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# ***Energy Storage & Transmission***

*By*



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*Lecture (2)*  
*25– 02 - 2019*



# Syllabus

1

- Introduction to energy resources.

2

- Energy Conversion.

3

- Transmission & Distribution & Consumption.

4

- Units of Energy and Power and Important Constants.

6

- Conservation of Energy and energy conversion techniques.

7

- Electricity generation, transmission and storage.

## Cont.

8

- Energy consumption; Domestic and industrial.

9

- Case studies.

10

- Introduction to green energy policy and climate change mitigation.

11

- Renewable energy systems; wind power, hydro power, solar, biomass, and biofuel, geothermal.

12

- Case studies of major installations.

13

- Economics and politics of renewable energy systems.

14

- Structure, design, efficiency of electrical transmission grids.

## Cont.

15

- Power electronics and their application in energy storage and conversion.

16

- Integrated approach for the storage and transmission of energy.

17

- Efficiency trade-off analysis of such systems.



# *Conversion of Energy*

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# Forms of Energy



**Mechanical Energy**



**Electrical Energy**



**Light Energy**



**Thermal Energy**



**Sound Energy**



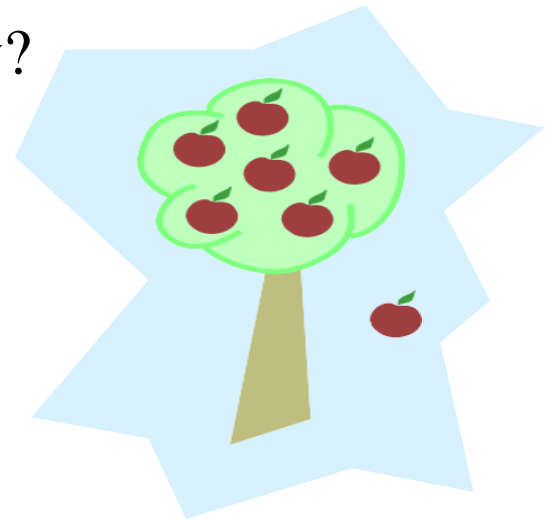
# 1. Mechanical Energy

- The energy of movement. This energy includes both kinetic energy (motion) and potential (stored) energy.
- Mechanical energy is due to the position and motion of the object.
- What happens to the mechanical energy of an apple as it falls from a tree?



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- As the apple falls to the ground, its height decreases. Therefore, its Potential Energy decreases.
- The potential energy is not lost... it is converted into kinetic energy as the velocity of the apple increases.
- What happens to the mechanical energy?



## 2. Kinetic Energy

- It's the energy an object has due to motion

### Example

- A moving bowling ball has energy that causes the pins to fall .
- This energy is called kinetic energy.



**The sky diver has kinetic energy**



**A ball kicked by a football player has a kinetic energy**

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# Mass, Speed and Kinetic Energy

- All moving objects have kinetic energy.
- Not all moving objects have the same amount of kinetic energy.
- The amount of kinetic energy an object has depends on the mass and the speed of the object.
- Kinetic energy also depends on speed. The faster object has more speed and has more kinetic energy.

- Imagine those two rocks are rolling down the hillside with the same speed.
- Which one will have more kinetic energy?
- Which one will cause more damage if they hit something at the bottom?
  
- The larger rock could cause more damage because it has larger mass and has more kinetic energy than the smaller rock



