
Chapter 6.1:
Forces

Making Things Move

Very often, we want to make something move, for example:

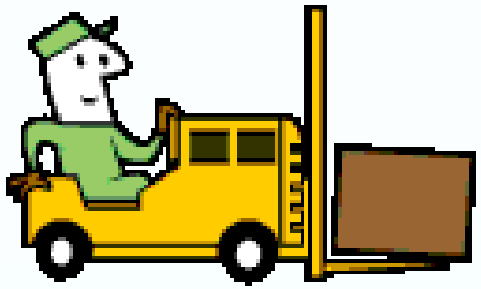
Opening a door
Opening a drawer

To open a drawer, we must pull, to open a door, we must push or pull. Pushes and pulls are called forces. You cannot see a force but often you can see the effect.

Forces

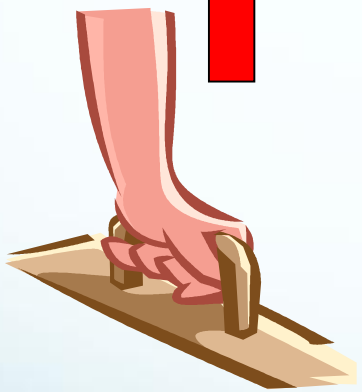
- **A force is a push or a pull.**
- **It makes an object at rest move.**
- **It makes an object which is moving change direction, speed or shape.**

Ex:



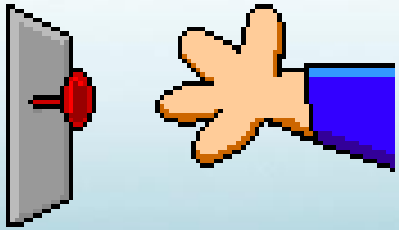
600N

30N



10N

5N



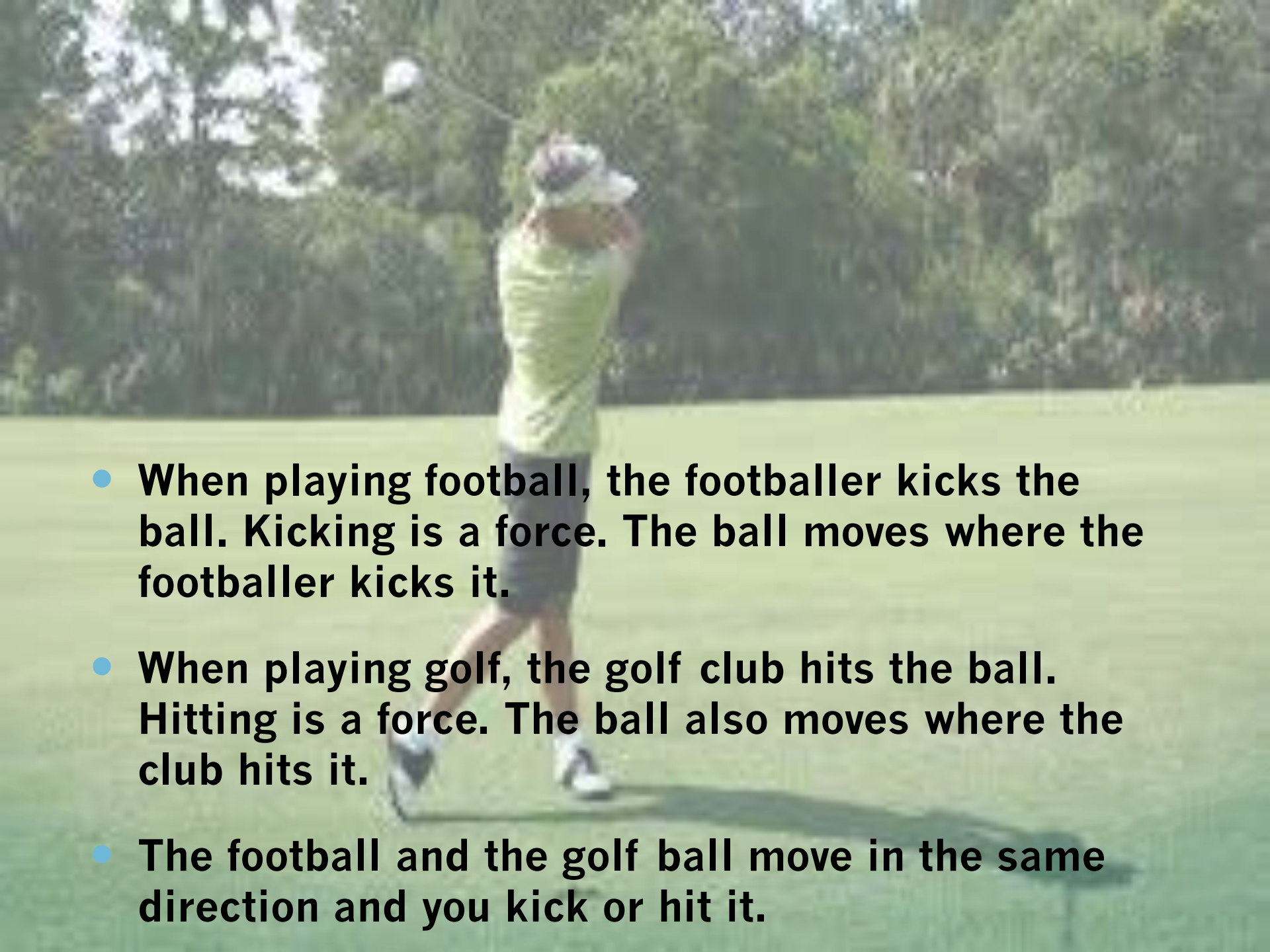
Forces

There are 2 types of forces:

