SPEED VS. VELOCITY
both describe motion

- **SPEED** – how much time it takes for an object to move or change position
- **Speed = $\frac{\text{Distance (d)}}{\text{Time (t)}}$**

- **VELOCITY** – How quickly an object moves or changes direction WITH REFERENCE TO A PARTICULAR DIRECTION (up/down, north/south)
- **Velocity = $\frac{\text{Distance(d)}}{\text{Time (t)}}$ (in a specific direction)**

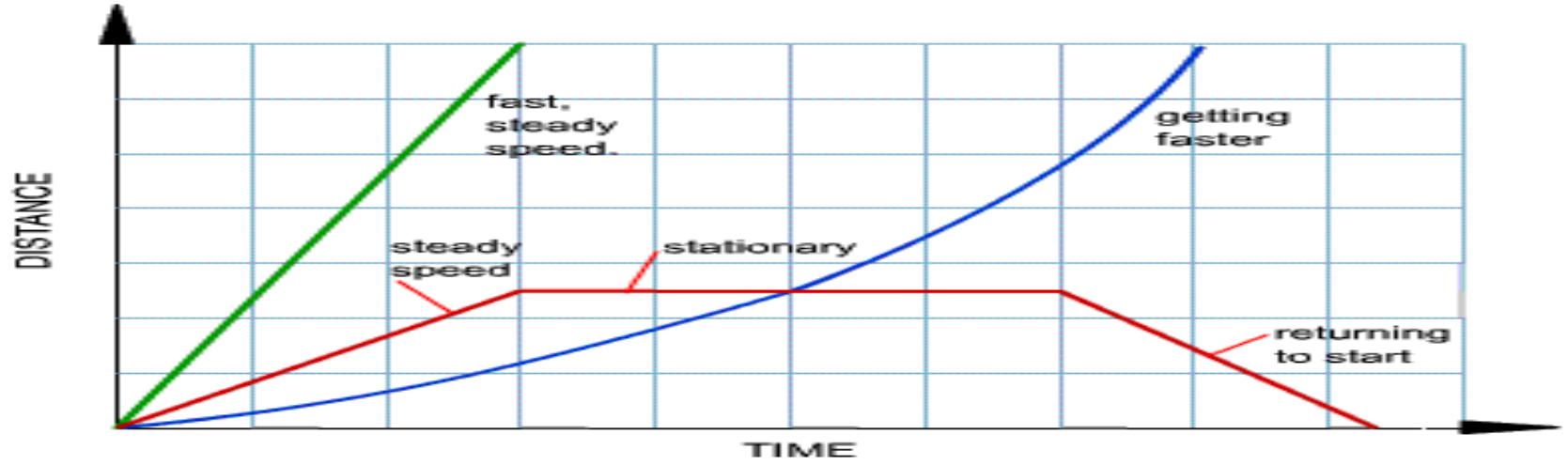
- **Both use units like**
  - Distance = cm, m, km
  - Time = sec, min, hours, years

SPEED VS. VELOCITY

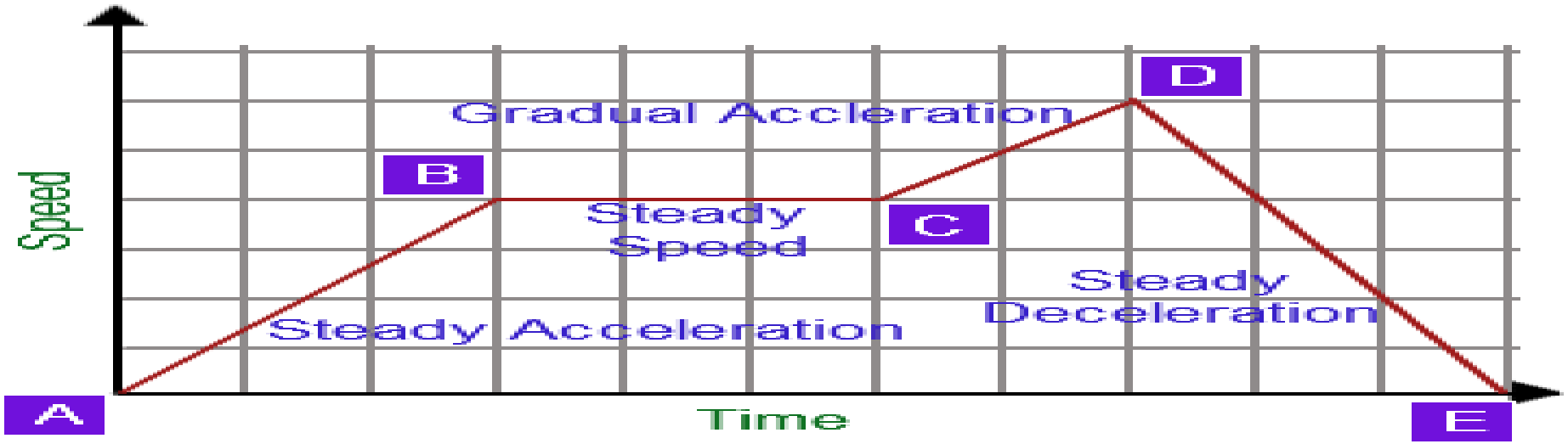
- Let's try a problem…
  - Calculate the average speed (in meters/sec) if a golf cart runs 140 meters in 10 seconds
    - First….remember the formula **Speed = d/t**
    - Substitute what you know into the formula
      - Speed = 140m/10s
    - Solve the problem
      - Speed = 14 m/s (don't forget your UNITS!)