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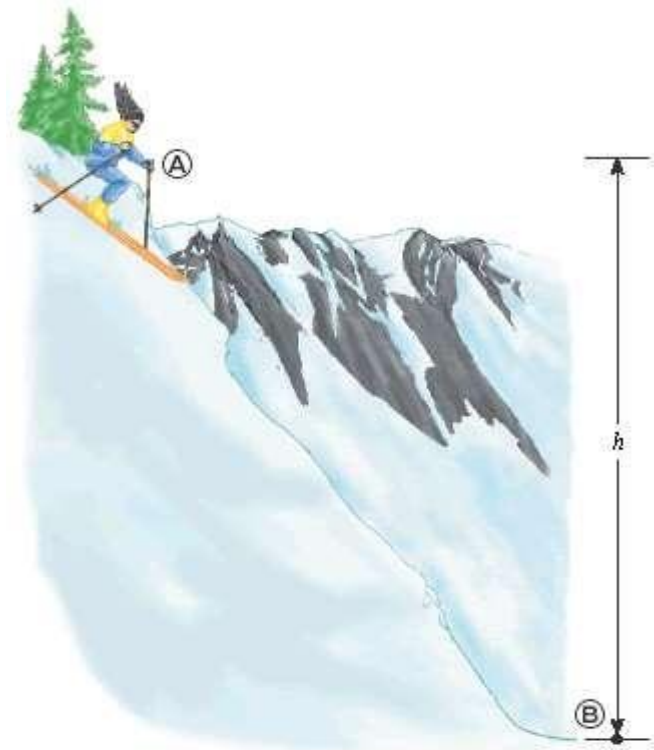
# Transferring kinetic energy

- Kinetic energy could be transferred from one object to another when they collide.
- The bowling ball does not touch all the pins but it can knock them down with one roll.
- The bowling ball transfer the kinetic energy to few pins.
- The pins will transfer this kinetic energy to each other and knock them down.



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- Gravity pulls the skater down the hill.
- If the skater was standing at the bottom of the hill, gravity wouldn't start her moving.
- When the skater is at the top of the hill, she has a form of energy called **Potential energy**.

