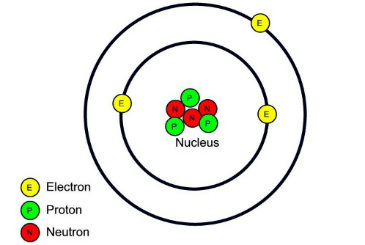
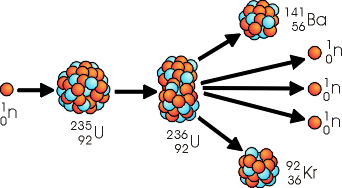
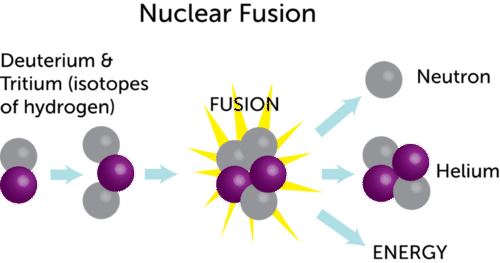
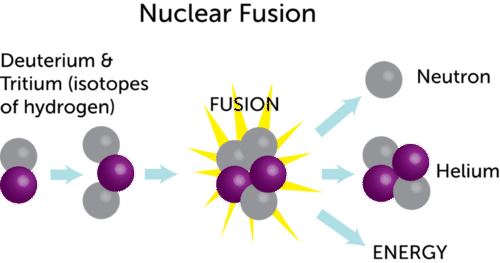
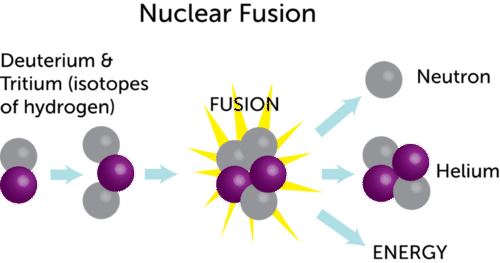
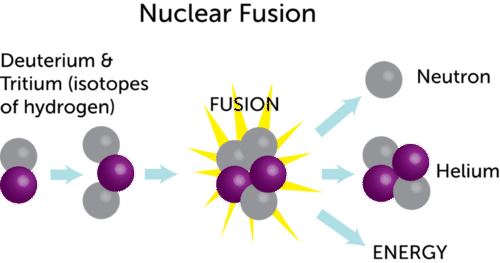
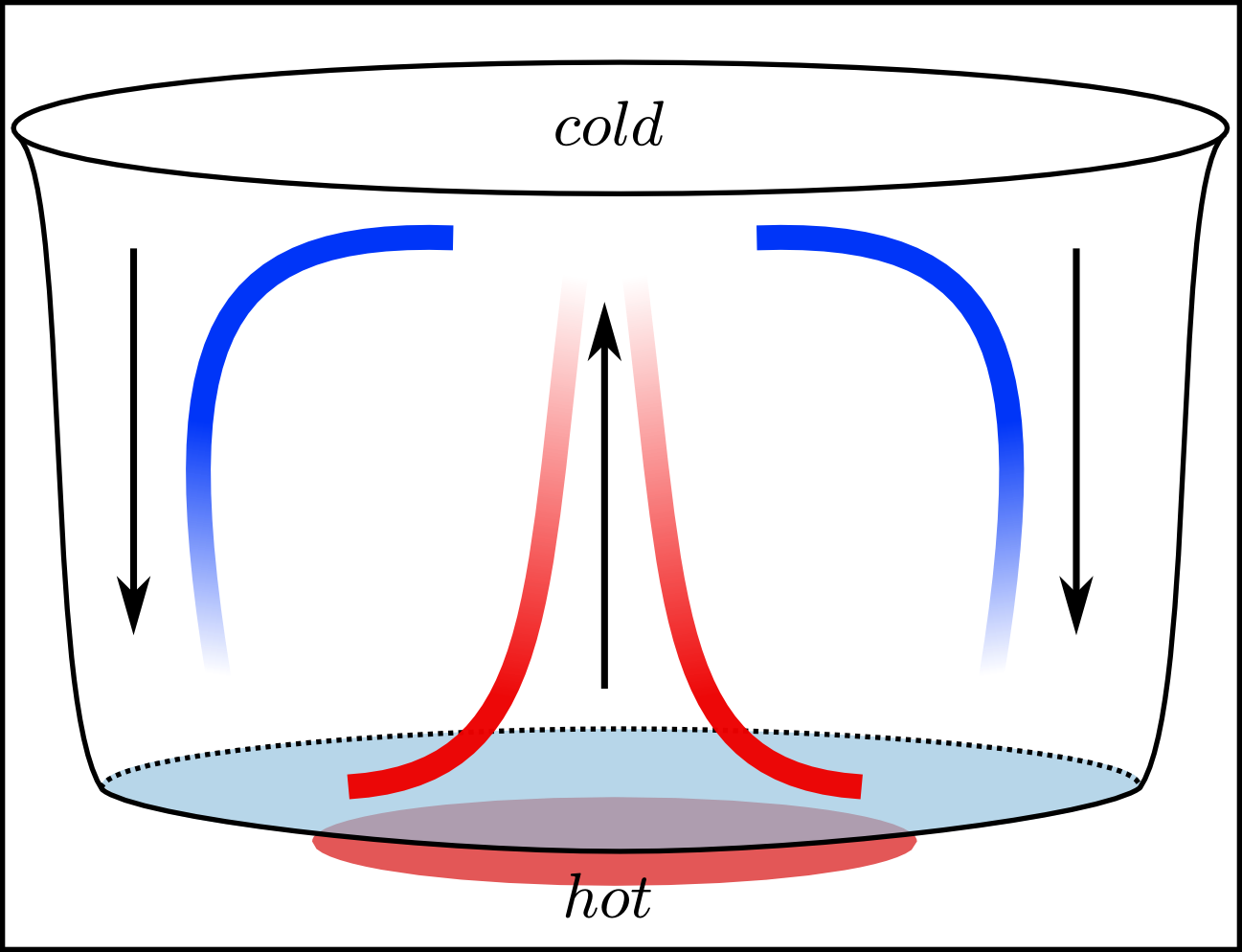
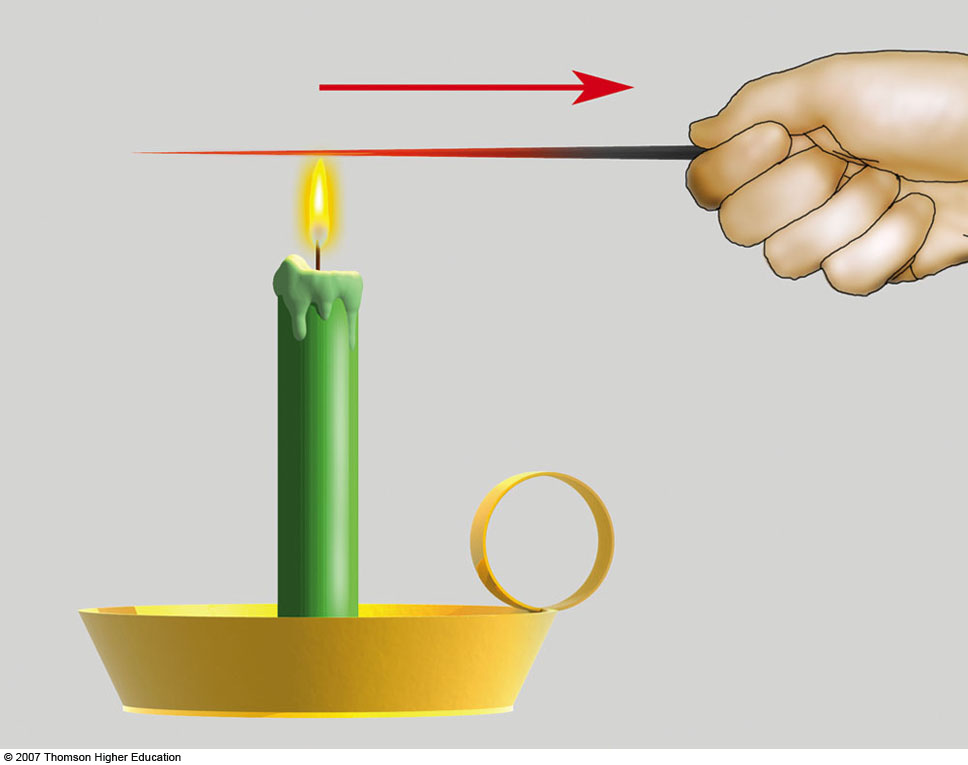
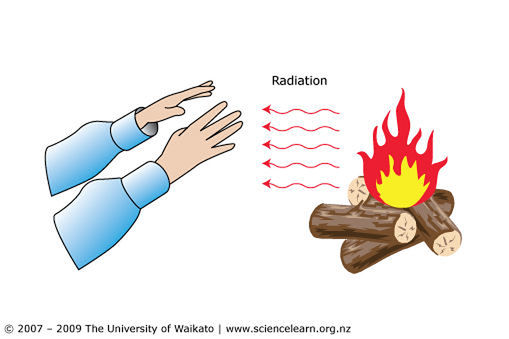
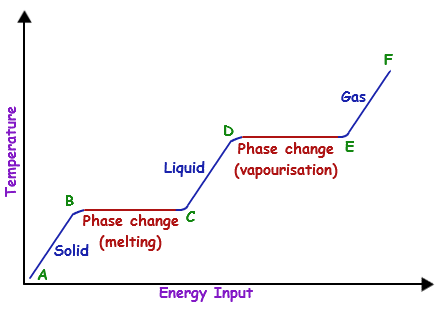
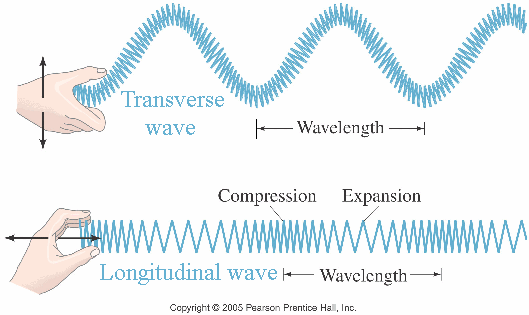
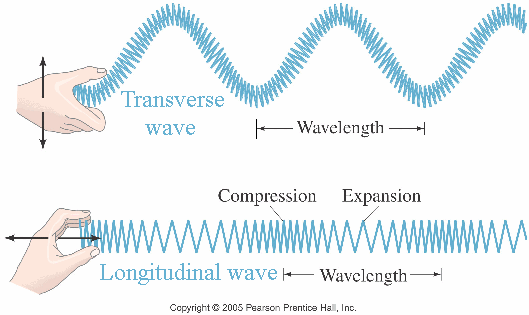