1) **Contact forces**

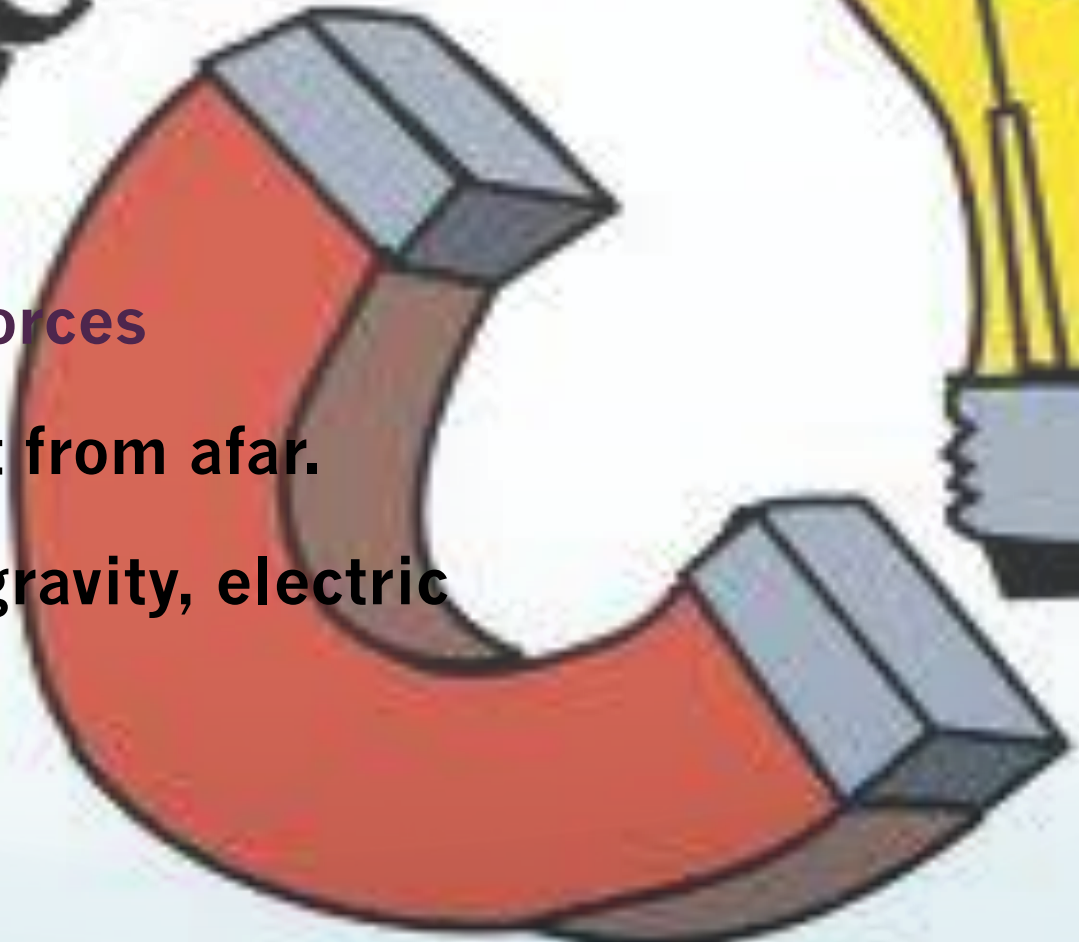
An object makes something happen when it touches it.

Ex: kicking a ball, lifting a chair, opening a door.



- When playing football, the footballer kicks the ball. Kicking is a force. The ball moves where the footballer kicks it.
- When playing golf, the golf club hits the ball. Hitting is a force. The ball also moves where the club hits it.
- The football and the golf ball move in the same direction and you kick or hit it.

Magnetism & Electricity



2) Non contact forces

The force can act from afar.

