

# Bell Ringer

1. This is the first day of the last term. Set a specific goal for these last 2.5 months (not just 'get good grades' or 'don't fail' or 'wake up on time'. *How* are you going to do these things. Set action word goals)
2. What science are you planning on taking next year?

# Heating the Earth

Energy From the Sun



# Where We Get Our Energy

- The Sun is a major source of energy for Earth.



# Forms of Energy

- Different forms of energy include heat, light, electrical, mechanical, sound, nuclear, and chemical.

## NUCLEAR


$E = mc^2$



Relates to the potential energy stored in bonds between particles in the nucleus of an atom.

**U<sup>235</sup>** 

## LIGHT Radiant



Relates to the vibration of an electrical charge or magnetic field that produces electromagnetic waves that can travel through a vacuum.


Low Frequency ELECTROMAGNETIC SPECTRUM High Frequency

Radio Waves  $10^4$  Hz -  $5 \times 10^7$  Hz (AM, VHF, FM)    Microwaves  $10^8$  Hz    Radiant Heat  $10^{14}$  Hz (4x10<sup>14</sup> Hz)    Infrared    Visible Light (R O Y G B I V)    Ultraviolet    X Rays  $10^{16}$  Hz    Gamma Rays  $10^{20}$  Hz

## HEAT Thermal

Relates to the motion of particles, atoms or molecules in a substance.

$Q = mc\Delta t$



CONDUCTION - movement of thermal energy through a solid  
CONVECTION - movement of thermal energy through a gas or liquid

## ELECTRICAL

Relates to the movement or flow of electrons.



Static Electricity    Current Electricity    HIGH VOLTAGE     $I = \frac{V}{R}$     MAGNETIC FIELD

## CHEMICAL

Relates to energy stored in the bonds between atoms in a compound.



Batteries    Fuel    Propane + Oxygen → Energy (Light, Heat, Sound) + Water    Carbon Dioxide

## MECHANICAL

Relates to the movement of objects or its position in gravity.

$W = \Delta E$

**POTENTIAL ENERGY Stored**

- Filled Balloon
- Sling Shot
- Water Pressure
- About to Swing
- Roller-coaster at the top
- Water in Reservoir

**KINETIC ENERGY Moving**

- Gravitational
- Mobil
- Windmill
- Bicycles

## SOUND Wave Motion

Relates to the repetitive compression and rarefaction of molecules in a substance.

**vibration**



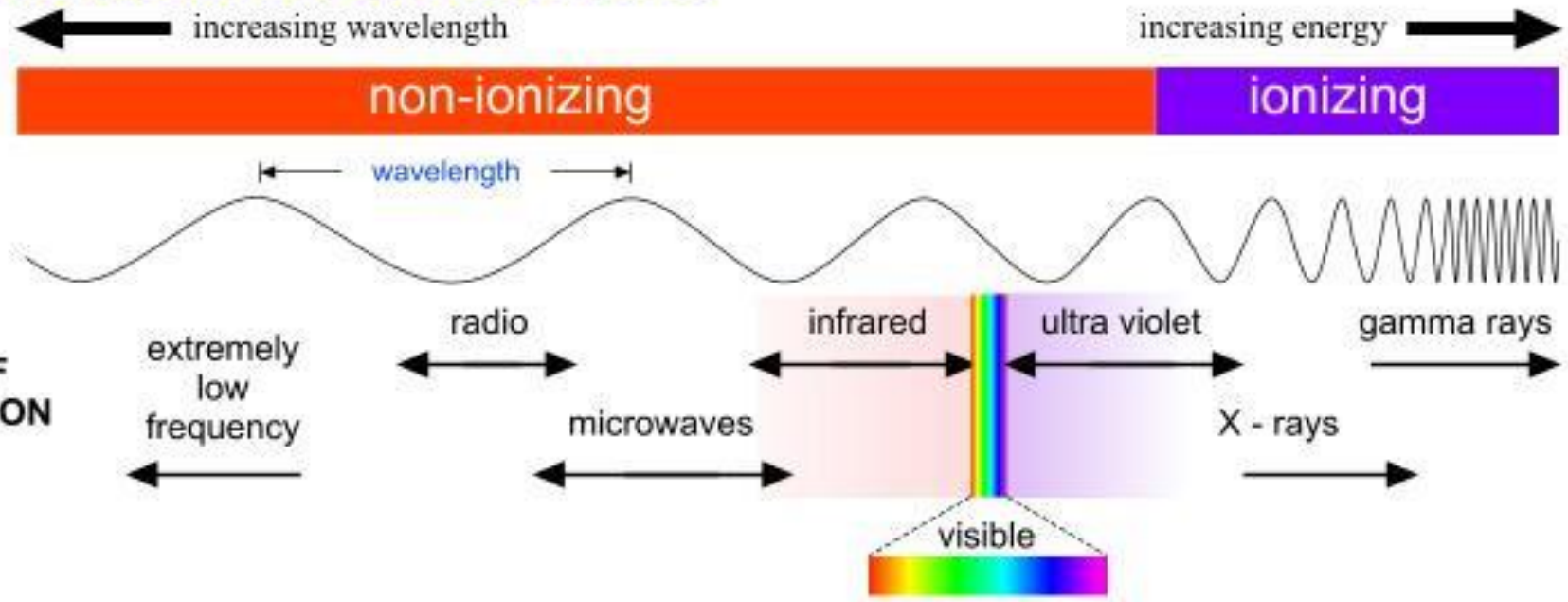
Music    Sonagram    Tuning Fork    sound waves

