UNIT 2 WEATHER DYNAMICS

Mr. Gillam Holy Heart

LAUNCH ACTIVITY 1

- LAB MANUAL: RESEARCHING WEATHER LORE

THE ATMOSPHERE: ENERGY TRANSFER AND PROPERTIES

- **WEATHER** THE PHYSICAL CONDITIONS OF THE ATMOSPHERE AT A SPECIFIC TIME AND PLACE
- SINCE WEATHER IS THE CONDITION OF THE ATMOSPHERE, AND SINCE THE ATMOSPHERE IS CONSTANTLY CHANGING, THE WEATHER ALSO CHANGES CONSTANTLY.
- IN FACT, WEATHER CHANGES FROM DAY TO DAY AND OFTEN FROM HOUR TO HOUR.
- WEATHER ALSO VARIES FROM PLACE TO PLACE AT ANY GIVEN TIME. THE EVER-CHANGING NATURE OF WEATHER IS ONE REASON THAT MANY PEOPLE WATCH, READ, OR LISTEN TO WEATHER REPORTS

St. John's, NL

No Alerts in effect

Current Conditions | Past 24 hours | Weather Radar | Satellite | Lightning

-3°C

°C | °F

Observed at: **St. John's Int'l Airport**
Date: **8:30 AM NST Saturday 30 January 2021**

Condition: **Light Snowshower**
Pressure: **99.7 kPa**
Tendency: **Rising**

Temperature: **-2.9°C**
Dew point: **-4.5°C**
Humidity: **89%**

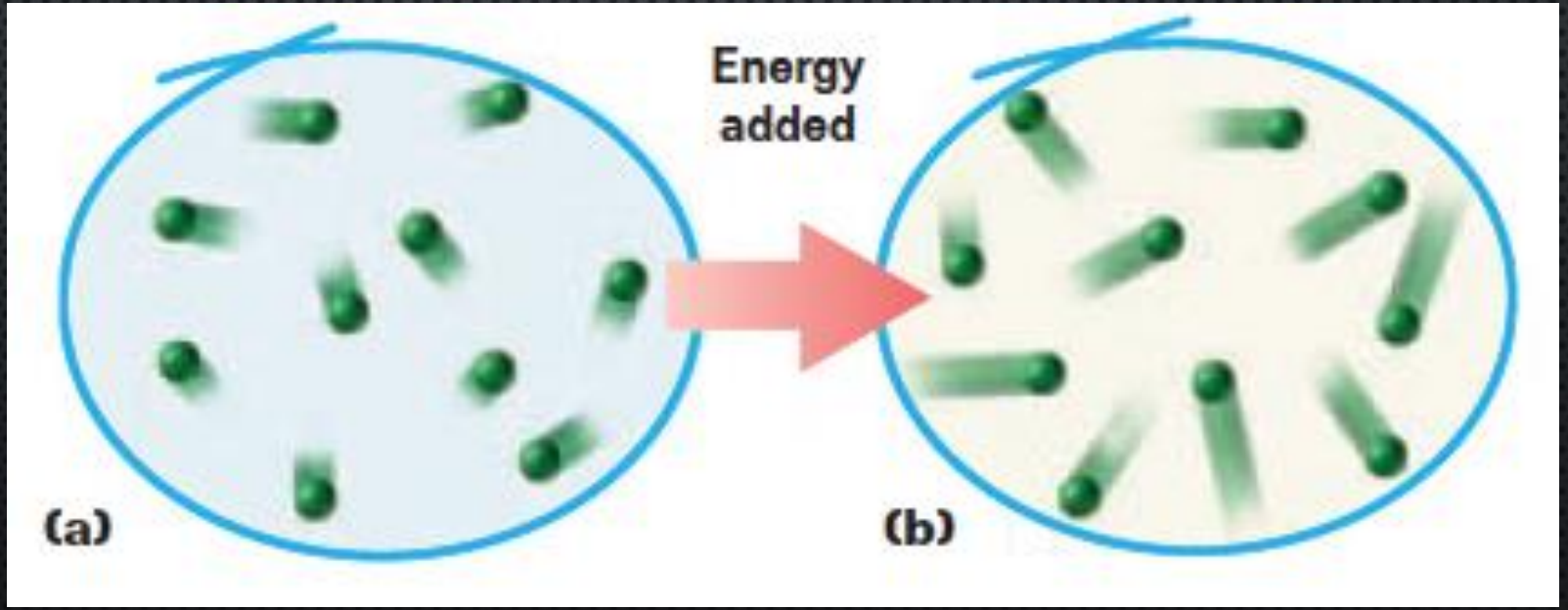
Wind: **N 31 gust 45 km/h**
Wind Chill: **-10**
Visibility: **24 km**

Forecast | Hourly Forecast | Air Quality | Alerts | Jet Stream

Sat 30 Jan	Sun 31 Jan	Mon 1 Feb	Tue 2 Feb	Wed 3 Feb	Thu 4 Feb	Fri 5 Feb
-2°C Flurries	0°C 40% Chance of flurries	-4°C Flurries	-1°C Cloudy	2°C Snow or rain	6°C Showers	1°C 60% Chance of flurries
Tonight	**Night**	**Night**	**Night**	**Night**	**Night**	
-2°C 40% Chance of flurries	-4°C Flurries	-4°C 40% Chance of flurries	-2°C Cloudy	2°C Showers	0°C 60% Chance of rain showers or flurries	

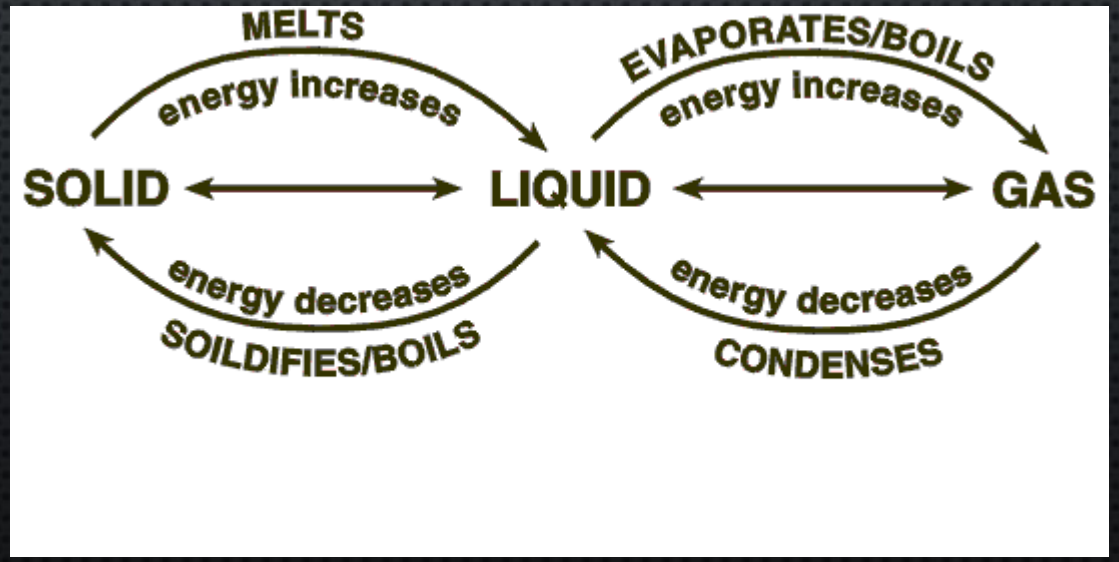
COMPONENTS OF WEATHER

- 1) TEMPERATURE
- QUALITATIVELY, THE COOLNESS OR WARMTH OF SOMETHING;
- QUANTITATIVELY, THE AVERAGE KINETIC ENERGY OF THE PARTICLES OF A SUBSTANCE.



COMPONENTS OF WEATHER

- THE KINETIC THEORY OF MATTER (PARTICLE THEORY) SAYS THAT ALL MATTER CONSISTS OF MANY, VERY SMALL PARTICLES WHICH ARE CONSTANTLY MOVING OR IN A CONTINUAL STATE OF MOTION.
- THE DEGREE TO WHICH THE PARTICLES MOVE IS DETERMINED BY THE AMOUNT OF ENERGY THEY HAVE AND THEIR RELATIONSHIP TO OTHER PARTICLES.