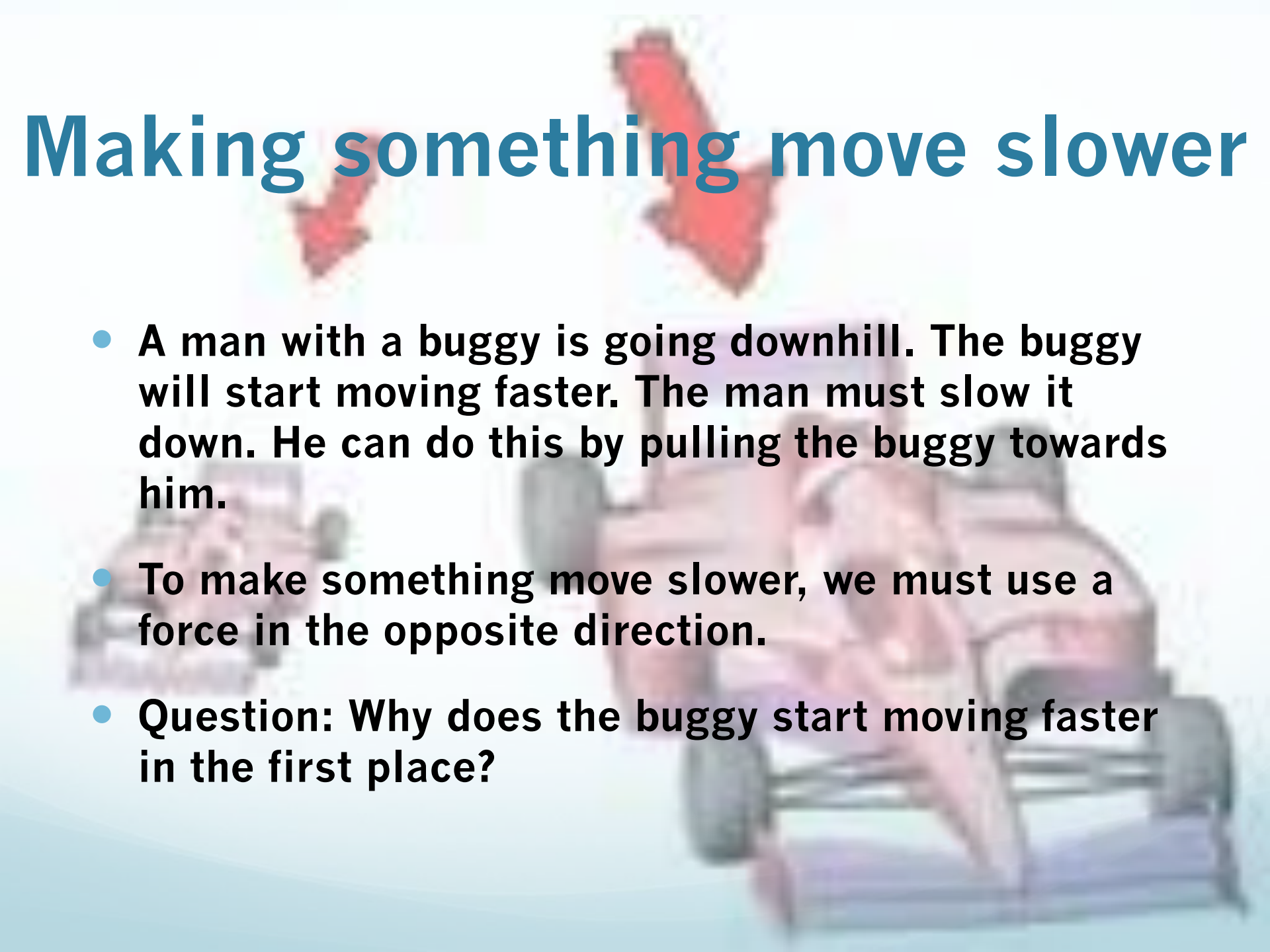
Ex: magnetism, gravity, electric force

Making something move faster

- If the golf club hits the ball strongly, the ball moves faster. The force (hitting) is bigger, the ball moves faster.
- To make something move faster, we must use a bigger force in the same direction.

Question: When playing football, how can you make the ball move faster?

Making something move slower



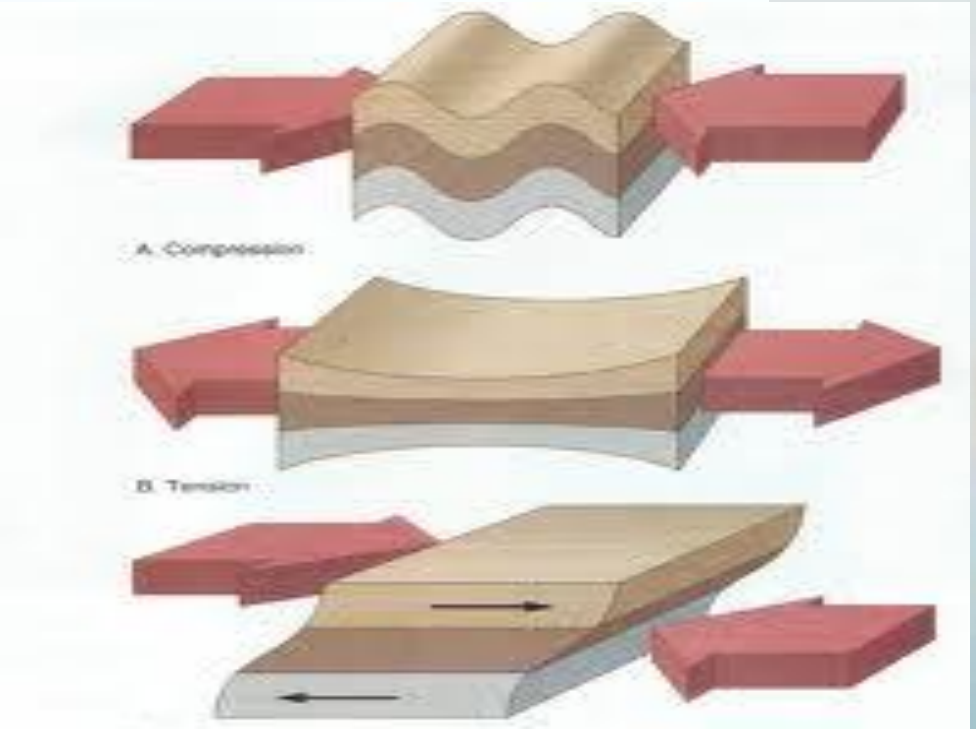
- A man with a buggy is going downhill. The buggy will start moving faster. The man must slow it down. He can do this by pulling the buggy towards him.
- To make something move slower, we must use a force in the opposite direction.
- Question: Why does the buggy start moving faster in the first place?