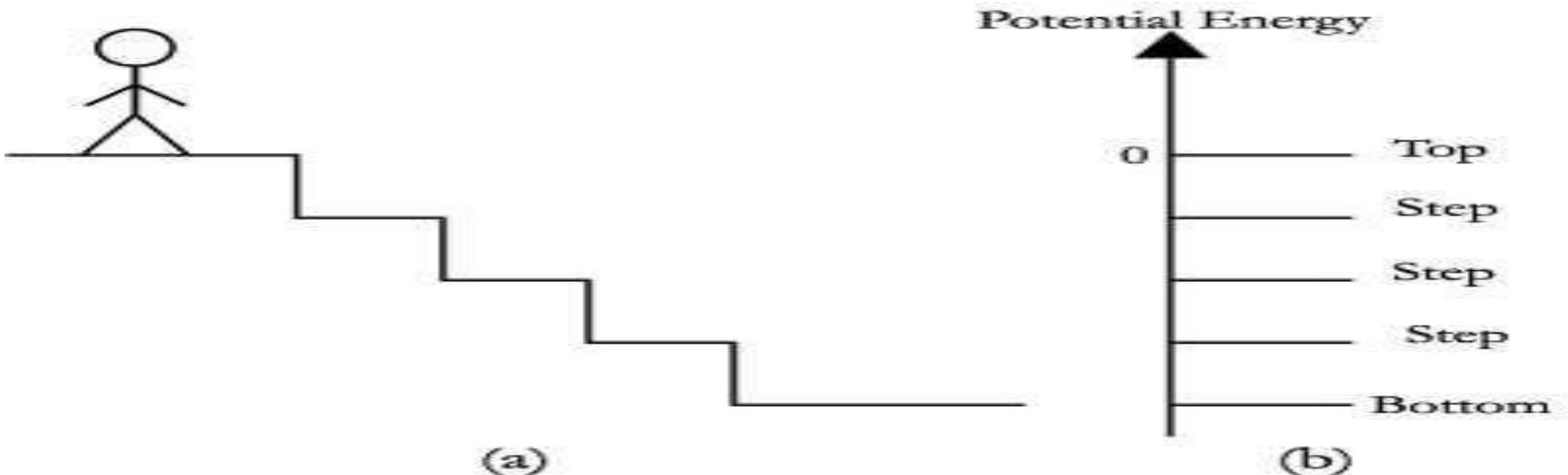


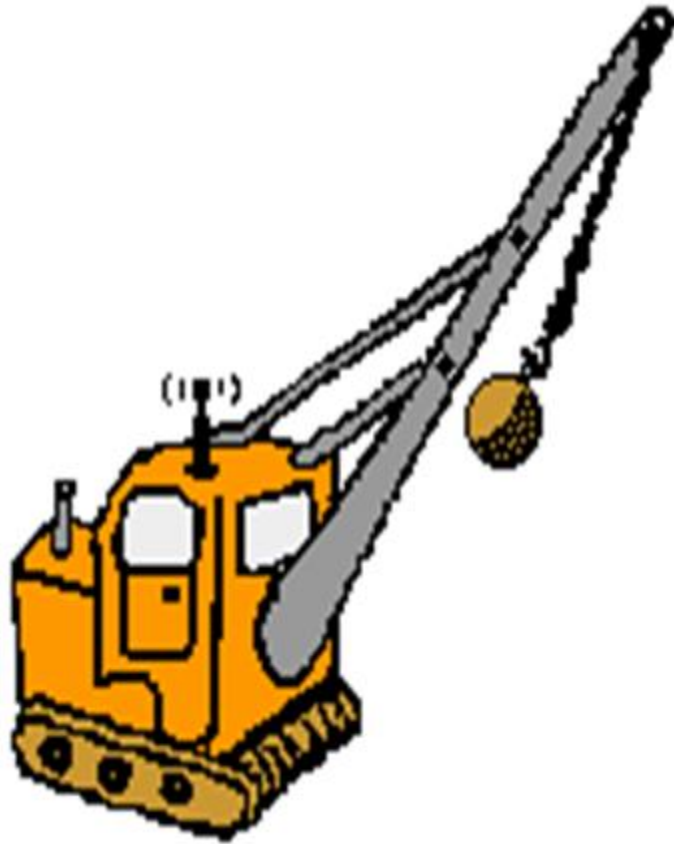
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# 3. Potential Energy

- It's the energy that is stored because of an object's position.
- The Higher an object is lifted above earth, the greater is it's potential energy.

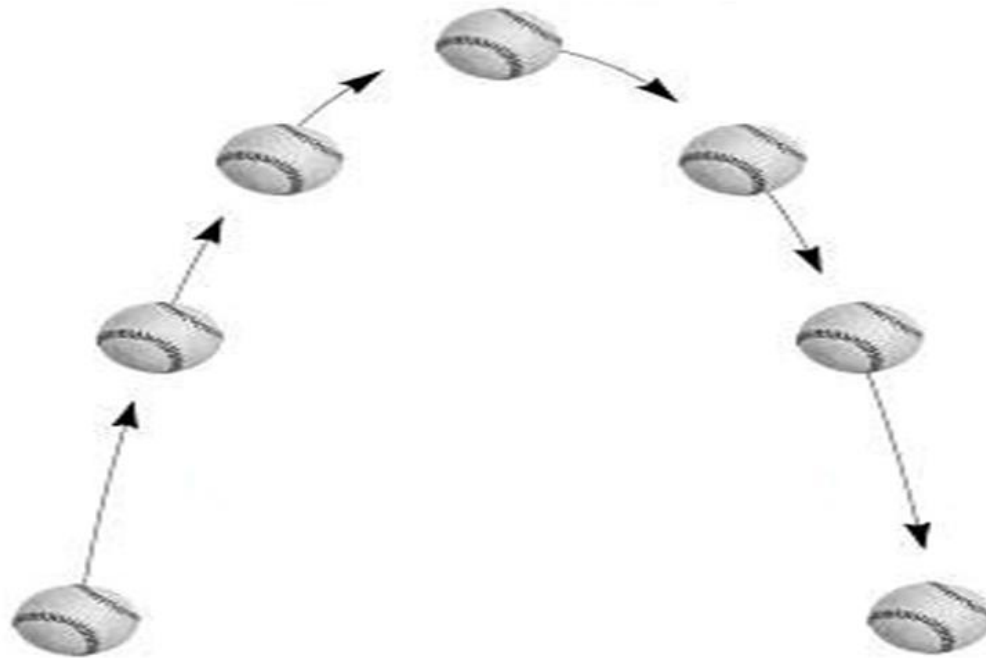




The massive ball of a demolition machine and the stretched bow possesses stored energy of position – potential energy.

