I know the relationship between speed, distance and time

- Speed is how fast an object travels.
- The units of measurements include miles per hours (mph), kilometres per hour (km/h) and metres per second (m/s)
- We measure speed by finding the distance an object travels in one unit of time.
- To calculate speed we divide the distance travelled by the time taken.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

I know the relationship between speed, distance and time

For example

A car takes 2 hours to travel 46 miles in heavy traffic.

The average speed is

$$\frac{46 \text{ miles}}{2 \text{ hours}} = 23 \text{ mph}$$

At times, the car may be travelling faster than this.
At other times it may be travelling more slowly.

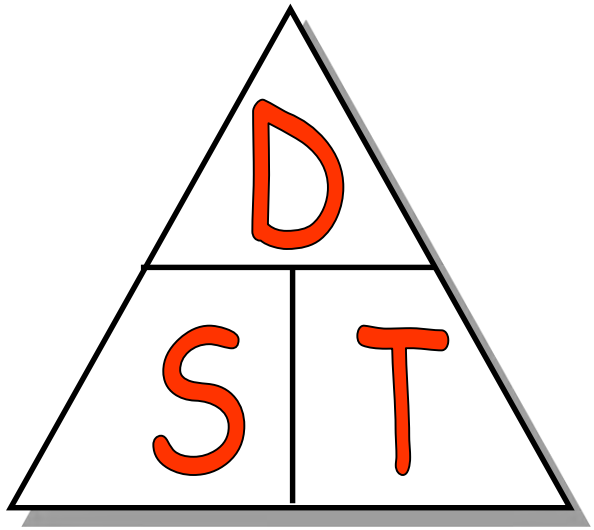
These changes give an average speed of 23 mph.

I know the relationship between speed, distance and time

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Time Taken} = \frac{\text{Distance}}{\text{Speed}}$$



I know the relationship between speed, distance and time

The distance from London to Leeds is 190 miles.
A train takes 2 hours and 15 minutes to travel from London to Leeds.

Calculate the average speed of the train.

Task

So, what is the average speed of the train. What is difficult about this question?

Gwaith Dosbarth

Forces

Balanced and Unbalanced

Learning Objectives

- That unbalanced forces change speed and / or direction.
- That balanced forces produce no change in the movement of an object

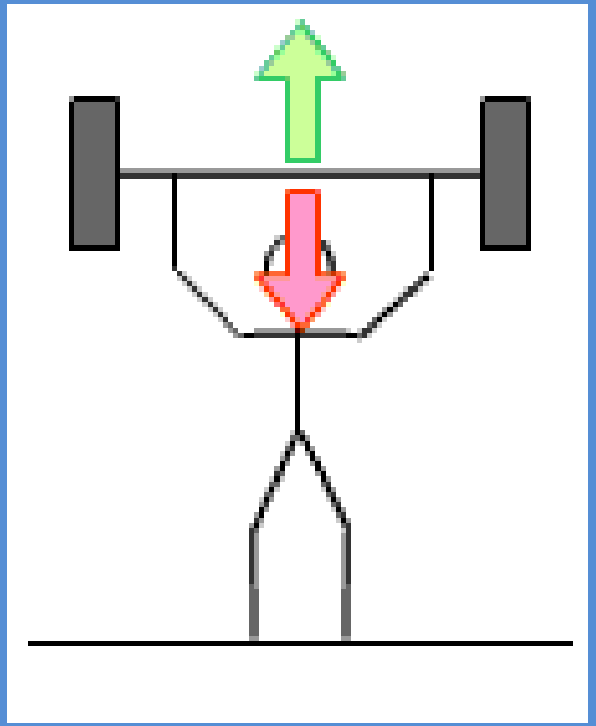
Starter Activity

1. How are these pictures different?
2. Will their movement be the same?
3. Describe the movement of cyclists A & B.

http://balanced and unbalanced forces

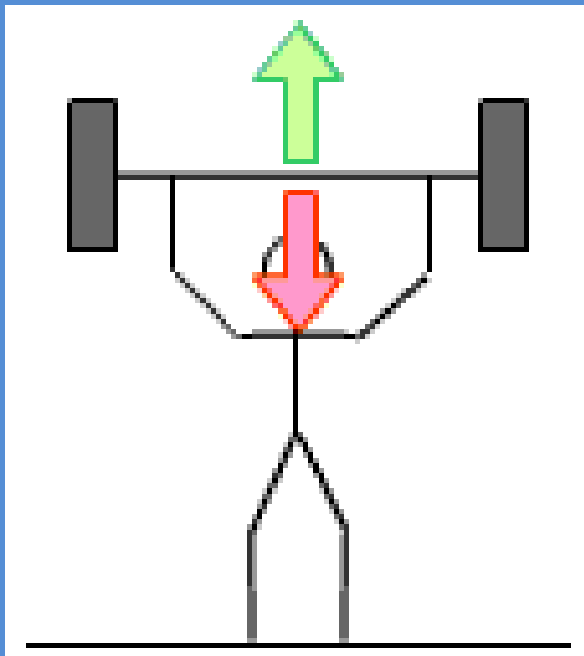
How to draw force diagram

- Use a ruler and pencil
- The size of arrow shows the size of the force.
- The direction of the arrow shows the direction of the force.



Balanced Forces

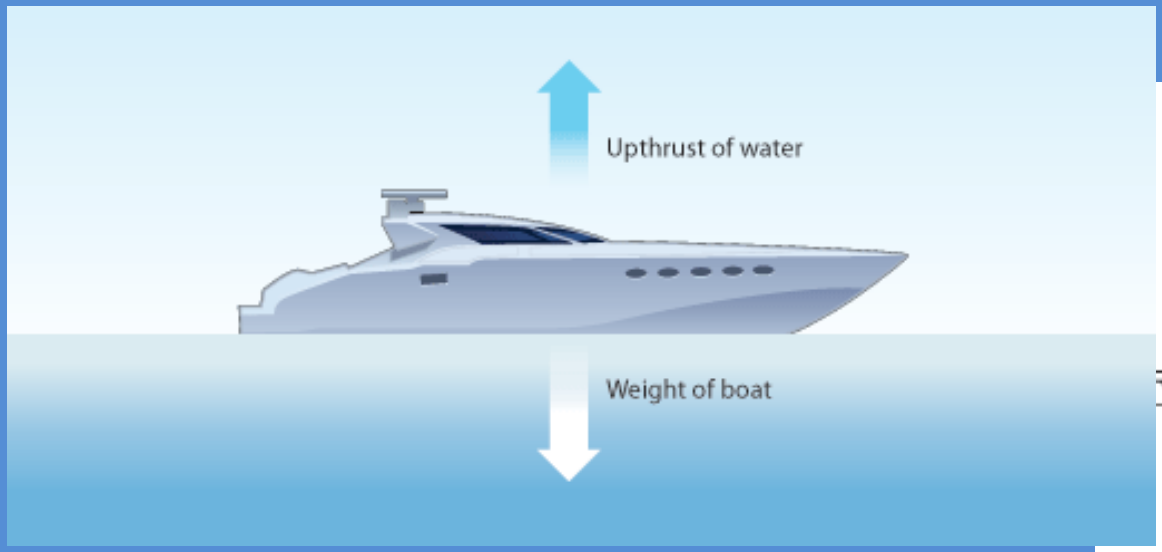
When two forces acting on an object are equal in size but act in opposite directions, we say that they are **balanced** forces.

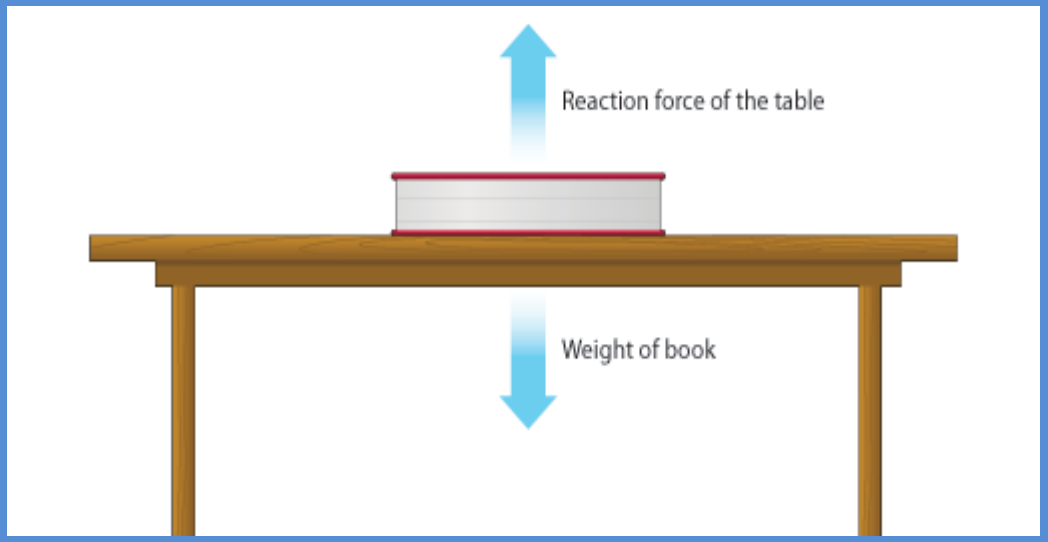


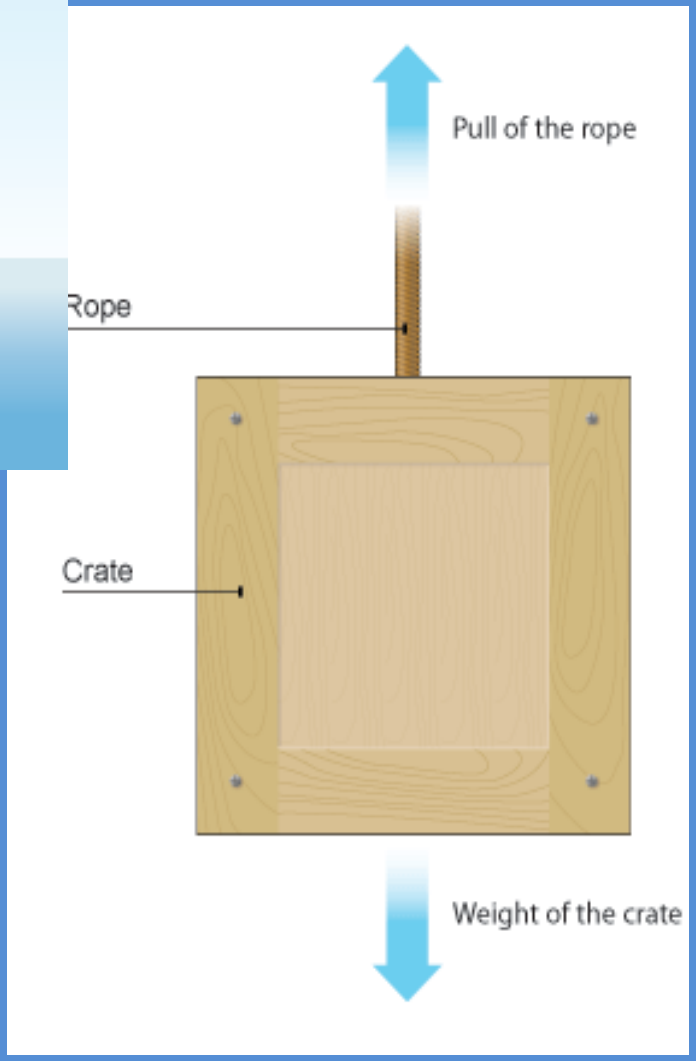
If the forces on an object are balanced (or if there are no forces acting on it) this is what happens:

- an object that is not moving stays still
- an object that is moving continues to move at the same speed and in the same direction

Balanced Forces







Unbalanced Forces

When two forces acting on an object are not equal in size, we say that they are **unbalanced** forces.

- an object that is not moving starts to move
- an object that is moving changes speed or direction

Gwaith Dosbath

Friction & Terminal Velocity

- An object in the sky will experience the gravitational force of the Earth pulling the object towards the ground.
- Skydivers use this force to their advantage because they will accelerate towards the ground in ‘free fall’.
- Aeroplane wings have to generate a huge amount of lift to keep them from falling out of the sky.

- When something falls downwards due to gravity, it accelerates and its velocity increases.
- The Earth's atmosphere acts like a liquid and it generates a resistive force to the falling object's motion.
- As its velocity increases the upwards force of air resistance increases.

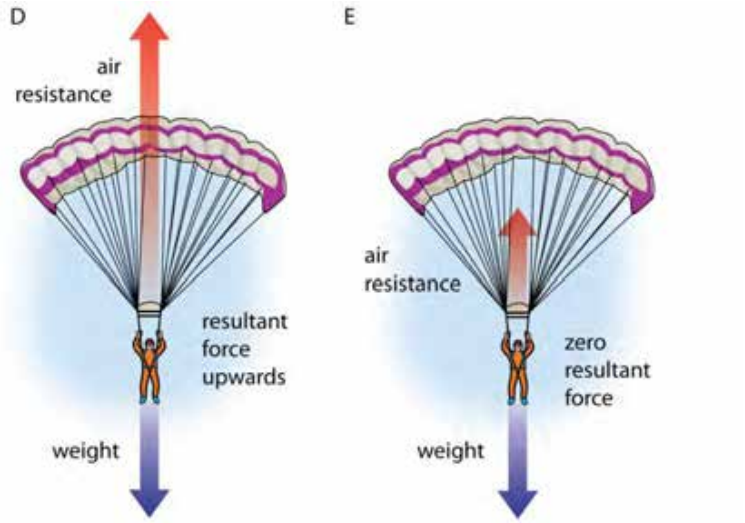
- For a skydiver in free fall the air resistance they experience increases as they speed up.
- Their weight remains constant throughout so the net force on them decreases.
- Over time their acceleration reduces because the force from air resistance balances the force from gravity.
- At a particular speed the force from air resistance exactly equals the force from gravity and at this point there is no net force on them – their acceleration is zero.
- Remember their velocity is still very high at this point.
- This velocity is called **terminal velocity**.

These pictures show the different stages of a skydiver's free fall experience.

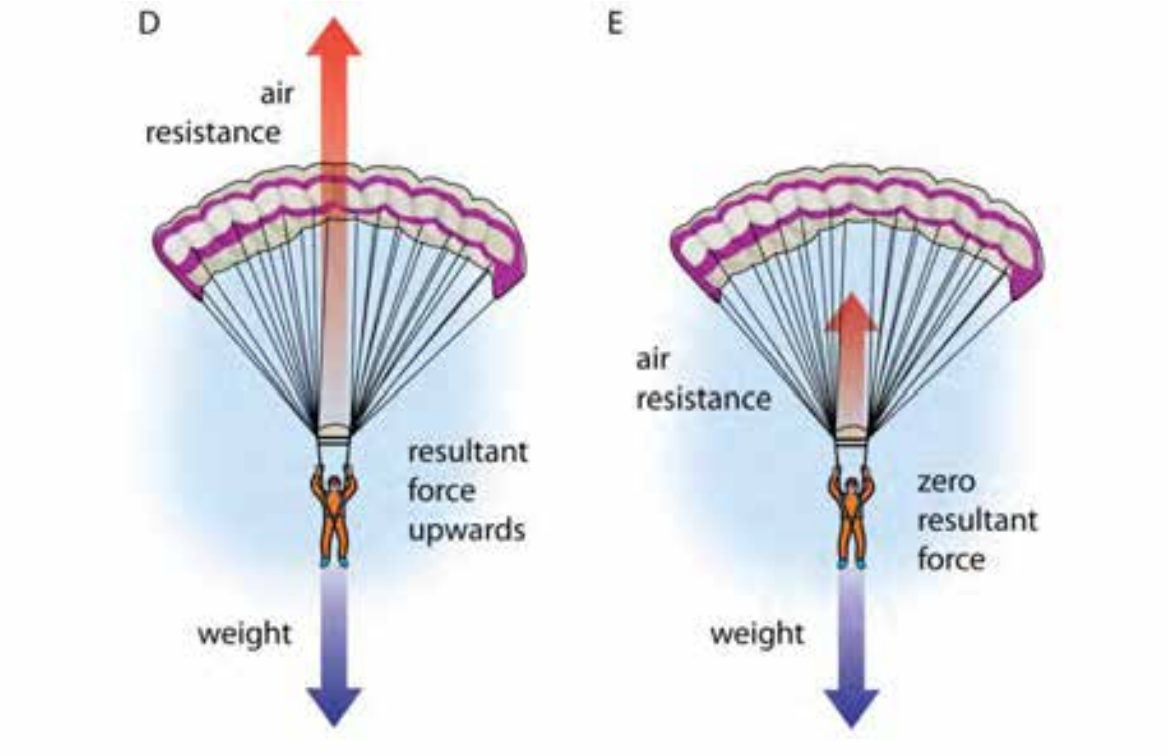
Part A shows the increasing velocity due to the high acceleration in the early stages.

Part B shows how when their speed has increased, the air resistance reduces the acceleration.

Part C shows where they have reached terminal velocity and their weight is balanced by the force of air resistance. They are not accelerating but are travelling at a high speed.



- Skydivers also use this ability to change their terminal velocity in one very useful and lifesaving way.
- They can reduce their terminal velocity to a very low value by deploying their parachute.
- The large amount of material produces a very large surface area which creates a very high air resistance.
- This force is greater than the gravity on them so there is an acceleration upwards (or a deceleration) which slows them down.
- As they slow down the air resistance drops and again they reach a slower terminal velocity when the forces balance each other.
- Their terminal velocity with the parachute is low enough for them to make a safe landing on the ground.



- The parachute has a high air resistance and the parachutist slows down.
- The parachutist will slow until the forces are balanced.
- A lower, safer, terminal velocity.

- Air resistance doesn't only affect the terminal velocities of falling objects. Any object which moves through air or any liquid will experience resistive forces that increase as their velocity increases.
- Aeroplanes, cars, trains and boats will also experience resistive forces at speed as they travel through the air.

- The force of resistance is dependent on the size and shape of the surface trying to move through the liquid, as well as its velocity.
- This explains why lorries have shaped pieces of plastic above their cabs, why aeroplanes and fighter jets are the shape they are, and why fast moving trains have a cone-shaped front to them.

