Earth Science

Chapter 24

Section 2 - Fronts

E.Q.: *What are the characteristic weather patterns of cold and warm fronts?*

STANDARDS:

SES5. Students will investigate the interaction of insolation and Earth systems to produce weather and climate.

b. Explain the relationship between air masses and the surfaces over which they form.

c. Relate weather patterns to interactions among ocean currents, air masses, and topography.

e. Describe the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming).

Objectives

- **Compare the characteristic weather patterns of cold fronts with those of warm fronts.**
- **Describe how a midlatitude cyclone forms.**
- **Describe the development of hurricanes, thunderstorms, and tornadoes.**

Fronts

- **A cool air mass is dense and does not mix with the less-dense air of a warm air mass.**
- **Thus, a boundary, called a *front,* forms between air masses.**
- **Changes in middle-latitude weather usually take place along the various types of fronts.**
- **Fronts do not exist in the Tropics because no air masses that have significant temperature differences exist there.**

Cold Fronts

***cold front* - the front edge of a moving mass of cold air that pushes beneath a warmer air mass like a wedge**

- **If the warm air is moist, clouds will form.**

- **Large cumulus and cumulonimbus clouds typically form along fast-moving cold fronts.**
- **A long line of heavy thunderstorms, called a *squall line,* may occur in the warm, moist air just ahead of a fast-moving cold front.**
- **A slow-moving cloud front typically produces weaker storms and lighter precipitation than a fast-moving cold front does.**

Warm Fronts

***warm front* - the front edge of advancing warm air mass that replaces colder air with warmer air**

- **The slope of a warm front is gradual.**
- **Because of this gentle slope, clouds may extend far ahead of the surface location, or *base*, of the front.**
- **A warm front generally produces precipitation over a large area and may cause violent weather.**

Stationary and Occluded Fronts

***stationary front* - a front of air masses that moves either very slowly or not at all**

occluded front a front that forms when a cold air mass overtakes a warm air mass and lifts the warm air mass of the ground and over another air mass

- **Sometimes, when air masses meet, the cold moves parallel to the front, and neither air mass is displaced.**

Polar Fronts and Midlatitudes Cyclones

- **Over each of Earth's polar regions is a dome of cold air that may extend as far as 60° latitude.**
- **The boundary where this cold polar air meets the tropical air mass of the middle latitudes, especially over the ocean, is called the *polar front*.**
- **Waves commonly develop along the polar front.**
- **A *waves* is a bend that forms in a cold front or stationary front.**

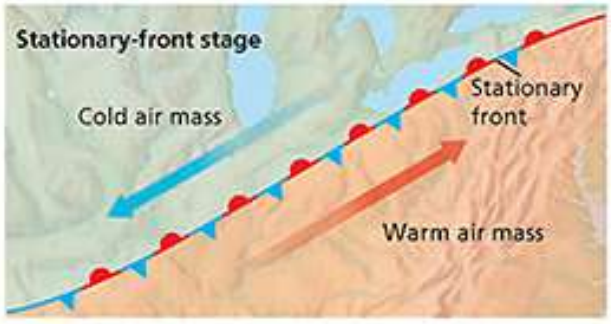
midlatitude cyclone **- an area of low pressure that is characterized by rotating wind that moves toward the rising air of the central low-pressure region**

- **Waves are the beginnings of low-pressure storm centers called midlatitude cyclones or *wave cyclones.***
- **These cyclones strongly influence weather patterns in the middle latitudes.**

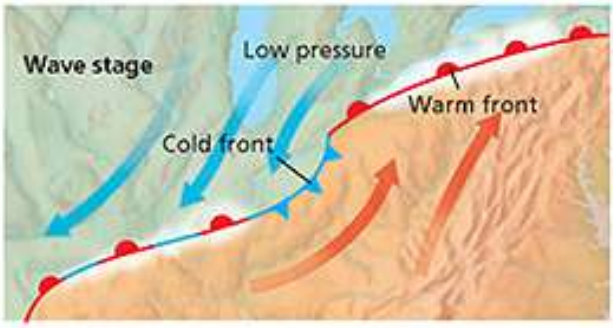
Stages of a Midlatitude Cyclones

- **A midlatitude cyclone usually last several days.**
- **In North America, midlatitude cyclones generally travel about 45 km/h in an easterly direction as they spin counterclockwise.**
- **They follow several storm tracks, or routes, as they move from the Pacific coast to the Atlantic coast.**

