Local Weather 1

Outcomes: (115-6)

Content: Page 198 - 201

Forecasting the Weather - Folklore

- Before there was weather science, there was .... weather folklore....
- Being able to predict the weather conditions for the afternoon and next day as well as for the next few days was very important.
- Their predictions of the weather helped them to decide when to plant or harvest a crop or what the growing season would be like.
- In a typical out-port fishing village a decision had to be made whether or not to put the salt fish out to dry or when to go on a fishing trip.
- In many cases their day-to-day activities depended on the weather.
- Without the help of modern day technology, it was necessary for people to develop a keen eye for signs in nature, which allowed them to predict changes in the weather.
- Many of these observations have led to the development of “old sayings” or weather proverbs.

Examples of Weather Sayings:

1. **Short term prediction:**
   - Red sky at night sailors delight; red sky in morning sailors take warning
2. **Long term prediction:**
   - Lots of dogberries in the fall is a sign of a winter with lots of snow.

How accurate are weather sayings?

- Today, many people will laugh at old time weather lore as old wives tales
- However, many of these primitive or unscientific methods were not really that far out to lunch.
- Not all weather predictions worked all the time, but many can in fact be explained using science.

Weather Sayings that may be true:

1. Consider the moon...

- **"A ring around the moon brings rain or snow."**
- **"When the moon is in her house, rain or snow will come."**
    - From a science perspective, when the moon has a halo or ring around it, this is due to a type of clouds (cirrus) in higher altitudes.
        - These clouds generally move in front of a low pressure system.
        - Low pressure systems usually bring wet, stormy weather.
        - These cirrus clouds contain tiny ice crystals, which bend the light reflecting from the moon creating a ring.
    - On a non-scientific note, some people say if you count the number of stars inside the ring, you can estimate how far away the rain or snow will be.
    - Bright stars count for 24 hours of time while faint stars count for 12 hours. Try it!

2. How about the sky...

- **Red sky at night, sailors delight; Red sky at morning, sailors take warning**
- **Evening red and morning grey, sends the traveler on his way. Evening grey, morning red, brings the rain down on his head.**
    - The red sky at night is caused by the scattering of light through the dust of a clear sky.
    - Since the sun sets in the west and our weather comes from the west, the next day should be a fine, clear day.
    - Red sky in the morning usually means that bad weather is pushing in. The sun rises in the east and the sunlight is scattered by those high clouds that get pushed in front of an approaching low pressure system.

3. Atmospheric pressure...

- **Sea gull, sea gull, sit on the sand; It's sign of a rain when you are at hand.**
    - When it rains, the air often becomes thinner, or less dense.
    - The lighter air is less able to support a bird in flight.
    - Since it's harder for the bird to fly, sea gulls are more likely to stay on land.

Weather Sayings That Aren't So Good:

- Weather sayings that make reference to the actions of birds and animals are not very good.
    - For instance, the size of a muskrat's house or a beaver's dam is determined by the water levels at the time it was built, **not** the beaver's prediction of the season ahead.
- Weather sayings that forecast the weather months in advance are of very little value.
    - Lot's of dogberries in the fall means harsh winter ahead.
        - The amount of growth and development of plants are the results of weather conditions that have already passed and have no connection with future weather

More Modern Methods of Predicting Weather:

- Depends on a variety of factors such as:
    - temperature, humidity, ocean currents, global wind patterns, and local geography (mountains, lakes, oceans, plains, etc).
- With all these weather factors in mind it is also important to note that modern day weather forecasters with all their state of the art gadgets are not always right all the time either.
- In fact, the best a modern day forecaster will ever do is predict the weather 3 days in advance.

Homework: page 201: # 1

Activity 4.1 From SRL (Handout)

Local Weather 2

Outcome: (114-6), (212-8)

Content: Page 202-205

Build a Weather Station:

- One of the best ways to learn about the weather is **to build and use your own weather station**.
- In order to build a weather station, some of the **important factors that affect the weather** must be considered.
- Some of the factors that must be measured or at least be able to detect a change include;
  - **Air temperature,**
  - **Humidity,**
  - **Wind direction,**
  - **Wind speed,**
  - **And air pressure.**

Measuring devices commonly used in a weather station:

1. **Thermometer**
2. **Hygrometer**

3. **Psychrometer**
4. **Aneroid barometer**
5. **Wind vane**
6. **Anemometer**
7. **Rain gauge.**

1. **Thermometer:**
   - A thermometer is a device used to **measure the outside air temperature.**
   - 
   - How does a thermometer work?
     - The mercury (or alcohol) in the bulb is mostly located in **the bulb of the thermometer**
     - When the temperature rises, **the liquid expands and rises up the tube**, which is marked (calibrated) to show the actual temperature outside

- Does it matter if the thermometer is placed in the sun or shade?
    - The thermometer will obviously show a **colder temperature in shade than in the sun**, therefore this must be considered when placing the thermometer
- Temperature is considered an important weather factor because it will determine **the type of precipitation (rain /snow) we may get**.
- Temperature is also related to our level of **comfort**.
- If it is cold outside, **we may wear a heavy coat to keep us warm**.
- On a hot summer day we would dress quite **differently**.