# Light - Electromagnetic Energy

- Different forms of electromagnetic energy have different wavelengths.
- Examples of electromagnetic energy are:
  - microwaves
  - infrared light
  - visible light
  - ultraviolet light
  - X-rays
  - gamma rays.
  - <https://www.youtube.com/watch?v=fpx7hs0YE+4>



# THE ELECTROMAGNETIC SPECTRUM



## SOURCES



Light "carries" energy.  
More energy = shorter wavelength

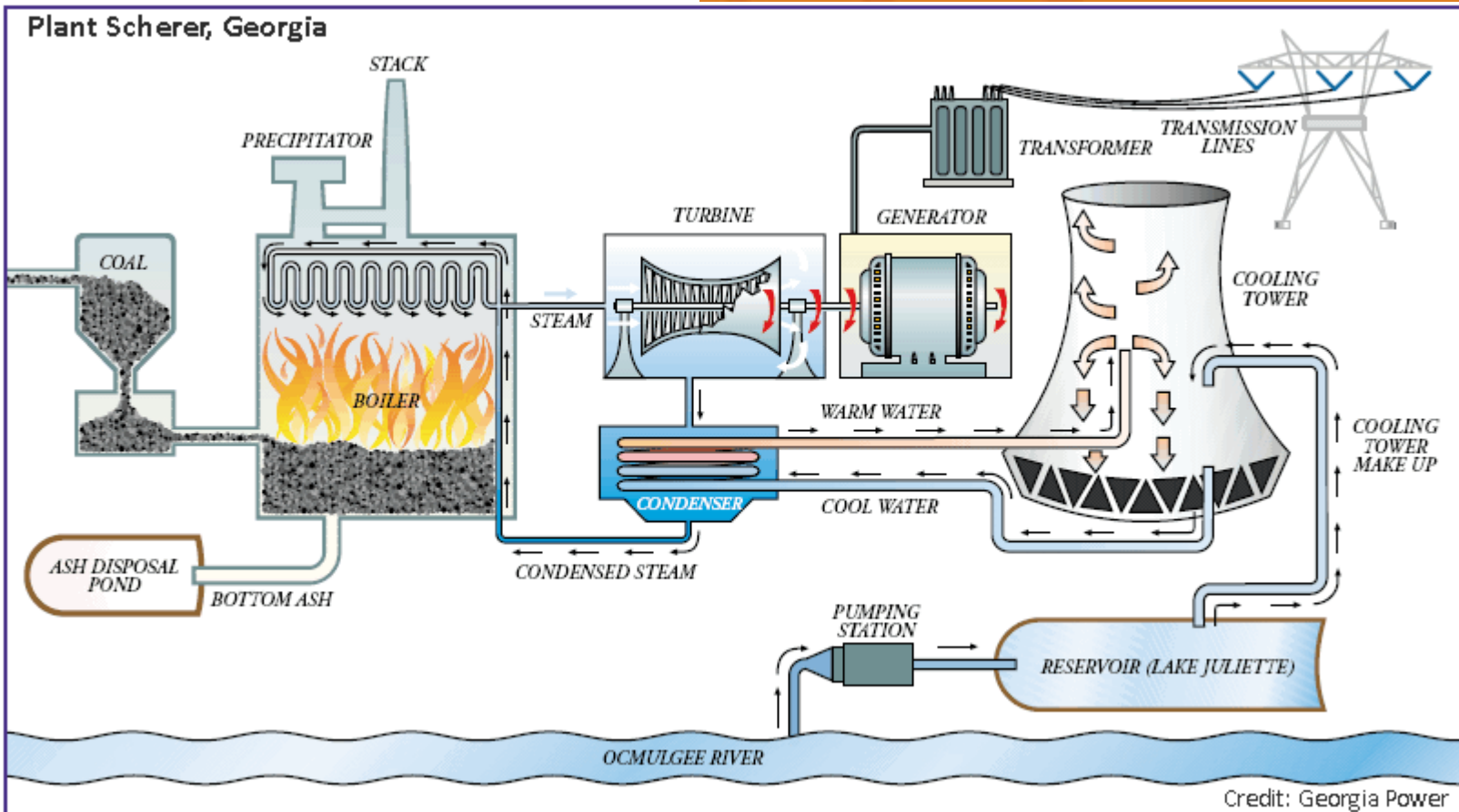
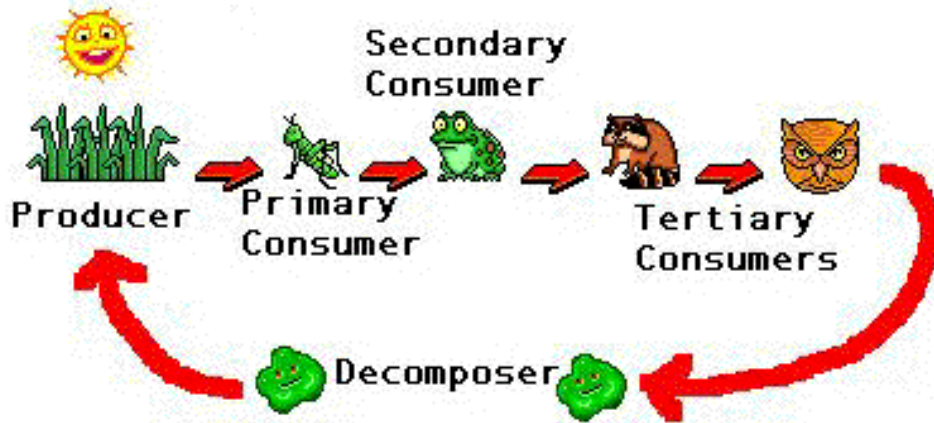
# Electromagnetic Spectrum