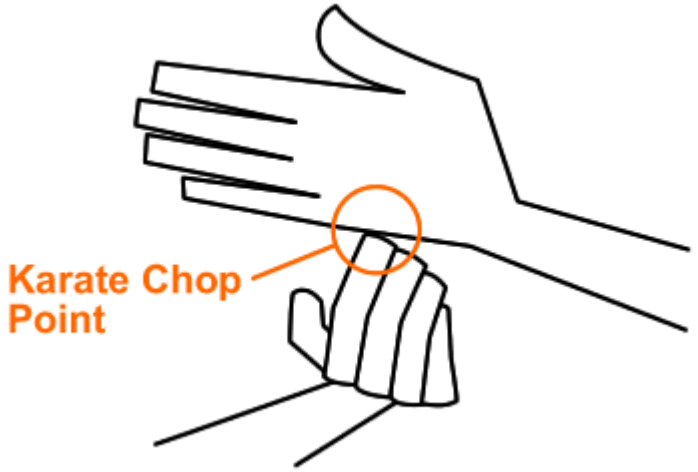
- Terminal velocities for cars are reached when the driving force from the engine balances the force from air resistance.
- Sports cars are specifically designed to make them streamlined. This minimises the forces from air resistance and allows them to have a higher terminal velocity than normal cars with the same power output.

Press ure

- Pressure contains the word ‘Press’
- Indicates something that is pressing on you
- Or in physics, something that is pressing on a surface!

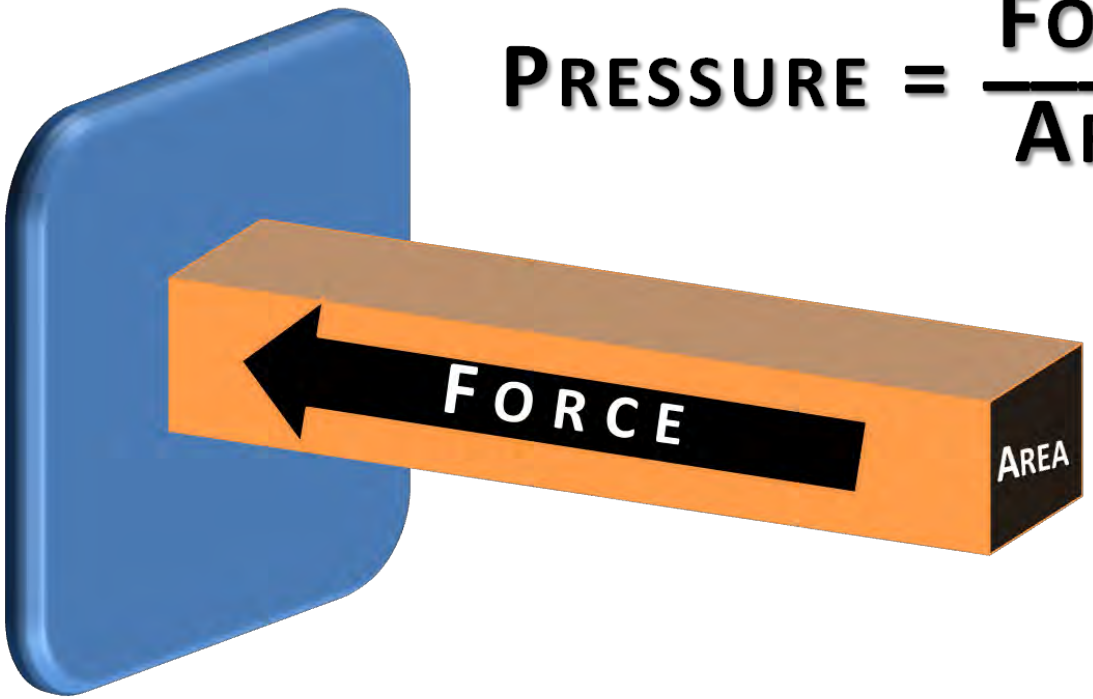
Do we have any Karate Kids?

Wondered why you don't use the palm of your hand and instead use the side of your hand for a karate chop?



Let’s define Pressure

$$\text{PRESSURE} = \frac{\text{FORCE}}{\text{AREA}}$$



Let's define Pressure

- Pressure is force per unit area
- SI Unit: Nm^{-2} = Pascal = Pa
- How does area affect Pressure?

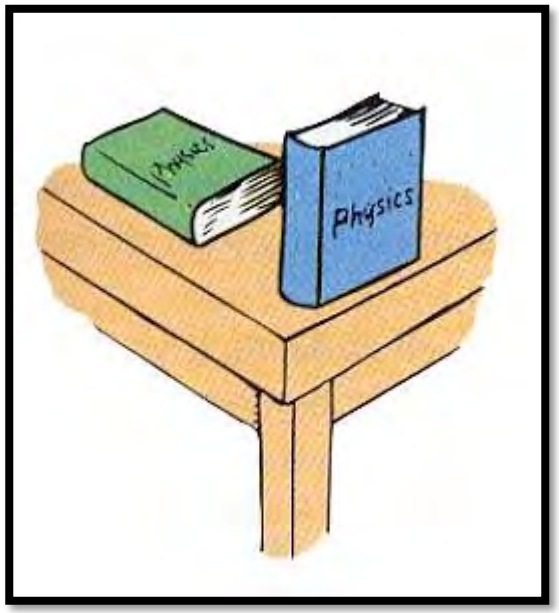
➢ Effect of a force acting over a small area is the production of high pressure over that area

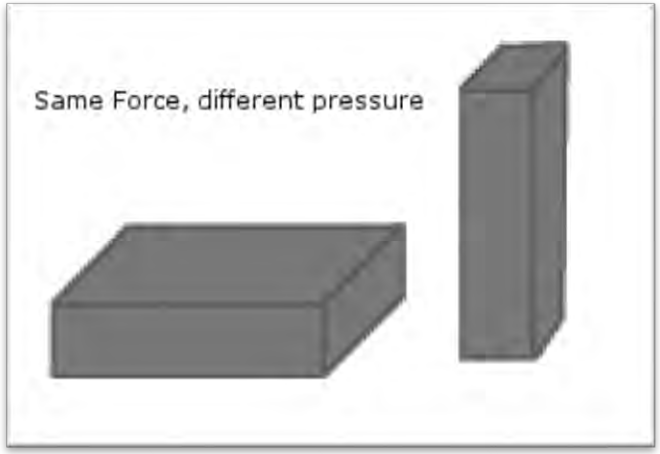
➢ Effect of a force acting over a large area is the production of a lower pressure over that area

More food for thought..

- So now you understand why karate chops and the stilts hurt? Because they exert more PRESSURE.
- Now think about this:

What is the difference between these two cases?





High Pressure Applications

- A sharp knife has a very small surface area on its cutting edge so that high pressure can be exerted to cut the bread.

High Pressure Applications

- The studs on a football boot have only a small area of contact with the ground. The pressure under the studs is high enough for them to sink into the ground, which gives extra grip.

High Pressure Applications

- Thumb tack have very sharp ends with very small surface areas. When a force is applied to the head of a thumb tack, the pressure will drive its sharp end into a soft board easily.

Low Pressure Applications

- A tractor moving on soft ground has wide tires to reduce the pressure on the ground so that they will not sink into the ground.

Low Pressure Applications

- Skis have a large area to reduce the pressure on the snow so that they do not sink in too far.

Gwaith Dosbarth

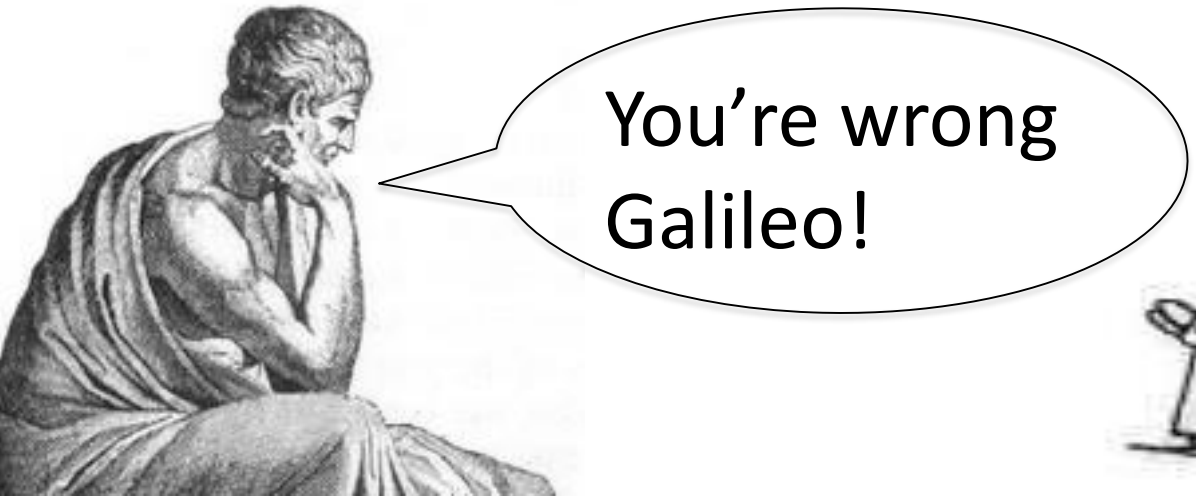
Mass, weight & gravity

Battle of the Brains

Years ago an Italian scientist; Galileo thought that objects would fall at the same speed when dropped at the same height. He tested his method by dropping two cannon balls from the leaning tower of Pisa. The cannon balls were made of the same material but one weighed 10lbs and the other was 1lb.

The Greek philosopher Aristotle thought that heavy objects fell faster than lighter objects.

WHO DO YOU BELIEVE WAS RIGHT?



So…

The myth-busters found out that in a normal atmosphere (on earth) air resistance slows down the fall of lighter objects.

Heavier objects are able to overcome or ‘beat’ the air resistance better than lighter objects.

Removing the air (creating a vacuum) removes the friction faced by falling objects.

What is mass?

Mass is *different* from weight!

Mass is a measurement of how much of something there is.

Mass is measured in grams and kilograms.

Weight a minute…

Weight is a measurement of force…

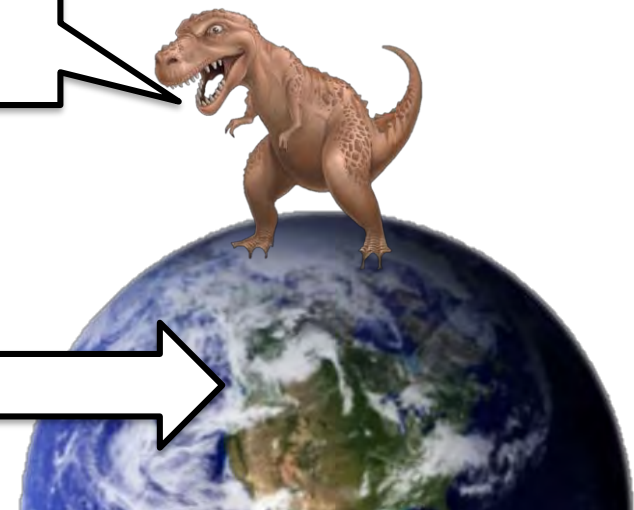
Force is always measured in Newtons (N)

Weight (N) = Mass (Kg) X Acceleration of Gravity

Mass = 1000Kg

What's my weight?
(in Newtons!)

Acceleration of gravity: 10.0 m/s

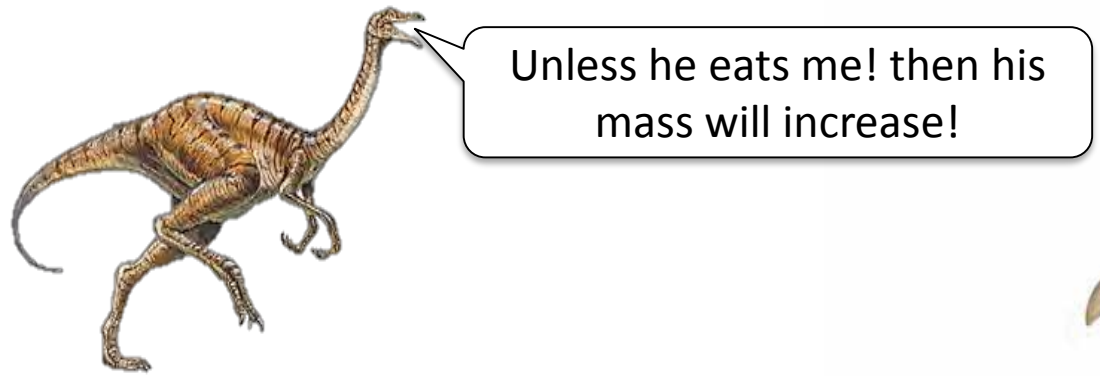


The effect of gravity

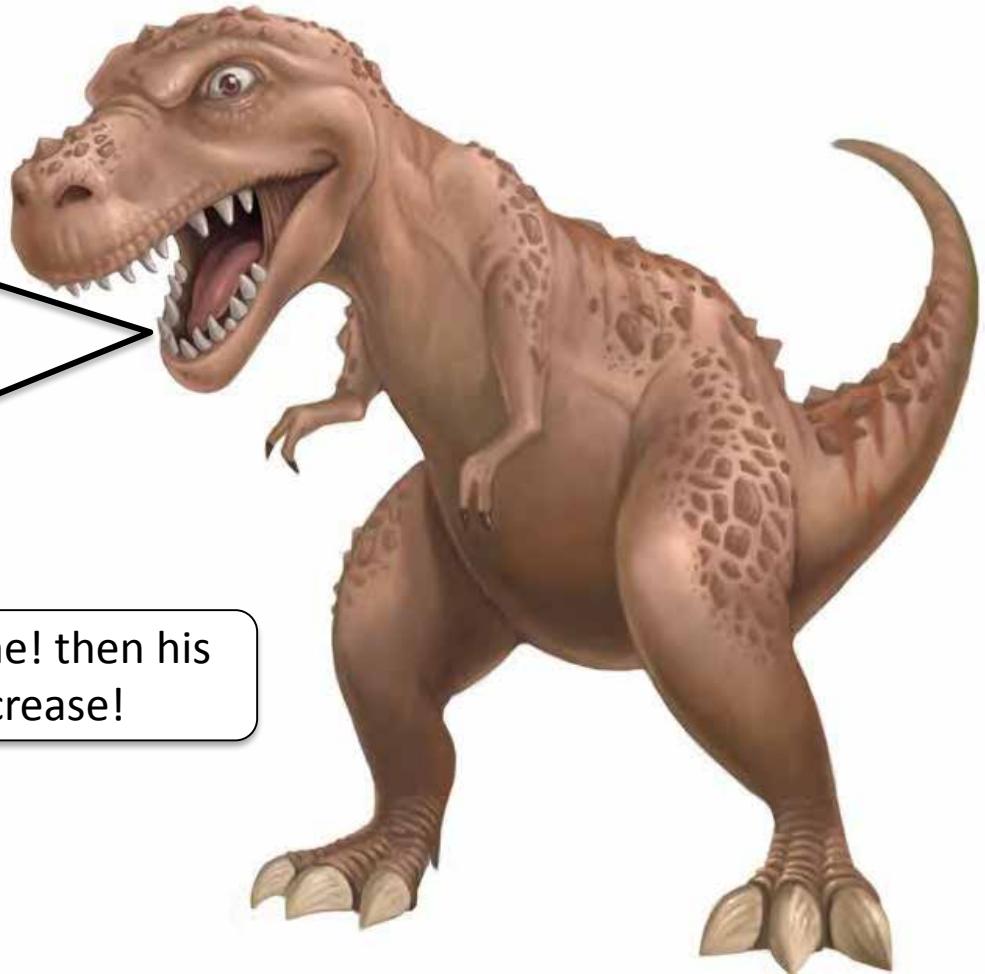
Gravity is a force that ‘pulls’ objects towards the center of the earth. That’s why you’re feet are on the floor…

Weight changes, mass doesn't!

I'm always going to be 1,000Kg
No matter where I am!
But my weight *(force)* can change when the force of gravity changes.



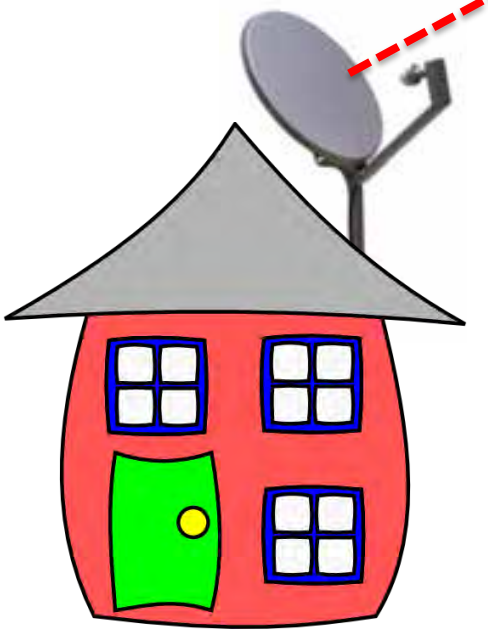
Unless he eats me! then his mass will increase!



Satellites & Orbits

Learning Objectives
Satellites are important devices that orbit planet earth.

We use satellites for **communication** and to observe the Earth and space itself.



2 Types of Satellite

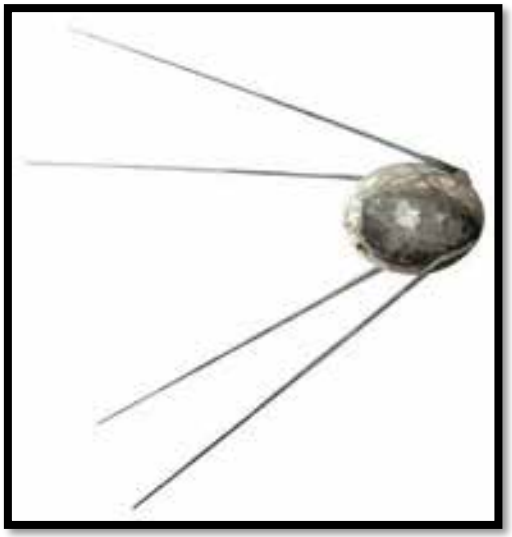
LEO Satellites

Geo-Stationary

GPS

Satellite navigation relies on…
satellites to tell you where
you are in the world!