Distance/time graphs vs. speed/time graphs

*A **distance-time graph** shows the speed of an object*

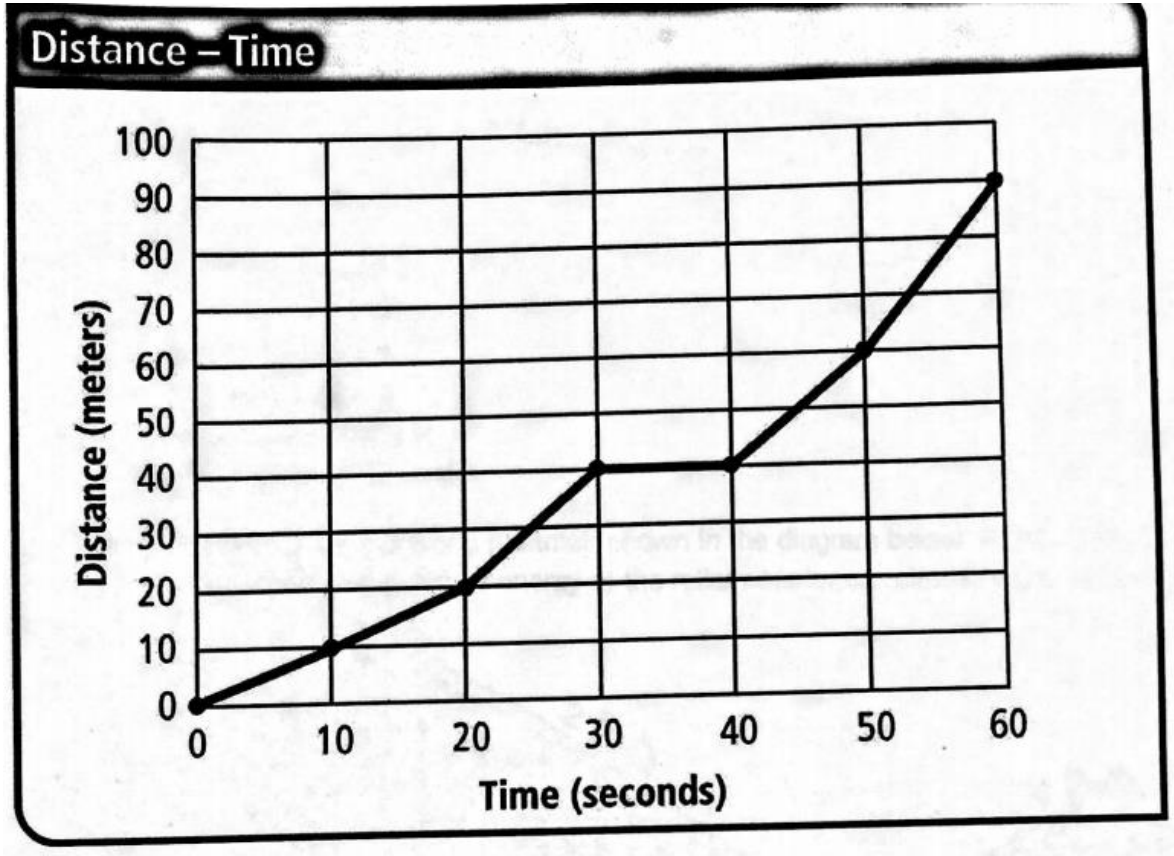


*A **speed-time graph** shows how an object's speed changes over time.*

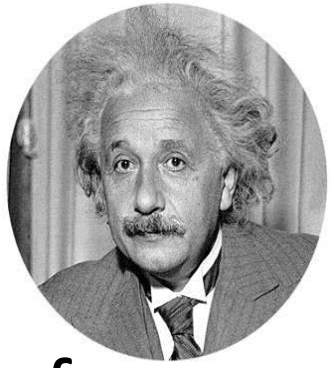


A family took a trip in a car traveling East from Raleigh to Wilminton, NC

1. What is the average speed of the trip? Speed = d/t
    1. **Speed = 90m/60s**
    2. **Speed = 1.5 m/s**
2. Between what times did the car stop?
    1. **Between 30-40 seconds**
3. Between what time intervals did the car move the fastest?
    1. **Between 50 – 60 seconds**



The Law of Conservation of Energy



- **ENERGY** is a crucial part of the never-ending cycle of change
- Defined as **THE ABILITY TO DO WORK**
- Found in many **FORMS**
- Classified as **POTENTIAL** OR **KINETIC**
- Amount in universe is **CONSTANT**
- **ALBERT EINSTEIN** studied energy

The Law of Conservation of Energy states…

- **Energy is *neither created nor destroyed*.**
  - **Energy can change forms and be transferred from one object or organism to another**

Real World Examples

POTENTIAL → KINETIC

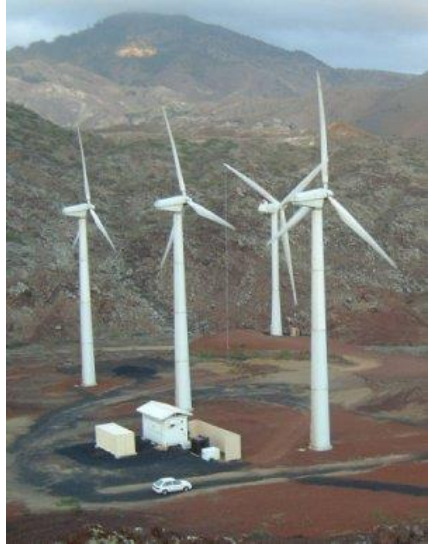
- The potential energy of gasoline becomes kinetic energy when the engine of a car burns the gasoline

- **KINETIC → POTENTIAL**
- The kinetic energy of wind can be used to make electricity, which can be stored in a battery as potential energy

Is energy lost?