* Energy **Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Two main forms:
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Primary sources of energy:
    - Atomic/nuclear, Electromagnetic, Mechanical,

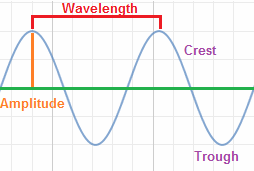
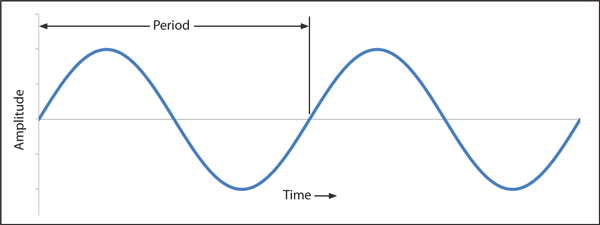
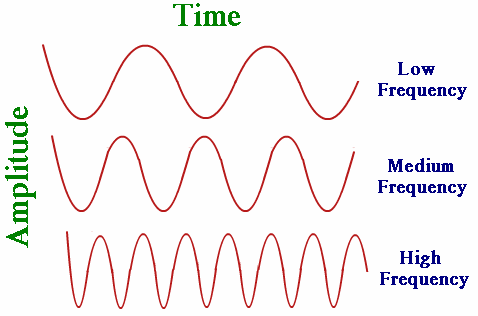
Electrical, Thermal, Gravitational

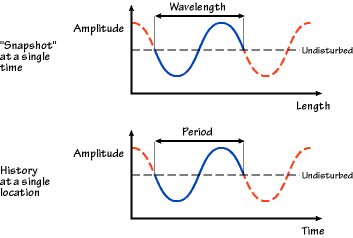
* + Energy is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Nuclear Forces
  + Atomic structure
    - Nucleus- center of atom
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are positively charged particles
      * Neutrons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or uncharged particles
    - Electrons
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged particles
      * Constantly moving and orbiting the nucleus
  + Similar forces repel each other
    - Think of what happens when you put positive ends of magnets together
    - So how do all of those protons stay packed together in the nucleus?