- These waves can travel through space; includes not only visible light but shorter waves, such as X-rays, and longer waves, such as radio waves or infrared.



# Changing Energy

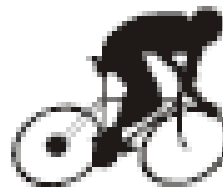
- Energy is transformed in many ways.
- Energy can change from one form into another
- <https://www.youtube.com/watch?v=GI7AhajfhWE>



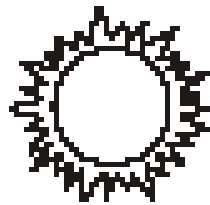
# Energy Transformations



Chemical



Motion



Radiant



Chemical



Chemical



Motion



Electrical



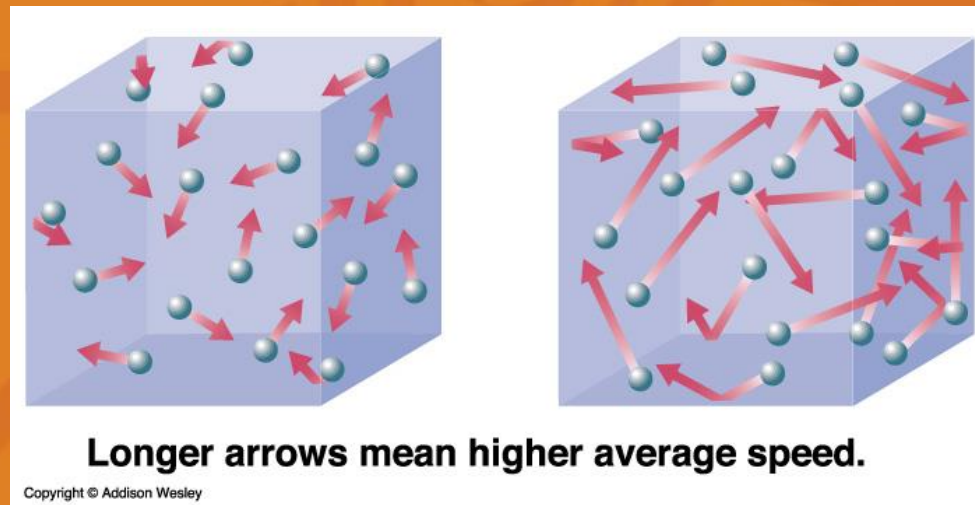
Thermal

# Conservation of Energy

- Energy cannot be created or destroyed, but only changed from one form into another.

# Heat Energy

- The energy of a material due to the random motion of its particles.
- Also called thermal energy.
- "Heat" is transferred when energy is transferred from one substance to another.