- NO…The Law of Conservation of Energy says something different.
- Energy isn't "lost"
  - When energy is transferred, some of the energy isn't useful for work, so not all of the energy is used
    - Most often the "lost" energy is heat energy
- The better term to use is **inefficient**

Energy



Potential vs. Kinetic Energy

POTENTIAL

- Defined as **STORED ENERGY**
- Many different forms…
- Gravitational energy is **POTENTIAL ENERGY THAT AN OBJECT HAS** because of its **POSITION** relative to the ground
- (Example) slide…
- Elastic Energy (example)…
  - **Rubber band (unstretched has no PE; the tighter you pull, the more elastic energy you have**
- Other forms of potential energy are…
- **CHEMICAL ENERGY**
- **THERMAL ENERGY**
- **ELECTRICAL ENERGY**
- **NUCLEAR ENERGY**

KINETIC

- Defined as **ENERGY OF MOTION**
- Many different forms…
- **RADIANT ENERGY** (light energy)
- **THERMAL ENERGY** (heat)
- **ELECTRICAL ENERGY**
- **SOUND ENERGY**

TYPES OF ENERGY

MECHANICAL ENERGY

- Work is done when **A FORCE ACTS ON AN OBJECT TO CAUSE IT TO MOVE, CHANGE SHAPE, DISPLACE, OR DO SOMETHING PHYSICAL**
- (example) – *pushing a door open for your dog to walk in. Work is done on the door for it to open*
- Define as the sum of **POTENTIAL** AND **KINETIC** energy in an **OBJECT** that is used to do **WORK**.
- For work to be done, an object has to supply a **FORCE** for another object to be **DISPLACED**