Making things change direction

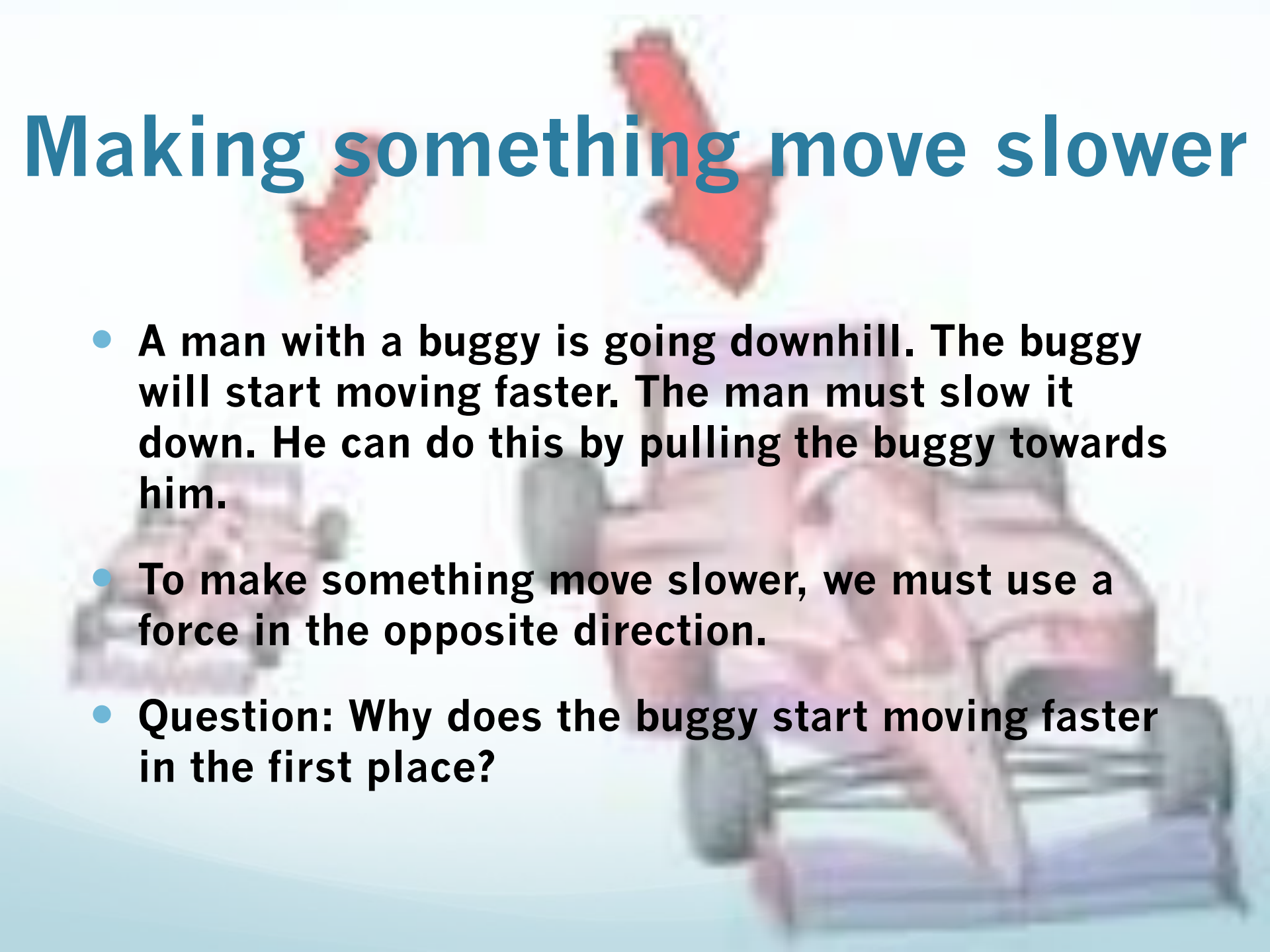
- **While playing tennis, a player must use the racquet to hit the ball and send it flying in another direction.**
- **To make something change direction, we must use another force in a different direction.**

Making things change shape

- **A force will also make an object change its shape. Example: squashing a can.**



Making something move slower



- A man with a buggy is going downhill. The buggy will start moving faster. The man must slow it down. He can do this by pulling the buggy towards him.
- To make something move slower, we must use a force in the opposite direction.
- Question: Why does the buggy start moving faster in the first place?

A force is a push or a pull.

It can cause an object at rest to move, or it it is already moving, it can change its speed or direction of motion

Examples of Forces in Everyday Life

- **You can use a pushing force to move a trolley.**

Examples of Forces in Everyday Life

- **In a tug of war, you use a pulling force. If both teams pull with the same force, there is no movement.**

Examples of Forces in Everyday Life

- **You normally use a push and a pull to turn the handlebars of your bicycle.**

Examples of Forces in Everyday Life

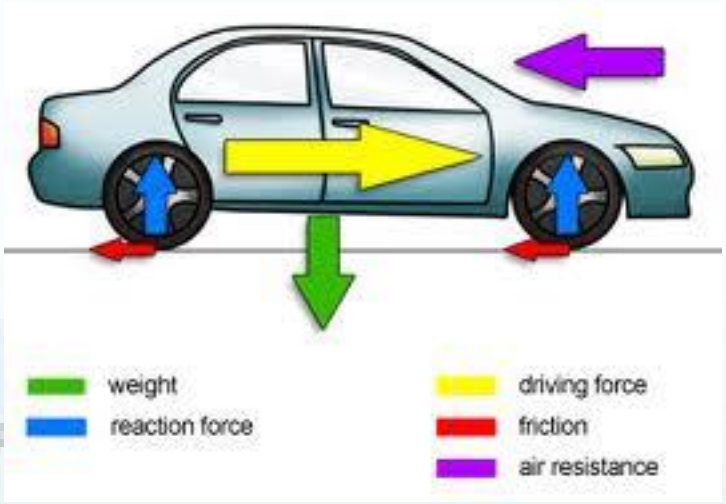
- **A strong man can produce a big enough force to stretch a chest expander or squash a can out of shape.**

Examples of Forces in Everyday Life

- **The force from a tennis player's racquet can change the direction in which the ball is travelling.**

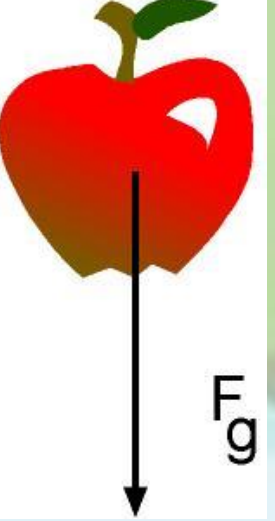
Examples of Forces in Everyday Life

- **The force produced by a car engine makes the car begin to move, then speed up. A force from the brakes can slow it down and then stop it.**



Measuring Forces

- Force can be measured using a force meter.
- A force meter contains a spring connected to a metal hook. The spring stretches when a force is applied to the hook. The bigger the force applied, the more the spring stretches and a result, the larger the reading.
- The unit of force is the **Newton**, and it has the symbol N. So, 100N is a bigger force than 5N.



Gravity

- Gravity of the force that pulls everything towards the centre of the Earth.
- The bigger the object, the bigger the force of gravity.