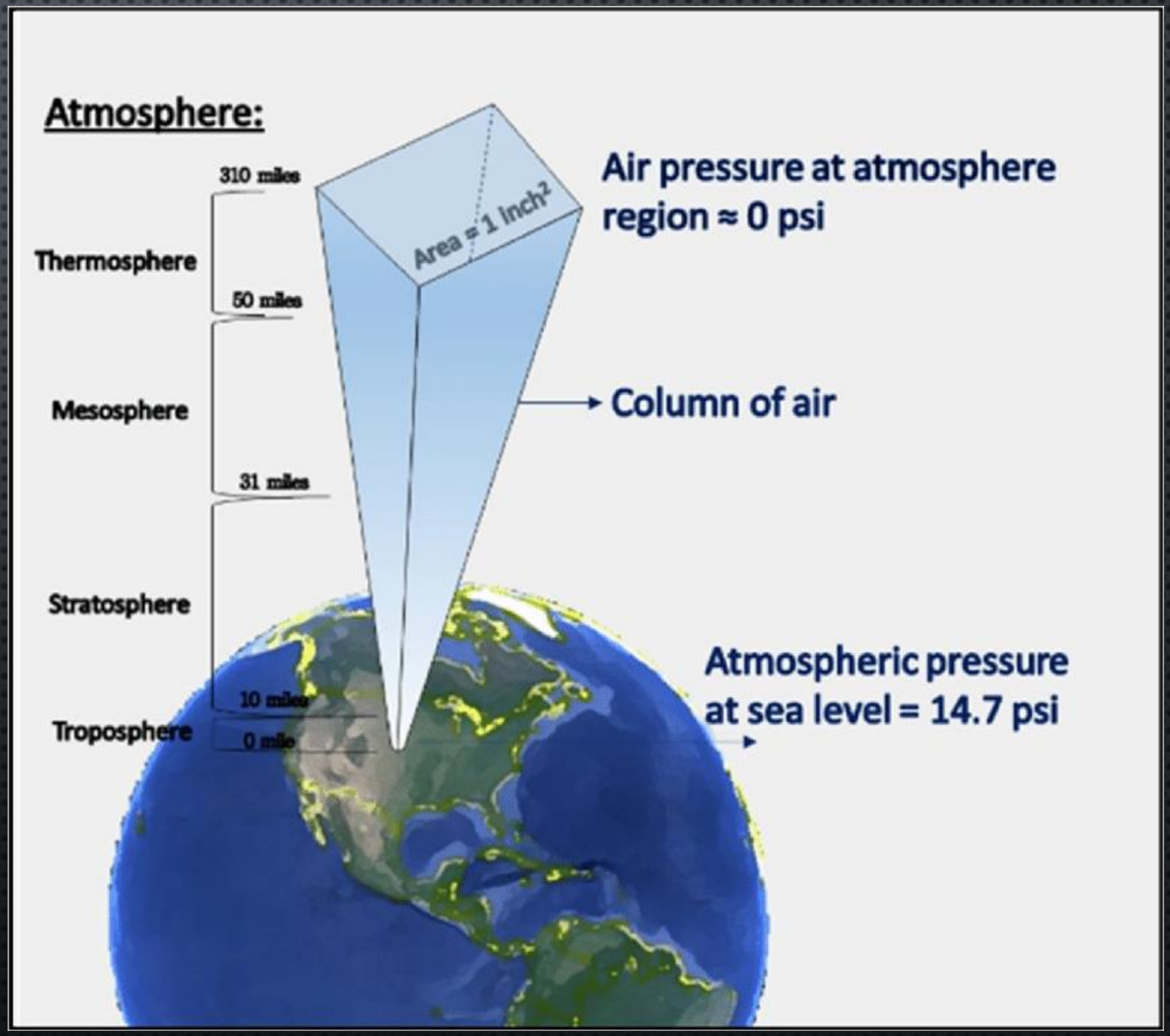
COMPONENTS OF WEATHER

- 2) PRECIPITATION
- ANY LIQUID OR SOLID FORM OF WATER THAT FALLS TO EARTH FROM THE ATMOSPHERE, INCLUDING RAIN, SNOW, AND HAIL

- PRECIPITATION INTENSITY
- LIGHT
- MODERATE
- HEAVY

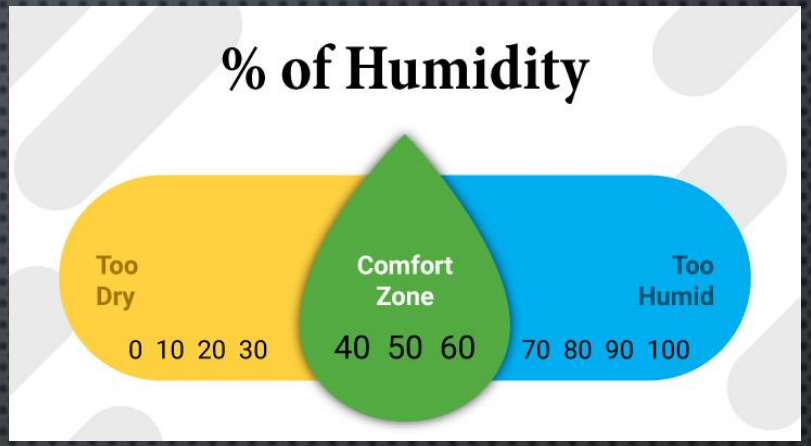
COMPONENTS OF WEATHER

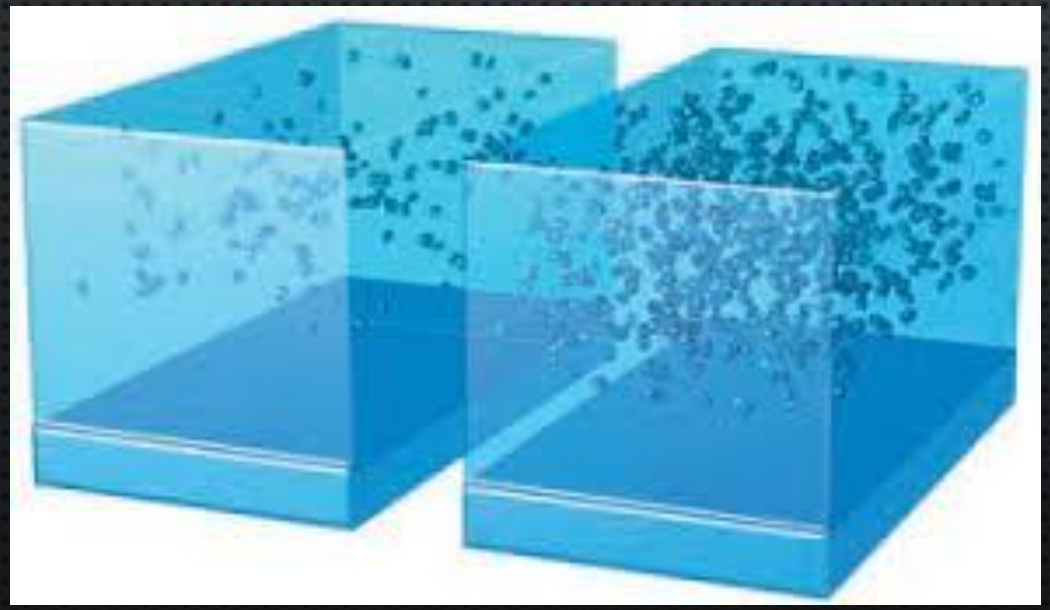
- 3) ATMOSPHERIC PRESSURE
- THE FORCE OF THE ATMOSPHERE ON THE SURFACE BELOW IT



COMPONENTS OF WEATHER

- 4) HUMIDITY
- THE AMOUNT OF WATER VAPOUR IN THE AIR





COMPONENTS OF WEATHER

- 5) WIND SPEED AND DIRECTION
- HOW QUICKLY MOVING AIR IS TRAVELLING AND THE DIRECTION FROM WHICH IT ORIGINATES

COMPONENTS OF WEATHER

- 6) SKY COVER
- THE PORTION OF THE SKY THAT IS COVERED BY CLOUDS
- CLEAR
- A FEW CLOUDS
- SCATTERED CLOUDS
- PARTLY CLOUDY
- MOSTLY CLOUDY
- OVERCAST