# How the Sun's EM energy heats the Earth

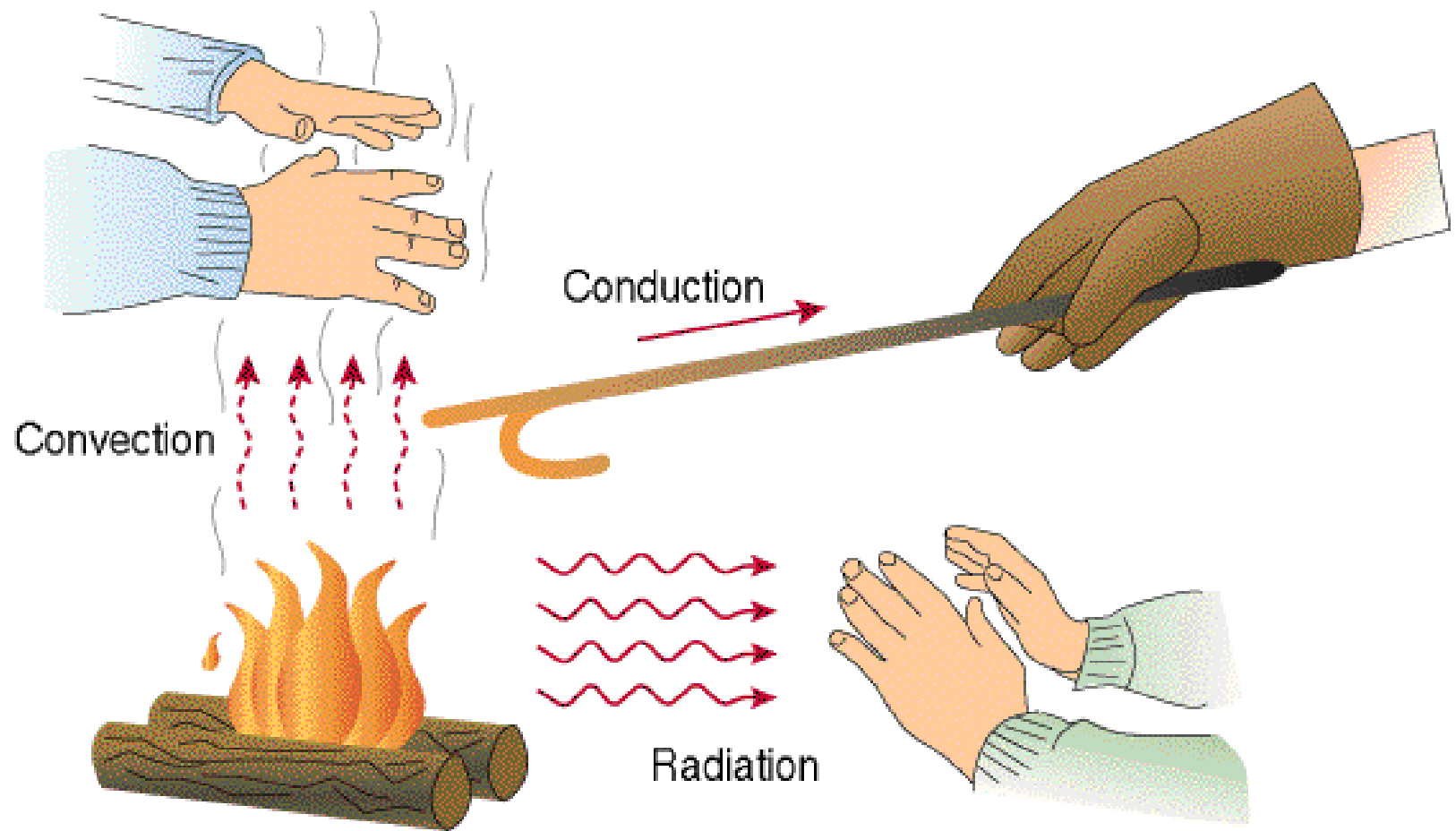
- The Sun send energy to Earth with EM waves that carry it through space.  
When the wave hits a material on Earth, it transfers the energy to that material's molecules. The molecules then move faster. Faster moving molecules = higher temperature.

# Uneven Heating

- **Insolation (Incoming solar radiation)** heats Earth's surface and atmosphere unequally due to variations in:
  - intensity (caused by variations in angle of incidence which vary with time of day, latitude, and season);
  - characteristics of the surface materials absorbing the energy (such as color, texture, transparency, states of matter, and specific heat); and
  - duration which varies with seasons and latitude.

# Heat Energy Moves

- Heat can be transferred through:
  - matter by the collision of atoms and/or molecules (conduction)
  - through space (radiation.)
  - In a liquid or gas, currents will cause the transfer of heat (convection.)
  - <https://www.youtube.com/watch?v=0mUU69ParFM>