# Converting potential and kinetic energy

**Max potential energy, Min kinetic energy**



**Max kinetic energy, Min potential energy**

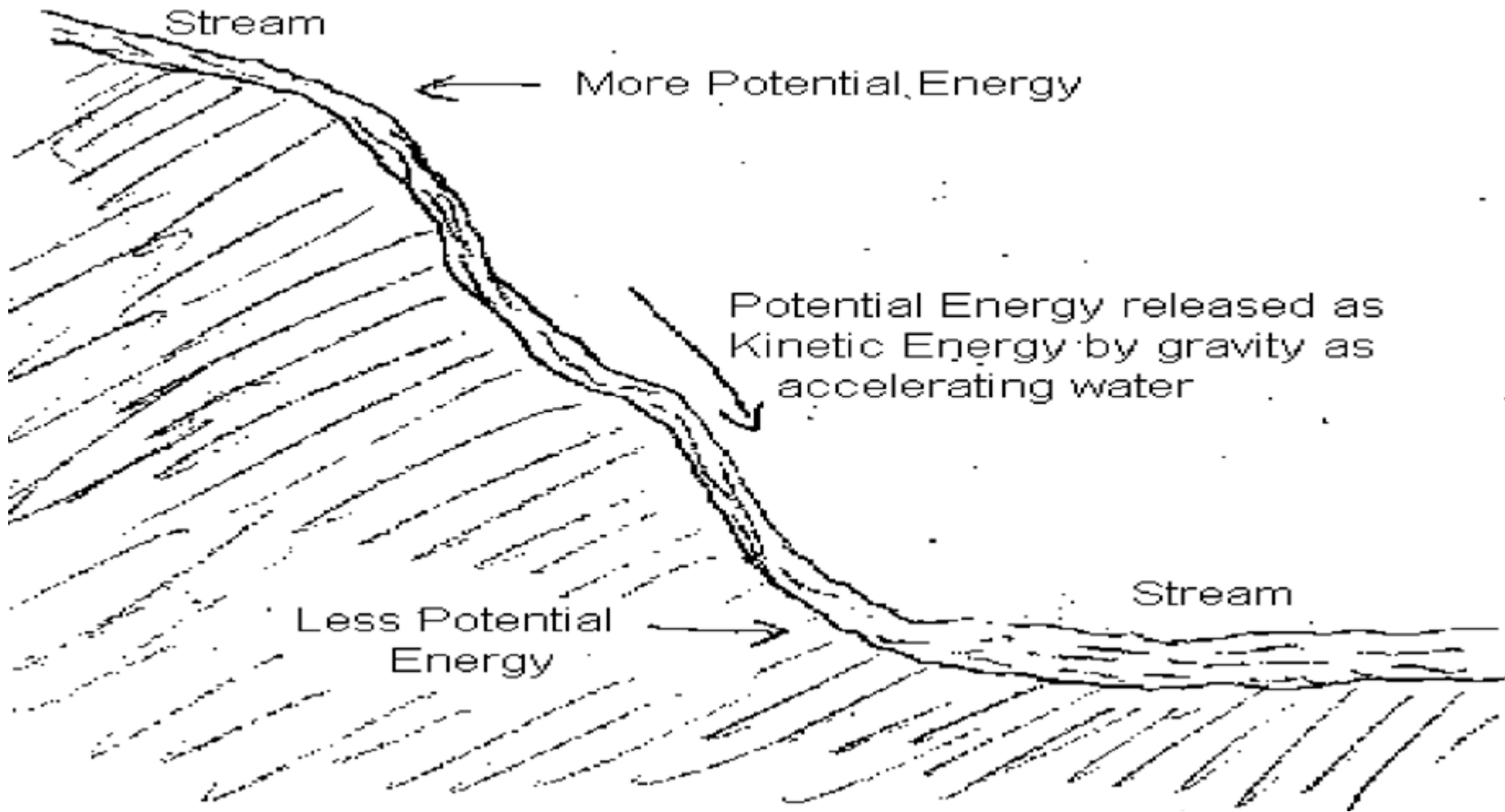
Potential energy = Maximum  
Kinetic energy = Minimum