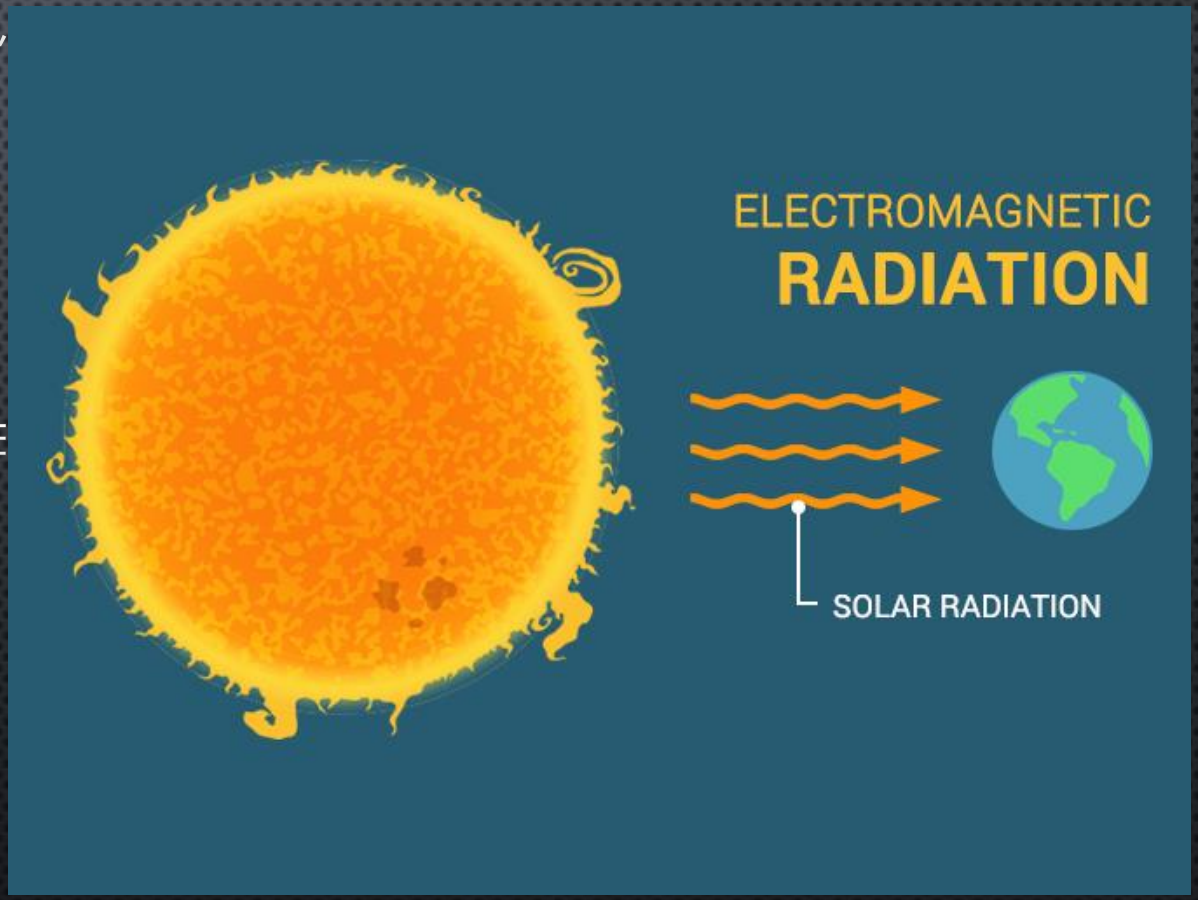
EARTHS SPHERES

- THE ATMOSPHERE (AIR) IS A MIXTURE OF NITROGEN, OXYGEN, AND OTHER GASES THAT EXTENDS MORE THAN 700 KM ABOVE EARTH'S SURFACE.
- THE FIRST 12 KM OF THE ATMOSPHERE, CALLED THE TROPOSPHERE, IS THE REGION IN WHICH ALL WEATHER TAKES PLACE.
- • THE LITHOSPHERE (LAND) IS MADE UP OF LAND-FORMING CONTINENTAL CRUST ABOVE SEA LEVEL AND OCEANIC CRUST AT THE OCEAN BOTTOM.
- • THE HYDROSPHERE (WATER) IS WATER ON OR NEAR EARTH'S SURFACE. IT INCLUDES LIQUID WATER AND SOLID WATER IN OCEANS, RIVERS, PONDS, AND STREAMS, AS WELL AS GASEOUS WATER VAPOUR IN THE ATMOSPHERE.
- THE BIOSPHERE CONSISTS OF ALL THE AREAS ON AND UNDER THE LITHOSPHERE, IN THE ATMOSPHERE, AND THE HYDROSPHERE THAT ARE INHABITED BY AND SUPPORT LIFE

RADIATION, CONDUCTION, AND CONVECTION

SOLAR ENERGY TRAVELS FROM THE SUN, THROUGH THE EMPTINESS OF SPACE, AND REACHES EARTH BY A PROCESS CALLED RADIATION.

- THESE WAVES RELEASE THE ENERGY ONLY WHEN THEY INTERACT WITH SOME FORM OF MATTER SUCH AS THE GROUND, WATER, OR AIR.
- RADIATION THERMAL ENERGY TRANSFER IN WHICH ATOMS OR MOLECULES GIVE OFF ENERGY AS ELECTROMAGNETIC WAVES

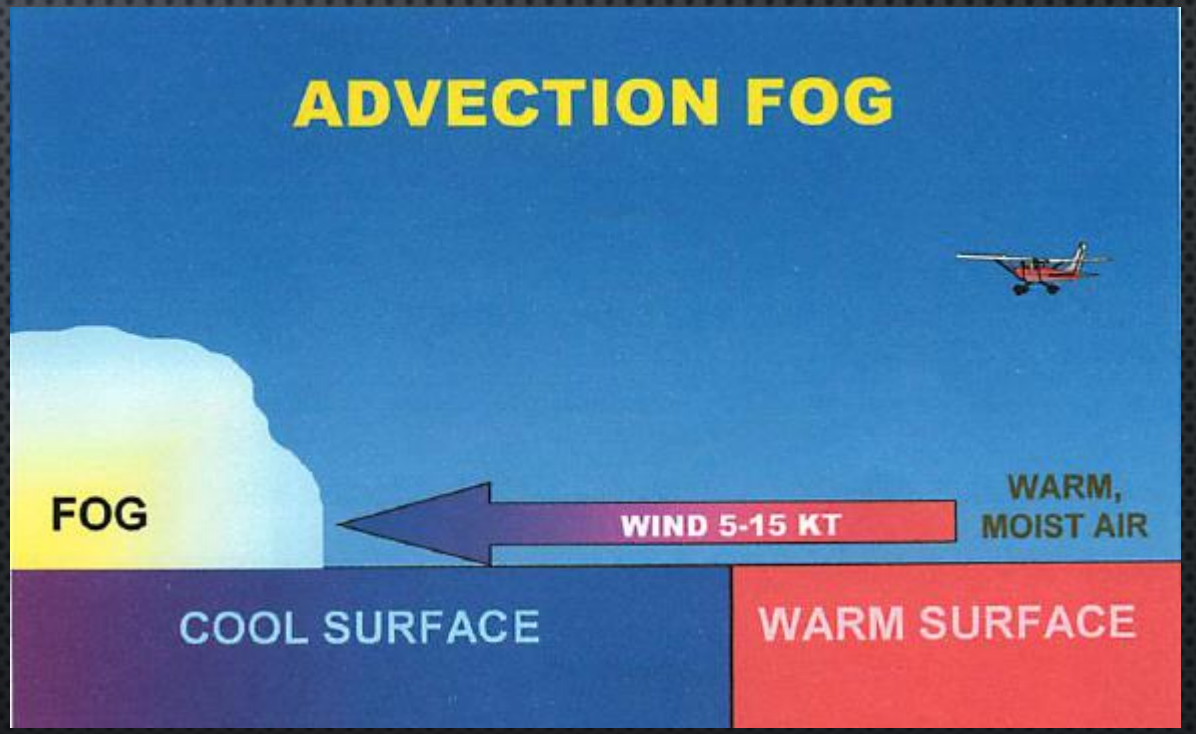


- **Conduction** thermal energy transfer between two objects or substances that are in direct contact