SOUND ENERGY

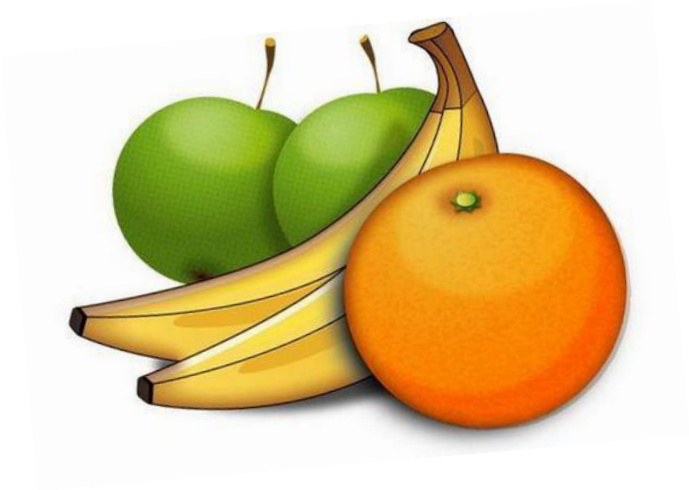
- Defined as the **MOVEMENT** of energy through **SUBSTANCES IN LONGITUDINAL WAVES**
- Produced when a **FORCE** causes an object or substance to **VIBRATE**

THERMAL (HEAT) ENERGY

- Defined as **THE ENERGY THAT COMES FROM THE TEMPERATURE OF MATTER**
- The hotter the substance, the **HIGHER ITS THERMAL ENERGY**

CHEMICAL ENERGY

- Defined as energy **STORED IN THE BONDS OF CHEMICAL COMPOUNDS**
- Released in a **CHEMICAL REACTION**
- Examples – **BATTERIES, PETROLEUM, FOOD**

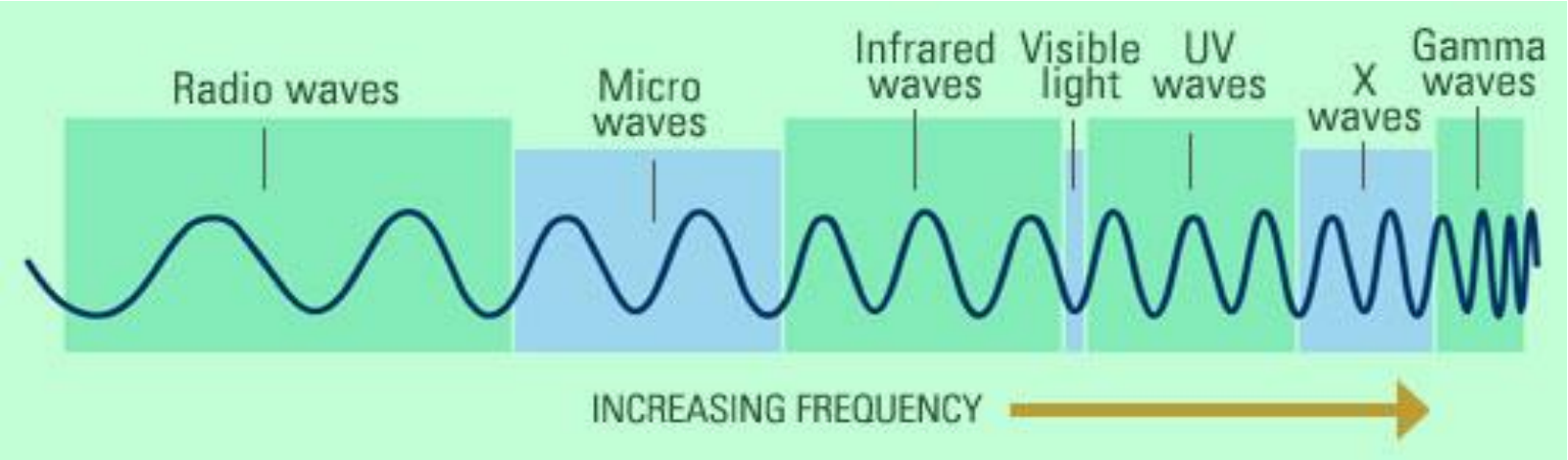


ELECTRICAL ENERGY

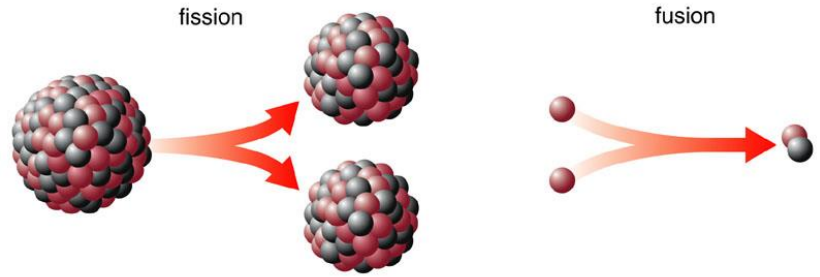
- Matter is made up of **ATOMS** and smaller things called **ELECTRONS** (that **ARE CONSTANTLY MOVING**)
- Generate this energy when cause ELECTRONS to move from one **ATOM** to **THE OTHER**