2. Hygrometer:

- Device used to measure the **humidity of the air**.

- 

- **Humidity** is a measure of the how much **moisture (water vapour) is in the air**.
- Have you ever seen your breath on a cold day?
    - **That's moisture in your breath**, just like the water in clouds, rain, or moisture in the air.
- **What does humidity have to do with the weather?**
    - Warm air can **hold more water than cold air**.
    - The more water that is in the air the **greater the chance for precipitation (rain or snow).**

- So warm, wet air is usually associated with **wet, stormy weather**.
- The hygrometer can detect a change in humidity and thus **predict a change in the weather.**

- **Here are the observations and their meanings.**
  - **When a Warm Front moves in:**
    - When a warm front (mass of warm air) approaches, the **humidity of the surrounding air begins to rise as the warm front moves in**.
    - The humidity stays high while the warm air is around, and then **the humidity slowly drops as the warm air moves away.**
  - **When a Cold Front moves in:**
    - When a cold front (mass of cold air) approaches, **the humidity doesn't change much as the cold air moves in**.
    - When the cold front arrives **the**

humidity will rise quickly and stay high while it is there.

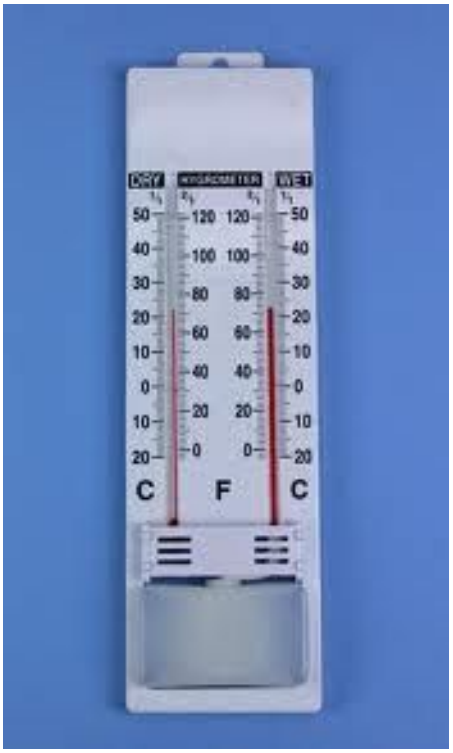
- As the cold fronts moves away the **humidity will drop quickly**.

- **So by measuring the change in humidity we can tell if a warm front or a cold front is approaching**.

- This type of hygrometer just shows that **humidity is changing**.
- In order to get an actual number value on humidity levels you will have to build a **psychrometer**.

3. Psychrometer:

- Device that measures the amount **of relative humidity in the air**.

- 

- **Relative humidity** is a measure of the **amount of water vapour that is in the air** compared to the **maximum amount of water vapour that the air can hold**.
    - The air can hold a maximum amount of water.
    - If we can measure how much water is actually in the air we can then **figure out its percentage or relative humidity**.
- A psychrometer is made up of **two thermometers mounted together**.
- One thermometer is ordinary **(dry bulb**) and the

other has a cloth wick (skate lace) over its bulb.

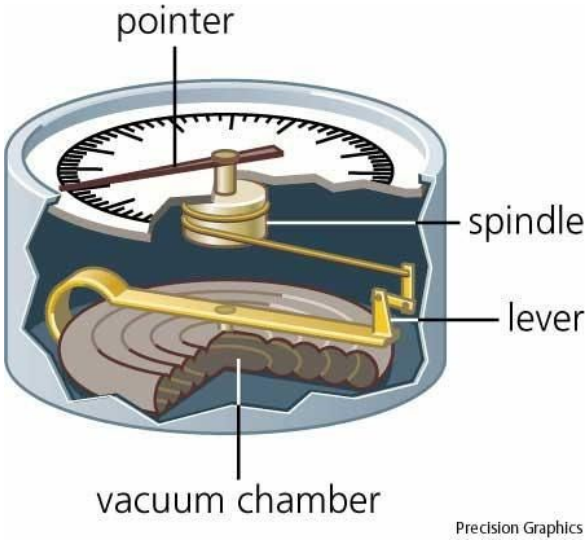
- The one with the wick over it is called a **wet-bulb thermometer**.
- When you are ready to take a reading, dip the wick (skate lace) in water and then fan air over the thermometers.
- When the air is blowing over the wick the water evaporates and has a **cooling effect on the wet-bulb thermometer**.
- After a few seconds you take a reading of the temperatures of both thermometers.
- **Understanding the Reading:**
    - If the surrounding air is dry, **more water evaporates from the wick**.
    - The more water that evaporates the **cooler the reading will be**.
    - There will be **a large difference** between the dry bulb and the wet bulb.
    - If the surrounding air is very damp then only a small amount of water will evaporate and the **two bulbs will be about the**

same.

- **The smaller the difference the greater the humidity.**
- If the surrounding air is holding as much moisture as possible (if the relative humidity is 100%) there is **no difference between the two temperatures**.