Famous Satellites

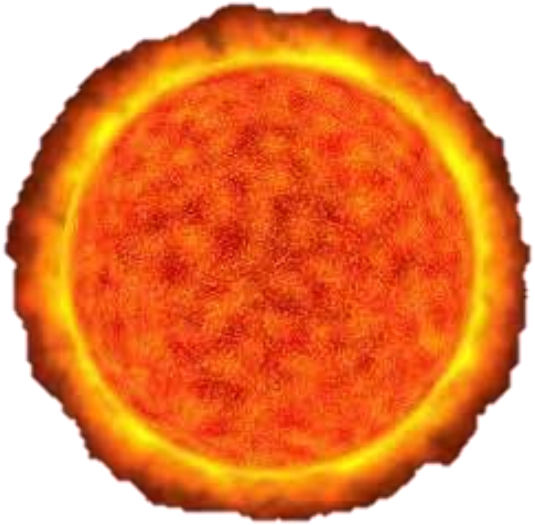


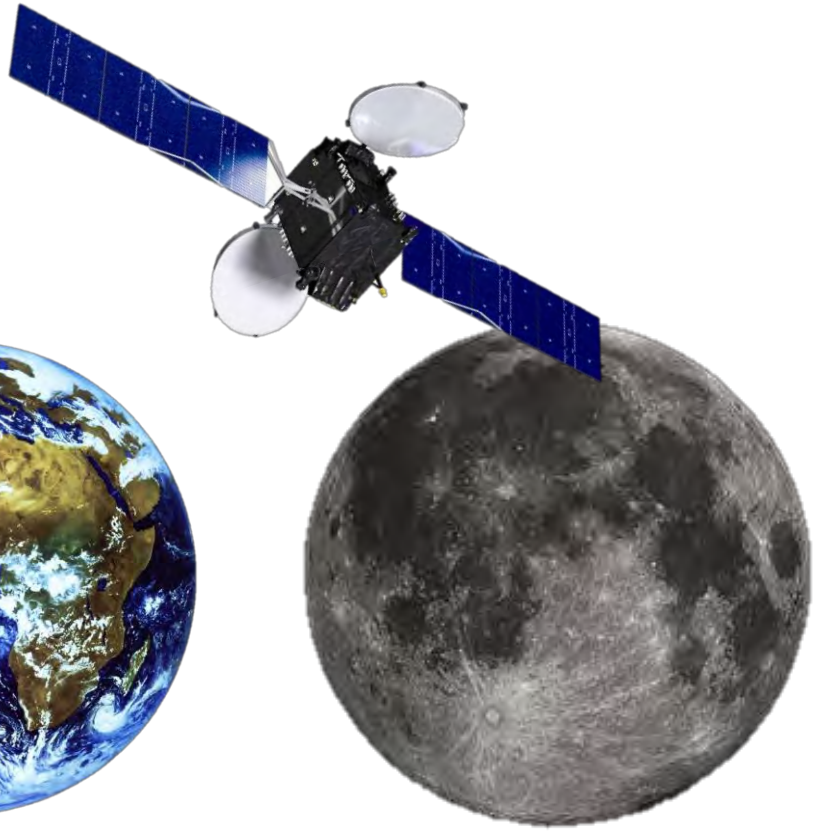
← This is Sputnik 1. A Soviet union satellite launched in 1957. It transmitted radio waves for 3 months before it died.

This is the **Hubble** space telescope and it's used to take awesome photos of space. It has been in orbit longer than you've been alive.→

The international space station **(ISS)** is a huge satellite that is home to up to 6 crew. It has been in orbit for 11 years and can be seen from Earth without a telescope. →

Who orbits who?

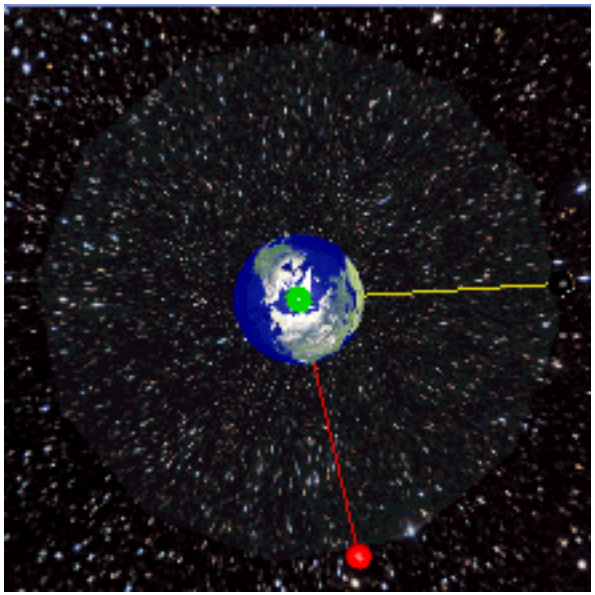




Draw the sun, moon, Earth and the satellite in the correct orbit.

Planet Earth orbits the sun over 365 days
The moon orbits planet Earth over 27 days
The satellite orbits planet Earth (depends on type of satellite)

Geostationary Satellites



Geostationary satellites are not stationary but they don't appear to move…

How?

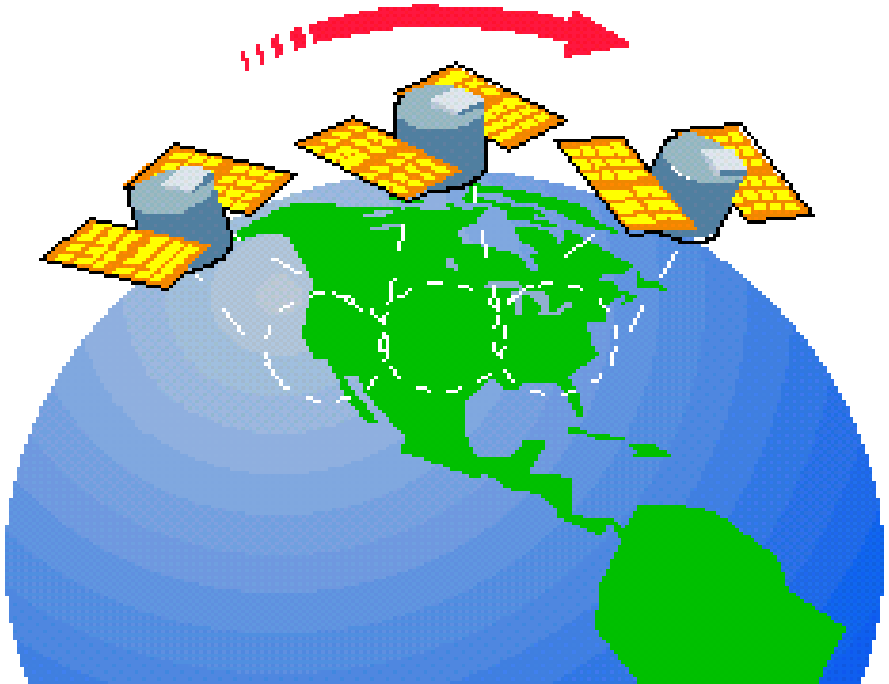
They just happen to move at the same speed as the natural rotation of Earth so they appear in the same place at all times.

Geostationary satellites make tracking and communicating with Earth a lot easier. As they are so far up they can monitor weather patterns and help track natural disasters over the world.

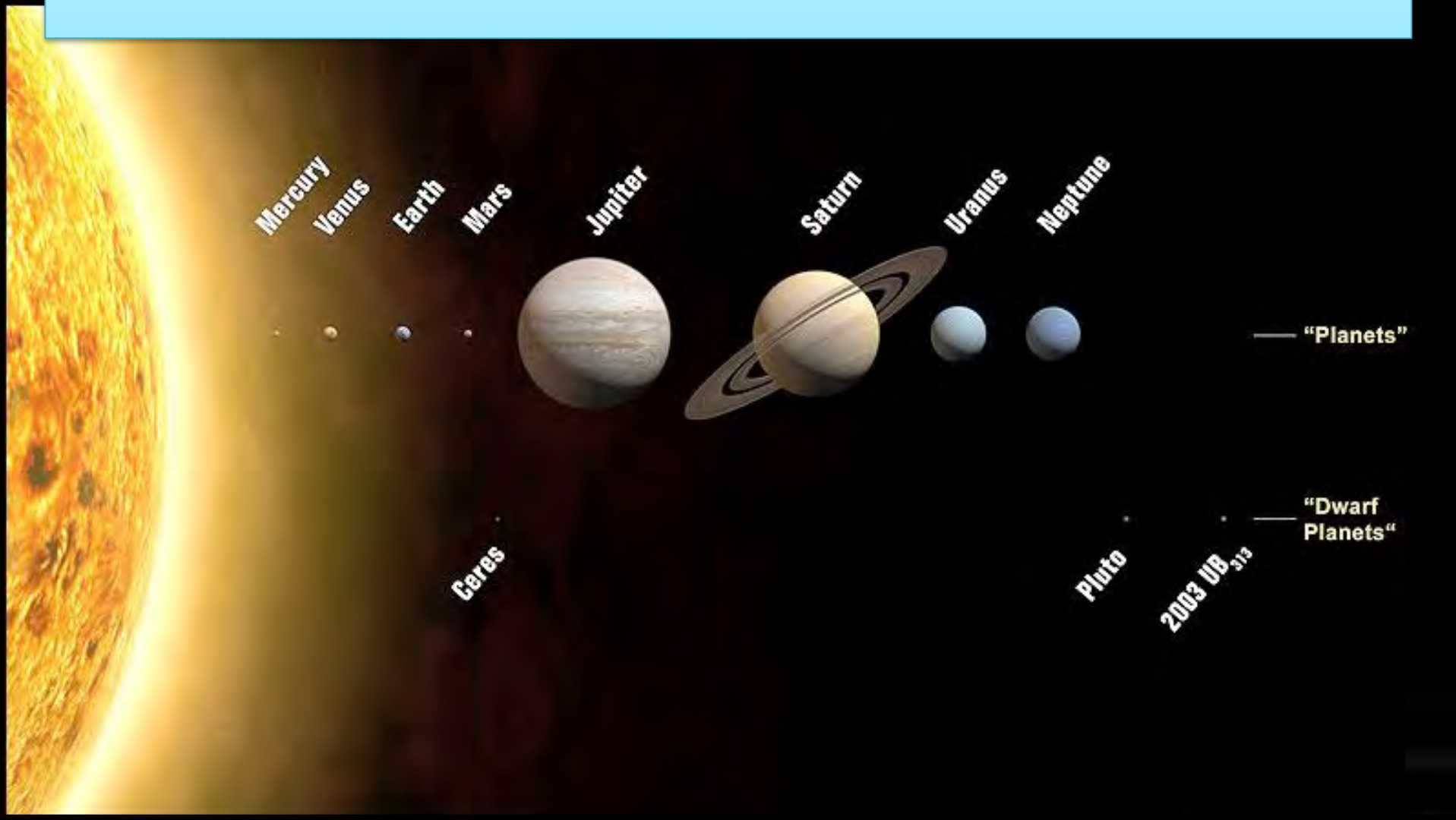
Low Earth Orbit (LEO) Satellites

GEO
Geostationary satellites are 22,282 miles high and rotate with the earth.

LEO
Low-earth orbit satellites are from 400 to 1600 miles high and revolve around the earth.



Our Solar System



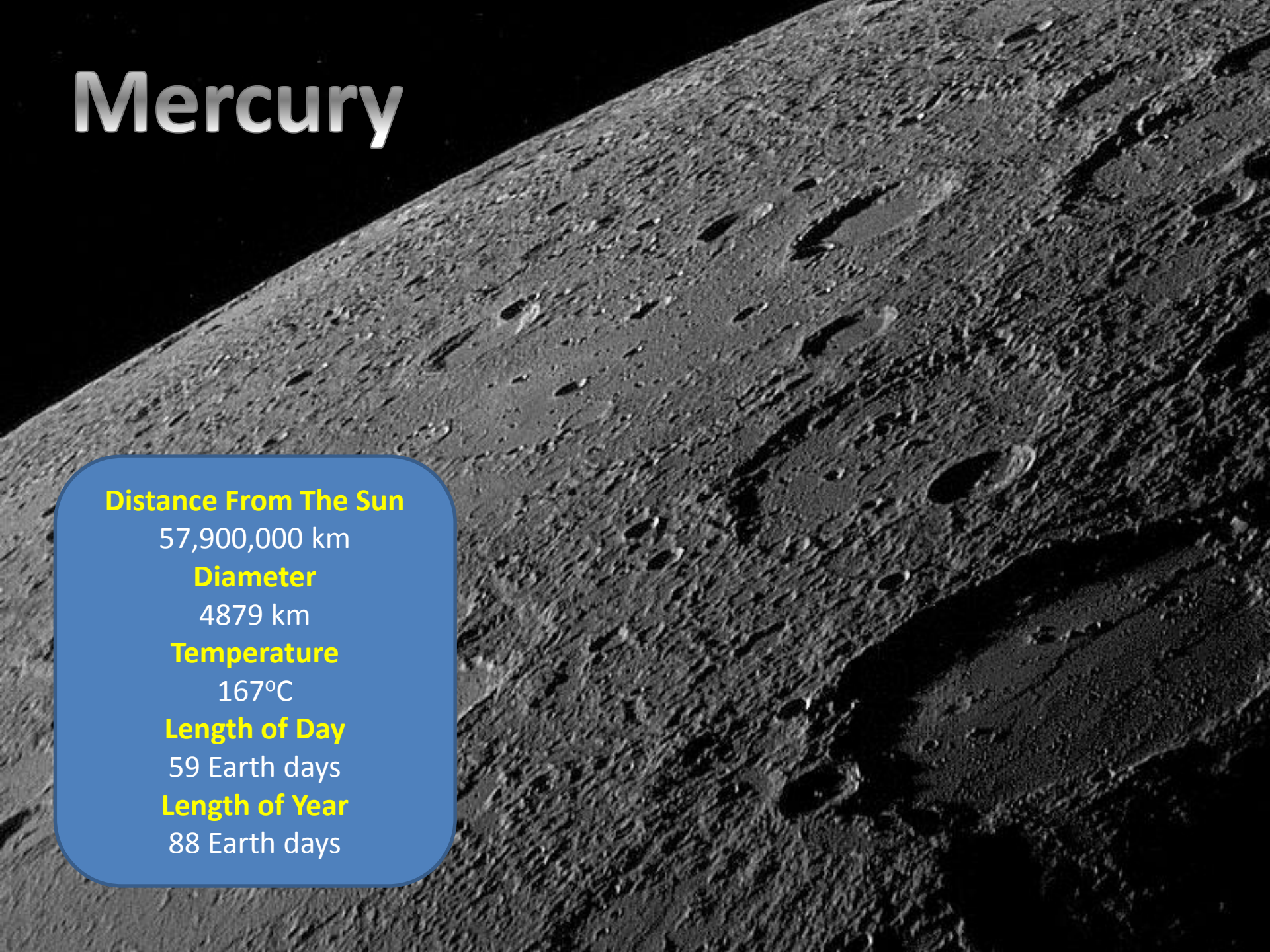
Learning Objectives

Know what makes up the solar system

Know the order of the planets

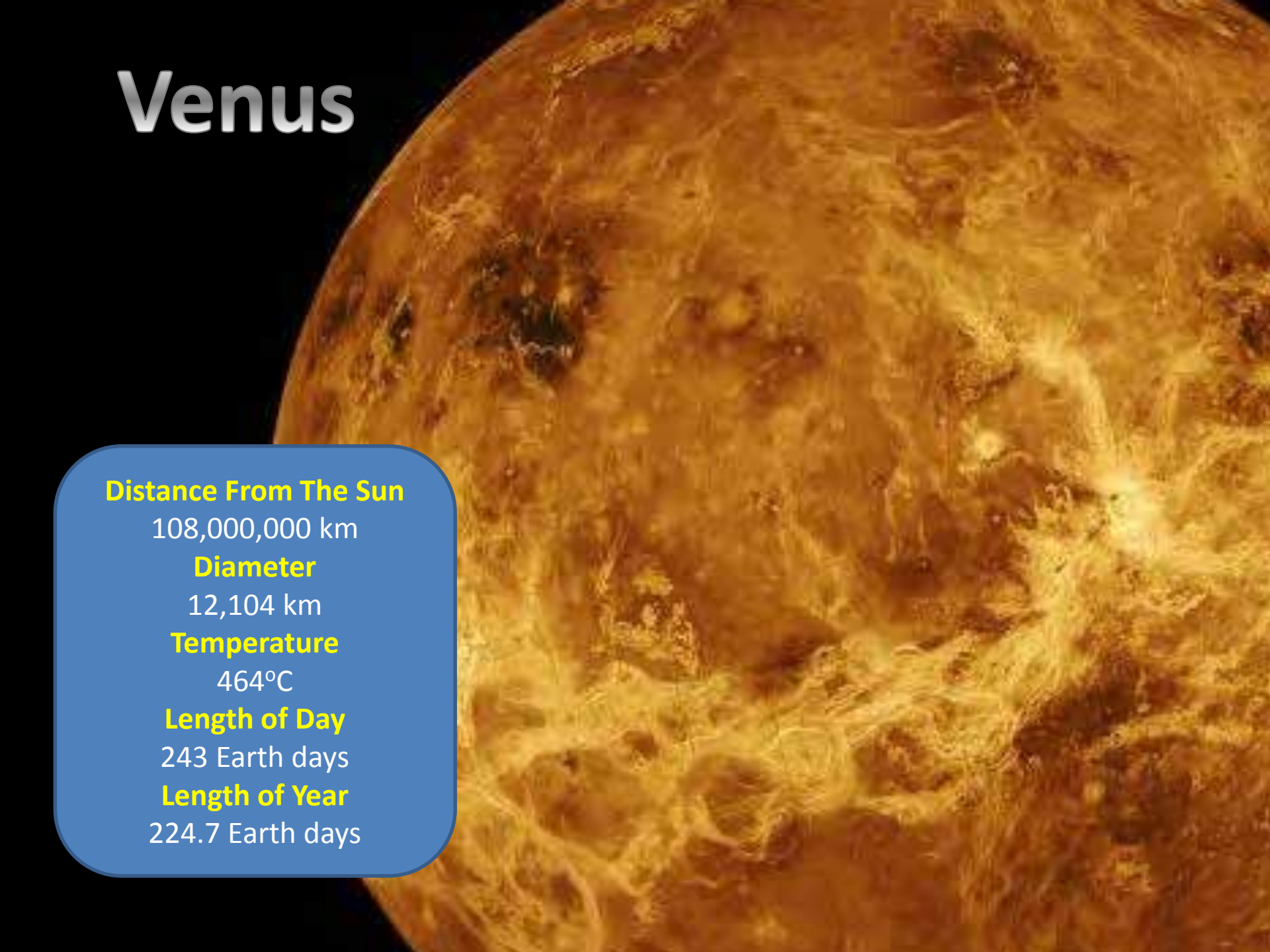
Know the nature (size, atmosphere, moons surface etc.) of the inner planets and of the outer planets.