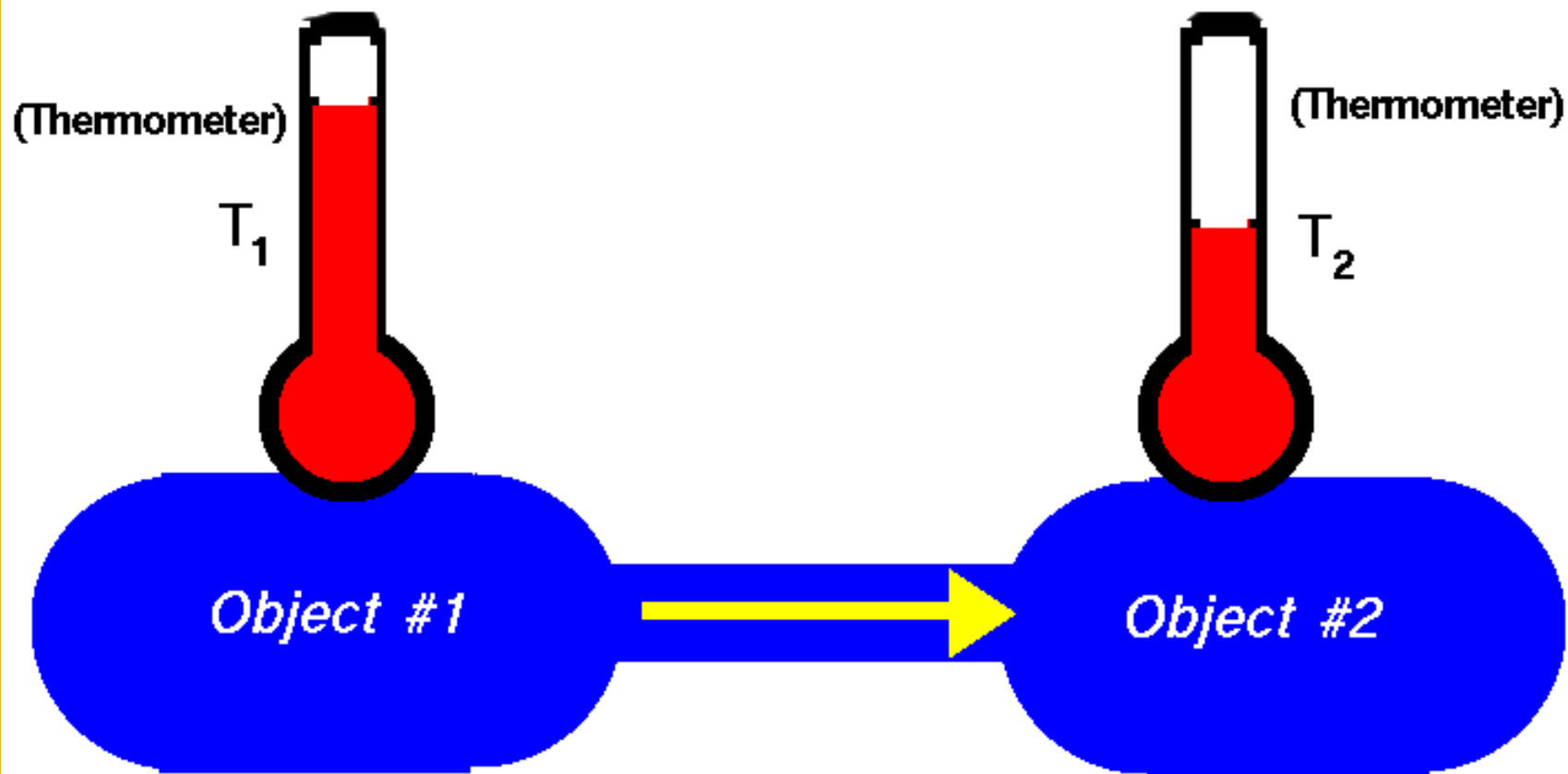


# Heat Energy Moves

- Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature





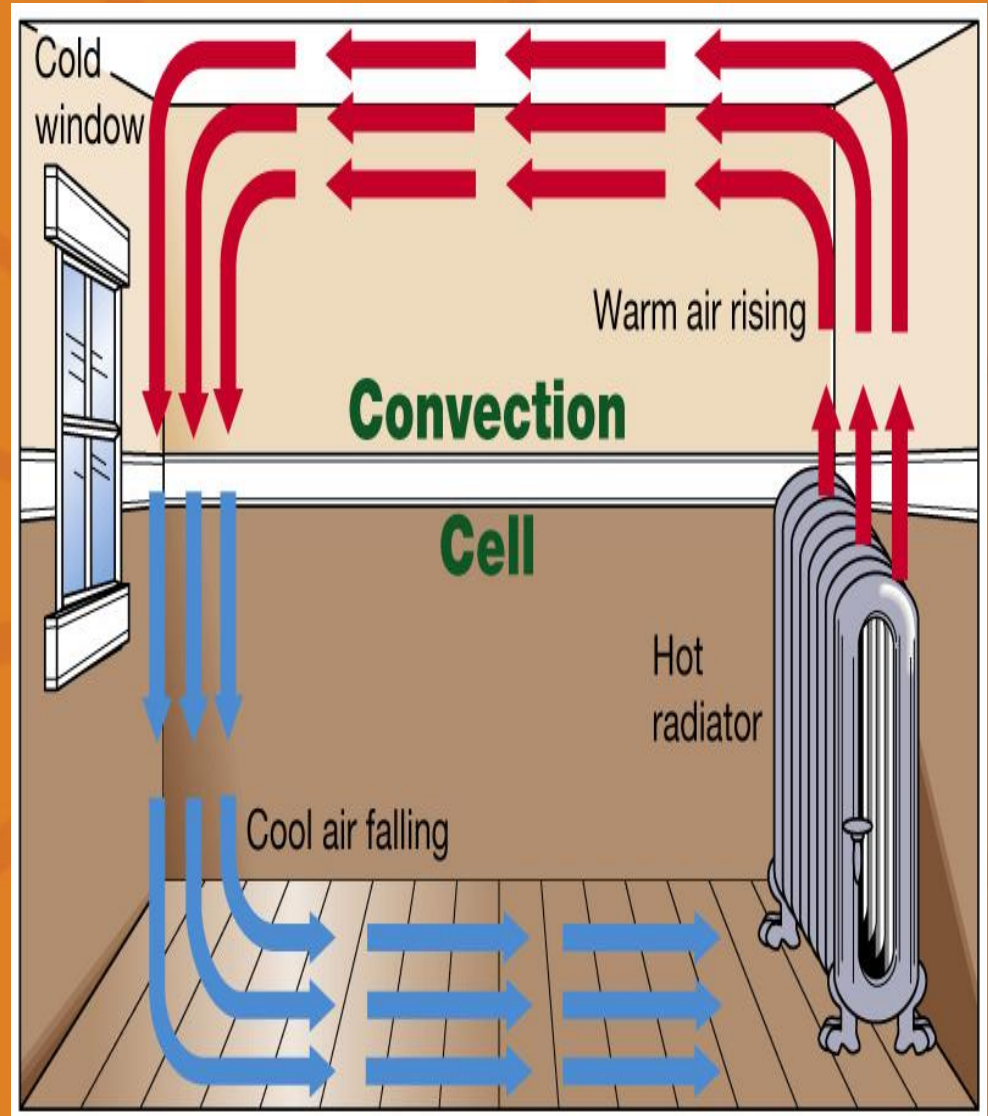


# Heat Moves Through the Atmosphere

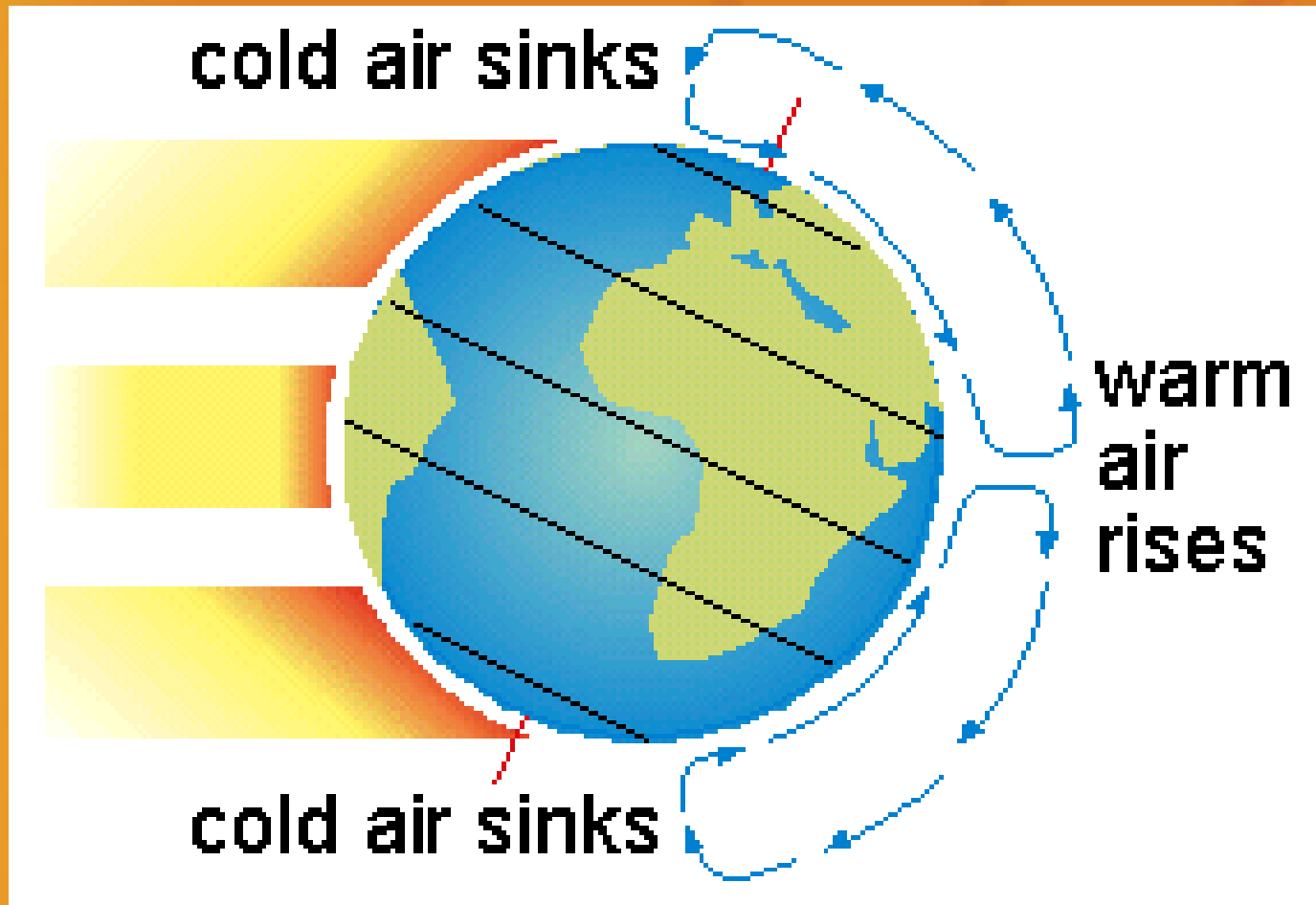
- The transfer of heat energy within the atmosphere occurs in three ways: radiation, convection, and conduction.
- The main way that energy is transferred within the atmosphere is convection.
- Uneven heating on Earth results in formation of regions of different densities.
- These density differences result in motion.

# Heat & Density

- In fluids (liquids and gases), less dense (warmer) substances can rise and more dense (cooler) substances can sink.



