

CH7

1. The Atmosphere

- Is the layer of gases surrounding the Earth.
- Blocks out ultraviolet rays from the sun.
- Ensures a relatively stable climate
 - Acts as blanket by retaining heat.
- Contains oxygen gas (O_2) \rightarrow cellular respiration & carbon dioxide (CO_2), \rightarrow photosynthesis.

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Other gases 1%

Nitrogen (N_2) 78%

Oxygen (O_2) 21%

Figure 7.2

Gas	Symbol	Volume (%)
Water vapour	H_2O	0 to 4
Argon	Ar	0.93
Carbon dioxide	CO_2	0.033 (variable)
Neon	Ne	0.0018
Helium	He	0.00052
Methane	CH_4	0.00017 (variable)
Krypton	Kr	0.00011
Hydrogen	H_2	0.00005
Nitrous oxide	N_2O	0.000007 (variable)
Xenon	Xe	0.0000007
Ozone	O_3	0.000001 (variable)
CF_4 (hydrofluorocarbons)	C.F.C.	0.000001 (variable)

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2. & 3. Composition of the atmosphere

- Atmosphere =
 - mostly oxygen (O_2) (21%) & nitrogen (N_2) (78%),
 - (a.k.a air).
- Water vapour is another important gas responsible for cloud formation & precipitation.
- Amount of water vapour = relative humidity
- The atmosphere also contains suspended solid and liquid matter originating from the Earth's surface (dust, pollen, soot, smoke, droplets,)

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7.2 Atmospheric Pressure (p224)

- Pressure is due to air particles colliding with each other.
- more collisions = higher pressure.
- The pressure of our air is called atmospheric pressure.
- At sea level, the average atmospheric pressure is 101.3 kPa (kilopascals).
- 101 kPa = to the pressure of 100 kg on 1 m²

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Factors affecting Atmospheric pressure:

- The more particles that are present, the more collisions that occur.
- This results in higher pressure.
- The reverse is also true.
 - As you increase in altitude there are less particles of air and therefore, less collisions with air particles.
 - This is why air pressure drops with increasing altitudes.

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7.3 Atmospheric circulation

- As air temperature rises, air particles move farther apart
- instead of increasing the number of collisions. The result is the density of the air drops and becomes "lighter".
- Thus, warm air rises as it is displaced by the more dense cool air.
- Air molecules move from areas of high pressure to areas of lower pressure.
- We call this movement wind.

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7.3 Atmospheric circulation

- It is the global-scale movement of the layer of air surrounding the Earth.
- Warmer humid air at the equator rises, heads toward the poles and then descends over the cold dry regions.
- At the same time, the cold polar air heads toward the equator.
- This type of convection distributes solar energy.

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Coriolis Effect

- Instead of the air traveling in a straight line to the poles, it is redirected due to the rotation of the Earth.
- The Earth spins in a West to East direction, therefore winds are redirected to the:
 - right in the Northern Hemisphere &
 - to the left in the Southern Hemisphere.
- This effect occurs in the troposphere
- It is responsible for the formation of warm fronts, cold fronts, and subsequent clouds.

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7.4 Air Mass

- A large expanse of the atmosphere with relatively uniform temperature and humidity.
- The climate in Quebec is affected by:
 - the warm air masses from tropical regions &
 - cold air masses from arctic regions.

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7.9 Air masses over North America affect the climate in Quebec.

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7.5 Fronts

- The line where warm and cold air masses meet.
- It is a transition zone where wind direction, temperature and relative humidity change rapidly.
- The cold denser air slides under the lighter warmer air.
- There are two types:
 - Cold fronts
 - Warm fronts

7.10 The cold denser air slides under the lighter warmer air.

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Cold front

- It occurs when a mass of cold air moves towards a mass of warm air
- The warm air rises, cools and condenses to form **cumulus clouds**.
- This is often accompanied by **wind** and **heavy rain**.
- It is represented on the weather map by a row of **blue triangles**.

Labels in diagram: Warm air rises rapidly, Cold air mass, Cold front, Heavy rain, Warm air mass.

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Typical Cumulus Clouds

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Warm front

- It occurs when a mass of warm air moves toward a mass of cold air.
- The warm air gently rises above the cold air creating stratified layers of light clouds called **nimbostratus**.
- Tend to bring **cloudy** weather and **showers**.
- Tend to move **slower** and thus last longer than cold fronts.

Labels in diagram: Warm air mass, Warm air rises gradually, Cold air mass, Rain at the base of the front, Warm front.

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Typical Nimbostratus Clouds

Labels: Ground level, Cirrocumulus, Cirrus, High Clouds, Middle Clouds, Low Clouds, Stratocumulus, Nimbostratus, Cumulus, Cumulonimbus, Clouds with Vertical Development.

Altitudes: 20,000 ft., 6,500 ft.

