Content Objectives:

- Clouds form when large areas of warm, moist air rise into the air to the point where water vapor condenses into water droplets.
- There are three main types of clouds: Cumulus, Stratus, and Cirrus.
- Certain types of clouds can be used to predict the weather.

Computers and machines that help us predict the weather are pretty new. It wasn't that long ago when people had to depend on what they observed in nature to tell them what the weather might be. Today we have all sorts of technology that provides information about weather. Satellites, weather balloons, computers, radar, as well tools like barometers, anemometers, thermometers, and wind vanes, all provide information about what is happening in the atmosphere. Weather forecasters use this information to make predictions about the weather.

In the early 1800s, a scientist named Luke Howard created a way to classify clouds. He realized that clouds looked differently, but there were three main types: cumulus, stratus, and cirrus. **Cumulus** clouds are puffy and look like cotton candy or cotton balls. They form when large areas of warm moist area rise up into the atmosphere. **Stratus** clouds look like gray blankets that cover the sky. They are formed when large areas of warm, moist air rises slowly into the sky. **Cirrus** clouds are the highest clouds. They look like commas or wisps of hair. Cirrus clouds are formed when the air rises high enough that the droplets freeze into ice crystals.

Inside the three families of clouds are different types of clouds named for where they can be found in the troposphere and whether or not they are a rain cloud. If a cloud has "**nimbo-**" or "**-nimbus**" in its name, it is a rain or snow cloud. Examples are nimbostratus and cumulonimbus clouds. If a cloud has "**cirro-**" in its name, it forms high in the sky. Examples include cirrostratus and cirrocumulus. Clouds with "**alto-**" in their name form in the middle of the troposphere, like altostratus and altocumulus.

Clouds can be used to predict the weather. Cirrus clouds and alto- clouds can mean that rainy or snowy weather is on the way. Cumulus clouds appear in sunny summer skies, and altostratus clouds can mean that the weather is going to dry up.

- **Weather satellite**: devices in space that are used to collect weather information
- **Cumulus clouds**: puffy clouds that look like cotton balls
- **Stratus clouds**: flat, gray blanket clouds that seem to cover the sky
- **Cirrus clouds**: look like commas or wisps of hair. Created when air rises high enough for ice crystals to form.
- **Nimbo-/-nimbus**: this prefix or suffix means the cloud is a rain cloud (Ex: nimbostratus)
- **Cirro-** : this prefix means the cloud forms high in the sky (Ex: cirrostratus)
- **Alto-** : this prefix means a cloud forms at a middle height (Ex: altocumulus)

Content Objectives

- A weather forecaster is someone who makes predictions about the weather using data collected from weather instruments.
- Warm fronts usually bring light rain or snow, and cold fronts usually bring thunderstorms.

Weather forecasters are men and women who make predictions about the weather. They may be on the TV news, work for an airport, the newspaper., o r something else entirely. Wherever they work they must collect data, or information, about the weather to make accurate predictions. Weather satellites, weather balloons, radar, computers, barometers, anemometers, and thermometers are some tools that provide this information. Forecasters take all the data and look at it closely to make their predictions. They can never be completely correct because the weather is always changing.

As you know, air surrounds the Earth, but the air in our atmosphere is actually divided into large areas called air masses. An **air mass** is a body of air that has the same general temperature and pressure throughout it. Some of these air masses are warm and some are cold.

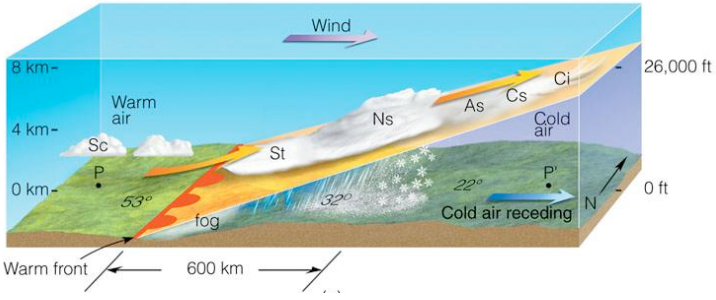
Cold fronts are formed when a cold air mass moves into a warm air mass. The cold air is heavier than the warm air, so the warm air is pushed up over the cold air. This often causes thunderstorms or cumulonimbus clouds to form. **Warm fronts** are formed when a warm air mass moves into a cold air mass. The warm air is lighter than the cold air, so it rises up over the cold air. This often causes light rain or snow.

High-pressure areas (air masses that have higher pressure than the air around them) usually bring clear, dry weather because the high pressure pushes the storms found in low-pressure areas away. Low-pressure areas (air masses that have lower pressure than surrounding air) usually bring wind, clouds, or rain.