- As we know the higher the humidity (the more water that there is in the air) the **greater the chance of rain or snow**.
- Meteorologists have made up charts of these differences between the wet and dry bulbs at each temperature. By using the chart you can find **relative humidity**. **(Table 1 Page 203)**
- Example: A psychrometer reading gives the dry bulb reading of 20^{o}C and a wet bulb reading of 18^{o}C. What is the relative humidity?

4. **Aneroid barometer:**
   - Device used to measure surrounding **air pressure**.

- 

- **Air pressure** is the force that **air pushes down on the earth.**
- Cold air is denser (thicker and heavier) than warm air.
- Recall that cold matter **contracts** (shrinks) therefore as air cools, it begins to get **squeezed together.**
- The colder the air, the more we can **squeeze into the same size air mass**.
- As a result **cold air is heavier than warm air**.
- The rising of the air pressure tells that a **high-pressure system** is moving in.
    - The high-pressure system is made up of cool,

dry air. So a high barometric pressure is usually associated with cool, clear, dry air – **fine weather**.

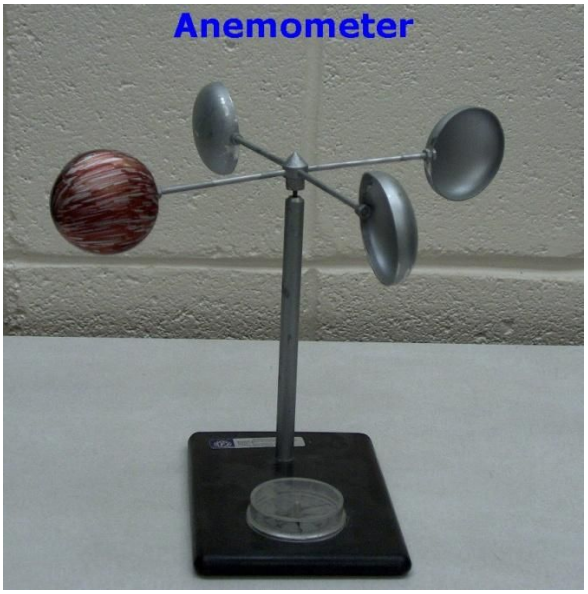
- If the air pressure begins to drop that means a **low-pressure system** is moving in.
    - A low-pressure system is usually warmer, moist air - **poor weather on the way**.

5. **Wind vane:**
    - Tool that measures the **direction of the wind**.
    - 
    - A typical wind vane would have a **pointer that can spin with one end larger than the other** and compass bearing.
    - The part of the vane that turns into the wind is usually shaped like an **arrow**.

- The **other end is wide** so it will catch the smallest breeze.
- The breeze turns the arrow until it catches both sides of the wide end equally.
- The arrow **always points into the wind**.
- **The arrow tells you the direction that the wind is coming from.**
- If the wind is blowing from the south, **the wind is usually warm**.
- If the wind is blowing from the north, **the wind is usually cooler**.
- The weather associated with wind direction depends a great deal on your local geography.
    - For instance, on the east coast of the Island an easterly wind is generally off the water and is cool and wet, usually **bringing fog and rain**.
    - Where as, on the west coast of the island a westerly wind would be blowing off the water.

6. Anemometer:

- Used to measure the **speed of the wind**.

- 

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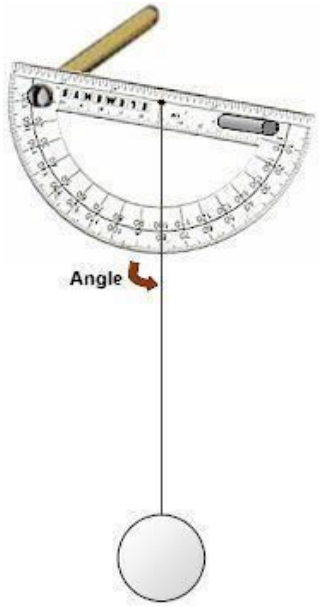
- The simplest of all anemometers is the **ping-pong ball anemometer**.
- 

    - When the wind blows the ping-pong ball suspended on the end of a **string is**

moved.

- The angle of the string is recorded and then the **speed of the wind can be estimated**.

- The **pressure anemometer** is another simple device used to measure wind speed.
  - Has a small plastic bead in a **glass tube**.
  - When the wind blows over the top of the tube it creates a **vacuum that sucks up the small plastic bead**.
  - The higher the bead rises, the **higher the wind speed**.
- A **rotation anemometer**
  - Consist of a **windmill, or a propeller, or three or more cone shaped cups**. As it spins, you can count the rotations (number of spins) that it makes in ten seconds.

    - This homemade anemometer cannot not tell the wind speed in kilometres per hour; but it can give you an idea of how fast the wind is blowing.

- More precise Weather forecasters' anemometers have the propeller connected to a small generator and computer that can **accurately count and calculate the revolutions per minute** into kilometres per hour. (km/h).

7. Rain gauge:

- Tool, which collects and measures the **amount of rainfall**.

- 
- It is simply a bottle or can with a millimetre scale.
- As it rains, the **bottle fills and then you go out and measure the height of the water** in the bottle (in mm).
- Snow is measured the same way but is measured in cm.