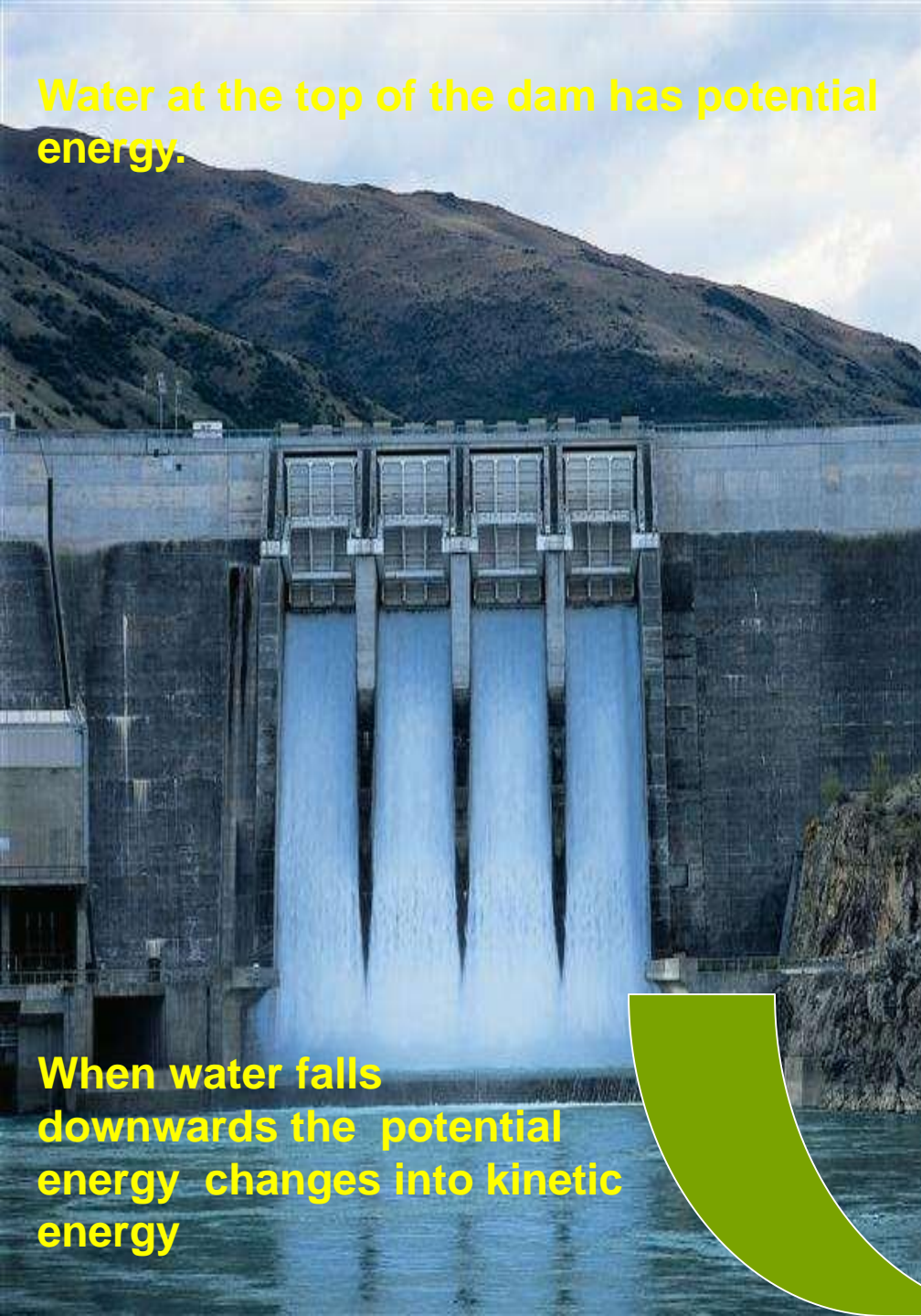
Potential energy = Minimum  
Kinetic Energy = Maximum