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cause protons to attract one another over a small distance
  + In a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nucleus, the nuclear forces are stronger than the repulsive forces
  + If a nucleus has too many protons or neutrons it becomes unstable
    - An unstable nucleus will undergo \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Nuclear decay is the release of particles from the nucleus of an atom in order to become more stable
    - As particles are released, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is also released
      * It takes energy to hold the nucleus together
* Nuclear Fission
  + Nuclear \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - splitting a large nuclei into smaller nuclei
    - This is done by firing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at the nucleus of a large atom
      * Destabilize the nuclear forces that hold together the nucleus
    - When the nucleus splits, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is released
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - when products of the initial reaction drive more reactions to occur
    - Can be controlled
    - Nuclear bomb makes use of uncontrolled chain reaction
  + Doesn’t require energy
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Easier to control
* Nuclear Fusion
  + Nuclear \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - combining small nuclei to form one larger nuclei

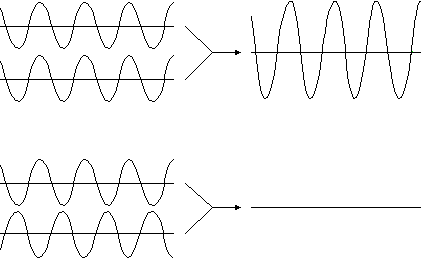


* + As nuclei form, large amounts of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are released
  + Requires a large amount of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to initiate the reaction
  + Nuclei are positively charged
  + Like forces repel, so energy is required to overcome those forces
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + In the sun, hydrogen atoms combine to form helium and release energy
  + Does not occur in chain reactions
  + Very \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - produces too much energy
* Pros of Nuclear Power
  + Fission produces the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for the least amount of fuel
    - 1 lb of Uranium produces as much energy as 3,000,000 lbs of coal
  + Uranium is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the Earth’s crust
  + Doesn’t produce any \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as a byproduct
    - CO2 is produced as the result of burning fossil fuels and is the cause of global warming
  + Doesn’t require storage (batteries) like wind and solar
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - takes up less land than wind or solar energy
* Cons of Nuclear Power
  + Accidents can lead to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Risk of terrorism and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Storage/disposal of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Radioactive waste has long half-life
  + High initial cost to build
  + Natural disasters can lead to contamination
    - Tsunami, earthquake, fire
  + Uranium’s half-life is 4.5 billion years
  + Products of Uranium and Plutonium fission have half-life of between 5 and 30 years
* Energy Transformations
  + Energy readily changes from one form to another
* Energy Transfer
  + Transfer of heat energy occurs in 3 ways:
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Recall from previous unit
    - Heat is the measure of average kinetic energy
    - More heat = more molecular movement = more energy
    - Solids have lowest energy, then liquids, then gases, with plasma having the most energy
* Conduction
  + - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- occurs between objects that are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - If you hold a wire hanger over a fire it will eventually heat the wire
    - The temperature at the end over the fire is higher
    - Atoms at that end heat up and vibrate
    - That causes collisions between other atoms and transfers that energy down the wire
    - This causes the heat to travel the length of the wire
  + Can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Convection
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- occurs due to the movement of warm fluid
    - As a fluid is heated, it expands and becomes less dense
    - This causes it to rise above colder, more dense fluids
    - You can feel the heat from a campfire
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - the cycle of heated fluids expanding, rising, cooling off and then sinking
* Radiation
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - energy that is transferred as electromagnetic waves
    - You can feel the heat from a campfire
    - This is because fire emits energy in the form of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * Infrared
      * ****Visible light
      * Ultraviolet light
* Conductors and Insulators
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - material that transfers energy as heat \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - material that transfers energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + How is energy transferred?
    - Through particle collisions
    - The tighter that particles are packed into a substance (density) the more chance those particles will collide
    - When they collide, energy is transferred
* Specific Heat
  + Specific heat- how much \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_it takes to change the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of an object
    - Raise temperature of 1kg by 1K
  + Formula
    - Energy = specific heat x mass x temperature change
    - ****Energy = cmΔT
* Phase Diagram
  + When energy is added to a system in the form of heat:
    - The temperature will increase OR
    - There will be a phase (or state) change
  + It is one or the other, never at the same time
    - The temperature does not increase during a phase change, only before and after
  + We can graph this data to create a phase diagram
* Work
  + What is the definition of energy?