Homework: Page 205: # 2, 3, 4

Local Weather 3

Outcome: (330-6)

Content: Page 206-207

North American Weather Systems:

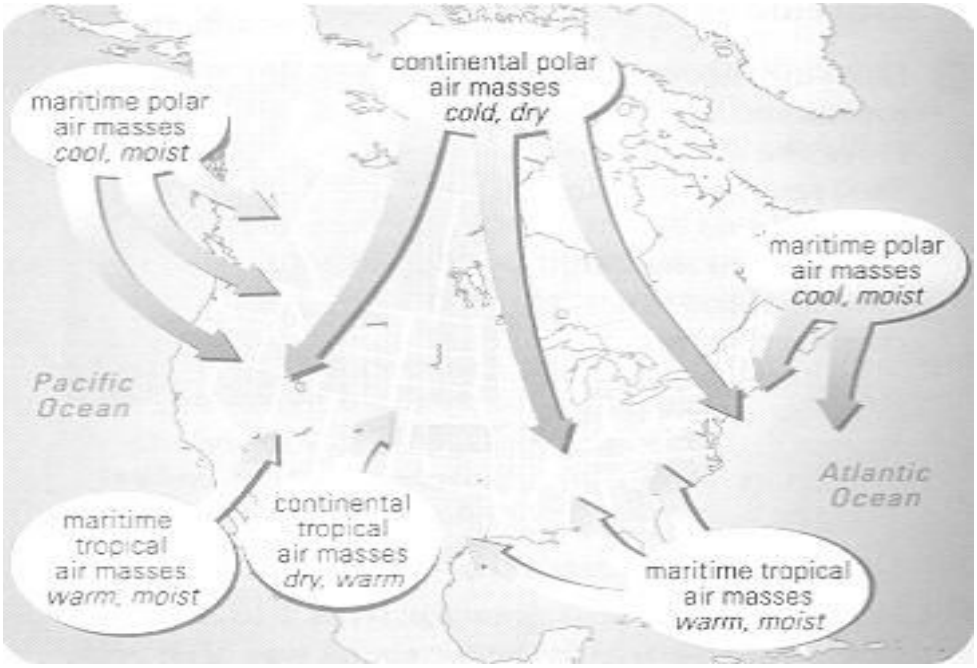
- We have all seen the local TV weather person tracking a storm and **predicting the weather a day or two in advance.**
- They can do this by looking at the weather that is being experienced by areas that are getting the storm now and then **estimating how long it will take that storm to get to us.**
- This is a very common technique that **is used to forecast the weather.**

Weather System:

- A set of **weather conditions that move through a region for a period of days**
- Changes in weather are caused by **movements in these systems**
- This is what a **weather forecaster normally tracks**
- Weather systems are **made up of large air masses**.

- An air mass can range in size from **100 km to 1000 km across.**
- These large air masses have **the same temperature and humidity.**
- The temperature and humidity of the air mass depends on **where the air mass begins to grow**.
- Air masses that form over water tend to pick up and carry much more **moisture than air masses formed over land.**
- Air masses that form up in the cold North tend to be cool while **air masses that form in the warm tropical regions tend to be warm**.

In general there are four types of air masses that affect the weather in North America:



1. **Maritime polar**
2. **Continental polar**
3. **Maritime tropical**
4. **Continental tropical**

- Quite simply, **maritime** means it is **formed over water**.
    - That is, forming over the **Atlantic or Pacific Ocean.**
    - As the maritime air mass grows it will suck up **moisture from the ocean like a sponge**.
    - This air will be **very wet**.
- **Continental** means it is **formed over land**
    - Since there is very little moisture to pick up over the land, the **continental air mass will be dry.**

- **Polar** means it is formed in **the cold regions of the North Pole.**
    - Most of the North Pole is covered in ice and snow, which means the **air over the ice, and snow will be cold also.**
- **Tropical** means the air mass is formed in the **warm tropical regions around the equator.**
    - As the air mass grows in the tropical regions it **gains a great deal of energy from the hot sun.**

	Polar (cold)	Tropical (Warm)
Maritime (wet)	Wet and cold	wet and warm
Continental (Dry)	Dry and cold	Dry and warm

- Polar Maritime air masses are **cold and wet** and usually **bring fog and cool temperatures in the summer** and **heavy snow and very cold temperatures** in the winter.
- Tropical maritime air masses are **warm and wet** and usually bring **warm "muggy" rain in the summer** and **slushy snow and mild temperatures** in the winter.

What happens if these air masses collide?