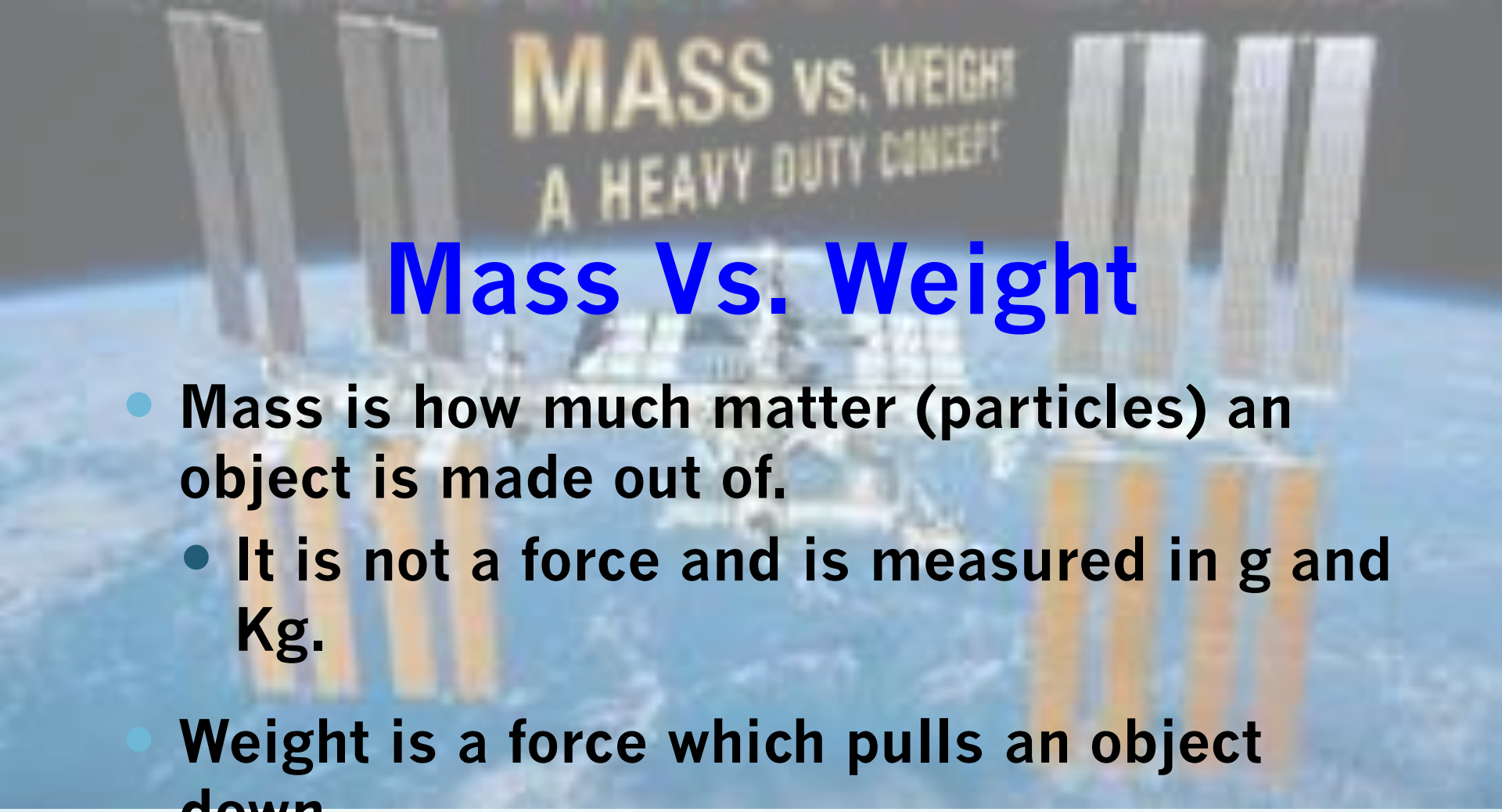
Examples:

On Jupiter, the force is 25 times larger than the force on Earth.

On the moon, the force is 1/6 the size of that on Earth.

Weight

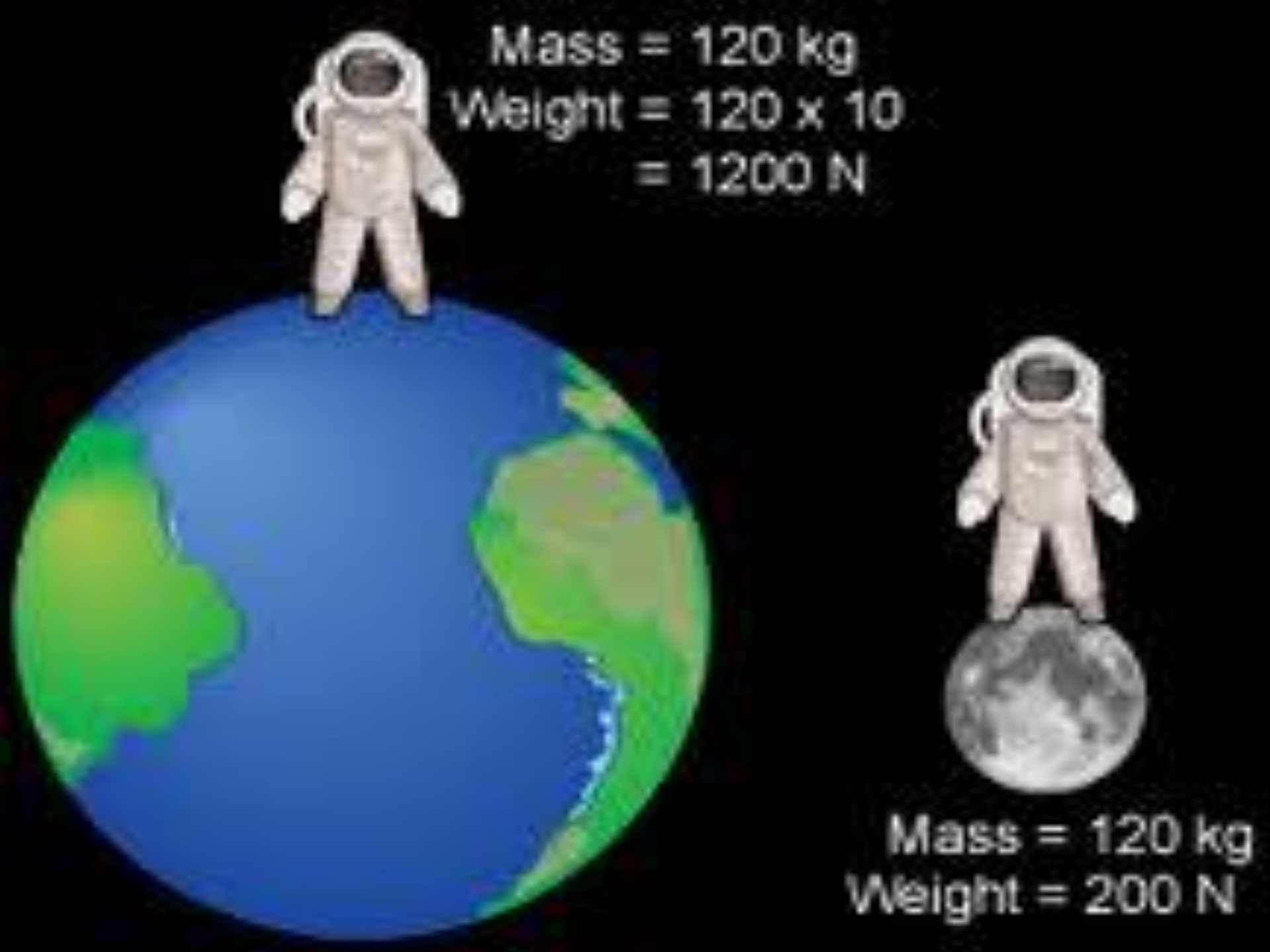
- The Earth pulls all objects downwards because of the pull of gravity.
- The downward force is called weight, which like all other forces, is measured in Newtons.
- On Earth, an object with a mass of 1Kg has a weight of 10N. How much would an object with a mass of 26.5Kg weigh?