Mercury



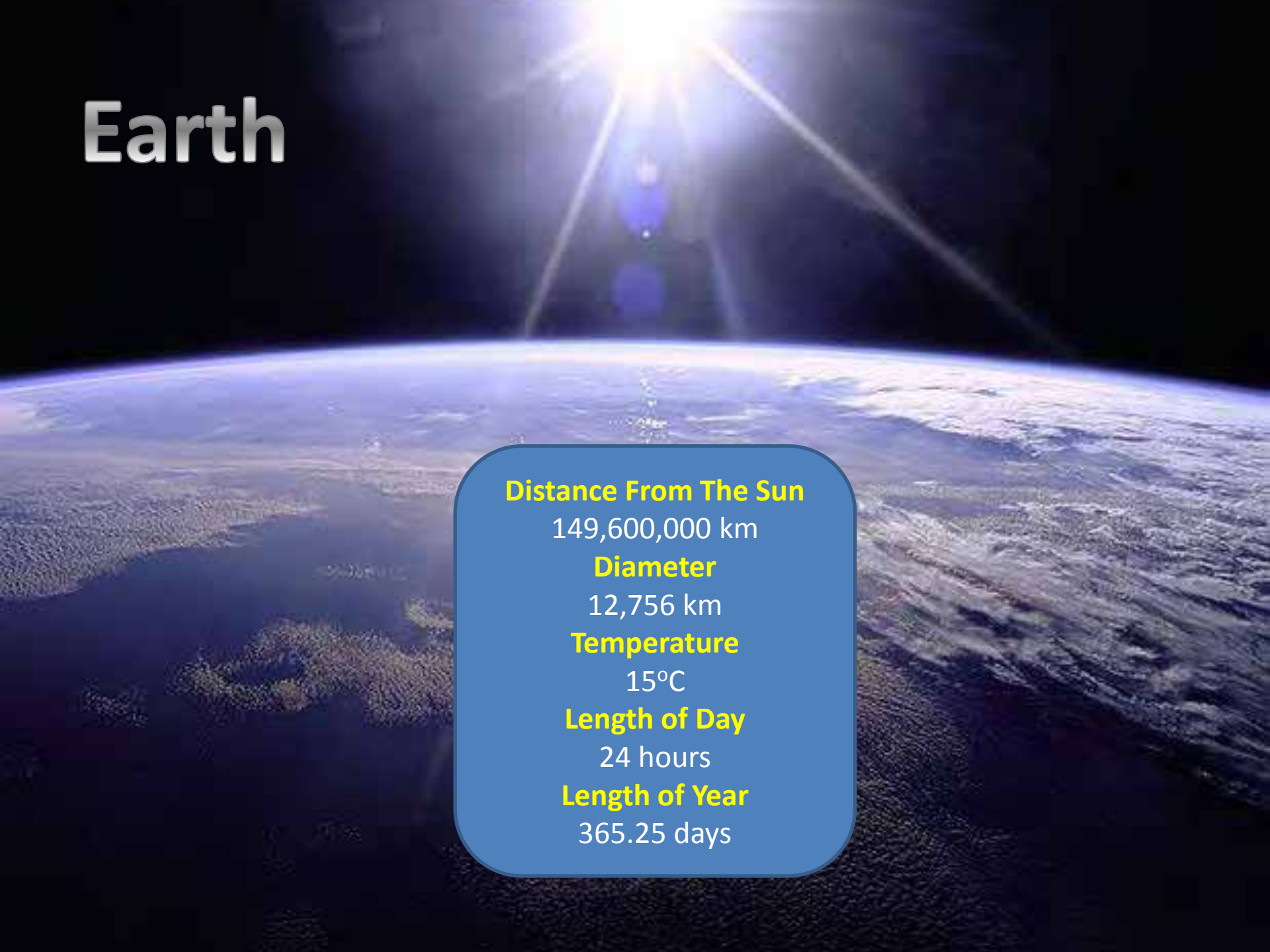
Distance From The Sun
57,900,000 km
Diameter
4879 km
Temperature
167°C
Length of Day
59 Earth days
Length of Year
88 Earth days

Venus



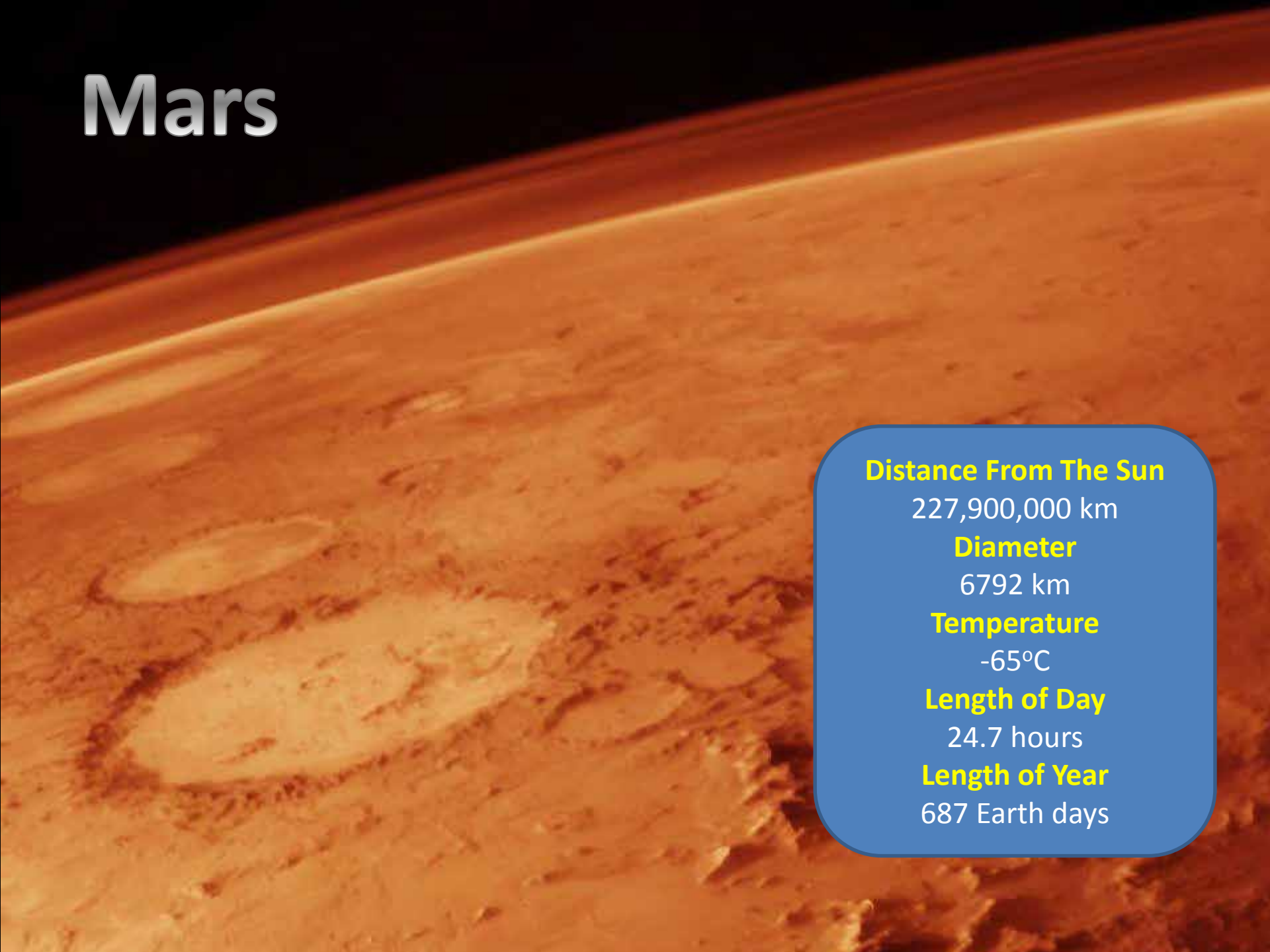
Distance From The Sun
108,000,000 km
Diameter
12,104 km
Temperature
464°C
Length of Day
243 Earth days
Length of Year
224.7 Earth days

Earth



Distance From The Sun
149,600,000 km
Diameter
12,756 km
Temperature
15°C
Length of Day
24 hours
Length of Year
365.25 days

Mars



Distance From The Sun
227,900,000 km
Diameter
6792 km
Temperature
-65°C
Length of Day
24.7 hours
Length of Year
687 Earth days

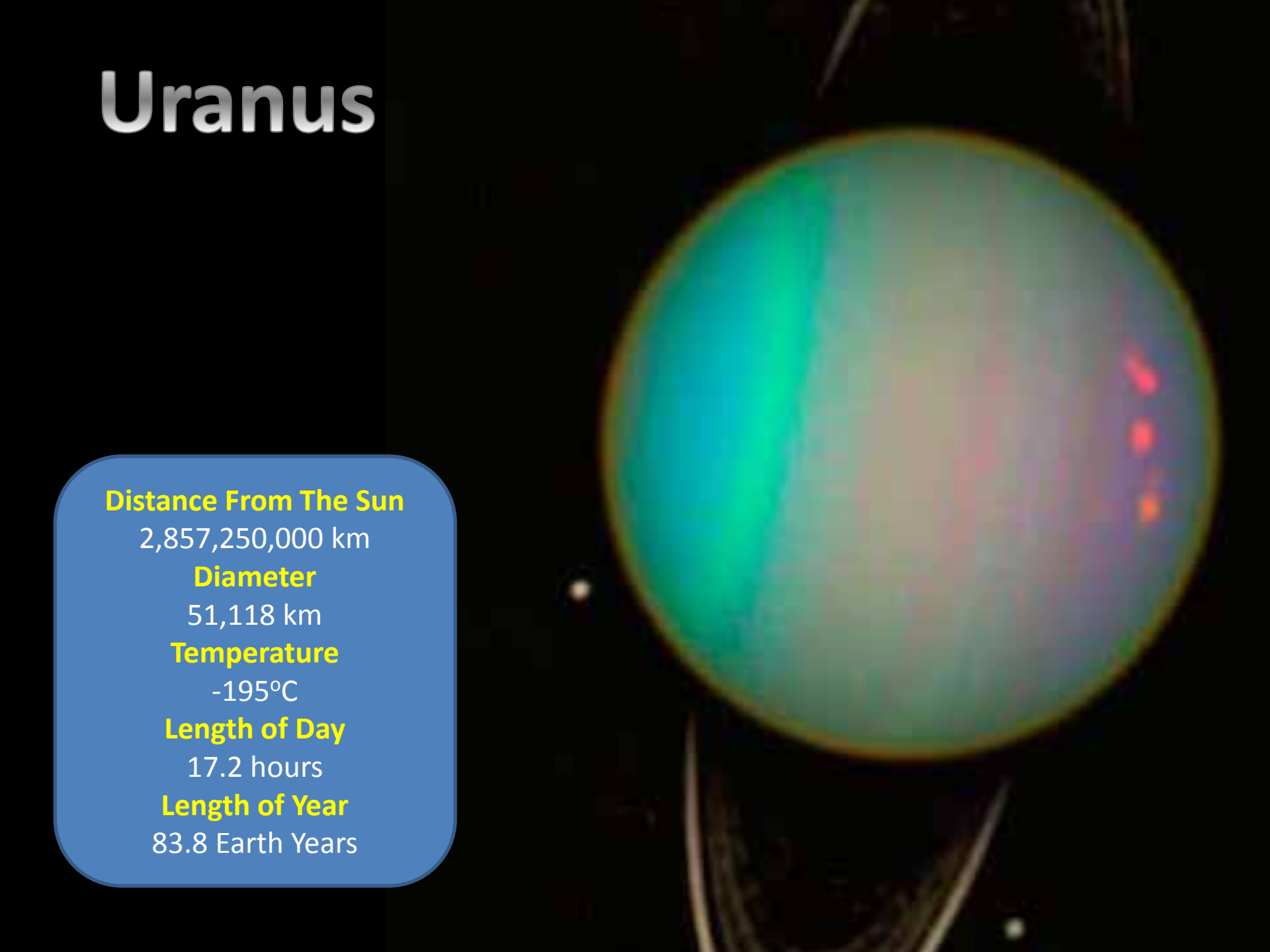
Jupiter

Distance From The Sun
778,600,000 km
Diameter
142,984 km
Temperature
-110°C
Length of Day
9.9 hours
Length of Year
11.9 Earth Years

Saturn

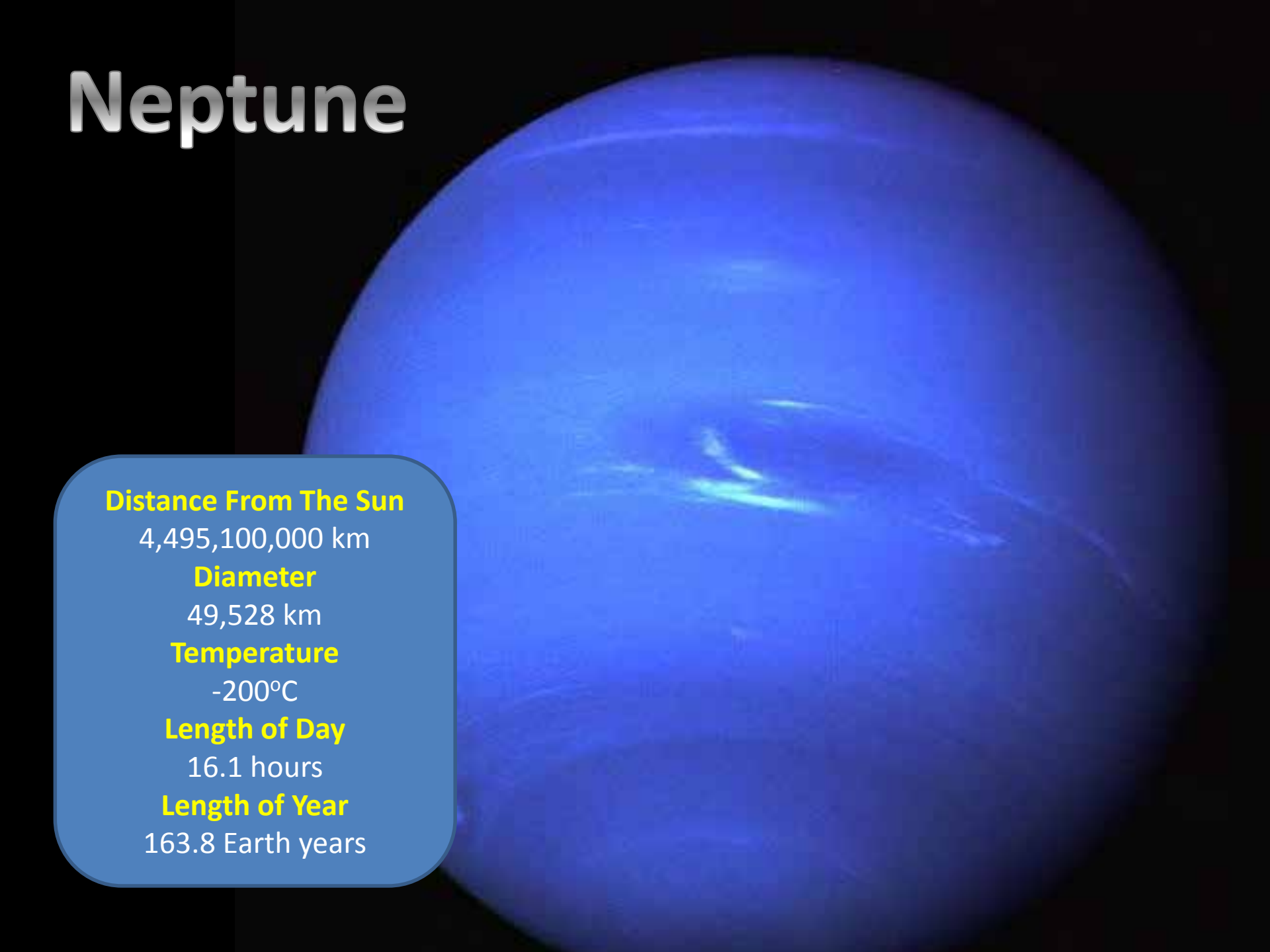
Distance From The Sun
1,433,000,000 km
Diameter
120,356 km
Temperature
-140°C
Length of Day
10.7 hours
Length of Year
29.4 Earth Years

Uranus



Distance From The Sun
2,857,250,000 km
Diameter
51,118 km
Temperature
-195°C
Length of Day
17.2 hours
Length of Year
83.8 Earth Years

Neptune



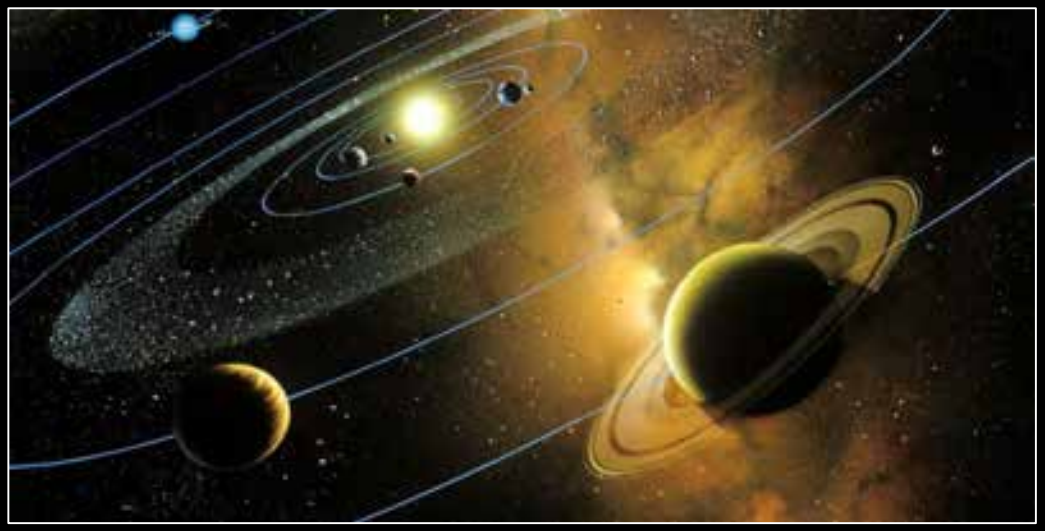
Distance From The Sun
4,495,100,000 km
Diameter
49,528 km
Temperature
-200°C
Length of Day
16.1 hours
Length of Year
163.8 Earth years

Pluto

Distance From The Sun
5,870,000,000 km
Diameter
2390 km
Temperature
-225°C
Length of Day
6.4 Earth days
Length of Year
248.2 Earth years

Arrange the following objects in the correct order as you would see them on your journey from planet Earth to Andromeda. **Check your answers**.