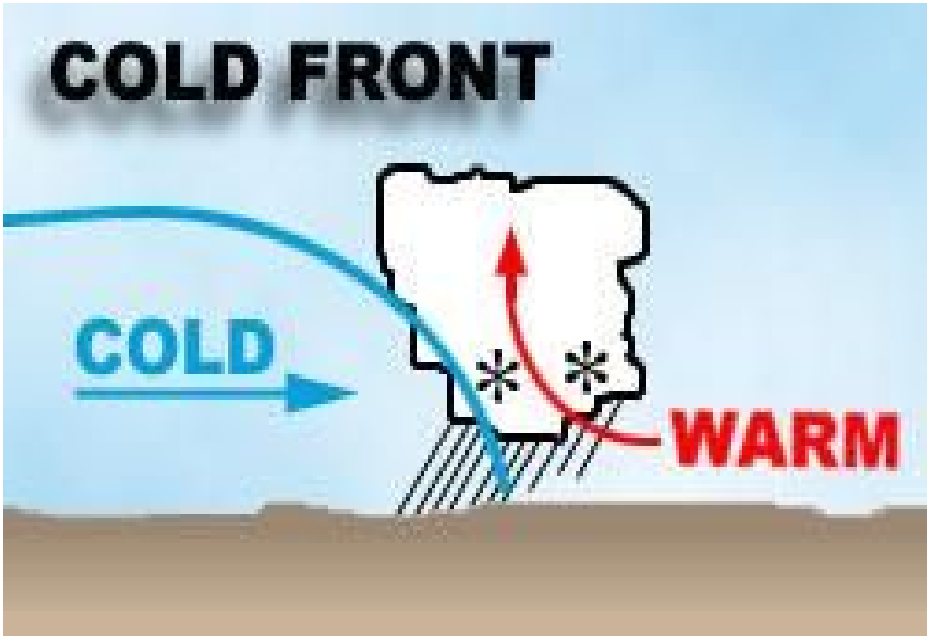
- When two air masses meet, the **boundary that forms between them is called a front.**
- The weather conditions at the **front are usually very stormy and unsettled. Fronts mean rain!**

There are four types off fronts:

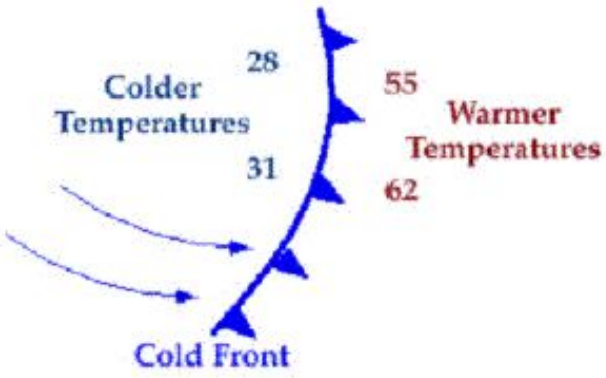
1. **Cold front**
2. **Warm front**
3. **Occluded front**
4. **Stationary front**

→ The type of front formed depends on **how they come together.**

Cold Front: 

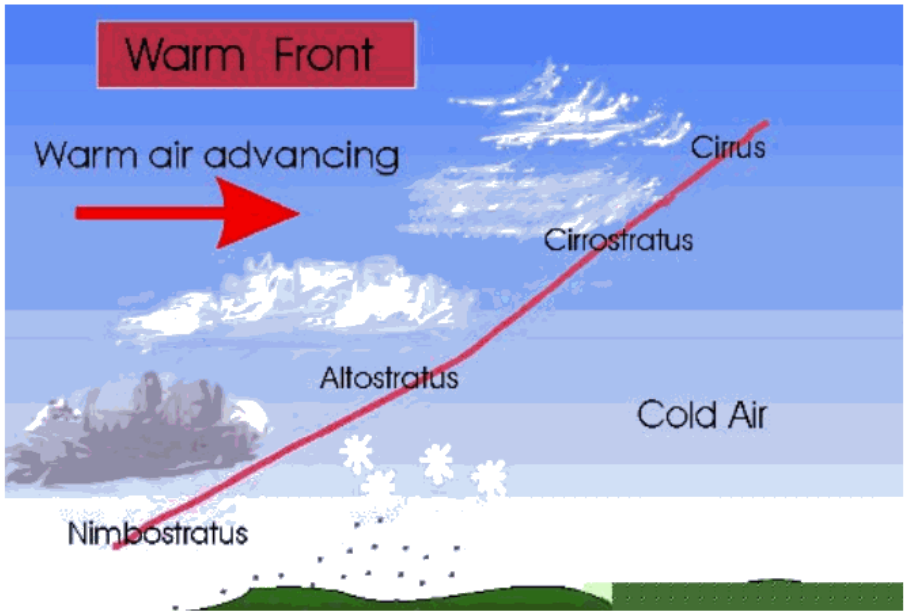


- Caused when a **cold air mass pushes underneath a warm air mass.**
- The warm air is **forced up**.
- As the warm air rises it begins to cool and is forced to **lose its moisture**.
- This moistures forms clouds at first but then develops into **heavy rain (or snow) and very stormy weather**.
- As the front moves through the conditions begin to clear.
- The air that follows behind the cold front is **cool and dry**.