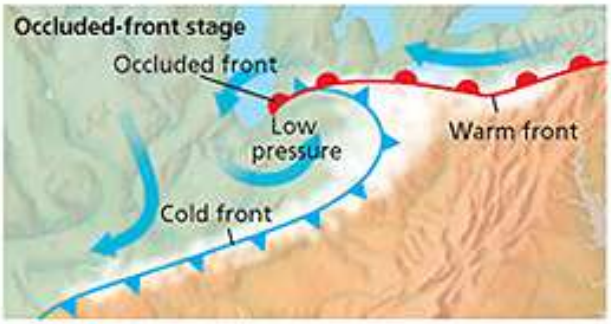
The diagram below shows the different stages of a midlatitude cyclone.



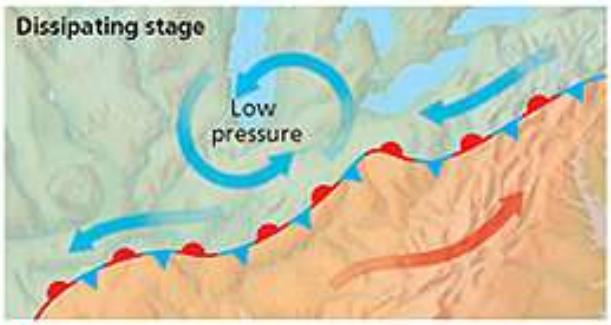
1 Midlatitude cyclones occur along a cold or a stationary front. Winds move parallel to the front but in opposite directions on each side of the front.



2 A wave forms when a bulge of cold air develops and advances slightly ahead of the rest of the front.



3 As the fast-moving part of the cold front overtakes the warm front, an occluded front forms and the storm reaches its highest intensity.



4 Eventually, the system generally loses all of its energy and the midlatitude cyclone dissipates.

Anticyclones

- **Unlike the air in the midlatitude cyclone, the air of an *anticyclone* sinks and flows outward from a center of high pressure.**
- **Because of the Coriolis effect, the circulation of air around an anticyclone is clockwise in the Northern Hemisphere.**
- **Anticyclones bring dry weather, because their sinking air does not promote cloud formation.**

READING CHECK

How is the air of an anticyclone different from that of a midlatitude cyclone?

The air of an anticyclone sinks and flows outward from a center of high pressure. The air of a midlatitude cyclone rotates toward the rising air of a central, low-pressure region.

SEVERE WEATHER

Thunderstorms

***thunderstorm* - a usually brief, heavy storm that consists of rain, strong winds, lightning, and thunder**

- **Thunderstorms develop in three distinct stages.**
- **The thunderstorm dissipates as the supply of water vapor decrease.**

Lightning

- **During a thunderstorm, clouds discharge electricity in the form of *lightning.***
- **The released electricity heats the air, and the air rapidly expands and produces a loud noise known as *thunder*.**
- **For lightning to occur, the clouds must have areas that carry distinct electrical charges.**

Hurricanes

hurricane **- a severe storm that develops over tropical oceans and whose strong winds of more than 120 km/h spiral in toward the intensely low-pressure storm center**

- **A hurricane begins when warm, moist air over the ocean rises rapidly.**
- **When moisture in the rising warm air condenses, a large amount of energy in the form of latent heat is released. This heat increases the force of the rising air.**
- **A fully developed hurricane consists of a series of thick cumulonimbus cloud bands that spiral upward around the center of the storm.**
- **The most dangerous aspect of a hurricane is a rising sea level and large waves, called a *storm surge*.**
- **Every hurricane is categorized on the *Safir-Simpson scale* by using several factors. These factors include central pressure, wind speed, and storm surge.**

READING CHECK

Where do hurricanes develop?

over warm tropical seas

Tornadoes

tornado **- a destructive, rotating column of air that has very high wind speeds and that maybe visible as a funnel-shaped cloud**

- **The smallest, most violent, and shortest-lived severe storm is a tornado.**
- **A tornado forms when a thunderstorm meets high-altitude horizontal winds. These winds cause the rising air in the thunderstorm to rotate.**
- **A storm cloud may develop a narrow, funnel-shaped rapidly spinning extension that reaches downward and may or may not touch the ground.**
- **If the funnel does touch the ground, it generally moves in a wandering, haphazard path.**

- **The destructive power of a tornado is due to mainly the speed of the winds. These winds may reach speeds of more than 400 km/h.**