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7.6 Anticyclones & Depressions

- When air **cools**, particles move closer together. The denser air sinks toward the ground, compressing the particles beneath it.
- This creates an area of high pressure, called an **anticyclone**.
- Symbolized by an H on the weather charts.
- Weather:
 - dry & sunny in the summer
 - cold in the winter.

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Write please!

- When air warms, it becomes less dense and rises, leaving an empty space beneath it.
- This creates an area of low pressure, called a depression.
- It is symbolized by an L on the weather charts.

Weather:

- Clouds
- Precipitation


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• The Coriolis effect causes the air to turn as it rises.

- In the Northern Hemisphere the air turns:
 - Clockwise around an anticyclone & *Write please!*
 - counterclockwise around a depression
- Opposite in the Southern Hemisphere.
 - counterclockwise around an anticyclone &
 - Clockwise around a depression



anticyclone



depression

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7.7 Cyclones (Hurricanes & Typhoons)

- When a depression forms over the warm waters of tropical oceans.
- Can be 800 km in diameter & wind speeds up to 360 km/hr.
- These storms are called cyclones, hurricanes (Atlantic ocean) or typhoons (Pacific Ocean).
- Can be powerful enough to cause:
 - Floods,
 - landslides,
 - uproot trees,
 - shatter windows, &
 - tear roofs off buildings.

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7.8 More Energy Resources


Alternatives to fossil fuels, hydro and nuclear power:

- Wind energy
- Solar energy
- Tidal energy

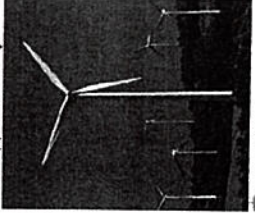
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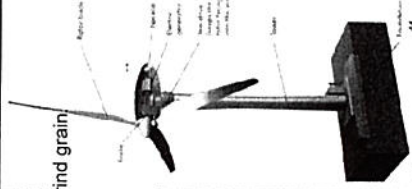
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Old idea: once used to grind grain.



New application: ↓





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1. Wind energy

Advantages

- Renewable
- No greenhouse gases.
- A one megawatt (1 MW) turbine can produce enough electricity to supply 150 – 300 households.

Disadvantages

- The towers ruin the beauty of the landscape.
- Wind cannot be regulated.
- Cannot be stored.
 - Must be paired with another energy source. (hydro)

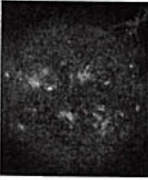
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2. Solar Radiation

- The Sun
- It is a star composed of 75% hydrogen & 25% helium.
- Core temperature is 15 million °C.
- It is 150 million km from the Earth.
- Its energy takes 8 min. to travel to the Earth.
- High temperatures cause nuclear reactions in the core to produce its energy.

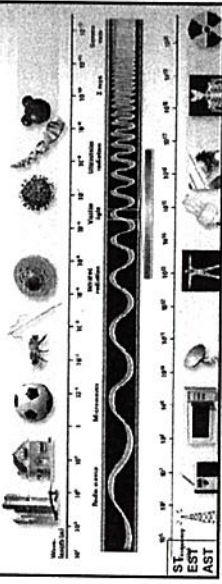


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Write please!

Solar Energy


- Travels to the Earth by electromagnetic waves.
- Only a portion make it to earth:
 - Visible light,
 - infrared rays (heat) &
 - UV



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Write please!

Due to the curvature of the Earth, tropical regions receive more solar energy than the polar regions.



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(78) Color temperatures are measured by latitude. The areas in red receive the most solar energy, and the areas in yellow receive the least.

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Write please!

Using Solar Energy

- Passive heating systems
 - South-facing windows to allow the sun to heat the air.
 - Use cement or tile to absorb energy and release it later.
- Photovoltaic cells (solar panels)
 - When these cells (made of silicon) are hit by light, it causes electrons to flow (electricity).
 - These cells can be found on houses, appliances (lights, calculators) and satellites

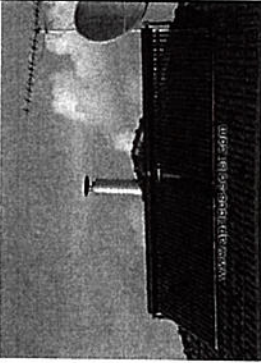


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Solar collectors

- These are large glass panels that capture the sun's rays and heat copper pipes filled with water.
- The heat is stored and used for:
 - Home heating
 - Pools



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Advantages

- Renewable
- No greenhouse gases produced.
- Good for remote areas
- Far North
- Space.