RADIANT (LIGHT) ENERGY

- Energy of **ELECTROMAGNETIC WAVES**
- Can travel through **SPACE**



NUCLEAR ENERGY



- Energy in the **NUCLEUS** of an **ATOM**
- Energy is **RELEASED** when **BONDS ARE BROKEN**
- Released through nuclear **FUSION** and **FISSION**
- Fission =
  - **ATOMS SPLIT APART TO FORM SMALLER ATOMS**

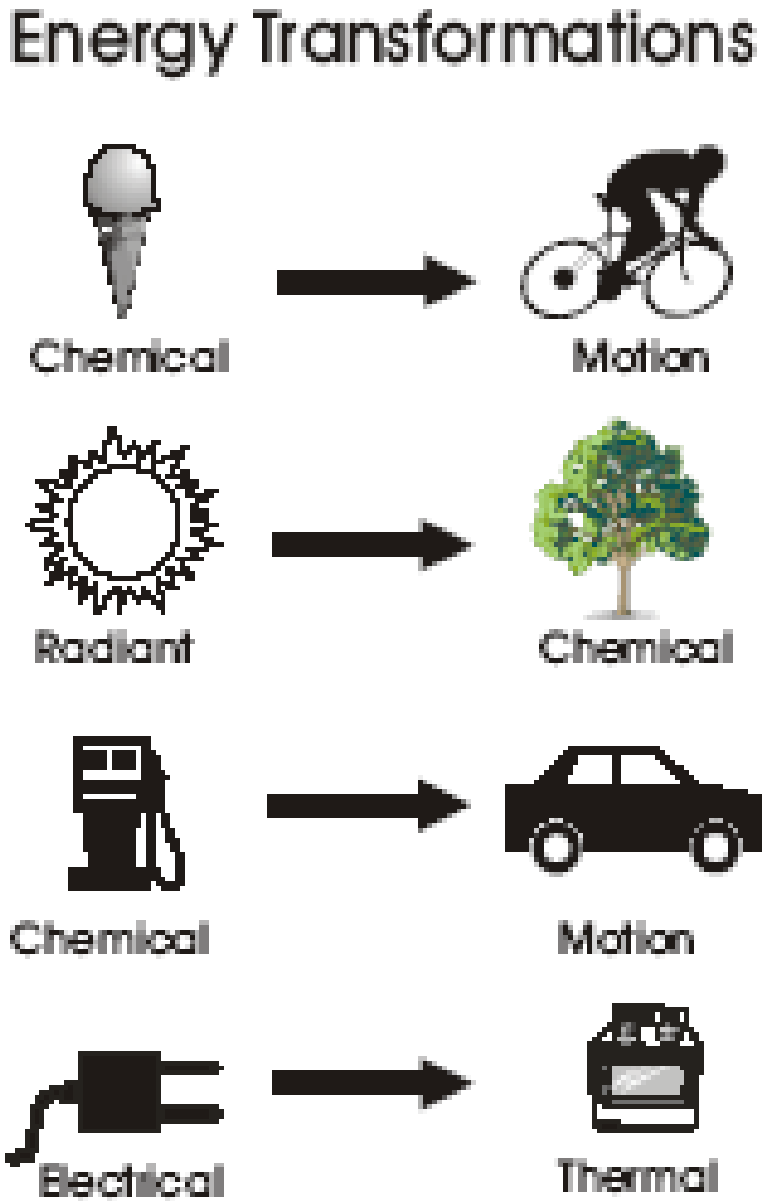
Fusion =

- **ATOMS COMBINE TO FORM LARGER ATOMS**

RENEWABLE (GREEN) ENERGY

- **NEVER** runs out
- In 2012, **20%** of energy consumed in the USA was renewable
- Examples of “green” energy
- **BIOMASS**
- **WIND**
- **HYDRO-POWER**
- **GEOTHERMAL**
- **SOLAR**

