warm ones. When a cold front catches up with a warm one, it pushes the warm air aloft over the cool air in front of the warm front.

# Activity #32: **Weather Fronts**

| COLD FRONT (sharp contrast or change in weather) | | | |
|---|---|---|---|
| **WEATHER ELEMENT** | **BEFORE PASSING** | **WHILE PASSING** | **AFTER PASSING** |
| Winds | south-southwest | gusty, shifting | west-northwest |
| Temperature | warm or mild | sudden drop | colder |
| Pressure | falling steadily | sharp rise | rising steadily |
| Clouds | increasing cirrus and cirrostratus, then either towering cumulus or cumulonimbus | towering cumulus or cumulonimbus | often cumulus |
| Precipitation | short period of showers | heavy rain or snow showers, sometimes with hail, thunder, and lightning | decreasing intensity of showers, then clearing |
| Humidity | high; remains steady | sharp drop | lowering |

| WARM FRONT (gradual change in weather) | | | |
|---|---|---|---|
| **WEATHER ELEMENT** | **BEFORE PASSING** | **WHILE PASSING** | **AFTER PASSING** |
| Winds | south-southeast | variable | south-southwest |
| Temperature | cool or cold | steady rise | warmer |
| Pressure | falling | leveling off | slight rise, then fall |
| Clouds | cirrus, cirrostratus, altostratus, nimbostratus, stratus; fog and cumulonimbus in summer | stratus-type | clearing with scattered stratocumulus; cumulonimbus in summer |
| Precipitation | light to moderate rain, snow, sleet, or drizzle | drizzle | usually none; sometimes light showers |
| Humidity | (change in humidity for warm front is insignificant) | | |

# Activity #33: **Storms**

**Did You Know?**
*More heat is released in a severe thunderstorm than is released by several small atomic bombs. And worldwide, there are over 40,000 thunderstorms every day.*

Storms, the most dramatic weather phenomenon, are disturbances of the atmosphere. In addition to frontal storms, there are three major types of storms: thunderstorms, tornadoes, and hurricanes. Thunderstorms and tornadoes occur in the lower and middle latitudes. Thunderstorms are the result of massive updrafts of air that create cumulonimbus clouds. The accompanying lightning is caused by the friction of rapidly moving ice particles and rain in the thunderclouds that builds up electrical charges. Thunder is the sound caused by the shock waves of expanding gases moving along the line of electricity. Tornadoes, which are violent whirlpools of air, are caused by the instability of thunderstorms that occur along a cold front. A tornado over water is called a waterspout. Hurricanes (called typhoons in the North Pacific Ocean and willy-willies off the coast of Australia) are tropical storms. Hurricanes are low-pressure cells with extremely high winds. They can develop only when there is a very warm, moist mass of air over the open ocean.

1. Scan the weather page in your newspaper for satellite weather photos. (Newspapers do not always print satellite photos. So, you may have to look at several different newspapers.) Or, call or write the nearest National Weather Service office to obtain one or more satellite pictures.

2. Notice the movement of storms that is shown in the pictures. How are the storms affected by the season (that is, the amount of direct sunlight)? Where are the areas of high and low pressure?

| SATELLITE PHOTO INFORMATION |
| --- |
| |

**Extension Activity:** If you have the equipment available, tape the satellite pictures from television weather reports for a week or two. Your videotape will be a clear demonstration of the movement of storms. Then, compare the information you gathered from the television with the information reported daily on the weather page in your newspaper. Create a graph to show the newspaper information.