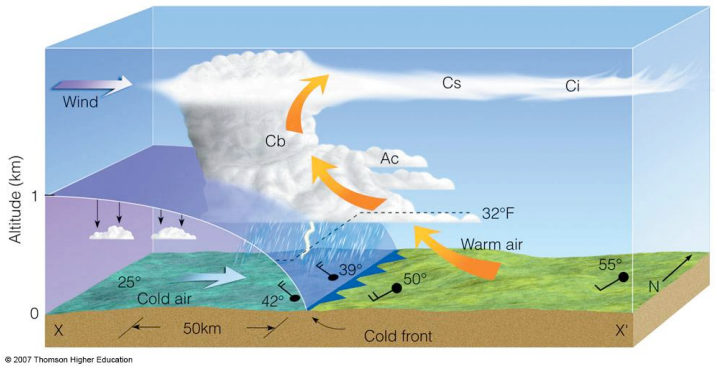
- **Weather forecaster**: a scientist who predicts the weather
- **Air mass**: a body of air that has the same general temperature and pressure
- **Front**: a place where two different air masses meet
- **Warm front**: when a mass of warm air moves into a mass of cold air. Often brings rain or snow.
- **Cold front**: when a mass of cold air moves into a mass of warm air. Often brings thunderstorms.

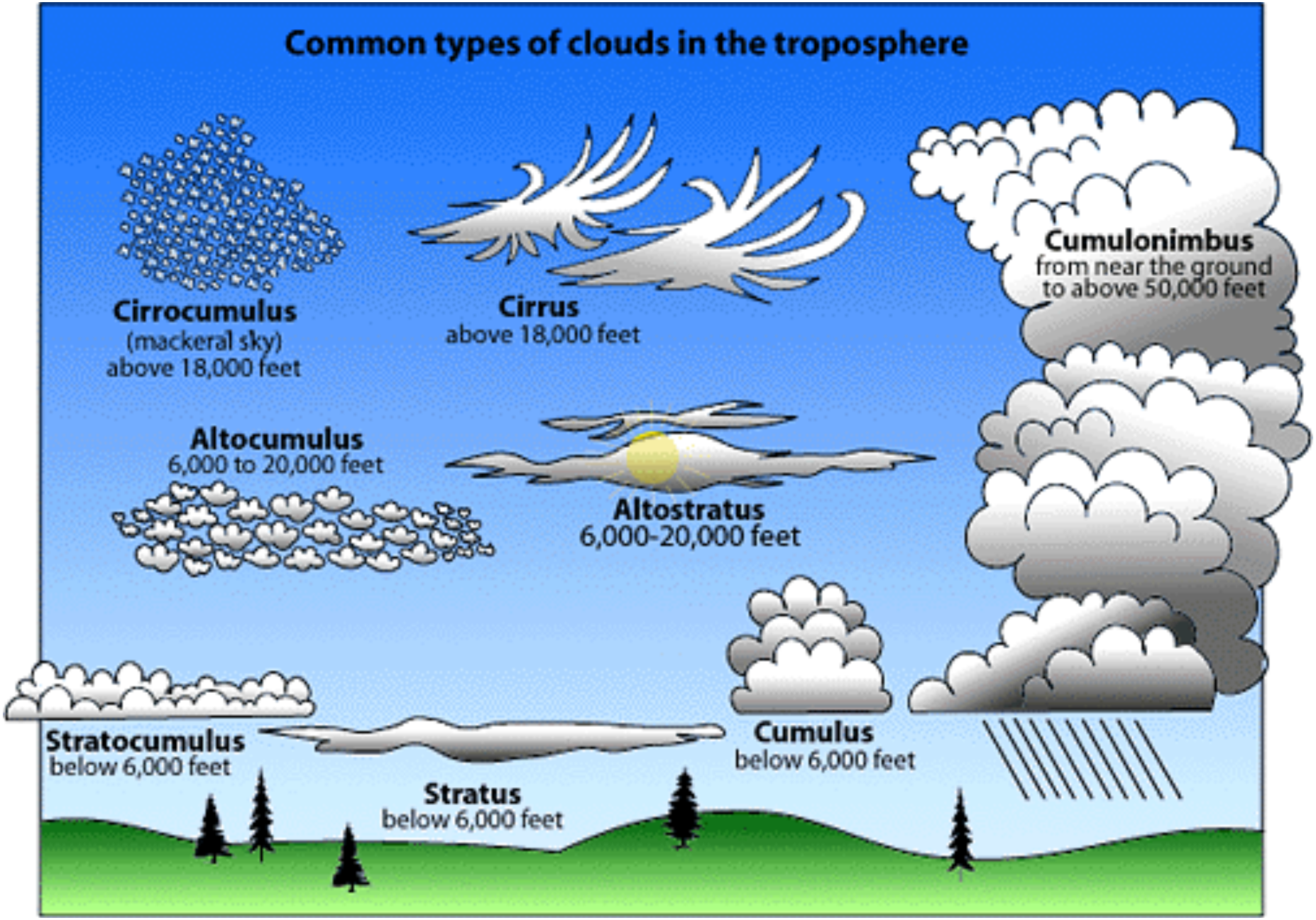
- Wind moves from high pressure to low pressure. Strong winds are caused by big differences in air pressure and how close the air masses are to each other.
- Low pressure = storms
- High pressure = dry weather