Energy Transformations & Conservation



Question for you…

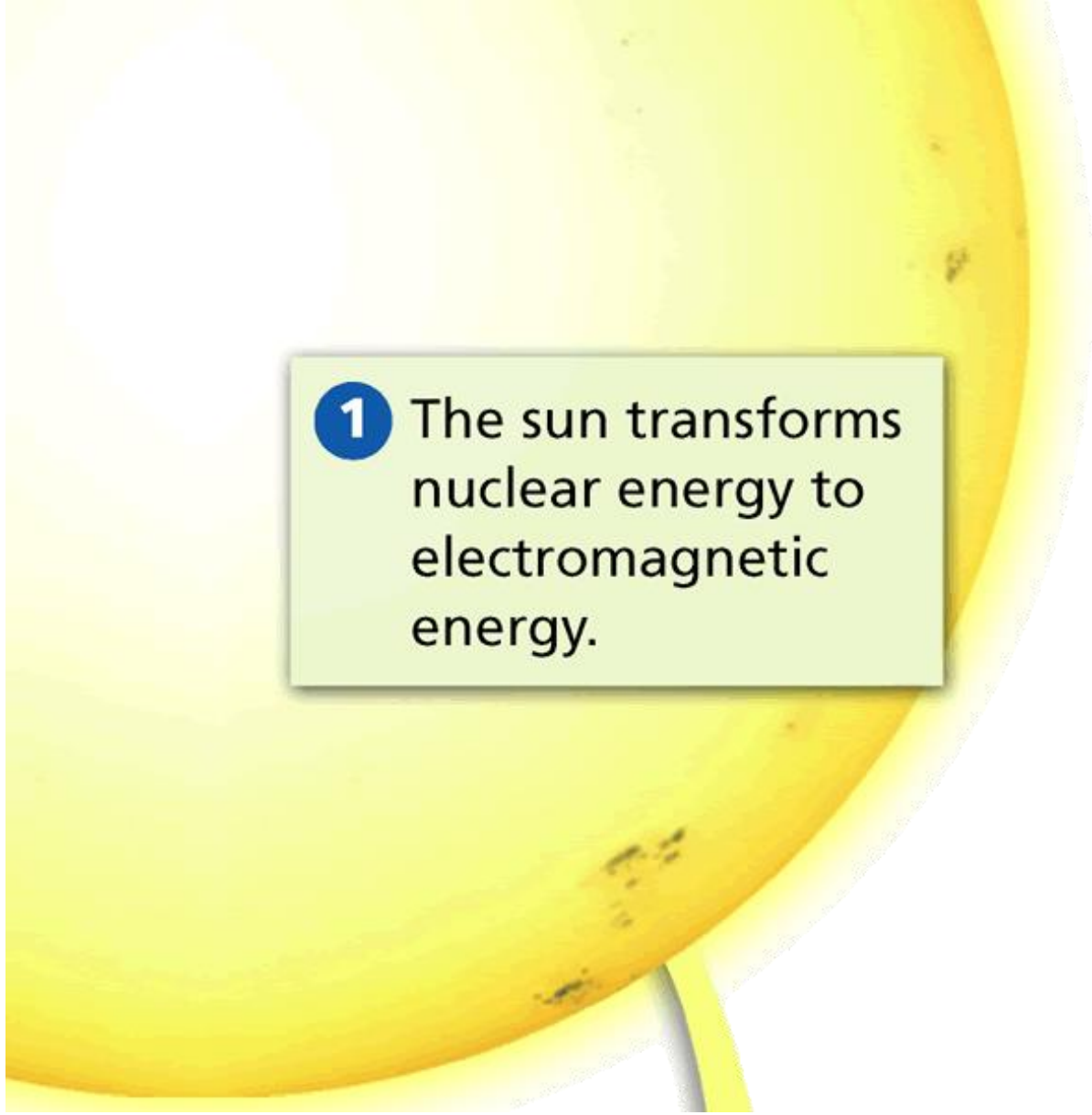
- What does flowing water have to do w/ electricity?
  - Moving water can be transformed into electrical energy
- **Most forms of energy can be transformed into other forms (energy transformation)**