- **Convection** thermal energy transfer by the movement of heated material from one place to another

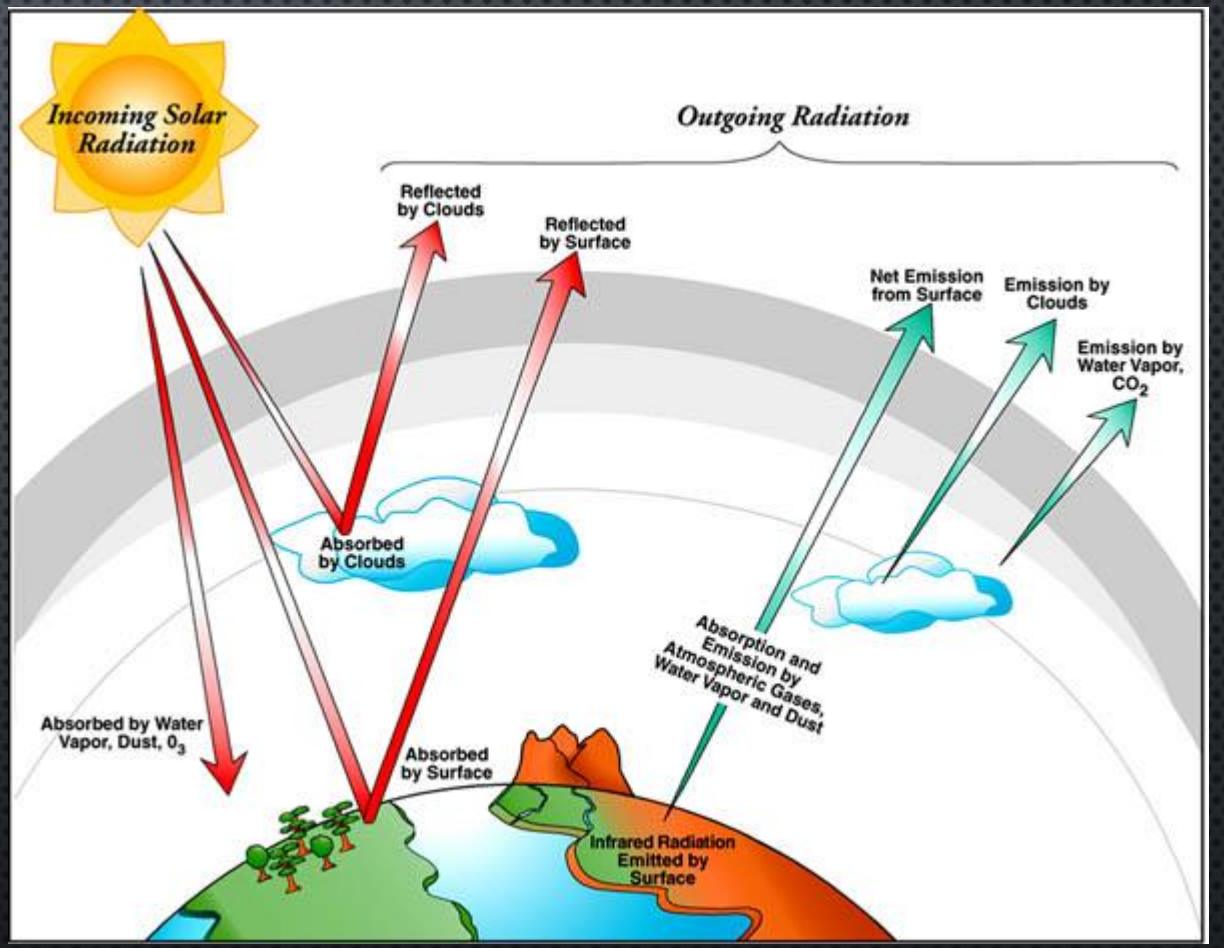
Figure 1.6 All three methods of thermal energy transfer are represented here.
Explain *How do conduction, convection, and radiation transfer thermal energy when a pot of water is being heated on a stove?*

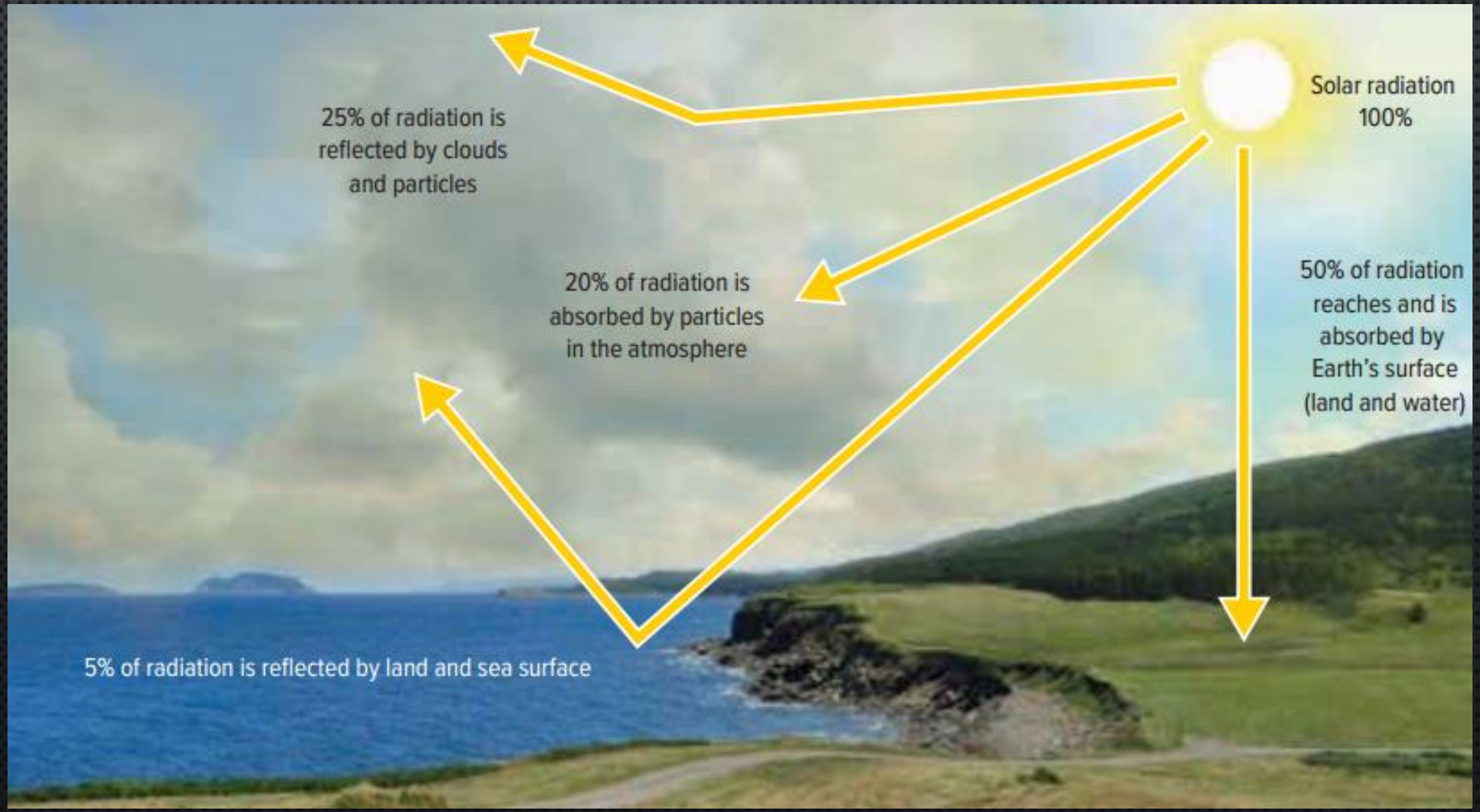
- Advection is the horizontal, large-scale movement of air in the atmosphere.
- As with convection, advection also transfers thermal energy.
- In meteorology, the term "advection fog" refers to fog that forms when warm, moist air moves over a cooler surface, such as cold ocean water or cold land.
- The moisture in the air condenses as it cools and fog results.