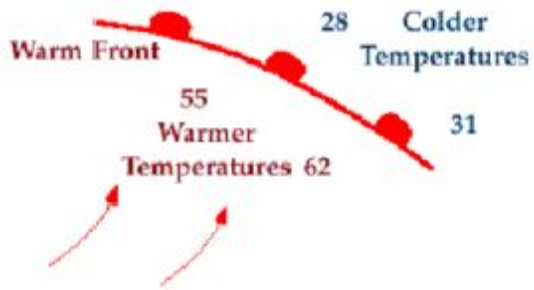


Warm Front:

Warm front

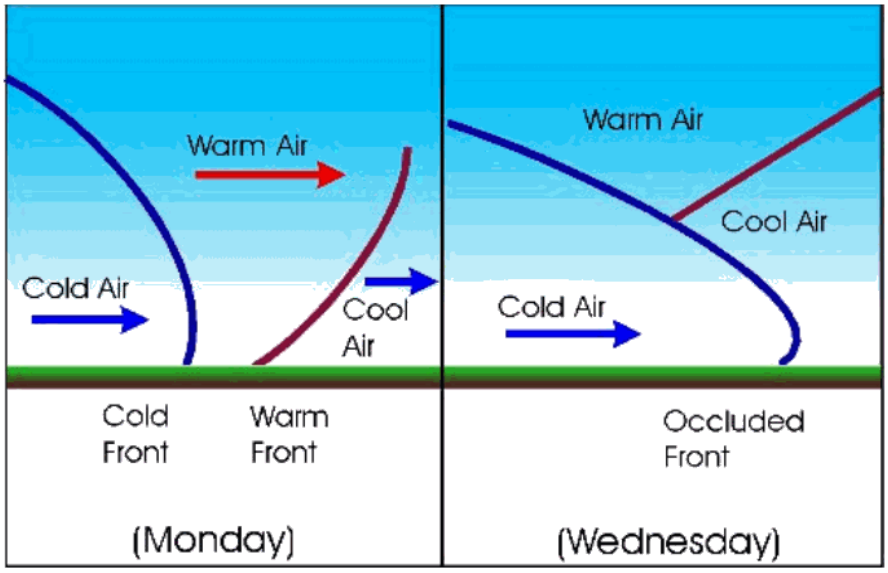


- Caused by **a warm air mass moving slowly up** a stationary (stopped) cold air mass.
- As the **warm air slowly rises and cool showers** (or flurries) develop.
- Conditions are **somewhat calm.**
- The air that follows behind the warm front is **warm and humid (damp).**

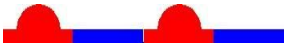


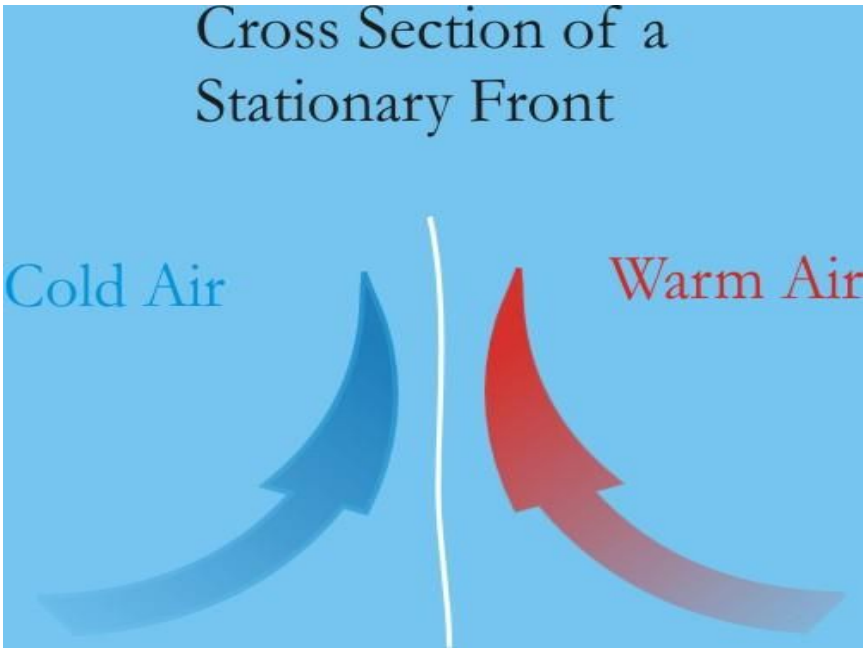
Occluded Front:

Occluded front – cross-section



- Cold air masses move **faster than warm air masses.**
- An occluded front is formed when a **cold air mass catches up with a slower moving warm air mass**.
- The cold air mass slowly pushes the warm air up **creating gentle precipitation.**
- Storms caused by an occluded front are **generally gentle**.

Stationary Front: 



- Sometimes when the **two slow moving air masses collide they stall (stop).**
- The front slowly moves through over a **long period of time.**
- Stationary fronts usually bring **rain / or snow for long periods of time** and the conditions stay quite calm.
- It is common to **have rain, drizzle and fog lasting for days**!

Homework: Page 207: # 1 - 5.

SRL: 4.3 : North American Weather Systems (Handout)

Local Weather 4

Outcomes: (330-6), (213-6), (213-7), (331-5)

Content: Page 208-209 & 270-272

Weather Maps and Symbols:

- You should all be familiar to weather maps used on TV weather broadcasts.
- A weather map gives us a **picture of the current weather conditions.**
- The map is created by gathering weather data from **different weather stations across Canada.**
- Weather maps show us the weather conditions **close to the ground.**
- They give us an idea of the type of **precipitation** (rain, snow, rain, fog), the **air temperature**, positions of high and low **pressures**, weather **fronts**, and the position of the **jet stream**.
- The information on weather maps is written down as **symbols**.
- In order to accurately describe the **weather conditions** we need to know what these symbols are and what they mean to the **local weather**.