# Energy changes in falling water



**Water at the top of the dam has potential energy.**



**When water falls downwards the potential energy changes into kinetic energy**



**The kinetic energy in the moving water spins the generators and that'll produce electrical energy**

# KE & PE

- In many situations, there is a conversion between potential and kinetic energy.
- The total amount of potential and kinetic energy in a system is called the mechanical energy

$$\text{Mechanical energy} = \text{PE} + \text{KE}$$

- The mechanical energy does not change because the loss in potential energy is simply transferred into kinetic energy.
- The energy in the system remains constant!!

# 4. Electrical Energy

- A form of energy that is produced when electrons move from one place to another place.
- Electrical energy is the movement of electrons. Lightning and static electricity are examples of electrical energy that occur naturally. Science hasn't found a way to use natural forms of electrical energy, like lightning.
- Instead, we use different energy sources to create electrical energy by using generators and turbines

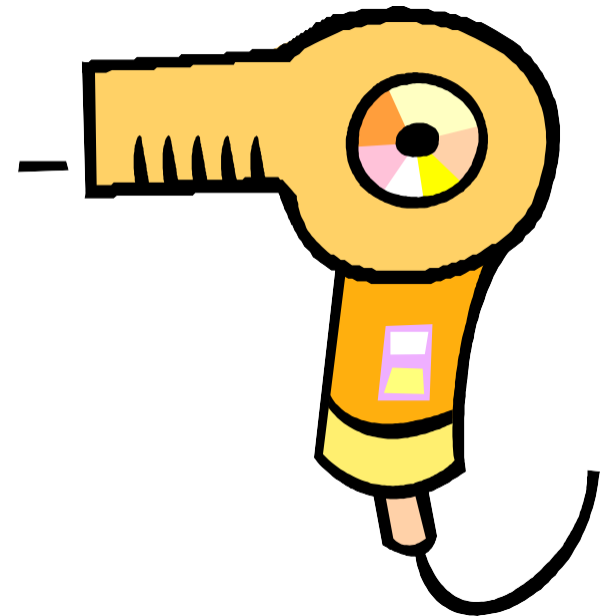
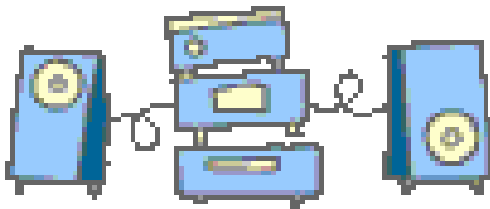


# 5. Nuclear Energy

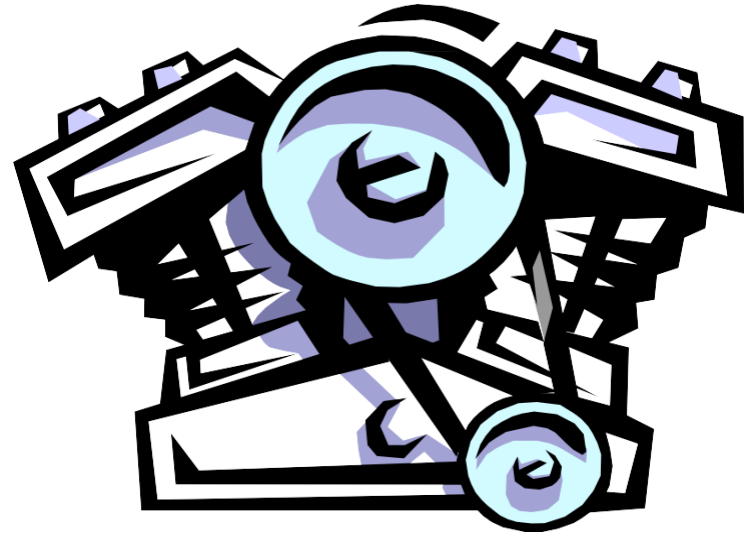
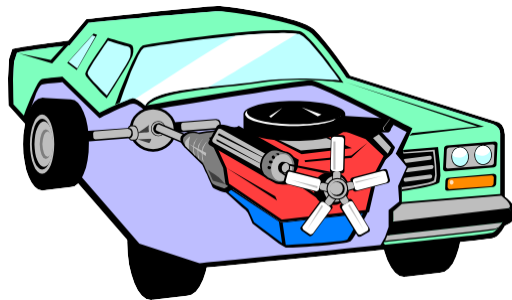
- **Nuclear energy** is the energy stored in the nucleus of an atom.
- Nuclear energy is unusual in that it can give off energy in the form of light or heat, but it is the change in the atom's makeup that produces the energy. Submarines, power plants, and smoke detectors all use nuclear energy.
- Nuclear power plants use uranium, a radioactive element, to create electricity.