3	Asteroid belt
5	outer edges of the Solar System
1	the Moon
7	Andromeda
6	the Milky Way galaxy
2	Mars
4	outer planets



Title : How does light travel ?

Starter :

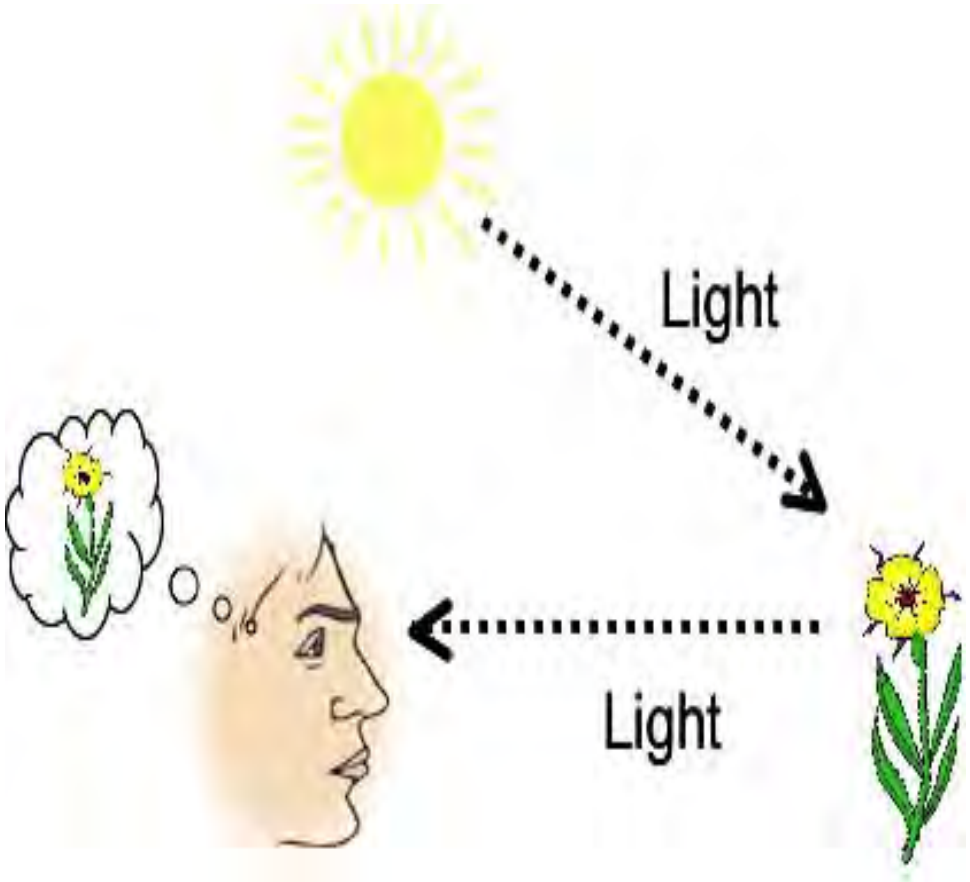
Copy these keywords into your book :

1. Light
2. Source
3. Luminous
4. Shadow
5. Ray

Write 2 sentences describing 2 of these images.

Try to include some key words

How do we see ?



Questions :

1. What is the LUMINOUS object ?
2. What is the NON-LUMINOUS object ?
3. How do we see the NON- LUMINOUS object ?

The Speed of Light

During a thunderstorm what do you notice FIRST ?

The speed of light (c), compared to the speed of sound

It takes time for light to travel !

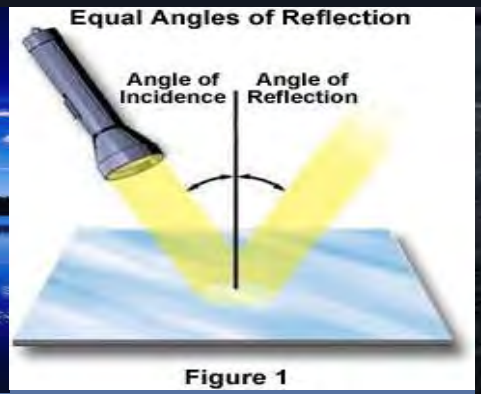
Time taken from our Sun :
8.5 minutes

Time taken from
Proxima Centauri :
4.2 years

Reflection of Light

Objectives:

- Describe some uses of mirrors
- Draw accurate ray diagrams of how an image is formed by a mirror
- Recall that the angle of incidence = angle of reflection

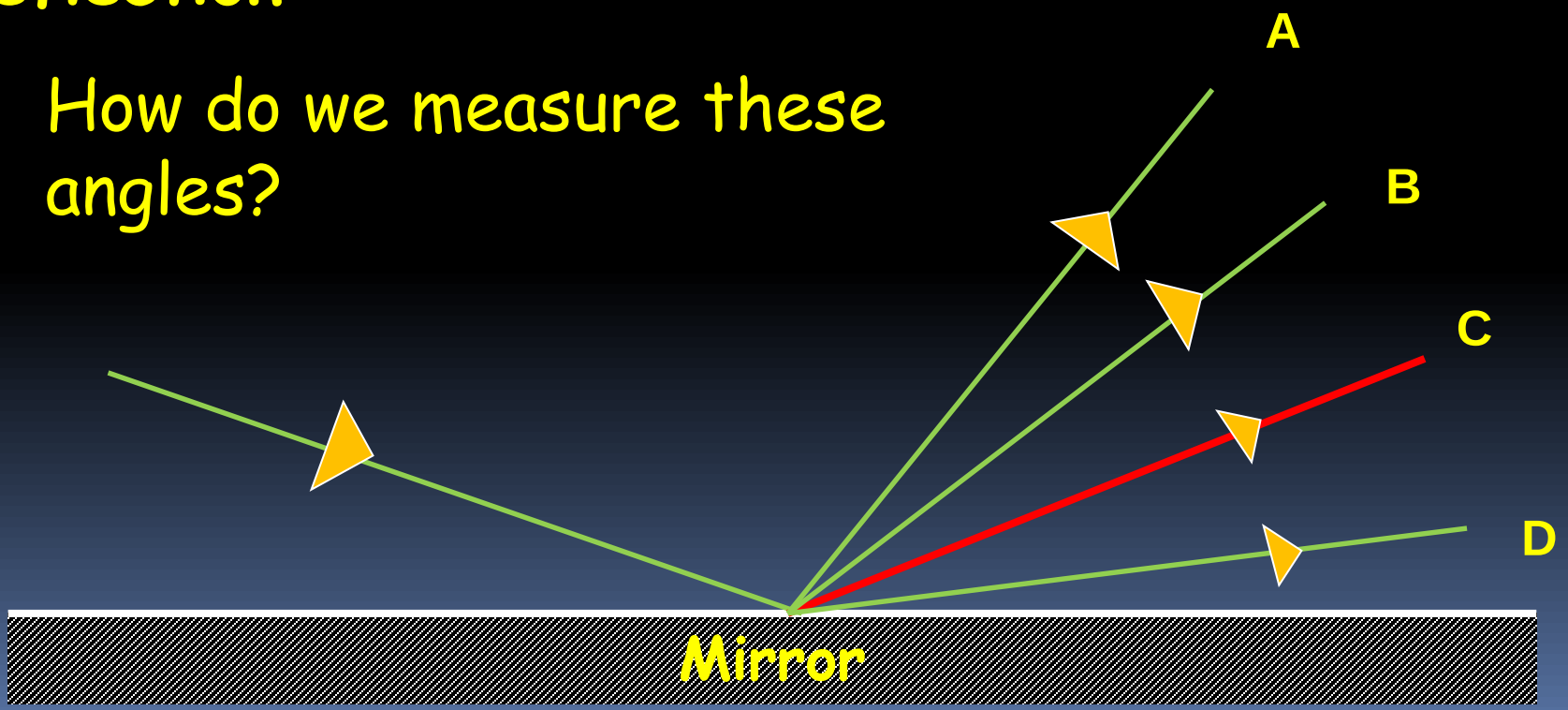


Reflection of Light

'the angle it comes in at = the angle it goes out at'

'angle of incidence = angle of reflection'

- How do we measure these angles?



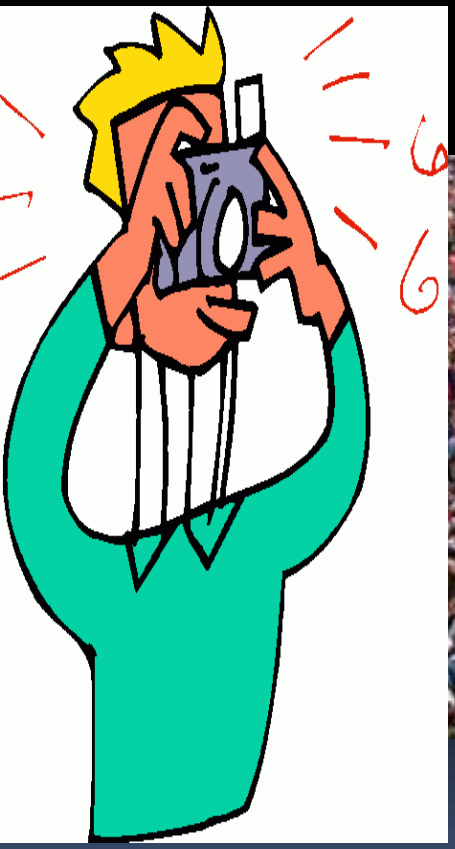
Rules of reflection in plane mirrors

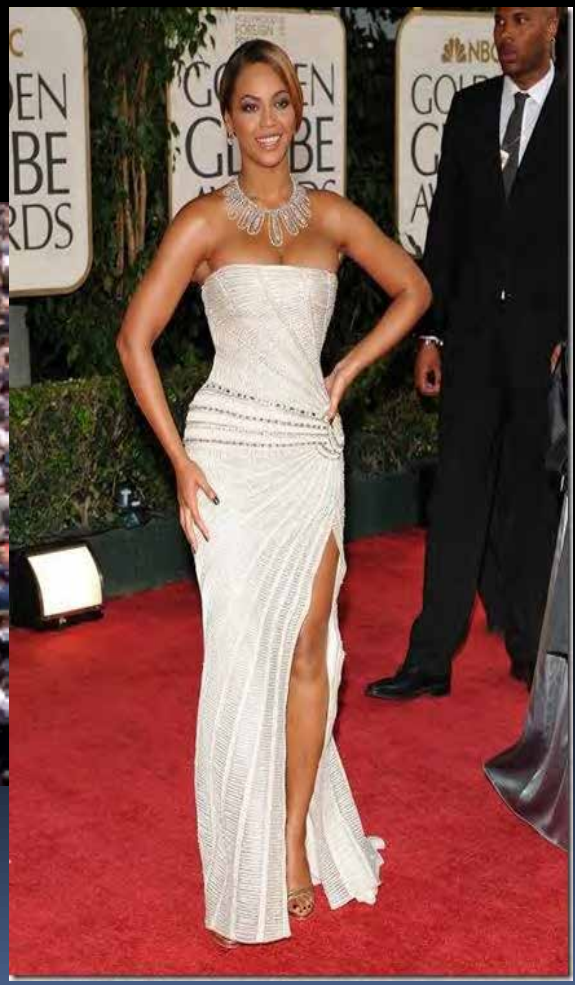
1) Angle of incidence = Angle of reflection

2) The reflected image is the same size as the object

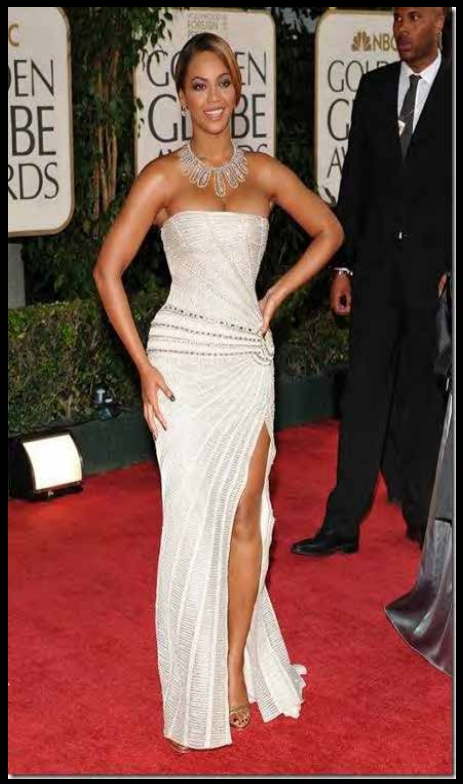
3) In the image, left is right and right becomes left

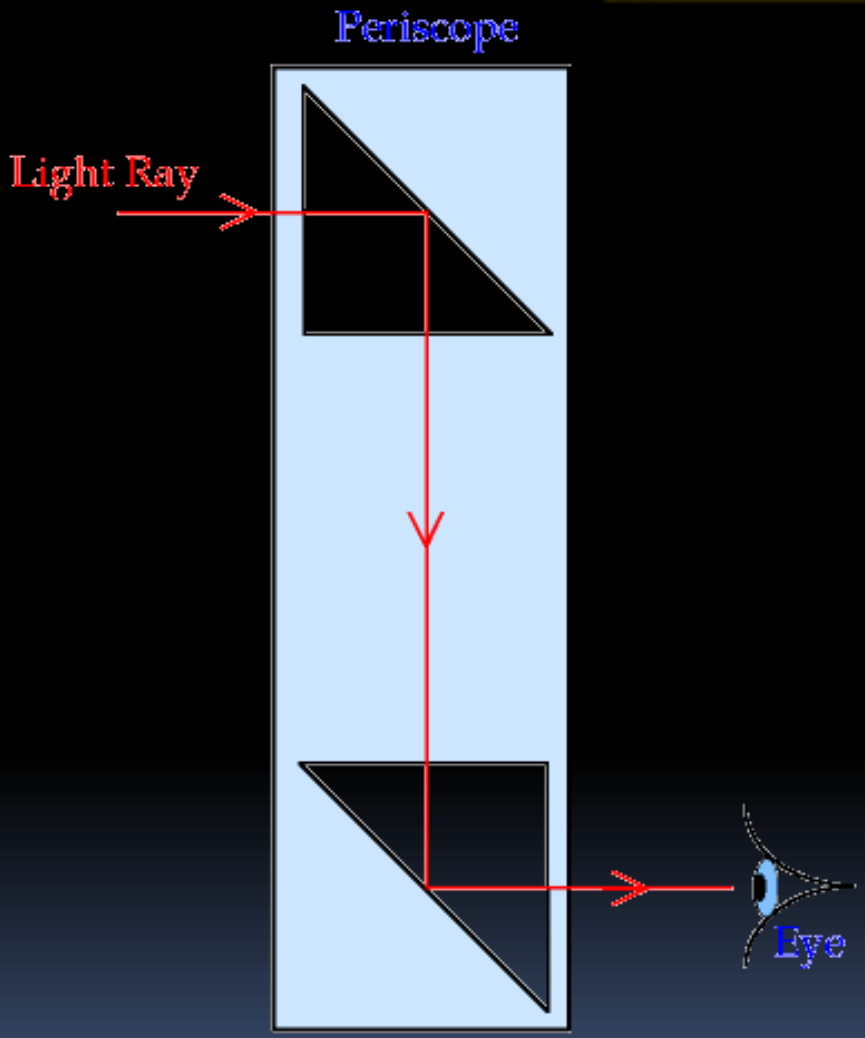
How could Jack use mirrors to help him see over the crowd to Beyonce?





Use a periscope





Gwaith Dosbarth

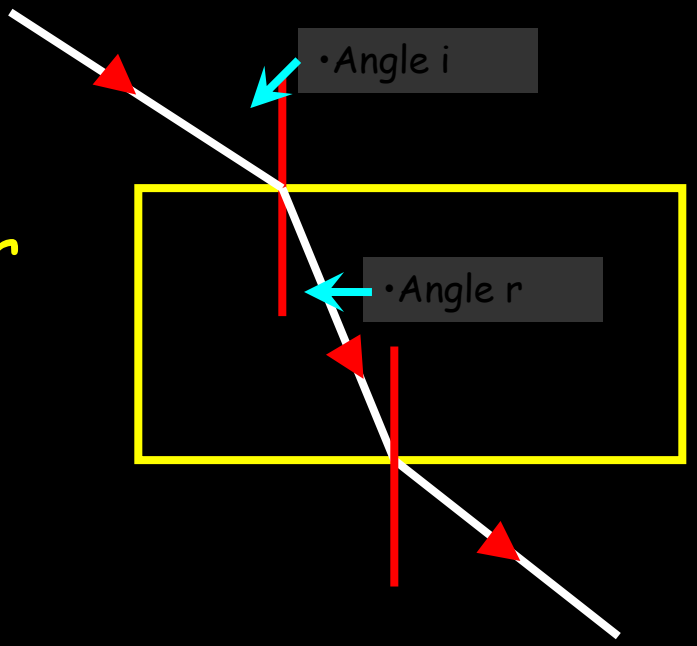
Refraction

Learning Objectives

- To know what refraction is.
- To know how the angle of incidence and the angle of refraction are related to each other.