Single Transformation

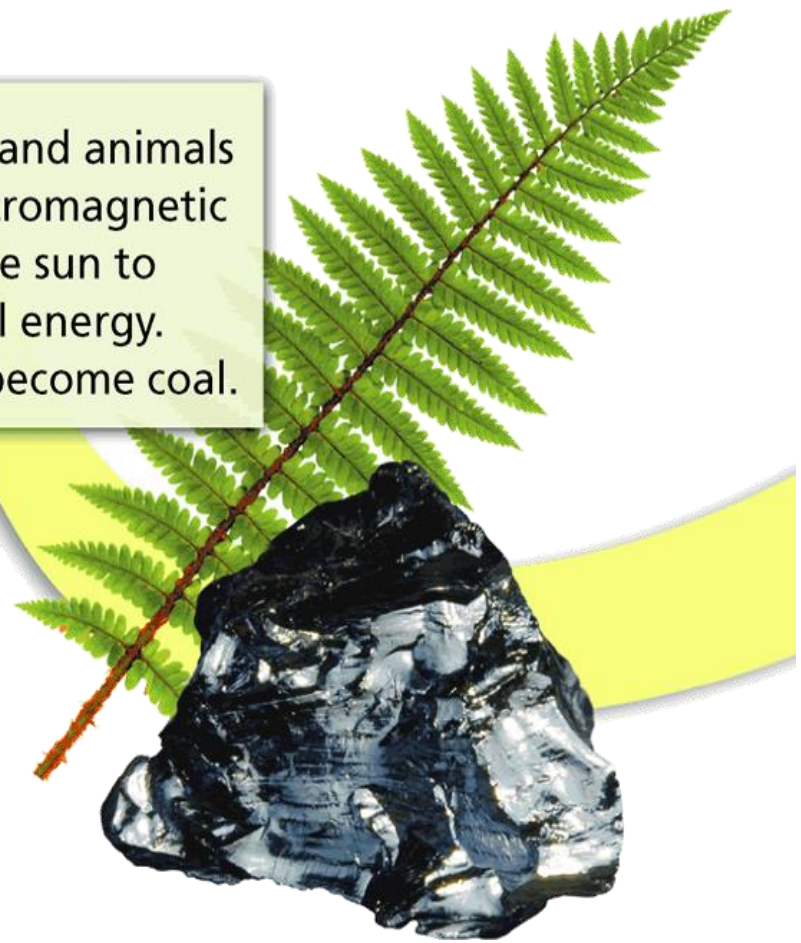
- When one form of energy needs to be transformed into another to get work done
  - Examples
    - … toaster transforms electrical energy to thermal energy to toast bread
    - Cell phone transforms electrical energy to electromagnetic energy that travels to other phones