INCOMING AND OUTGOING RADIATION

- About 50 percent of the solar energy that enters Earth's atmosphere is absorbed by the land (continental crust of the lithosphere) and ocean (hydrosphere).
- About 50 percent is absorbed, reflected, and scattered by clouds, gases, and aerosols in the Atmosphere. (Aerosols are microscopic particles of dust, smog, mist, and other very fine particles that are suspended in the atmosphere.)



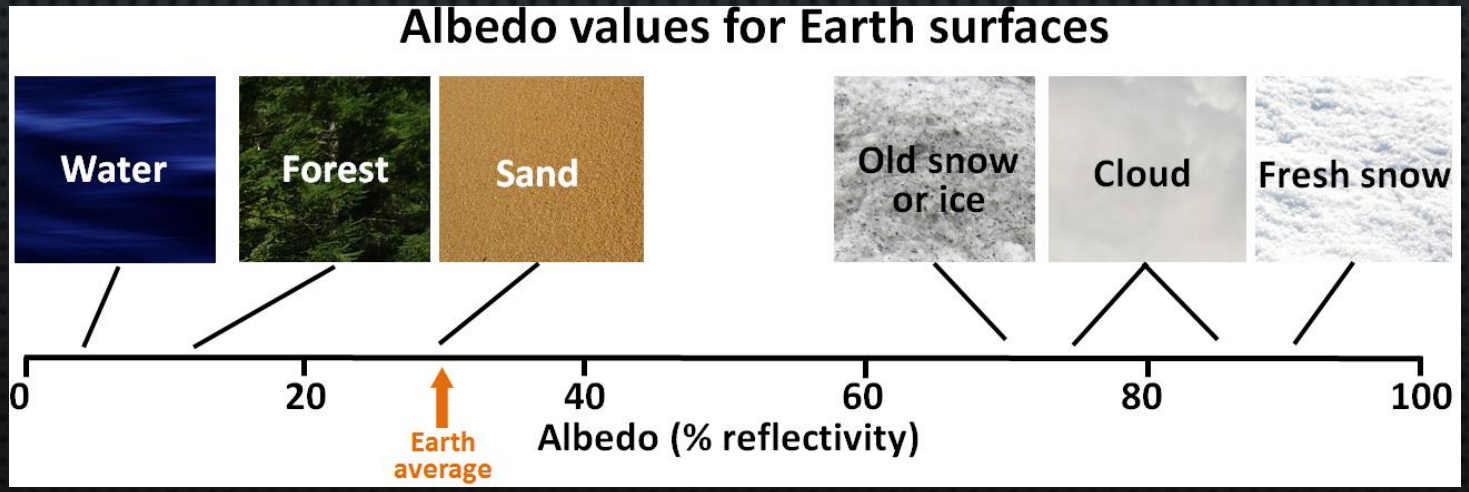

Solar radiation
100%
25% of radiation is reflected by clouds and particles
20% of radiation is absorbed by particles in the atmosphere
50% of radiation reaches and is absorbed by Earth's surface (land and water)
5% of radiation is reflected by land and sea surface

1-1B TEMPERATURE IN THE ATMOSPHERE

- Lab Manual

FACTORS AFFECTING ABSORPTION OF ENERGY

- 1) THE COLOUR OF A SURFACE AFFECTS THE AMOUNT OF ENERGY IT WILL ABSORB.
- DARK SURFACES ABSORB ENERGY, AND LIGHTER SURFACES REFLECT ENERGY.
- ALBEDO THE REFLECTIVITY OF A SURFACE, HOW MUCH ENERGY IT REFLECTS
- A SNOW-COVERED FIELD, FOR EXAMPLE, MIGHT REFLECT 70 OR 80 PERCENT OF THE ENERGY STRIKING IT, SO IT HAS A HIGH ALBEDO.
- DURING THE SUMMER, THE SAME FIELD GROWING CROPS MIGHT REFLECT ONLY 20 PERCENT OR LESS OF THE INCOMING ENERGY.
- THE FIELD OF CROPS HAS A LOWER ALBEDO THAN HIGHLY REFLECTIVE SNOW