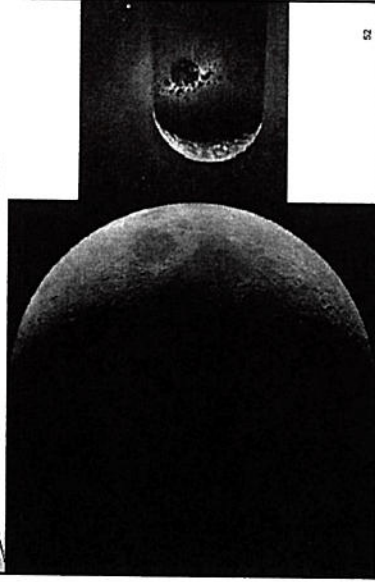
Disadvantages

- Very expensive
- Amount of energy depends on the position of the sun and the amount of cloud cover.

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Formation of the Moon



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7.9 The Earth-Moon System

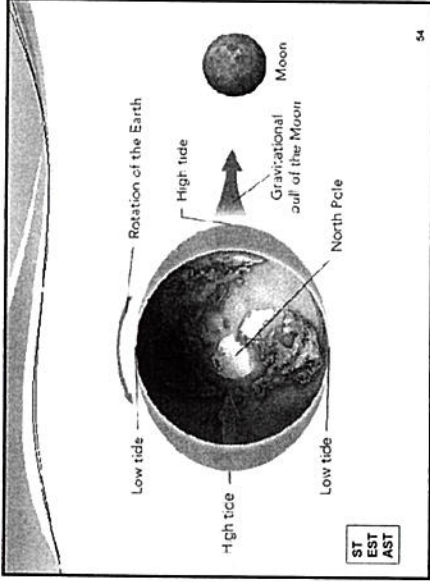


Moon

- Formed when the Earth was hit by an enormous meteor.
- The pieces of the Earth reunited in space to form the moon.
- Its diameter is 3476 km (1/4 the Earth's diameter).
- It takes 27.3 days to rotate around the Earth.
- It also spins on its axis. (we always see the same side)

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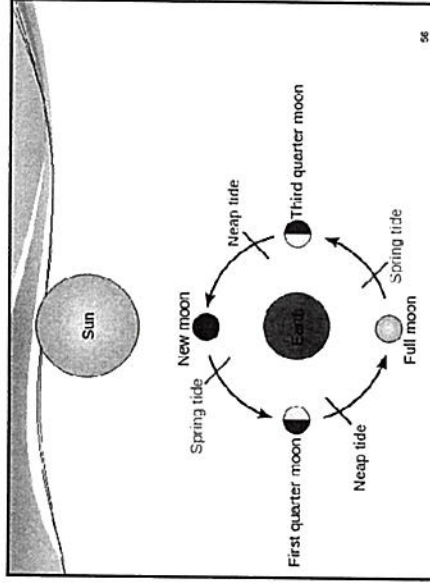
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Tides

- The moon stays in orbit due to the gravitational force between itself and the Earth.
- Since water is fluid, it bulges in the direction of the moon (high tide).
- On the opposite side of the Earth.
- The water is less attracted to the moon than the Earth.
- The Earth is therefore drawn closer to the moon than the water.
- The result is a bulge on the other side of the Earth

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- The other parts of the Earth have resulting low water levels (low tide).
- Two high tides and two low tides occur every day.
- Tidal range:
 - The difference in water levels between low & high tides.
 - Is influenced by :
 - slope and shape of coastline,
 - the depth of the water &
 - the distance from the Moon or Sun.

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The Bay of Fundy tides.

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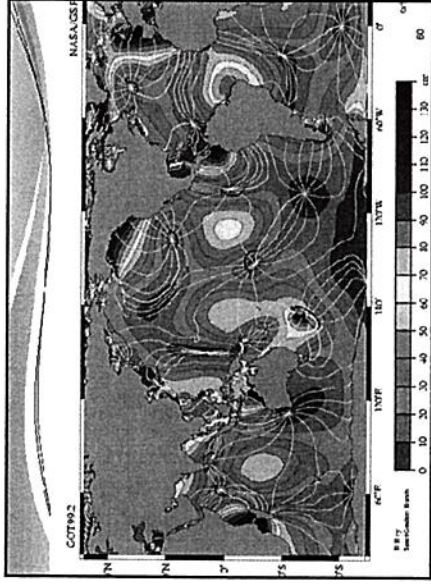
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When the Moon and Sun pull on the Earth's water in the same direction, Spring Tides result. Water levels will be at their highest and lowest.

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Tidal energy

- Tidal power plants harness the energy from this moving water.
- The tides come in and fill a huge basin. When the tide retreats, a gate is opened allowing water to flow through a turbine. This generates electricity.
- <http://forecast.brunswick.edu/>

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<p>Advantages</p> <ul style="list-style-type: none"> • renewable • does not produce GHGs • reliable 	<p>Disadvantages</p> <ul style="list-style-type: none"> • Building the plants are complex and costly. • There are very few sites suitable. (Must have a tidal range of at least 5 meters.)
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