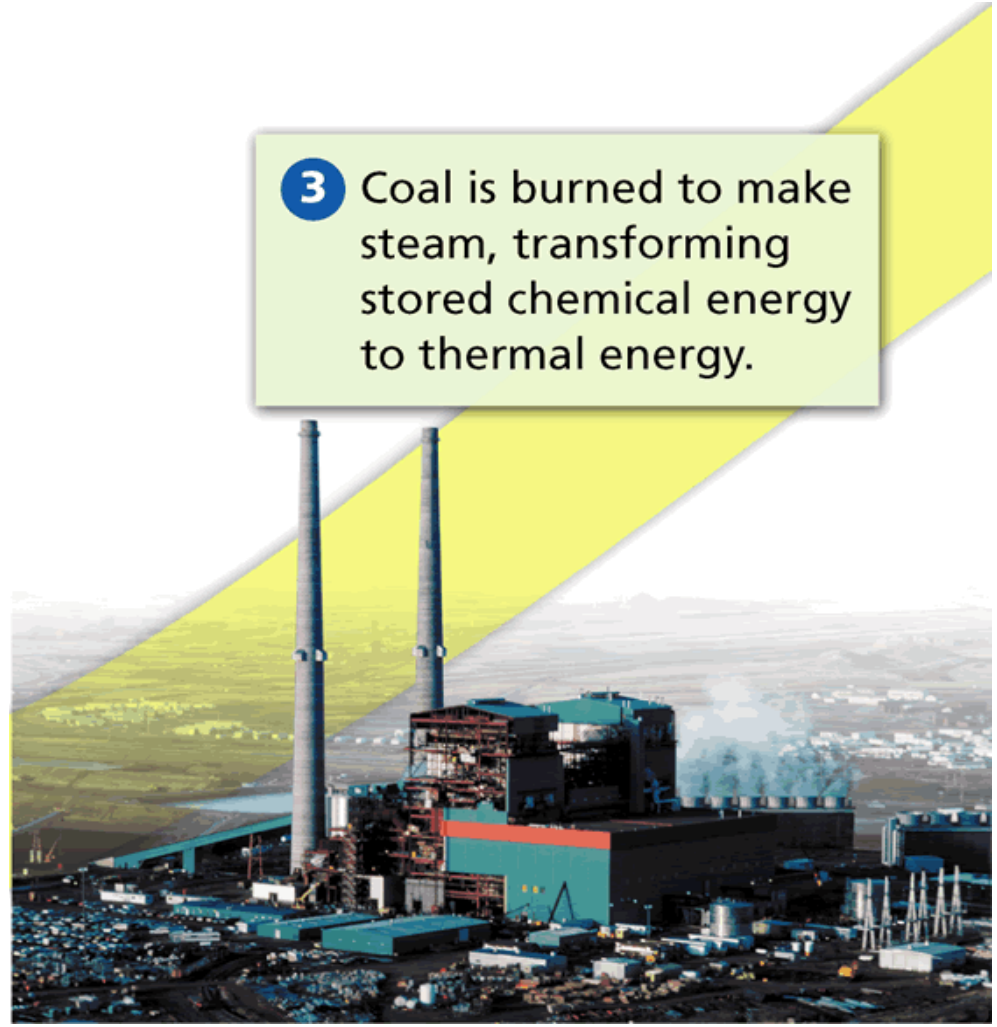
Multiple Transformations

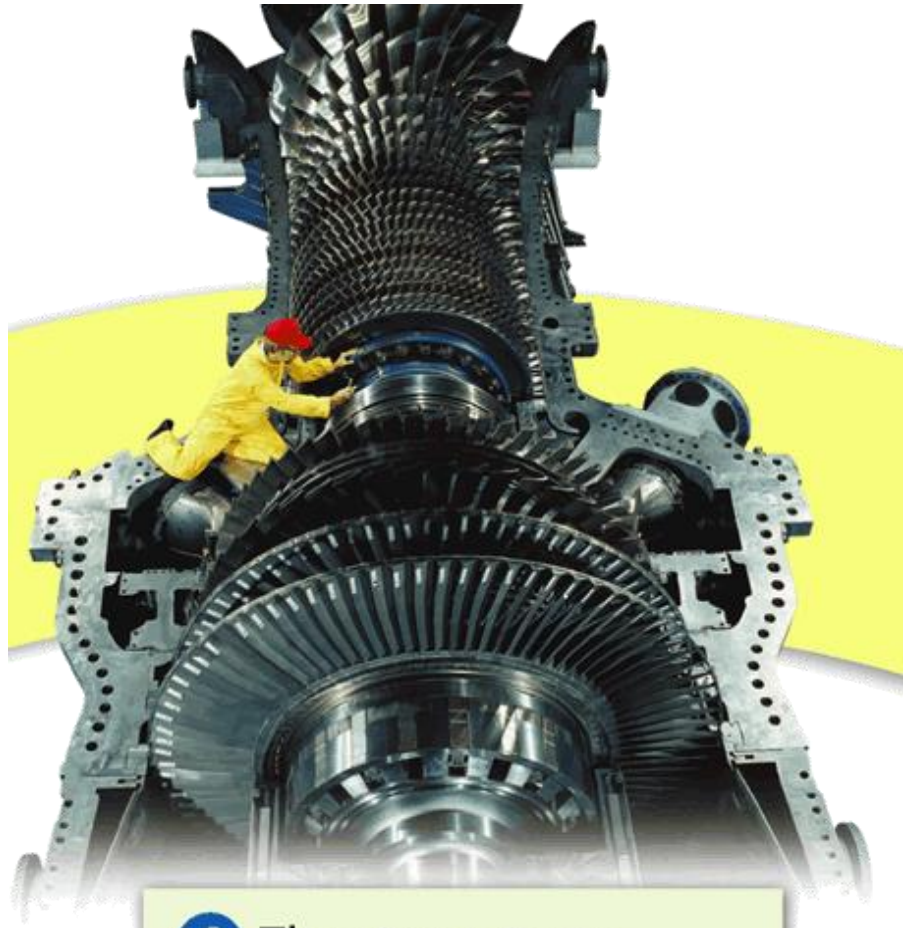
- When a series of energy transformations are needed to do work
- Example… car engine
  - **Electrical** energy produces spark. **Thermal** energy of spark releases **chemical** energy in fuel. Fuel's **chemical** energy becomes **thermal** energy. **Thermal** energy changed to **mechanical** energy used to move car and **electrical** energy to produce more sparks


1 The sun transforms nuclear energy to electromagnetic energy.

2 Ancient plants and animals transform electromagnetic energy from the sun to stored chemical energy. Their remains become coal.




3 Coal is burned to make steam, transforming stored chemical energy to thermal energy.



4 The steam turns turbines, transforming thermal energy to mechanical energy.

5 The turbines spin electric generators, transforming mechanical energy to electrical energy.

6 Your hair dryer transforms electrical energy to thermal energy.