- The pencil appears bent because light travels at different speeds in different materials.
- This causes the light to bend/refract.
- **Refraction is the change in the direction of light.**

Investigation



1) Draw around a rectangular block

2) Draw a normal line 90° from the top of the block

3) Shine light into the block, making sure it hits it where the normal line crosses the glass surface.

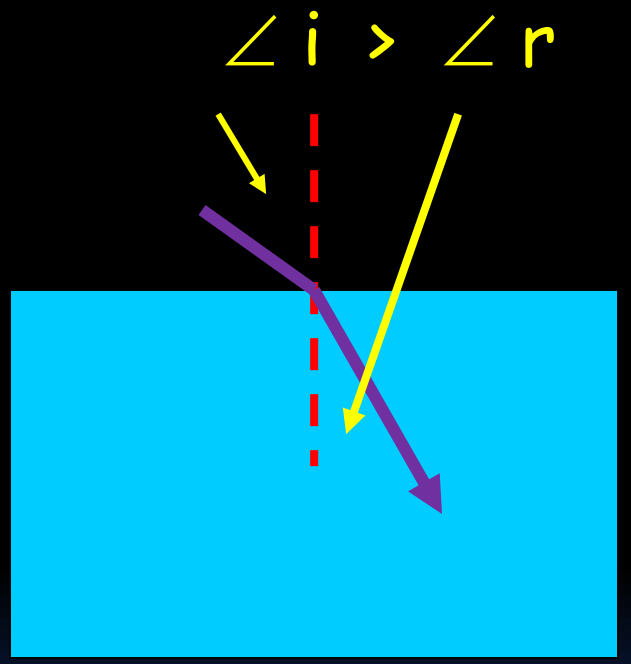
4) Draw the rays of light **entering** and **leaving** your block onto your paper

5) Remove the block and draw a line across the block

•Air to Glass:

angle of incidence > angle of refraction

$\angle i > \angle r$



- ✓ If light rays move from a less dense medium (air) to a more dense medium (glass) they move towards the normal.

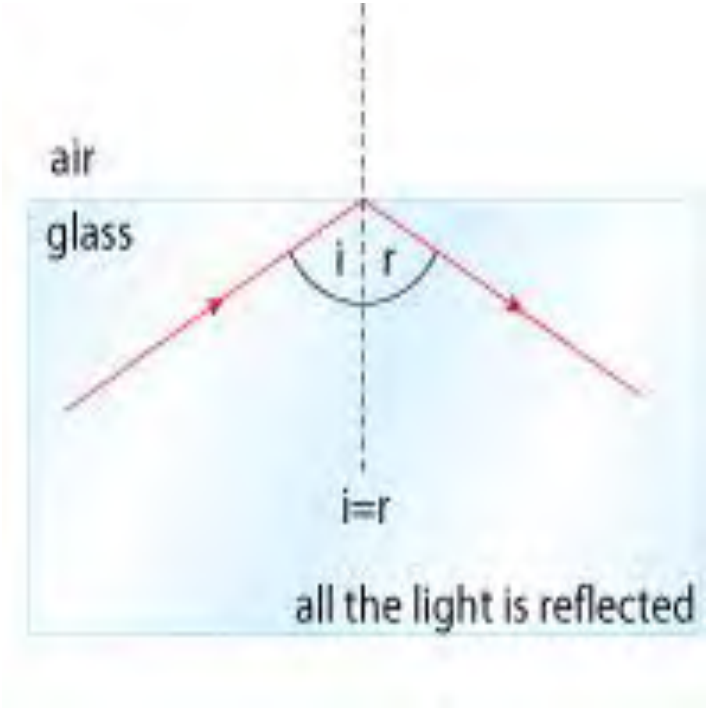
When light bends this is called refraction.

Refraction happens because the light changes speed.

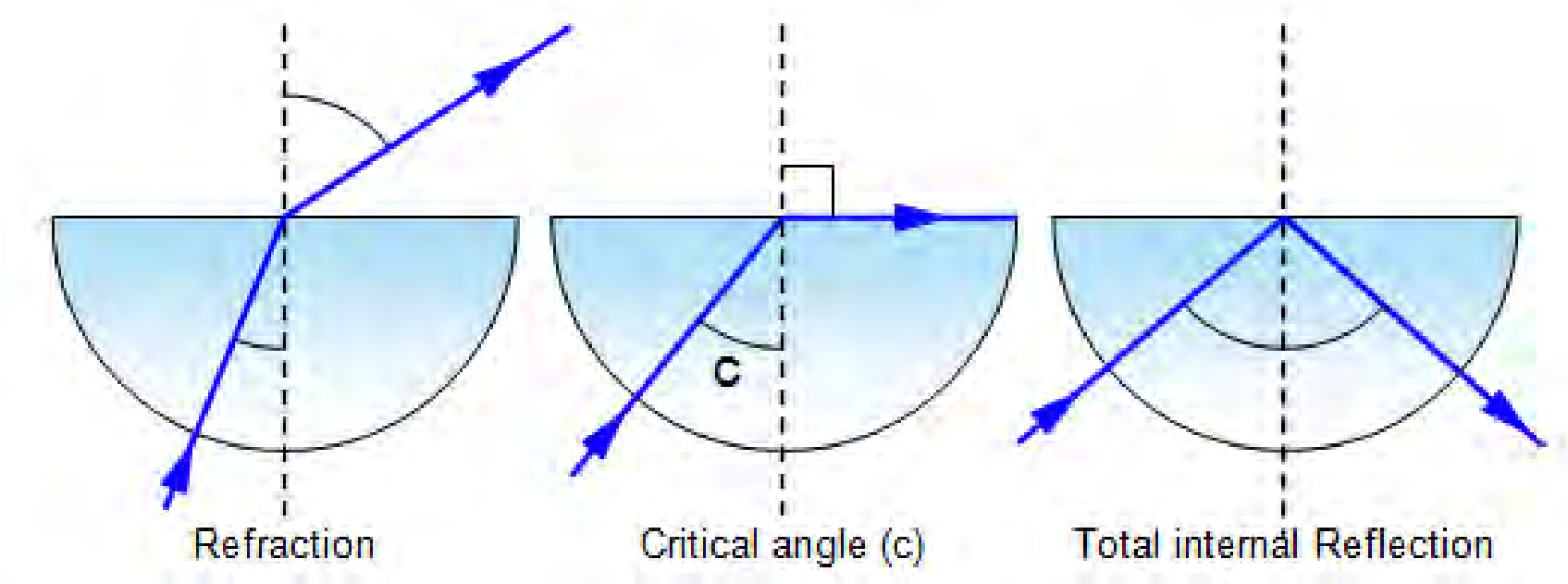
When light enters a more *dense* medium [e.g. glass], it bends towards the normal.

When light enters a less *dense* medium [e.g. air], it bends away from the normal.

It's like Totally internal reflection, yeah?

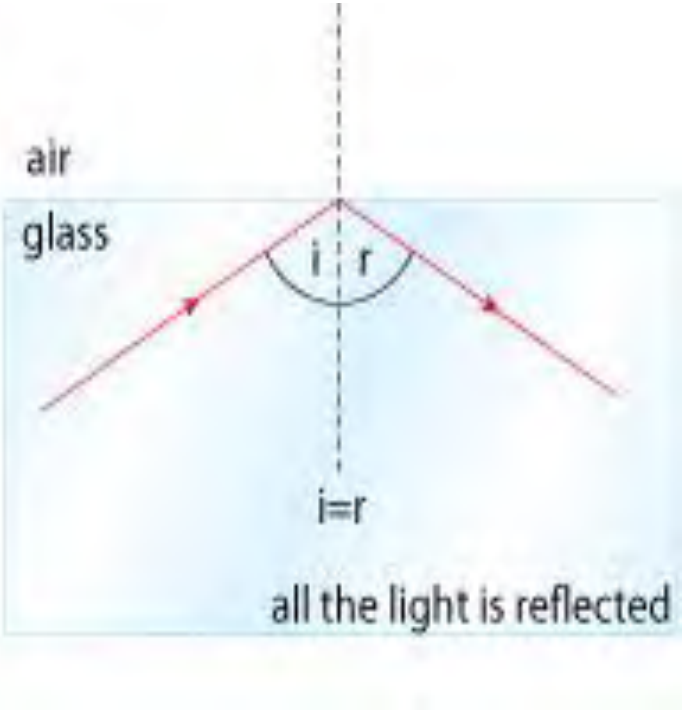


Total internal Reflection



The CRITICAL ANGLE should be around 42^0.

When the angle of incidence is higher than the critical angle, all light will be reflected.



This will only happen when light passes from one substance to another of lower density (e.g. air has a lower density than glass, which means that all light will be reflected at incident angles higher than the critical angle).

This is called TOTAL INTERNAL REFLECTION.

Applications

Periscopes are used on submarines so that the surface of the sea can be seen but the submarine remains submerged.

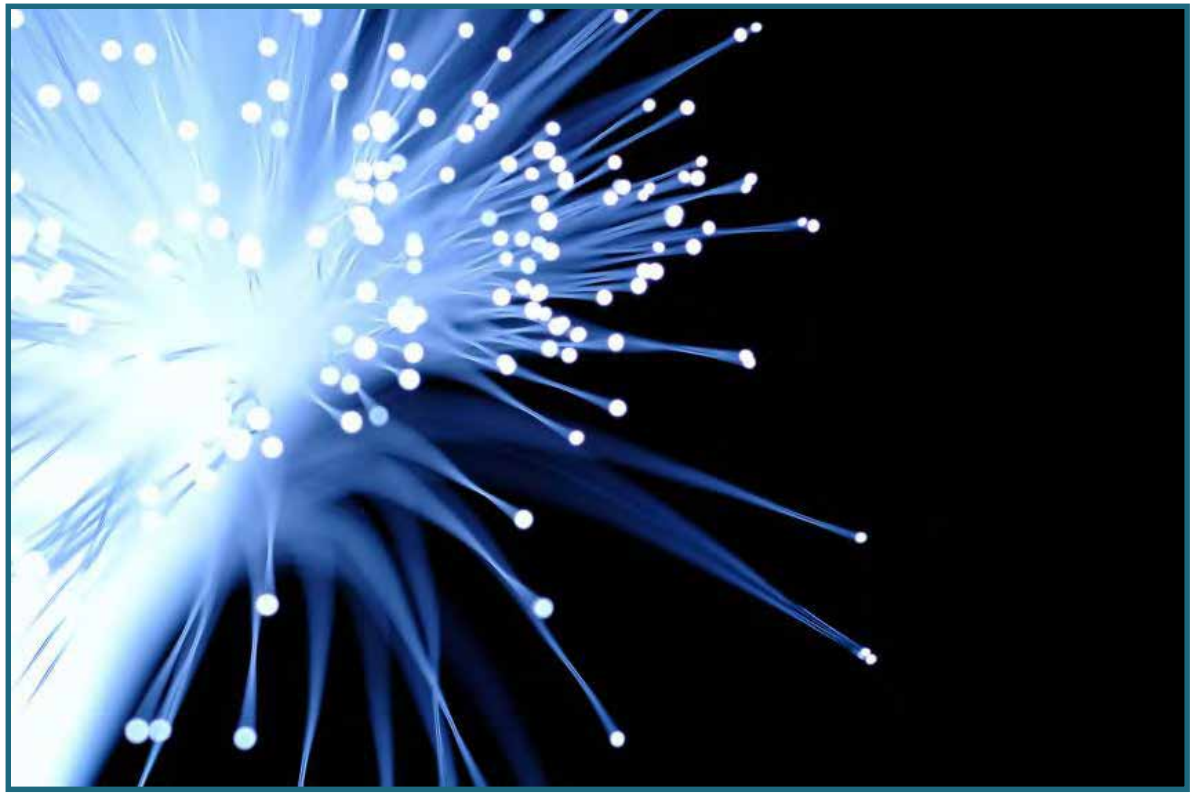
These periscopes use prisms rather than mirrors. Can you suggest why?

Applications

Optical fibres

Optical fibres are used for transmitting light around corners.

They are made from very thin, flexible glass.



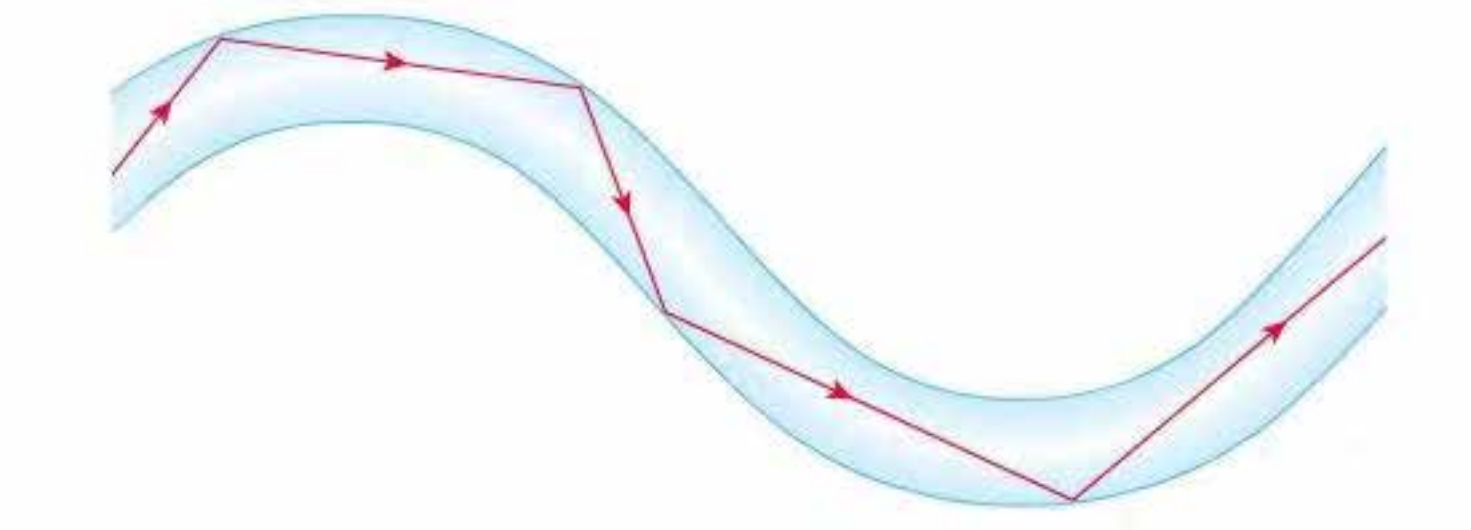
Applications

Optical fibres carry light signals along their length using total internal reflection.

All the light is reflected.

This means signals can be sent over long distances.

They don't lose energy very quickly.



Applications

Using optical fibres in medicine

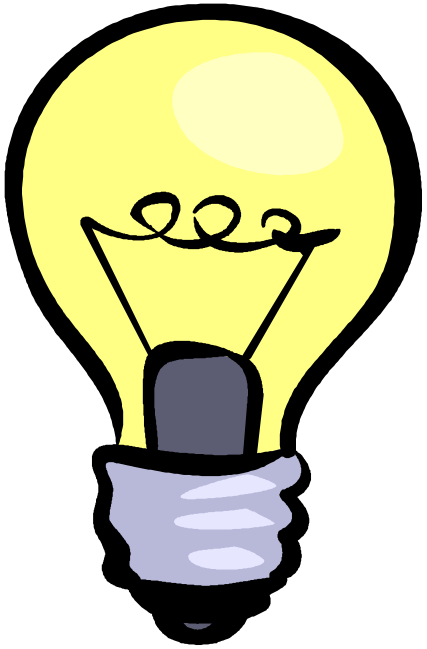
The doctor is using a fibre optic device to see inside the patient's body.

Light passes down some of the fibres to light up the inside of the body.

Reflected light passes from inside back up other fibres and forms an image on screen.

Gwaith Dosbarth

Electrical components and circuits



Learning Objectives

- To know how to build circuits.

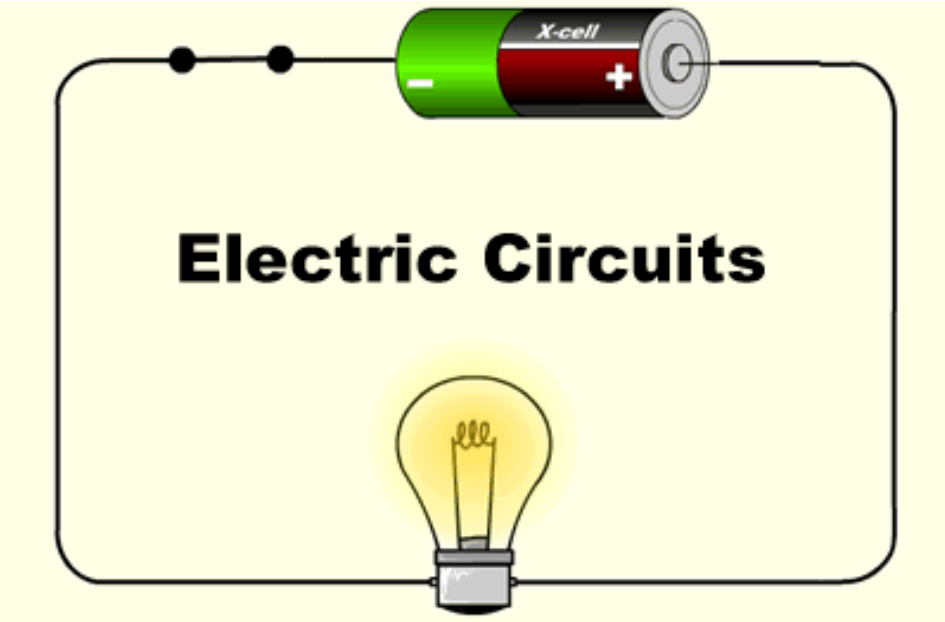
- To know how current and voltage changes in circuits.

What is electricity?