Mass Vs. Weight

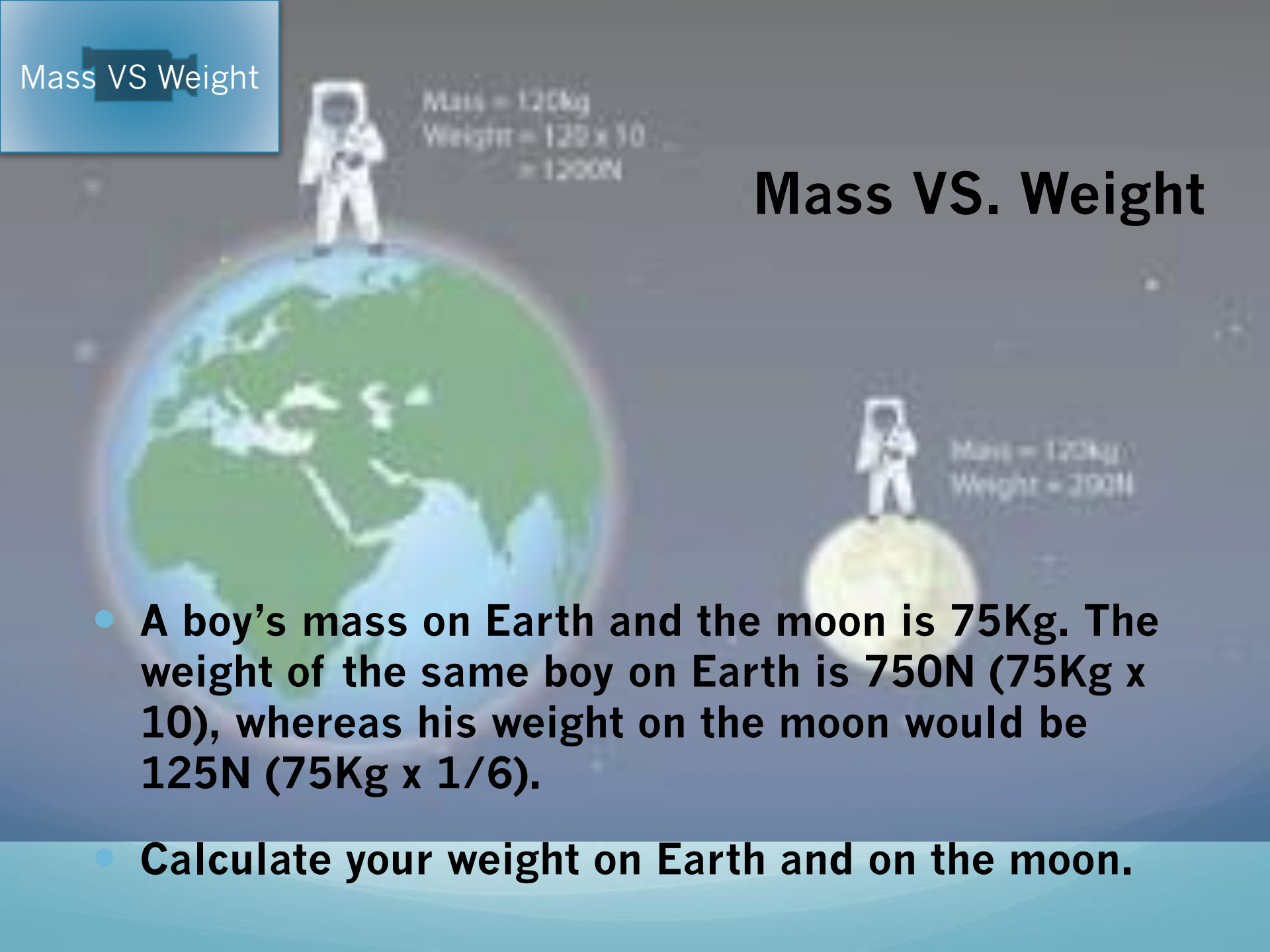
- Mass is how much matter (particles) an object is made out of.
  - It is not a force and is measured in g and Kg.
- Weight is a force which pulls an object down.
  - It is measured in Newtons

Weight = Mass x Force of Gravity (w = mg)


Mass = 120 kg
Weight = 120 x 10
= 1200 N
Mass = 120 kg
Weight = 200 N

- **The pull of gravity on the moon is smaller than that on Earth. The force of gravity on the moon is 1/6 that of Earth. Things feel lighter on the moon because the pulling force downward is smaller. Things on the moon and Earth will have the SAME mass as they have the SAME number of particles.**

Mass VS. Weight



- A boy's mass on Earth and the moon is 75Kg. The weight of the same boy on Earth is 750N (75Kg x 10), whereas his weight on the moon would be 125N (75Kg x 1/6).
- Calculate your weight on Earth and on the moon.