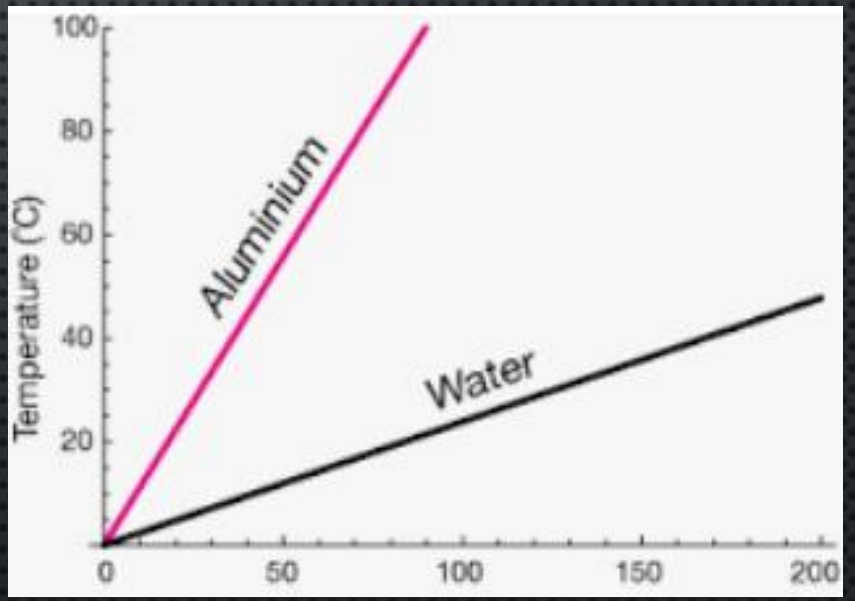


INVESTIGATION 1-1E

- LAB MANUAL ALBEDO AND SURFACES

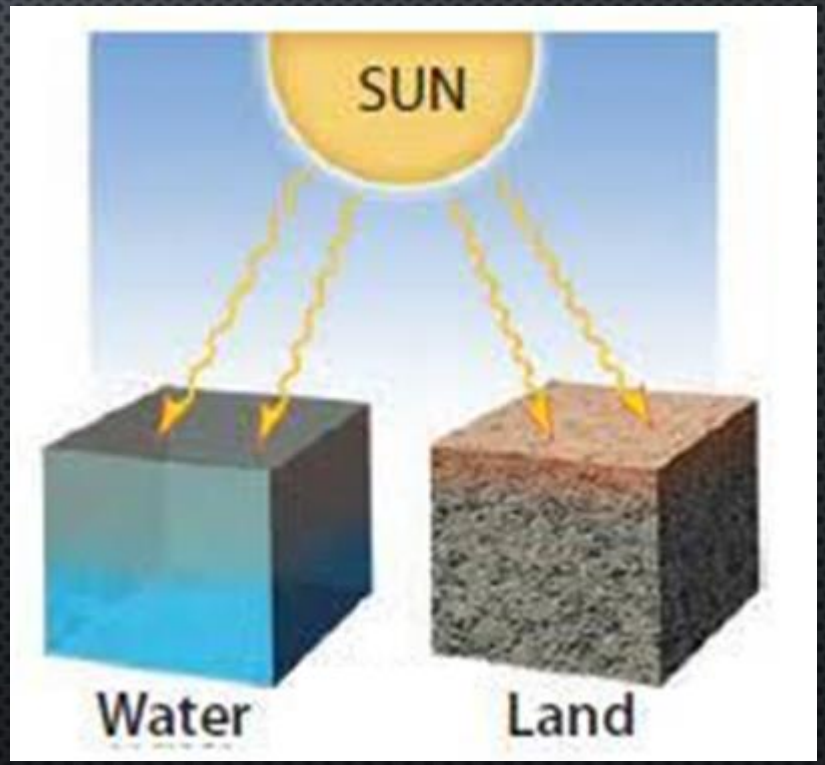
FACTORS AFFECTING ABSORPTION OF ENERGY

- 2) THE TYPE OF SUBSTANCE IS ANOTHER FACTOR THAT AFFECTS ENERGY ABSORPTION.
- DIFFERENT SUBSTANCES ABSORB ENERGY AT DIFFERENT RATES.
- *FOR EXAMPLE, WHEN WATER ABSORBS ENERGY, IT HEATS UP AND COOLS OFF MUCH MORE SLOWLY THAN LAND DOES, AND BOTH WATER AND LAND HEAT UP AND COOL OFF MORE SLOWLY THAN AIR DOES.*
- SPECIFIC HEAT CAPACITY HOW A SUBSTANCE ABSORBS AND RELEASES ENERGY AND HOW QUICKLY IT DOES IT. IT IS MEASURED AS THE AMOUNT OF ENERGY REQUIRED TO RAISE 1KG OF MATERIAL BY 1 ^{O}C
- WATER HAS A MUCH HIGHER SPECIFIC HEAT CAPACITY THAN LAND AND AIR DO.



- HEAT SINK ANY SUBSTANCE THAT CAN ABSORB AND RETAIN ENERGY WITHOUT CHANGING STATE

- BECAUSE OF ITS HIGH SPECIFIC HEAT CAPACITY COMPARED WITH LAND, WATER IS A BETTER HEAT SINK THAN LAND IS.



1-1F

- Lab manual Heat sinks

- Because there is so much water on Earth, and water is such a good heat sink, water has a great influence on weather.
- For example, because they are so close to large bodies of water, coastal locations generally have cooler summer weather and milder winter weather than inland locations.

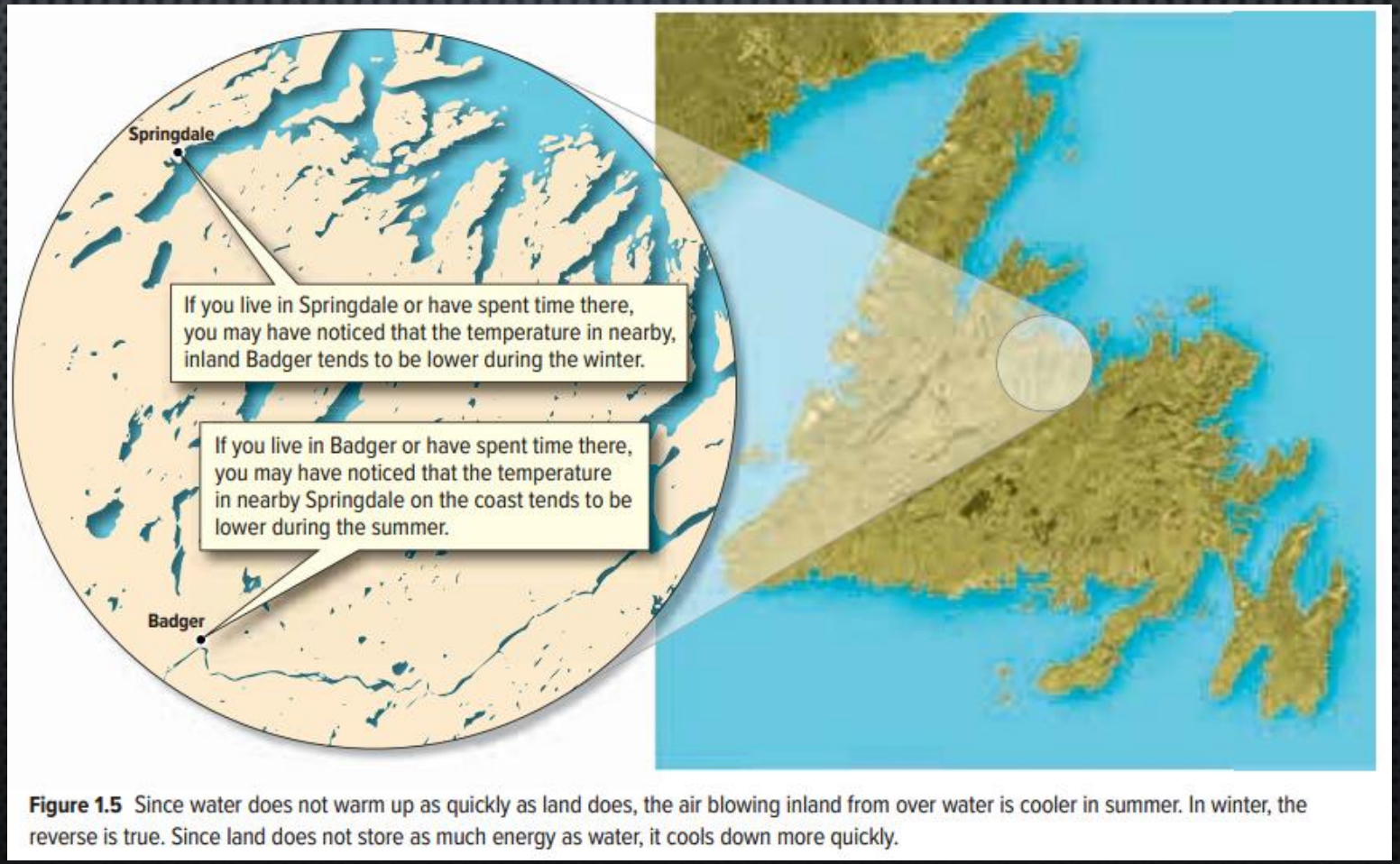
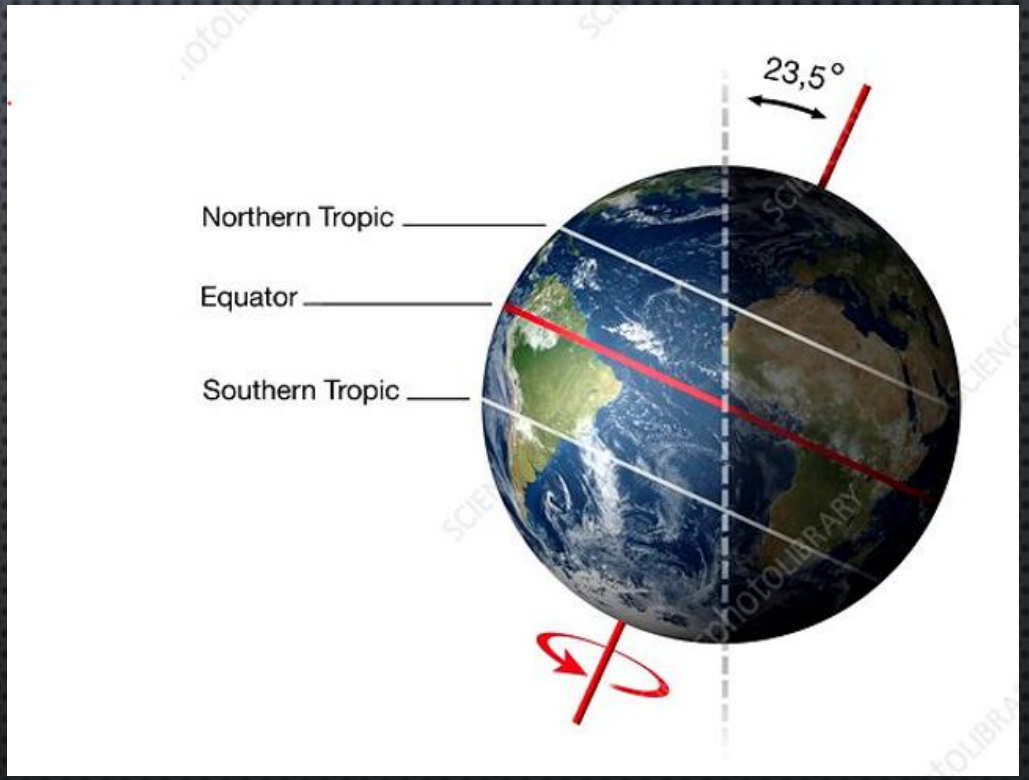


Figure 1.5 Since water does not warm up as quickly as land does, the air blowing inland from over water is cooler in summer. In winter, the reverse is true. Since land does not store as much energy as water, it cools down more quickly.