    - The ability to move matter
    - Another definition is: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + What is work?
    - When a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_applied on an object causes it to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_in the same direction
    - Work is also the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * From potential to kinetic, mechanical to kinetic, one object to another, etc
    - Work = force x distance or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Calculating work
    - Work = force x distance
      * Force is measured in Newtons
      * Distance is measured in meters
      * What is work measured in?
        + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which are the same as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Power
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the measure of how much \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is done over a period of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Or, how much energy is transformed over time
  + Power = work / time or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Measured in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Takes 1W to do 1J of work in 1s
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Machines
  + Machines don’t change the amount of work you do
    - They make the same amount of work easier to do
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- make work \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by:
    - Changing the size of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Changing the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the force
    - Both
* Mechanical Advantage
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the output force and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Mechanical advantage 🡪 **output force = input distance**
  + **input force output distance**
  + Any machine that has a mechanical advantage more than \_\_\_\_\_ is reducing the amount of force you have to apply
* Waves
  + Wave- a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that carries \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ through \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - 2 types:
      * Electromagnetic: requires \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: requires a medium
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- the physical environment the wave travels through
    - Air, water, any type of matter
* Wave Movement
  + Transverse wave
    - Particles in the medium move perpendicularly to the direction the wave is traveling
      * Both mechanical and electromagnetic waves can move this way

****

* + Longitudinal wave
    - Particles of the medium vibrate parallel to the direction of wave motion
      * Only mechanical waves can move like this
* Mechanical Waves
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- requires a medium, transfers energy through matter
    - Most waves are mechanical waves
* Electromagnetic Waves
  + Electromagnetic wave- changing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fields in space
    - Don’t require medium because they don’t move matter
    - This is why light and heat from the sun can travel to Earth
    - Travels through open space
  + Includes:
    - Visible light, not visible light, radio waves
* Energy and Waves
  + As wave travels, the energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Same thing happens with sound
    - Standing right next to a speaker, sound appears louder
    - Standing further away it sounds softer
      * Because the further you get from the source of the energy (speaker), the more spread out the energy becomes
* Properties of Waves
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- the point in the wave where it is the furthest from the rest position
    - The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ peaks
  + Wavelength (λ)- the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Tell you information about energy
    - Higher amplitude = higher energy
    - Shorter wavelength = higher energy
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ it takes for a complete wave (or cycle) to occur
    - How long it takes for the wave to get back to it’s starting point
    - What’s the difference between wavelength and period?
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - the number of waves produced over a set time
    - Measured in Hertz (Hz)
    - High frequency = high \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Calculations
    - Frequency (f) = 1 / period (T) 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Wave speed
      * speed = distance / time
      * ****wave speed = wavelength / period 🡪 **v = λ / T**



* + - * wave speed = frequency X wavelength 🡪 **v = f x λ**
* Wave Interactions
  + Reflection
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- when light, sound, or heat hits a surface that it cannot pass through
      * The bounding back of a wave when it meets a surface or boundary
  + Diffractions
    - Diffraction- a change in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a wave due to an obstacle or edge
    - The amount of diffraction depends on the wavelength and on the barrier
      * Larger wavelength = more diffraction
      * Larger opening = less diffraction
  + Refraction
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- bending of a wave as it passes from one medium to another
      * Ex: a pencil in a glass of water
  + Interference
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- the combination of two or more waves to create a new wave
    - Two types:
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ interference- increases \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ interference- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ amplitude
* Speed of Waves
  + Sound travels at \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or about 764 mph
    - Sound travels very fast, so you don’t usually notice the sound delay
  + Light travels at 299,792,458 m/s or about 6.7 x 108 mph
    - Light travels so fast, you can’t notice a delay
* Speed of Sound
  + Sound travels faster through \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - More \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, more closely packed particles
    - Small vibrations are more quickly transferred to neighboring particles
  + Sound travels a bit slower through \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Less dense, particles not as close together
  + Sound travels slowest through \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Less dense
* Doppler Effect
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- the observable change in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of a wave when the source or observer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_