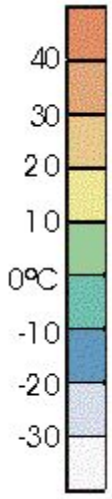
Here are the basic weather symbols found on weather maps.

1. **Pressure systems:**
    - **High pressure region** (indicated by H) 
    - **Low pressure region** (indicated by L) 
    - A high-pressure system usually means fair (clear) weather.
        - The high-pressure system is made up of **heavy, cool air that cannot rise.**
        - If the air cannot rise, then **clouds cannot form**

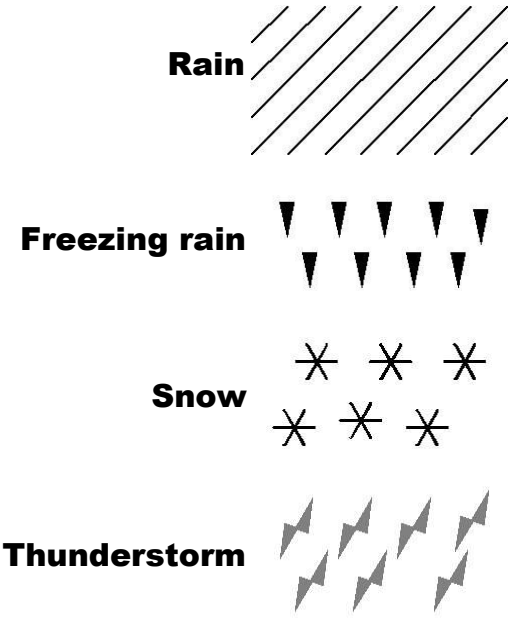
- A low-pressure system usually means **unstable stormy weather.**
    - A low-pressure system is made up of **warm, light, moist air.**
    - The air begins to rise and **as it rises it cools**.
    - As the air cools, it **releases its moisture to form clouds**, rain, snow, or other forms of precipitation.

2. Air Temperature:

- Air temperature changes from region to region, depending on **the air mass.**
- Most weather maps use a **colour scale** to indicate the temperature.
- The colour of the region of the map tells you **the temperature** of that area.
- Temperature is measured in **degrees Celsius (°C)**



3. Weather conditions:



4. Fronts:

Warm front 

Cold front 

Stationary Front 

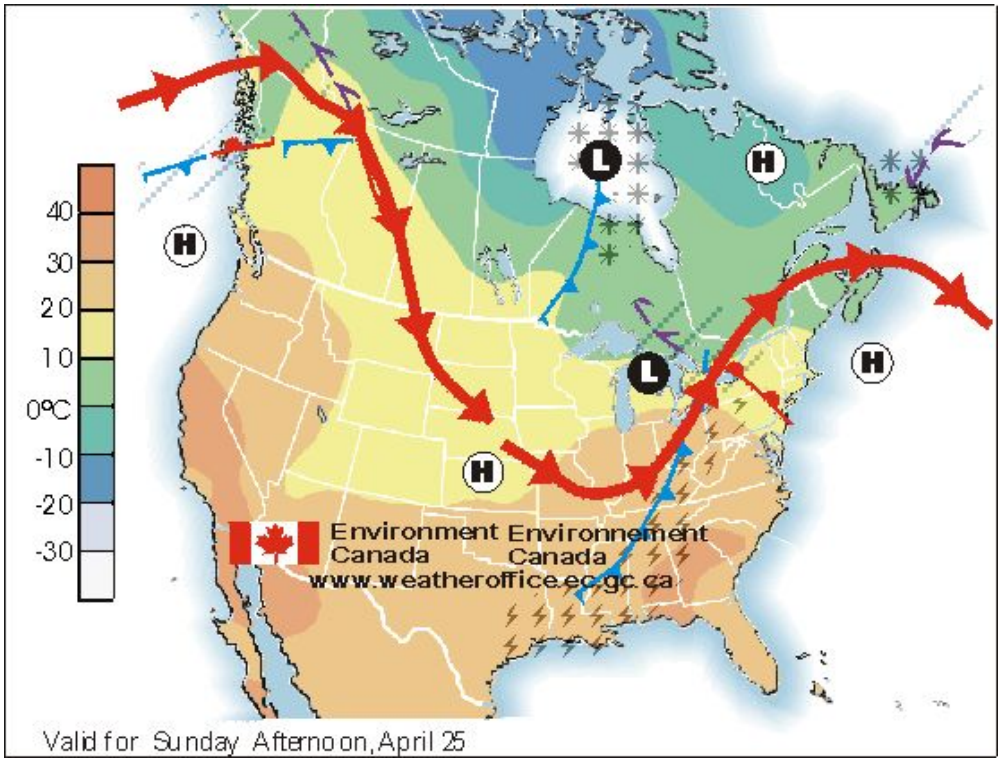
Occluded Front 

- As you learned in the last lesson, **fronts are caused by the collision of air masses.**
- No matter what type of front is moving through it **usually means rain or snow.**
- By considering the type of front we can tell how much rain we will get, how long it will last, and the **type of weather conditions that will follow.**

5. Jet Stream: 

- A narrow region of **very fast moving air**.
- Jet streams are caused by the collisions of the **major air masses at high altitudes.**
- When these air masses collide they create a **narrow region of very fast moving air** (greater than 400 km/h).
- The air North of the jet stream is from the polar air masses, so the **air above the jet stream is generally cooler**.
- The air South of the jet stream is from the tropical air masses which is **generally warmer**.