- Investigation 10-A
  Earths Tilt
- Lab Manual – Discovery
  Activity

- 3) Earth's Tilted Axis
- the tilt of Earth's axis, together with the curvature of Earth's surface, result in different amounts of solar energy absorbed.
- At the North and South Pole, Earth's axis is tilted towards the Sun for about 182 days or about half a year. It is tilted away from the Sun for the other 182 days.
- When the axis is tilted towards the Sun in the North during spring and summer, it is tilted away from the Sun in the South.
- Conversely, when the axis is tilted away from the Sun in the North during fall and winter, it is tilted towards from the Sun in the South.



- When the North Pole is tilted towards the Sun. The Sun's rays are perpendicular to a line in the Northern Hemisphere. Therefore, it is summer in the Northern Hemisphere.
- Earth's curvature causes solar energy to be distributed unequally. As you go toward the North Pole, the Sun's rays become more and more slanted relative to Earth's surface. Solar radiation is spread out over a larger area and a smaller amount of solar energy is absorbed by each square metre of surface area.
- Although day length is 24 h at the North Pole, it is not warm because the solar energy is spread over a very large area. In addition, the solar rays pass through much more atmosphere near the poles and less energy reaches the surface.

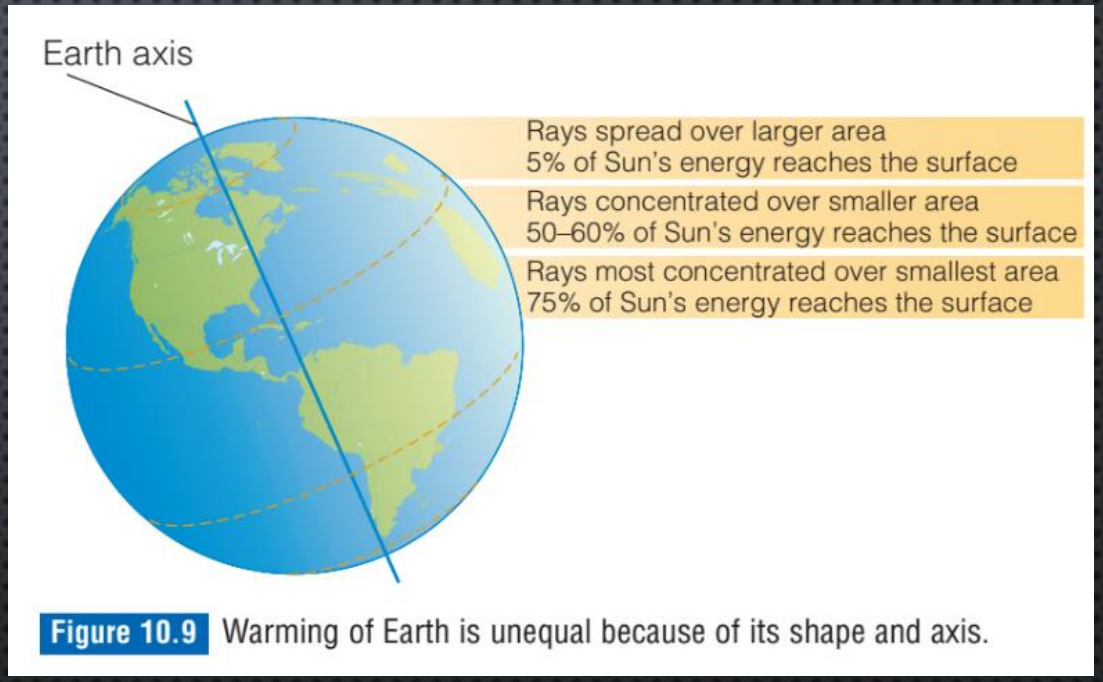


Figure 10.9 Warming of Earth is unequal because of its shape and axis.

- Geographers identify three major climate regions, or zones. They are named according to their general climates: polar, temperate, and tropical.
- Latitudinal lines on maps mark out these climate zones. These lines are called the Arctic Circle, the Tropic of Cancer, the Tropic of Capricorn, and the Antarctic

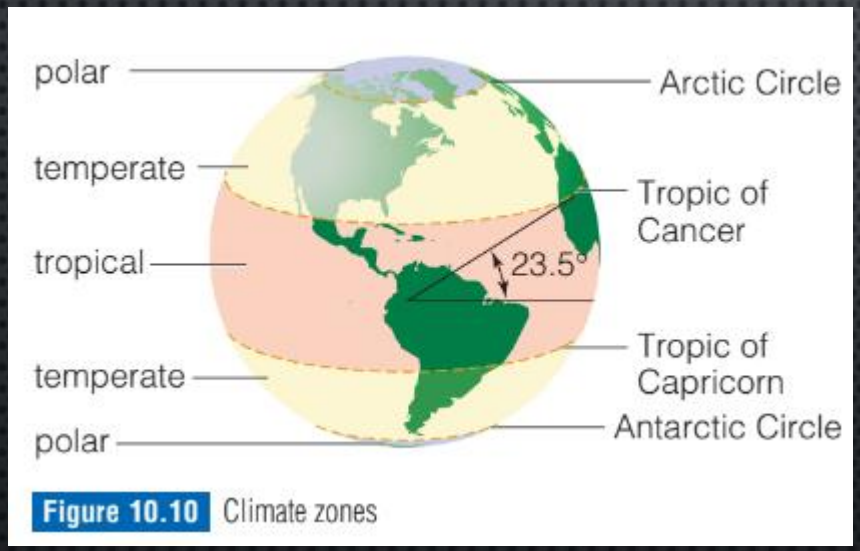
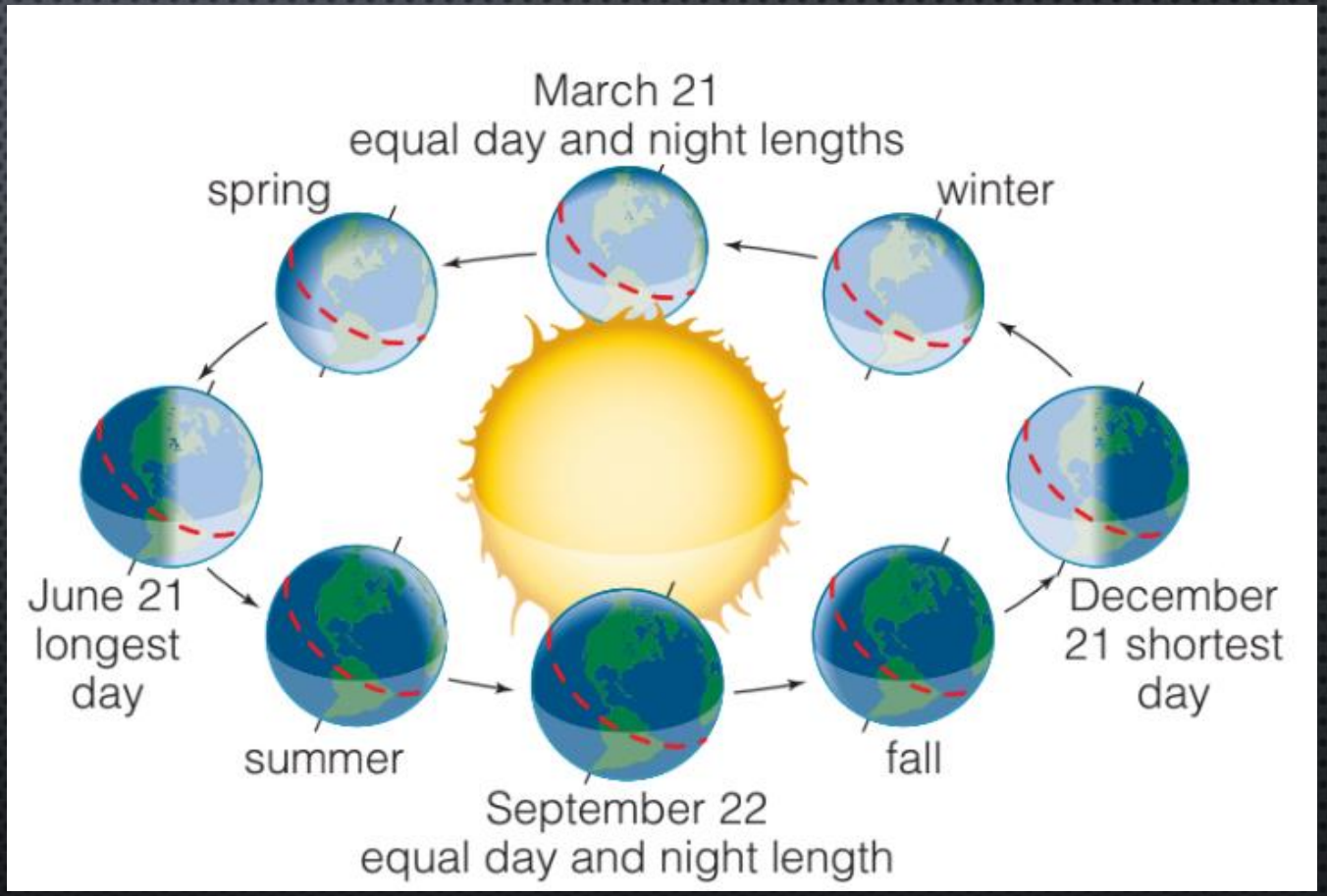