Warm Front



Cold Front




Common types of clouds in the troposphere
Cirrocumulus
(mackeral sky)
above 18,000 feet
Cirrus
above 18,000 feet
Cumulonimbus
from near the ground
to above 50,000 feet
Altocumulus
6,000 to 20,000 feet
Altostratus
6,000-20,000 feet
Stratocumulus
below 6,000 feet
Cumulus
below 6,000 feet
Stratus
below 6,000 feet

Content Objectives

- A thunderstorm is a storm that produces heavy rain, strong winds, lightning and thunder.
- Thunderstorms are cumulonimbus clouds formed when warm moist air rises more quickly and higher into the atmosphere than usual.

When lots of warm, moist (humid) air rises quickly and higher into the atmosphere than usual, a **cumulonimbus** cloud can form. These clouds are thunderstorms, also called **thunderheads**, and they create heavy rain, strong winds, lightning and thunder. Cumulonimbus clouds usually form along **cold fronts**, and where the air is very hot and humid.

When there are strong winds several miles above Earth's surface, they can pull lots of warm, humid air up from the ground very fast. This causes the thunderhead to grow taller. Some cumulonimbus clouds can actually be several miles tall, and very wide as well.

Inside the cloud there are very strong winds swirling in all directions. As raindrops begin to form, they are carried up and down inside the cloud. Sometimes the raindrops freeze, but are then carried back up into the cloud, where they gain another layer of water which freezes. The ice pellets continue moving up and down inside the cloud, getting bigger and bigger until they're too heavy and fall to Earth. This is how hail is formed.

The movement of ice and water droplets up and down inside the cloud also creates static electricity. As it moves through the atmosphere, the negative charges in the cloud collect at the bottom of the cloud. This attracts positive charges on the ground, and repels the negatives. When a negative charge from the cloud connects to a positive charge from the ground, a giant static discharge is created. This static discharge is **lightning**.

Lightning is extremely hot, fast, and powerful. It can reach temperatures hotter than the surface of the sun (54,000^{O} F). When lightning moves through the atmosphere, it heats the air so that it expands very quickly. This is how thunder is created. **Thunder** is the sound of lightning, and it happens at the same time as lightning. However, we hear thunder after we see lightning because light travels faster than sound.

Thunderstorms end because the rain cools the air below the cloud. Since thunderstorms need warm, moist air to continue, without it, the cloud breaks apart and the storm ends.

- **Thunderstorm**: a storm that produces heavy rain, strong winds, lightning and thunder
- **Cold front**: when a cold air mass moves into a warm air mass, often bringing thunderstorms.
- **Thunderhead/Cumulonimbus**: other names for a thunderstorm
- **Lightning**: a flash of light and heat (static discharge) created by static electricity in a thunder cloud.
- **Thunder**: the sound of lightning. Created as the air is heated by lightning.
- **Hail**: pieces of ice that fall to Earth from a cumulonimbus cloud
- **Flash flood**: sudden, violent floods

- Thunderstorms can cause problems on the ground. They often produce a lot of rain that can cause **flash floods**. Heavy **hail** can damage property. Lightning can cause fires and power outages.

Content Objectives

- A hurricane is a large, violent storm that creates strong winds and waves, and forms over warm ocean water.
- A tornado is a funnel-shaped storm of spinning wind.

Hurricanes and tornadoes are the most powerful storms on Earth. They both create strong winds that can cause a lot of damage. Although they are similar in some ways, they are different as well.

Hurricanes are very large storms with violent, powerful winds. Although we call the hurricanes in our part of the world, they are called **typhoons** in the west Pacific and **cyclones**

Hurricanes form near the equator, over warm ocean water. They start as strong thunderstorms that may join together to form one large storm cloud. To become a hurricane, the winds need to be at least 70 mph, but some can have speeds that are twice that.

Thunderstorms can sometimes produce tornadoes. A **tornado** is a funnel-shaped storm of spinning wind. Tornadoes usually happen on land—those that form over water are called water spouts. They form when winds roll across the ground and then are pushed up into the atmosphere, forming a fast spinning column of air. The air pressure in the center of the funnel is very low.

Although tornadoes are smaller than hurricanes, they can be extremely dangerous. Wind speeds during a tornado can reach as high as 300mph: twice as fast as a Category 5 hurricane. These winds can lift almost anything off the ground and into the air: dirt, trees, roofs, and cars. Trees, houses, and buildings can be destroyed.

- **Hurricane**: a large violent storm that forms over warm ocean water. Hurricanes bring strong winds and waves.
- **Typhoon**: the name for a hurricane that forms in the west Pacific Ocean
- **Cyclone**: the name for a hurricane that forms in the Indian Ocean
- **Tornado**: a funnel-shaped storm with spinning wind.
- **Twister/Funnel-cloud**: other names for a tornado