- Electricity is a form of energy
- It is caused by a flow of tiny particles called electrons through a material

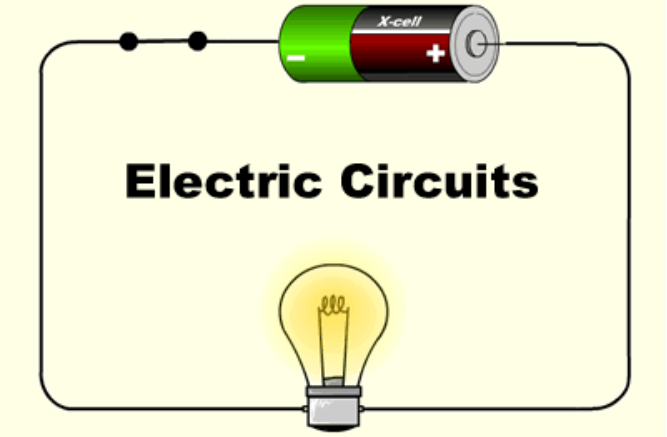
What is an Electrical Circuit?

- A circuit is an electrical device that provides a path for electricity to flow



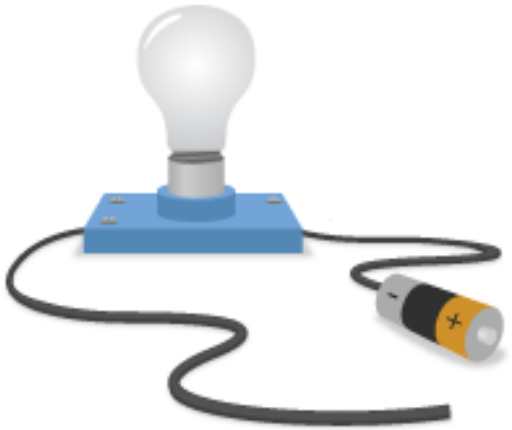
Complete or Incomplete?

- A complete circuit is where all the components of a circuit are joined up and there are no gaps
- The pathway for electricity is complete



Complete or Incomplete?

- An incomplete circuit is where the pathway for electricity is broken
- The electricity cannot flow



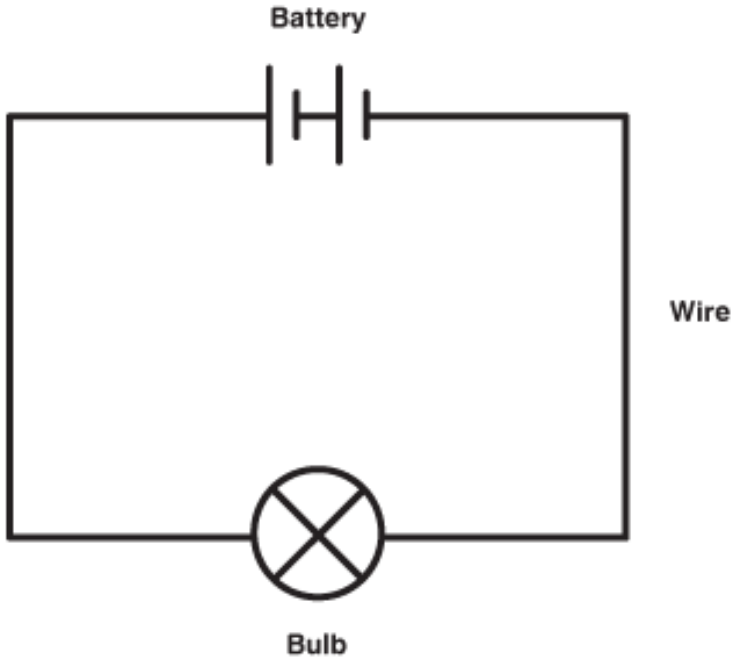
Circuit Diagrams

RULES:

1. Each component has its own symbol
2. Wires connect the components
3. Wires must be drawn with straight lines with a ruler
4. The wires should never cross each other

Circuit Diagrams

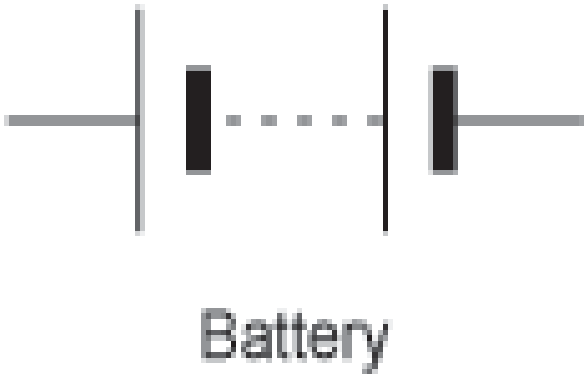
- An easy way to draw a circuit is with a circuit diagram



Component Symbols – a cell

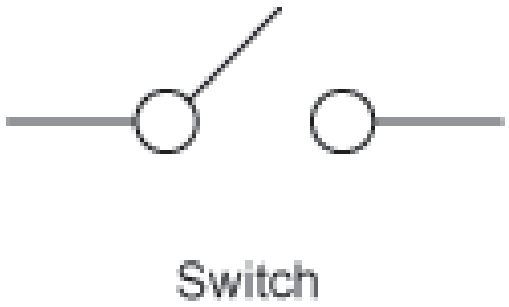
- A cell is what gives the circuit power
- The long line is the positive end
- The short line is the negative end

Battery



- A battery is made up of 2 or more cells
- It gives the circuit power
- It is important that each cell faces the right way

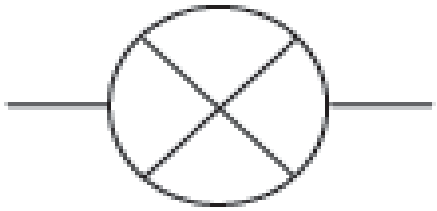
Switch



Switch

- A switch can be open (as shown) or closed
- When the switch is open, the circuit is incomplete – no electricity can flow
- **What happens when the switch is closed?**

Bulb / Lamp



Lamp

- The lamp lights up when electricity flows through it

- **What would happen to a lamp if there was an open switch in the circuit?**

Voltmeter

Voltmeter

- The voltmeter measures the voltage of the circuit
- We will discuss this in another lesson

Ammeter

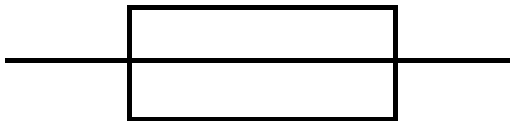
Ammeter

- The ammeter measures the current in the circuit
- We will discuss this in another lesson

Resistor

- A resistor can change the amount of current in a circuit

Fuse



- A fuse is a safety device
- When the current is too high, the fuse breaks

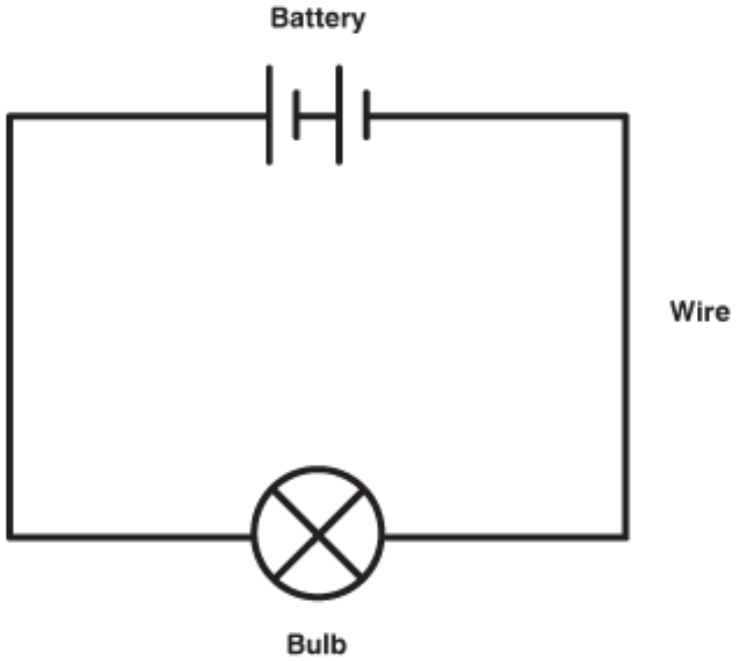
Motor

Motor

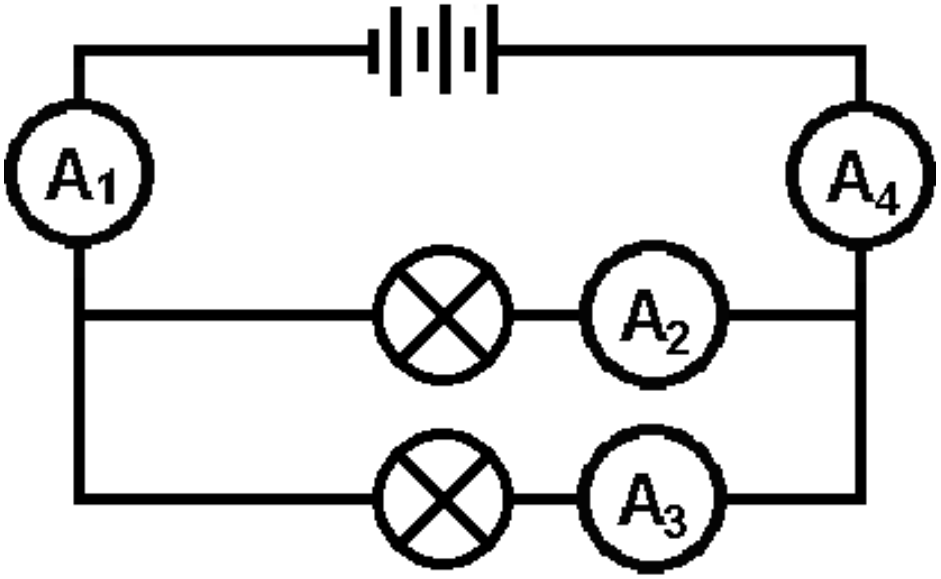
- A motor can be fitted into a circuit
- **What do you think happens to a motor in a complete circuit?**

Circuit Diagrams

- An easy way to draw a circuit is with a circuit diagram



Current in Parallel Circuits



A_1 = _____ Amps

A_2 = _____ Amps

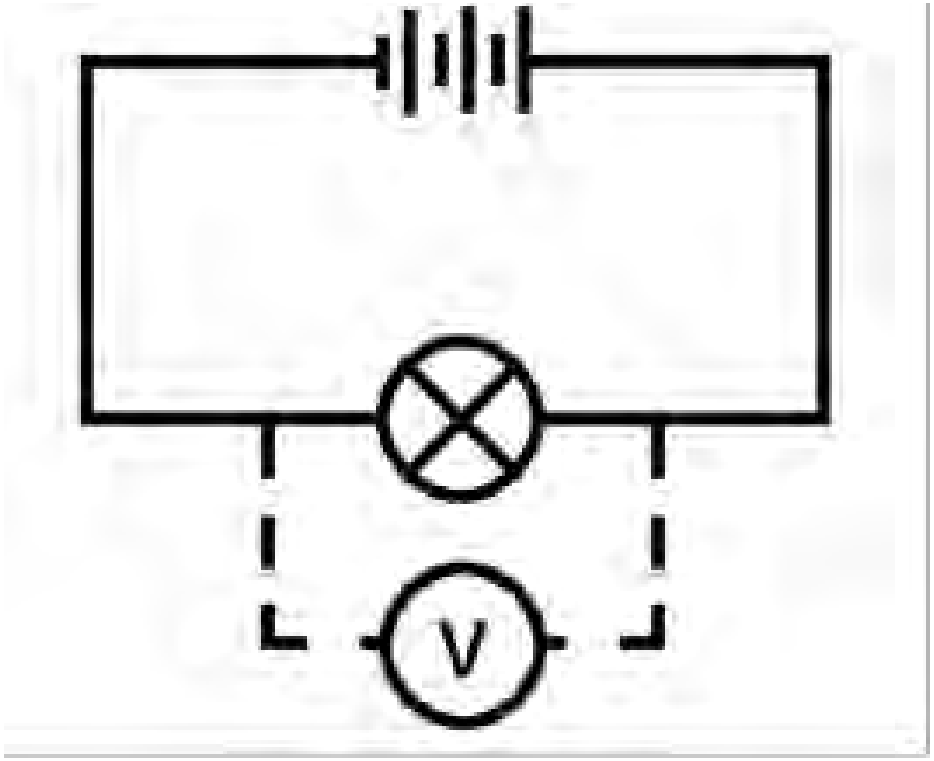
A_3 = _____ Amps

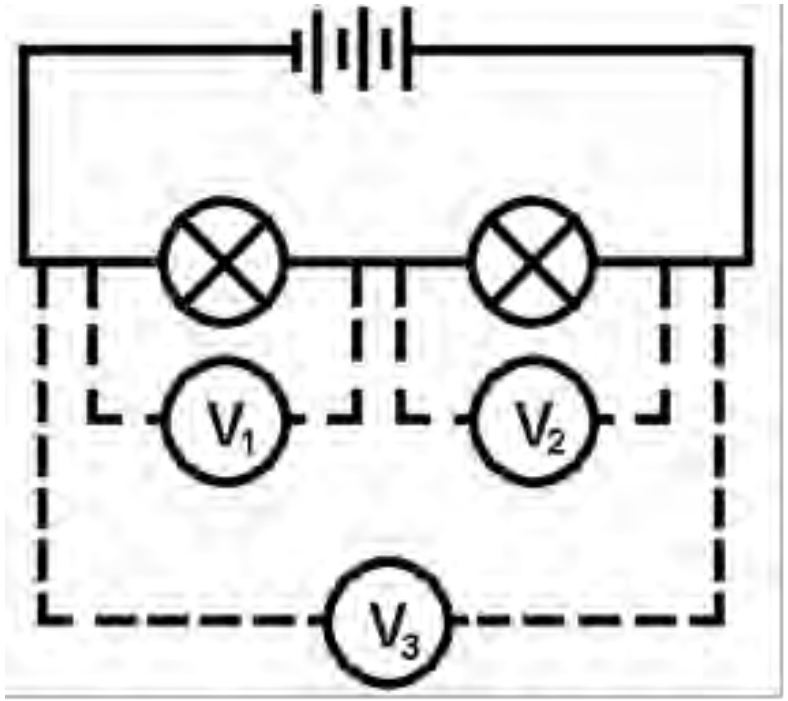
A_4 = _____ Amps

What have you found out about the current in a parallel circuit?

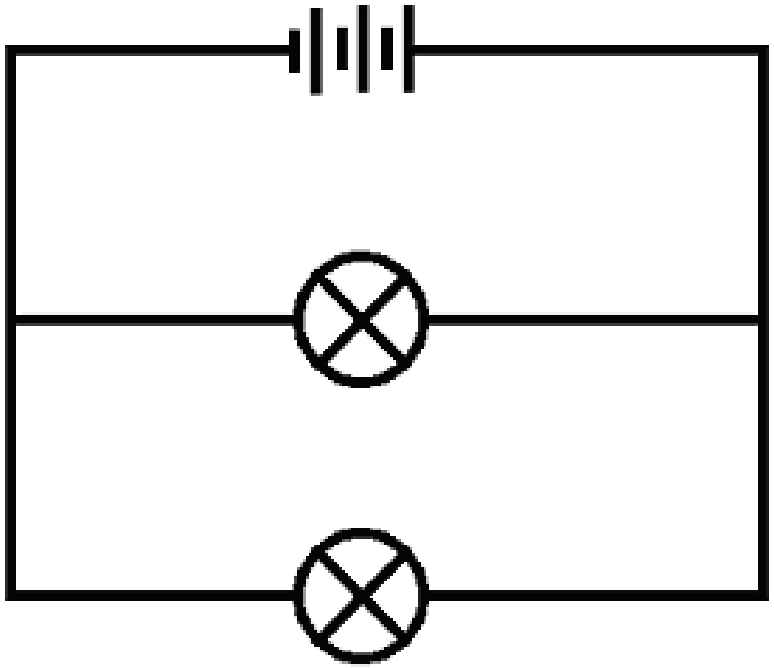
(Remember to compare your results to your findings for your series circuits)