Figure 10.10 Climate zones

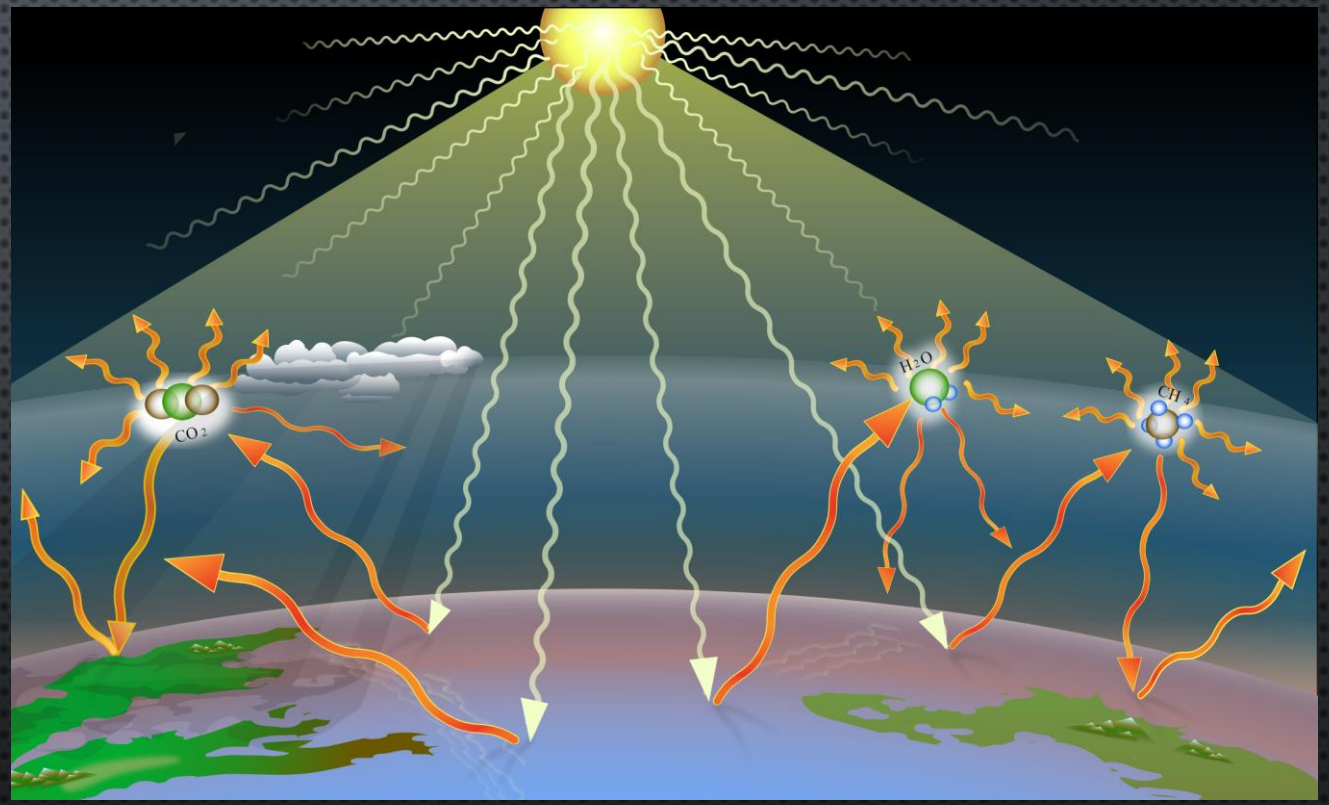
- The POLAR ZONES have 24 h of darkness during parts of the winter and 24 h of sunlight during parts of the summer. The 24 h of sunlight, however, do not cause significant warming. This is because the Sun's rays make such a SMALL ANGLE with Earth's surface that the energy is spread over a very large area.
- The Sun's rays are NEVER PERPENDICULAR to Earth's surface in the TEMPERATE ZONES. The temperature and weather conditions are quite variable. There is usually a significant difference in the weather during the summer and the winter.
- The Sun's rays ARE PERPENDICULAR to Earth's surface at some location in the TROPICAL ZONE throughout the entire year. Therefore, the average temperatures in this zone are generally warmer than those in the other zones.

- The Sun is not exactly at the centre of the orbit. Earth moves faster when it is close to the Sun than when it is farther away.
- As a result, the seasons that occur when Earth is close to the sun pass more quickly. Earth is closest to the Sun in January and farthest away in July.



KEEPING IN THE HEAT

- WHY DOESN'T THERMAL ENERGY JUST RADIATE INTO SPACE AT NIGHT, COOLING OFF EARTH WHEN THE SUN SETS?
- OF THE MANY GASES THAT MAKE UP THE ATMOSPHERE, ONLY A FEW ABSORB THE INFRARED RADIATION RELEASED FROM THE SURFACE.
- THESE ENERGY-ABSORBING GASES INCLUDE WATER VAPOUR, CARBON DIOXIDE, AND METHANE.
- YOU PROBABLY RECOGNIZE THEM AS THE GREENHOUSE GASES RESPONSIBLE FOR THE GREENHOUSE EFFECT.



GREENHOUSE EFFECT

- GREENHOUSE GASES ABSORB INFRARED RADIATION AND GIVE IT OFF IN ALL DIRECTIONS, INCLUDING BACK TO EARTH'S SURFACE.
- THIS RADIATION WARMS THE SURFACE AND THE ATMOSPHERE BEFORE IT IS EVENTUALLY LOST TO OUTER SPACE.
- THEREFORE, THE GREENHOUSE GASES IN EARTH'S ATMOSPHERE ACT AS A HEAT SINK.
- THEY CAUSE THE TROPOSPHERE—WHERE WEATHER OCCURS—TO RETAIN MORE HEAT THAN IT WOULD IF THESE GASES WERE NOT PRESENT.