# Changing Forms of Energy

- Energy is most noticeable as it transforms from one type to another.
- What are some examples of transforming electrical energy?
  1. A lightbulb
  2. A hair dryer



- An example of transforming chemical energy is a car engine.
- Chemical potential energy in gasoline is transformed into kinetic energy of the car as it moves!!



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# 6. Magnetic Energy

- **Magnetic energy** is the attraction of objects made of iron. Medical equipment, compass, refrigerator magnets are all examples of magnetic energy.
- Any type of energy source that uses a generator in the process to make electricity uses magnetic energy.

## 7. Light Energy

- A form of energy that travels in waves and can move through empty space where there is no air.

# 8. Thermal Energy

- The energy of moving particles in a substance; also called heat energy.
- Thermal energy is the internal energy in substances-the vibration and movement of atoms and molecules within substance.
- Thermal energy is created in the movement of atoms.
- Boiling water, burning wood, and rubbing your hands together really fast are all examples of heat energy. Geothermal and passive solar are sources of heat energy, but biomass (a type of chemical energy) can be burned to produce heat energy.

# 9. Sound Energy

- A form of energy produced by vibrating objects.
- Sound energy is the movement molecules in the air that produces vibrations. Alarms, music, speech, ultrasound medical equipment all use sound energy.
- The electrical energy records the sound using magnetic tape. Speakers read the magnetic tape and change it back into sound.

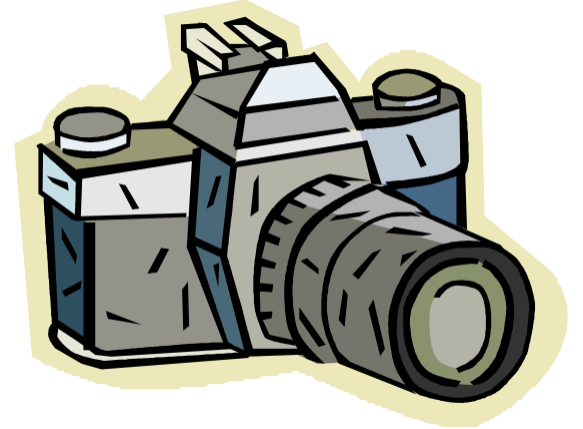
# 10. Chemical Energy

- Chemical energy is the energy stored in the bonds of atoms and molecules. This is a form of potential energy until the bonds are broken.
- Fossil fuels and biomass store chemical energy. Products that contain chemical energy include: baking soda, and a match.
- Biomass, petroleum, natural gas, propane and coal are examples of stored chemical energy.



# The Law of Conservation of Energy

- The Law of Conservation of Energy states that energy cannot be **created** or **destroyed**.
- The big picture... the total energy in the universe remains constant.



# Energy in your body

- Even the energy converted in your body follows the law of conservation of energy.
- Chemical potential energy is transferred to kinetic energy that allows your body to move!!



Energy is transformed... not destroyed!!

The total amount of Energy stays the same