- As these huge air masses push against each other the **jet stream changes shape.**
- The high and low pressure systems causing the local weather to get **pushed around and follow the jet stream.**
- Weather forecasters use the position of the jet stream to **predict the path of high and low pressure systems.**



Based on this weather map, what weather conditions are being experienced by:

1. Newfoundland

2. Labrador

3. Coastal British Columbia

4. Florida

5. What types of fronts are shown on this map?

Homework: Page 208 a-j

SRL: 4.4: Case study: Three days of Canadian weather: p 322 - 325.

Local Weather 5

Outcomes: (115-2)

Content: Page 210-211

Regional Weather:

- As we have seen in the last few lessons the weather conditions you get depend on large weather systems that move across the country.
- However, we also see some weather conditions that are affected by **local geographic features**.
- Living close to **the ocean, a large pond, a mountain range or large hills** will influence your local wind patterns and temperatures.

Have you ever heard the saying; "the wind comes and goes with the sun"?

- This is why fishermen get out on the water early in the morning when it is calm.
- By mid-day, when the **sun is at its strongest the wind picks up and becomes**

quite breezy.

- Then in the evening **when the sun begins to set the wind drops off again.**

Why is this true?

- It all has to do with **convection currents**.
- Have you ever wondered why the heaters in your house are down near the floor?
    - The answer of course is that **heat rises**.
    - If you lie down on the floor in front of the heater you should feel a **draught of cool air**.
    - This cool air is coming in to **take the place of the warm air that has risen** up away from the heater.
    - The warm air **cycles around warming the room** and as it cools off it drops and makes its way back to the heater to cycle around again.

- This cycling of rising warm and sinking cool air is called a **convection current.**

Convection currents are the reason behind some of the local wind patterns that we see such as:

1. **Thermals:**
   - A **thermal or updraft** is simply a **mass of warm, rising air**.
   - Thermals can be created by a small local feature such as a farmer's field or a large paved area like an airport runway.
   - During the day the earth is heated by the **hot sun**.
   - The warmed earth then **heats the air above it**.
   - This warmed air then expands becoming much **lighter and starts to rise**.
   - As the warmed air rises, **colder air**

rushes in underneath to take its place.

- This creates a convection current in the area of the local heating.

2. Sea Breezes:

- Very similar to a thermal, in the way it is formed, however, sea breezes happen on a much **larger scale**.
- During the day the sun **heats a large land mass**.
- The **hot air would rise up off the land** and cooler air from the surrounding water would rush in and take its place (just like the thermal).
- The cool wind will **blow in from the lake or ocean**.
- As the hot air continues to rise, **it cools and begins to fall**.
- Creating **a large convection current**.

3. Land Breeze:

- During the night time the **sea breeze reverses**.
- At night the **land cools off quickly** while the water tends to be a little warmer than the land.
- In this case, **the convection current is reversed**.
- The warm air rises up off the water while the **cool land air now sweeps out from the land**.
- This creates a **soft offshore wind in the night**.

4. Lake Effect Snow: (Snow squalls)

- Snow squalls are created when **winds blow over an open body of water** such as a large unfrozen pond, lake, or ocean.
- In winter, **water stays warmer than the land**.

- As this air blows over the water it warms slightly and the air **picks up moisture** from the water.
- When this moist wind blows onshore the land is much colder and **quickly cools the air**.
- This quick cooling causes the air to rapidly **release its moisture in the form of snow**.
- The **snowfalls can be quite large** in the area downwind and around the body of water.

5. Chinook:

- The word Chinook is a Native American name given to a wind, which is known as **"the snow eater"**.
- A Chinook is experienced by areas on the **eastern side of the Rocky Mountains**.

- Warm, moist air from the **Pacific Ocean** blows on shore and begins to rise over the very high Rocky Mountains.
- As this warm, moist air rises it **cools and clouds form**.
- This air continues to rise and starts to release its moisture as **rain or snow**.
- The release of precipitation has a **warming effect on the air**.
- When this air reaches the other side of the mountains it gets trapped underneath a **very cold air mass above**.
- As the heavy cold air mass sinks it pushes this **pocket of warm air underneath it**.
- The warm air then starts to get squeezed together (compressed) which **heats this pocket of air even more**.

- As this warmed air moves through the temperature has been know to change from -20 ^{o}C to + 15 ^{o}C in a few hours.
- In the middle of a winter deep freeze conditions **rapidly change to a warm spring day in hours**.
- However, rushing in behind this very warm air is an intense cold air mass, which **returns the normal cold winter temperatures.**

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