Important

Weight = Mass x Gravity (10)

Example: Convert 10Kg to weight:

Weight = Mass x Gravity

Weight = 10Kg x 10

Weight = 100N

Remember:

Kg ➔ g: x 1000
G ➔ Kg: ÷ 1000

Mass and Weight

Convert the following masses into weight:

1) 1Kg
2) 5Kg
3) 120Kg
4) 340Kg
5) 5000g
6) 9500g
7) 6750g
8) 8690g

1) 10N
2) 50N
3) 1,200N
4) 3,400N
5) 50N
6) 95N
7) 67.5N
8) 86.9N

Mass and Weight

Convert the following weights into mass:

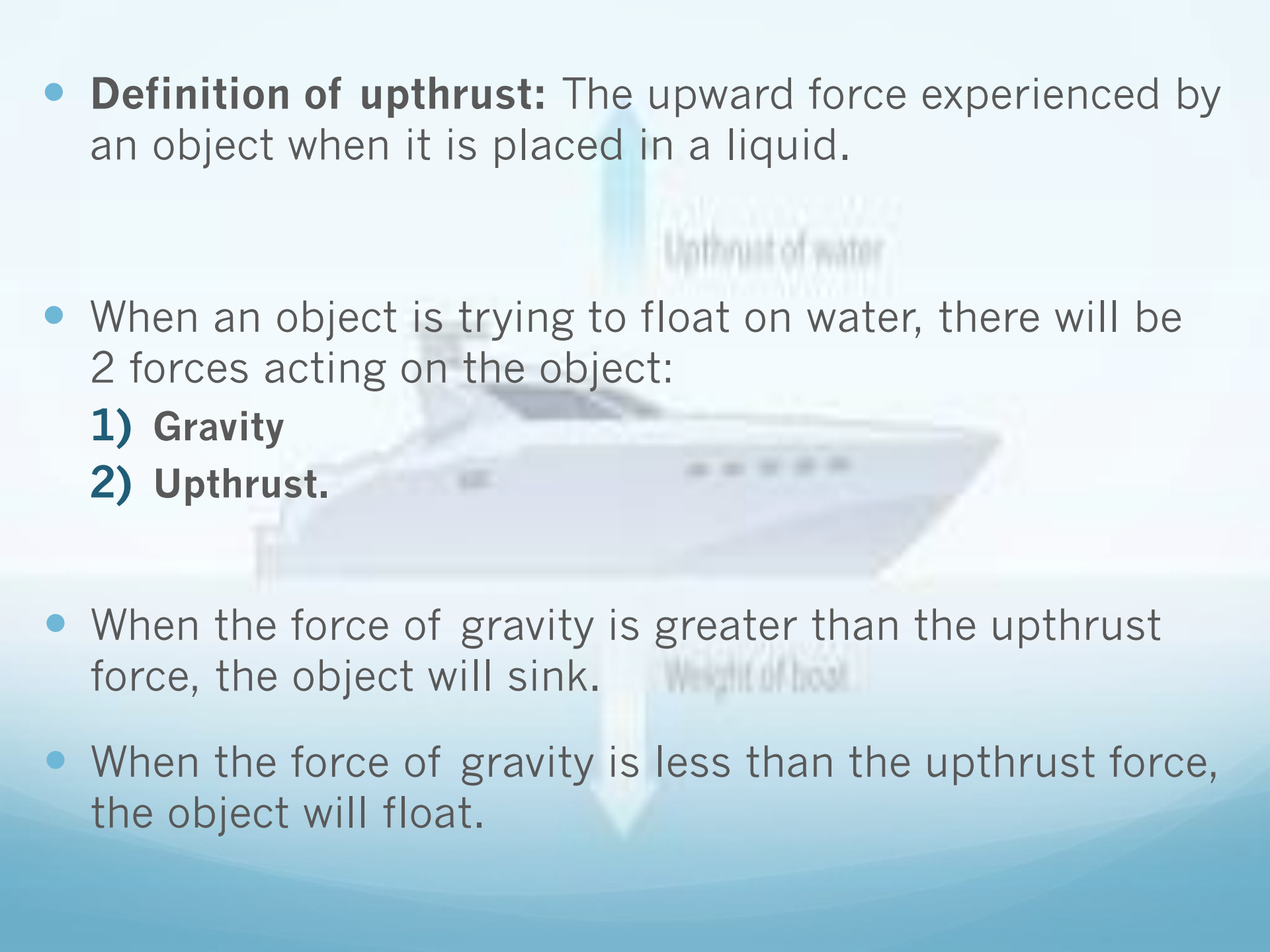
1) 10N
2) 200N
3) 500N
4) 1500N
5) 6500N
6) 7500N
7) 9670N
8) 8650N

1) 1Kg
2) 20Kg
3) 50Kg
4) 150Kg
5) 650Kg
6) 750Kg
7) 967Kg
8) 865Kg

Upthrust

Imagine a boat on the water. Gravity pulls it down, but it stays on top of the water. The boat does not sink because of an upward force called upthrust which is equal to the weight of the boat.

- **Definition of upthrust:** The upward force experienced by an object when it is placed in a liquid.