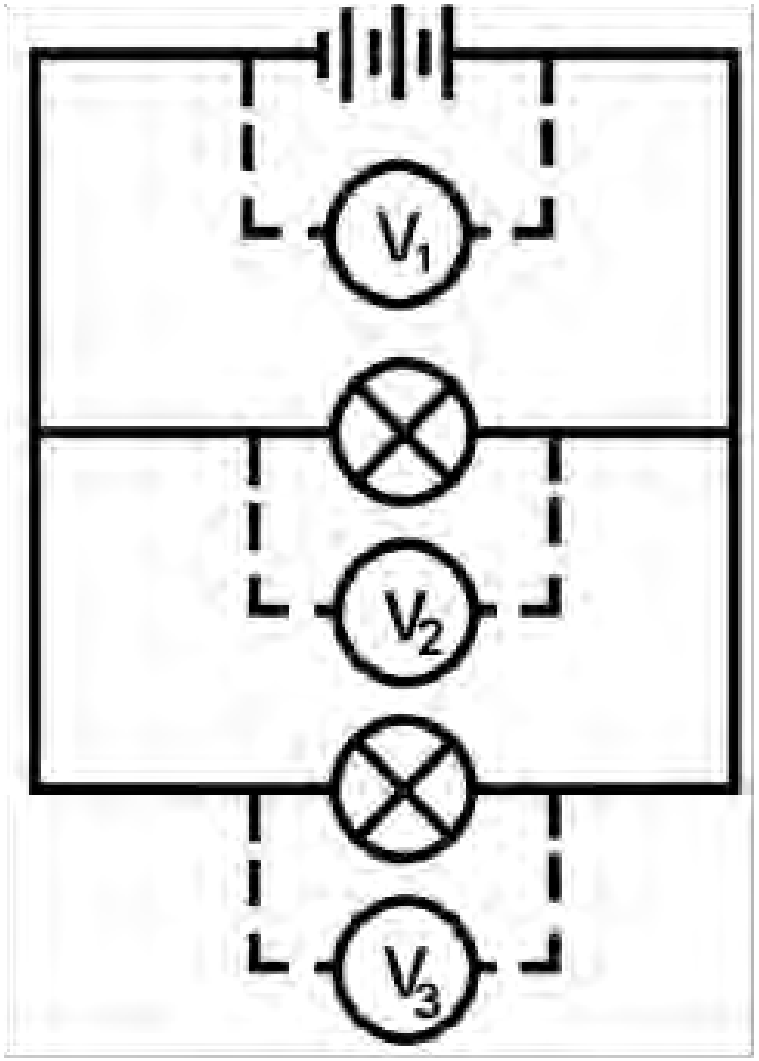
Voltage in Series Circuit





Voltage in Parallel Circuit





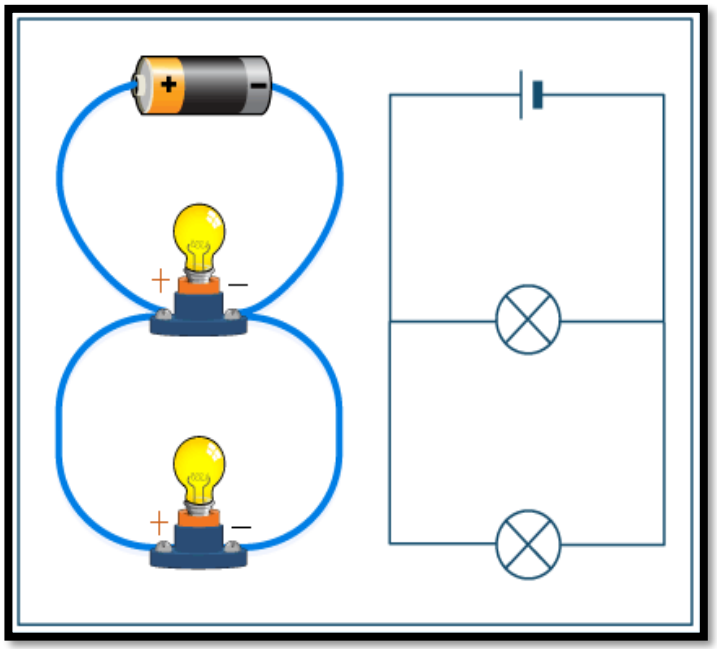
Series vs Parallel Chart

	Series	Parallel
Voltage (V)	$V_{tot} = V_1 + V_2 + V_3 \ldots$	$V_{tot} = V_1 = V_2 = \ldots$
Current (I)	$I_{tot} = I_1 = I_2 = I_3$	$I_{tot} = I_1 + I_2 + \ldots$

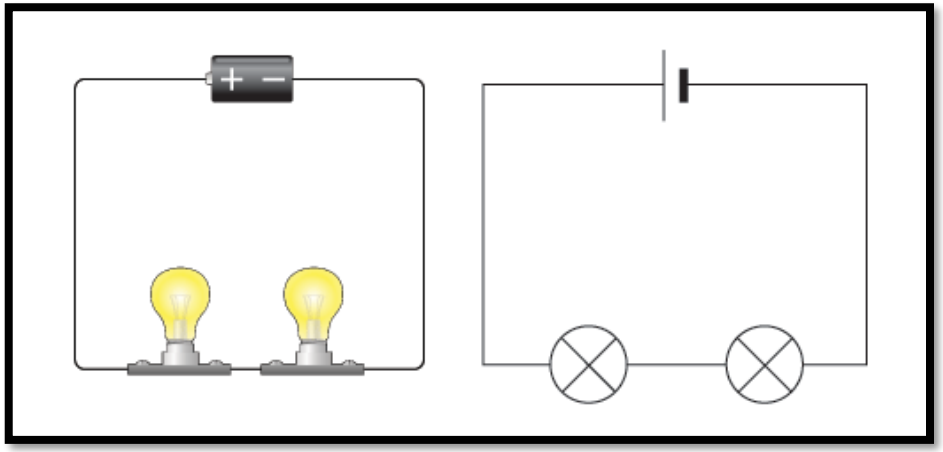
Series vs Parallel Chart

	Series	**Parallel**
Voltage (V)	Add	Same
Current (I)	Same	Add

Series vs. Parallel



PARALLEL



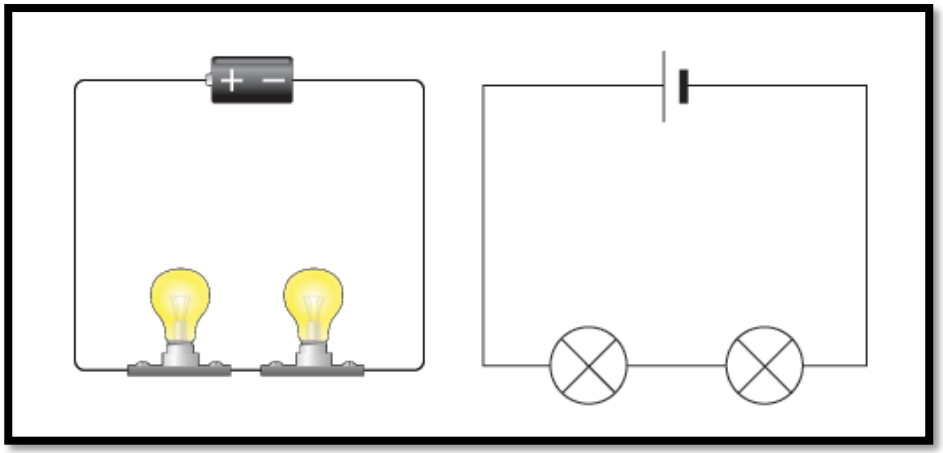
SERIES

Same number of bulbs and batteries, but what is the difference?

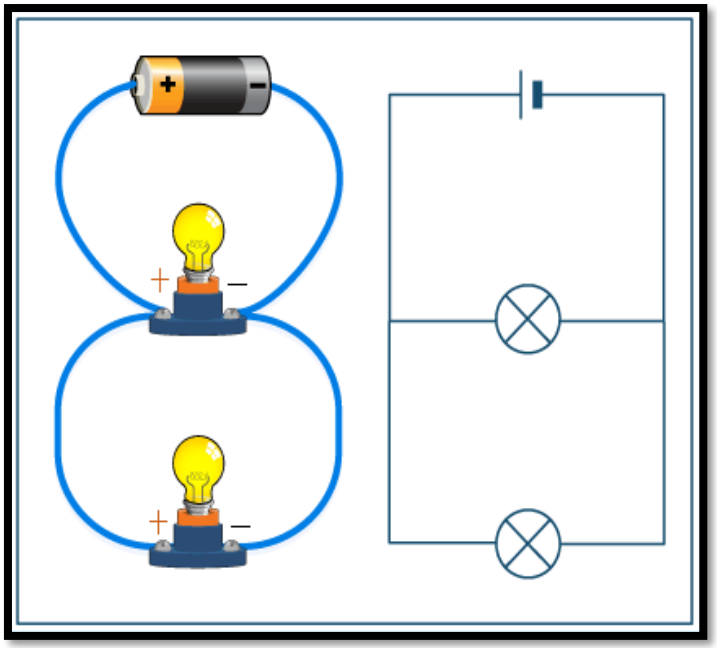
Think – pair – share

Series vs. Parallel circuits

Current is the flow of electrons



Current is the same across the bulbs

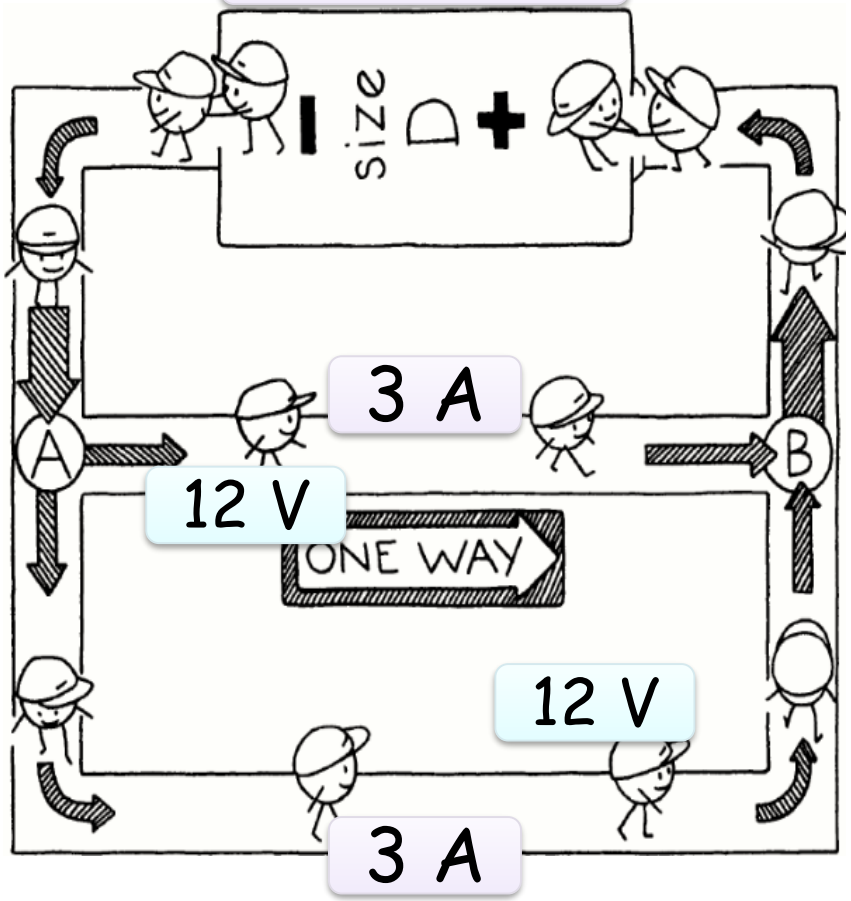


Current is different across bulbs

Why is it different?

Current and Voltage in Parallel

12 V; 6 A



6 A

3 A

12 V

12 V

3 A

A

Current splits equally at the **junction**

B

Current joins back together

Each electron has 12V!

Gwaith Dosbarth

Electricity and Resistance

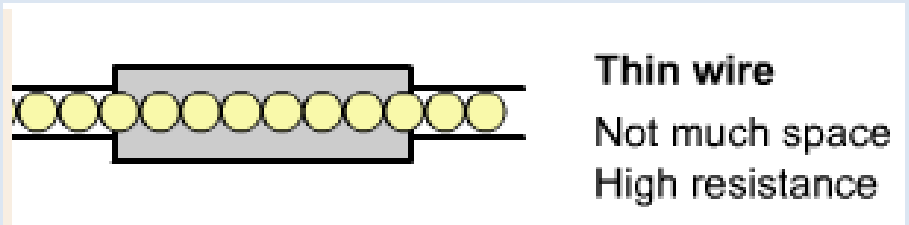
Learning Objective

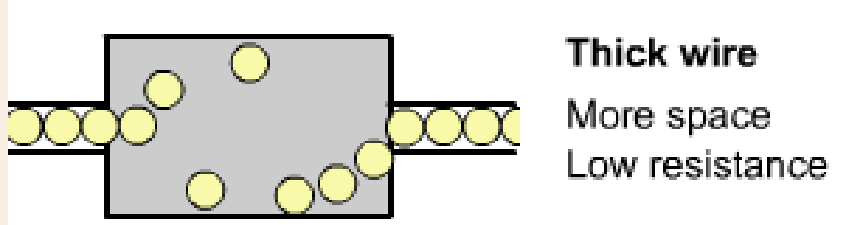
- To know how the brightness of a bulb can be changed.

Resistance

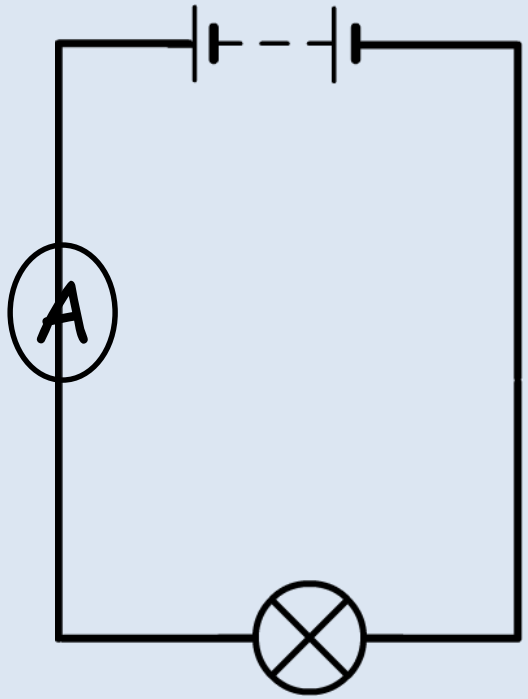
- **Resistance** is how hard it is for a **current to travel** through a component in a circuit, at a particular voltage.

Basically – it is how difficult it is for the current to flow.



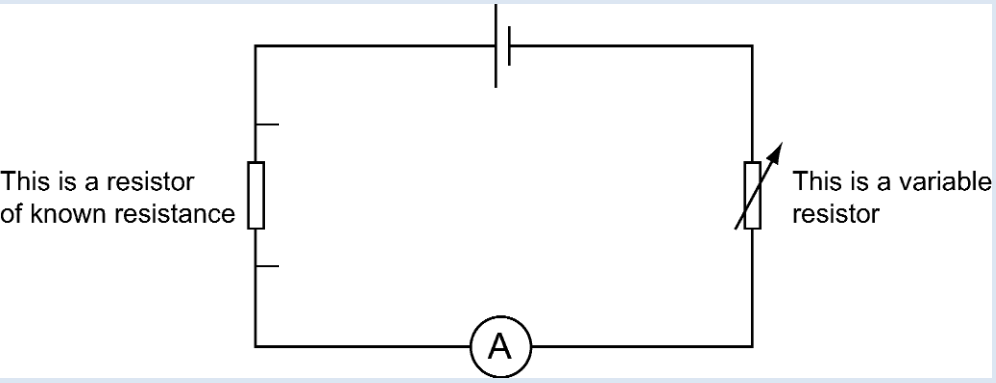


Current and Resistance



1. Make the simple circuit, and write the Ammeter reading for the bulb.
2. Add a second bulb, and take the ammeter reading for the circuit.
3. Repeat this for up to 4 bulbs.
4. Write the current reading into a table. You will need to draw this up first.

How Does Current Change with Resistance?



Change the current 7 times by moving the variable resistor. Record the current and the position in a table of results.

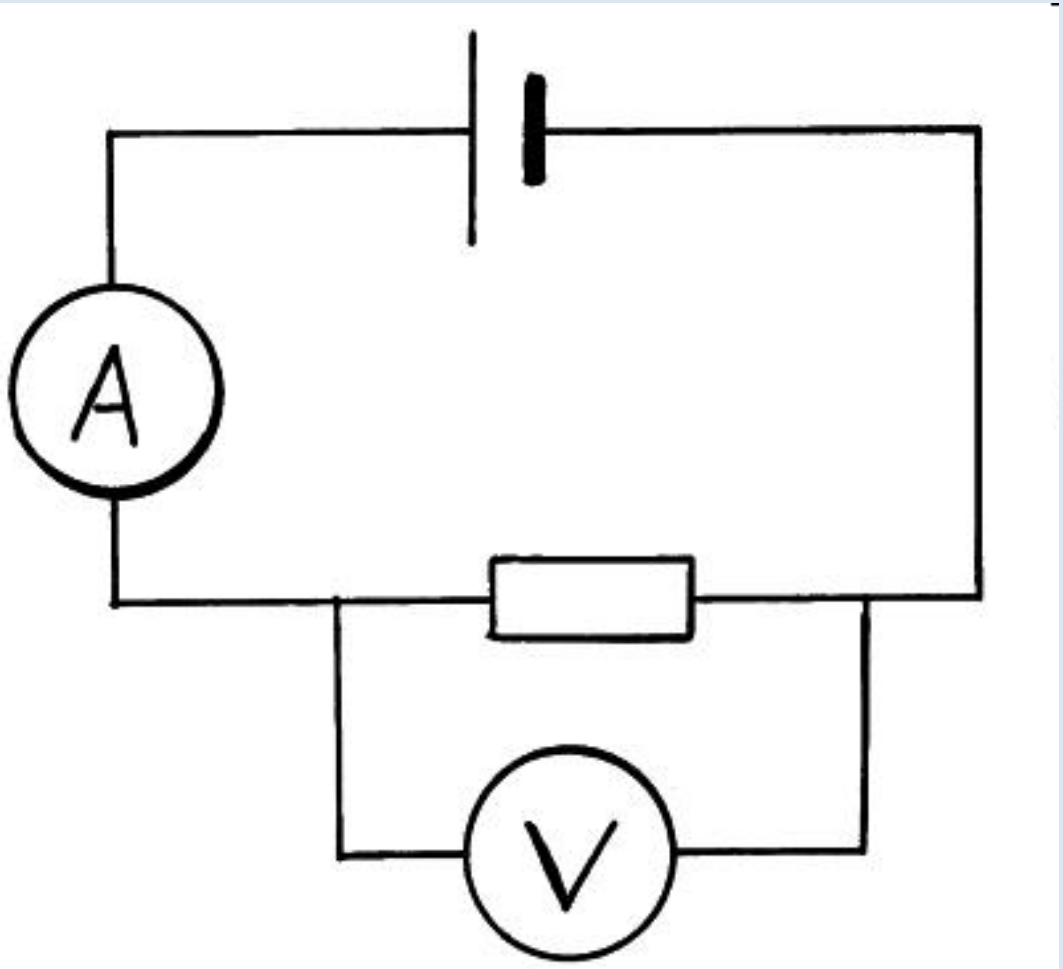
Plot a graph of your results on some graph paper.

Distance (cm)	Current (A)
0	
2	
4	
6	
8	
10	
12	

Hinge Quiz

1. Adding more bulbs increases the ….?
2. More bulbs reduces the ……?
3. When the resistance is high the current is ……?
4. When current is high it means the resistance is……?

The Standard Measuring Circuit



Ohm's Law

$$R = V / I$$

Georg Simon Ohm (1787-1854)

I = Current (Amperes) (amps)

V = Voltage (Volts)

R = Resistance (ohms)

OHM's LAW

- Measure the current and voltage across each circuit.
- Use Ohm's Law to compute resistance

Voltage /V	Current /A	Resistance /Ω