# Hypothetical Earth



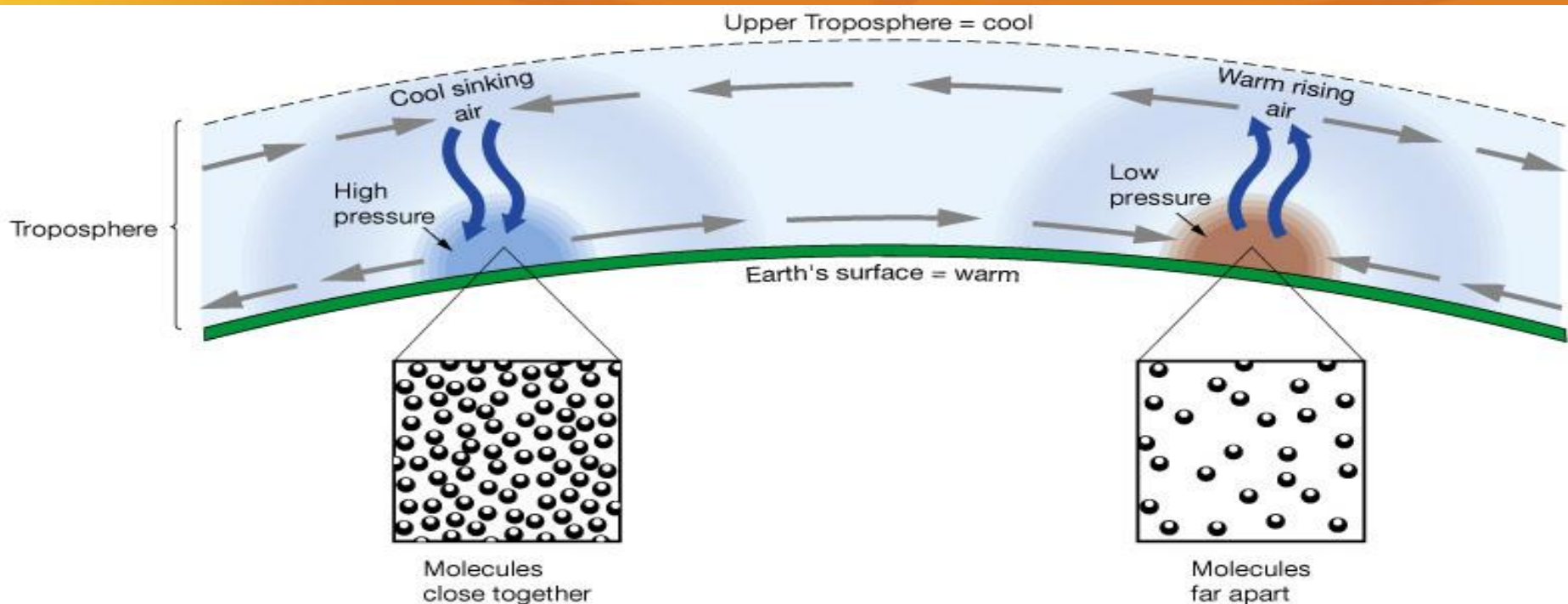
# Heat Movement & Density in the Atmosphere

- These density differences are the basis for many Earth phenomena, including cloud formation and the formation of atmospheric storms.

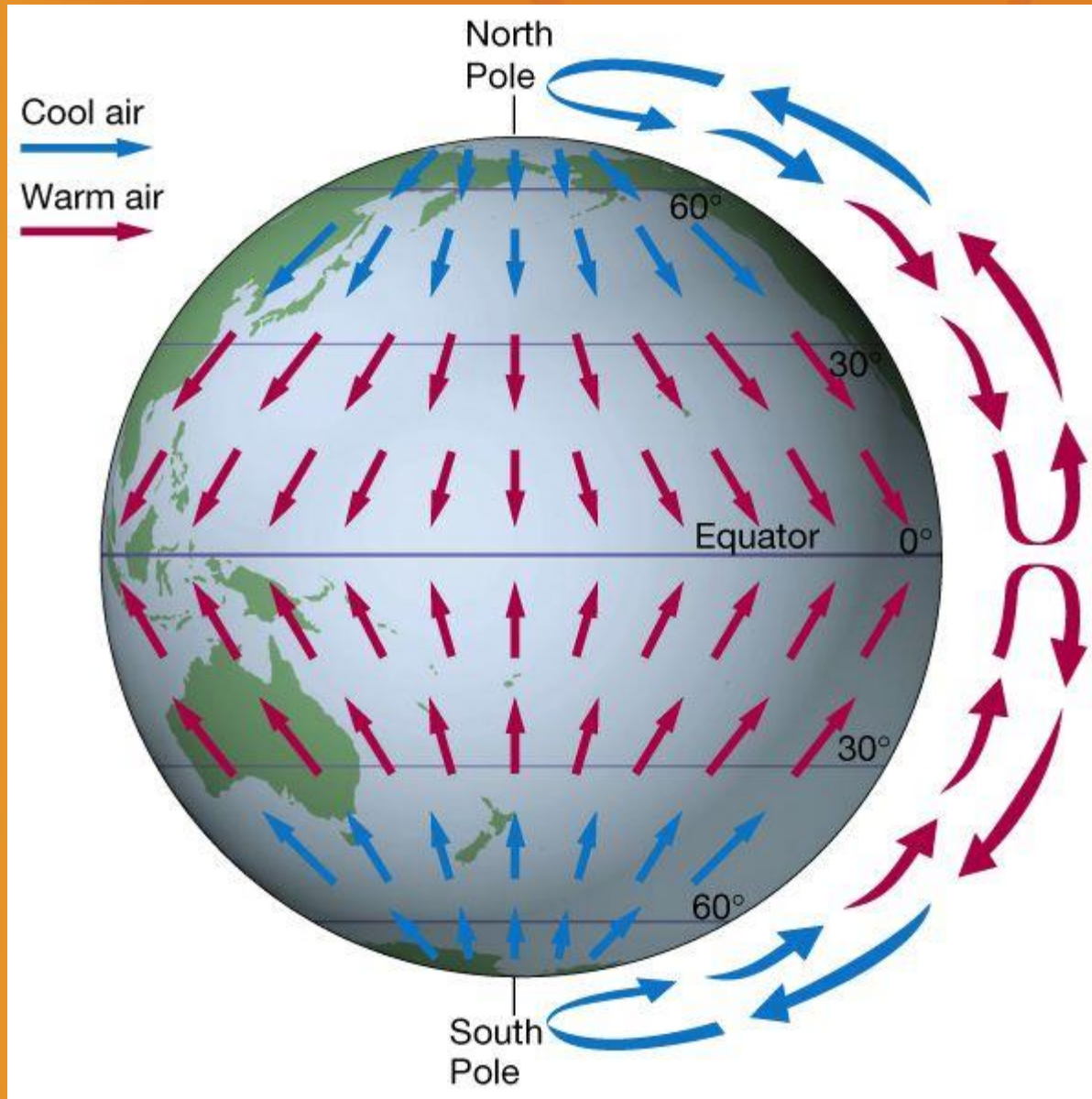


# Heat Movement & Density in the Atmosphere

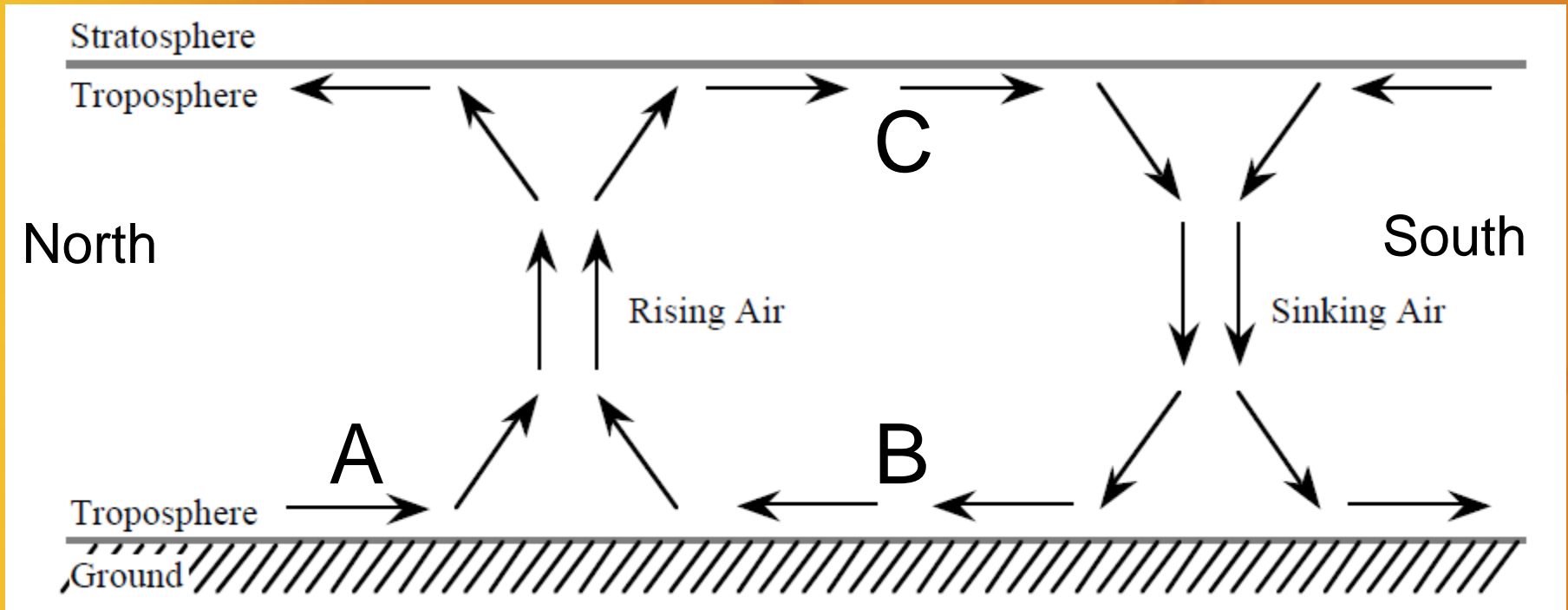
- Heating of Earth's surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents.



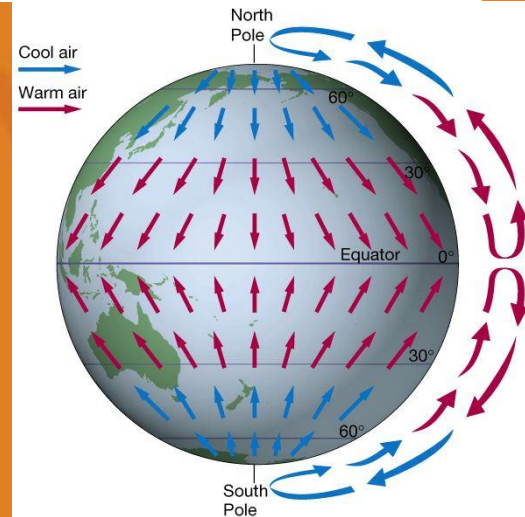
This would make sense, but it is an **INCORRECT MODEL**.



# Coriolis Effect activity



Which direction is the wind blowing at A?  
At B?  
At C?



# Coriolis Effect