- When an object is trying to float on water, there will be 2 forces acting on the object:
  1) **Gravity**
  2) **Upthrust.**

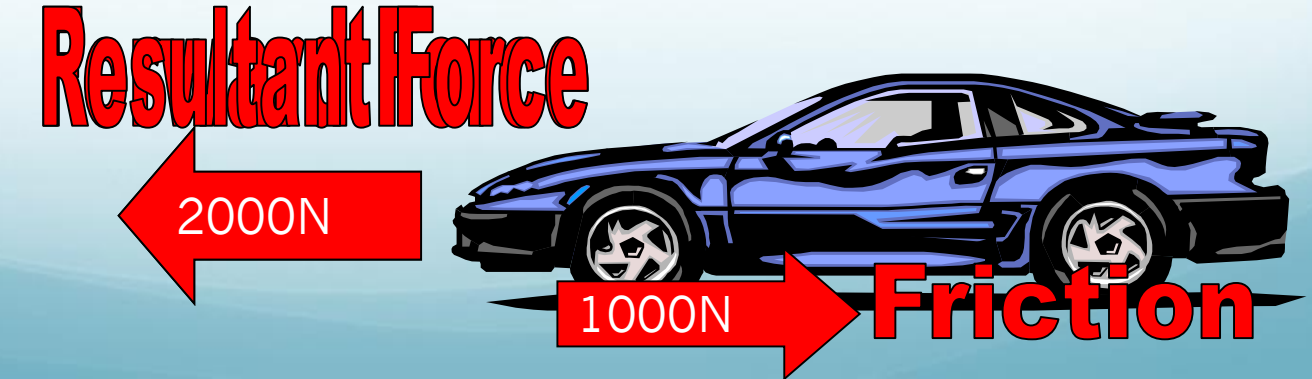
- When the force of gravity is greater than the upthrust force, the object will sink.
- When the force of gravity is less than the upthrust force, the object will float.

Why does an object feel lighter in water?

When an object is on land, only gravity will be acting on it. When an object is in water, there will be two forces acting on it: upthrust and gravity. The upthrust force helps to push the object upwards, working against the force of gravity. As a result, the object feels lighter.

It is that force which opposes the motion of an object moving along a surface.

Friction



Friction

- The force that is exerted when two things rub together.
- Moving things often slow down by themselves. This happens because friction is acting on them.
- Friction opposes motion and it arises because the surfaces are not totally smooth. In fact, every surface has microscopic grooves.
- When two objects touch, the grooves fit inside each other and grip one another.

Example: Shoes touching the floor.

Friction

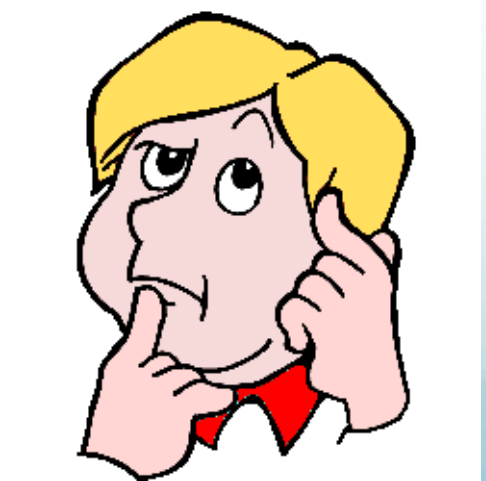
The force that moves the bike forward is coming from pedalling. This makes the bike move.

The tyre creates a friction force with the ground.

Friction is a force that ALWAYS acts in the OPPOSITE direction of motion of an object.

Question

- What happens to the bicycle if we stop pedalling?
- What can we do to stop the bike from slowing down?



Advantages of Friction

- Allows us to move, walk and run.
- Allows us to hold on to objects.
- Allows cars and vehicles to stop when brakes are applied.

Disadvantages of Friction

- Too much friction → movement would not happen.

Example: Too much friction between door and floor and hinges and door would result in the door not being able to open.

Lubricants are used to reduce friction, ex: grease and oil.


marlboro
vodafone

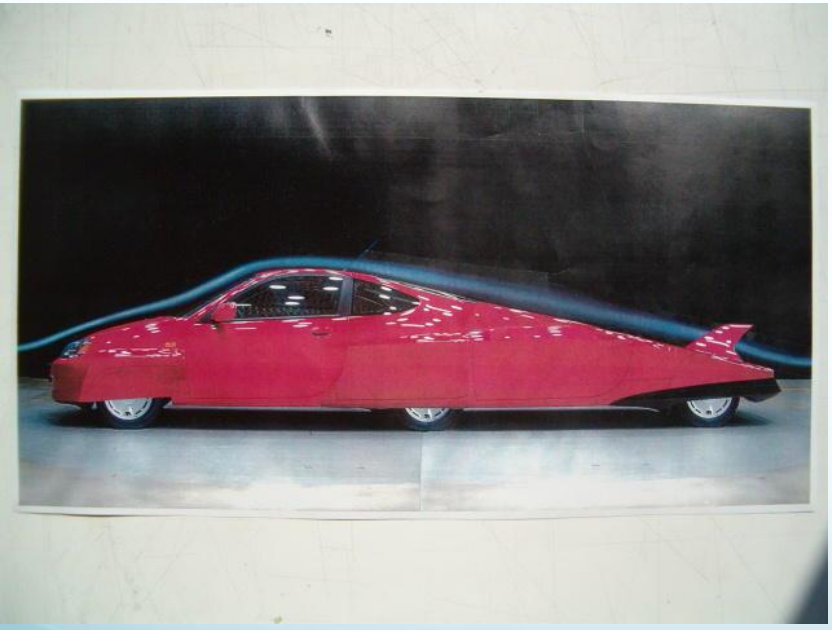

JR

Air Resistance

- Air makes friction with moving objects, and this is called air resistance.
- Water also creates friction with things moving through water, and this is called water resistance.

Decreasing Friction and Air Resistance

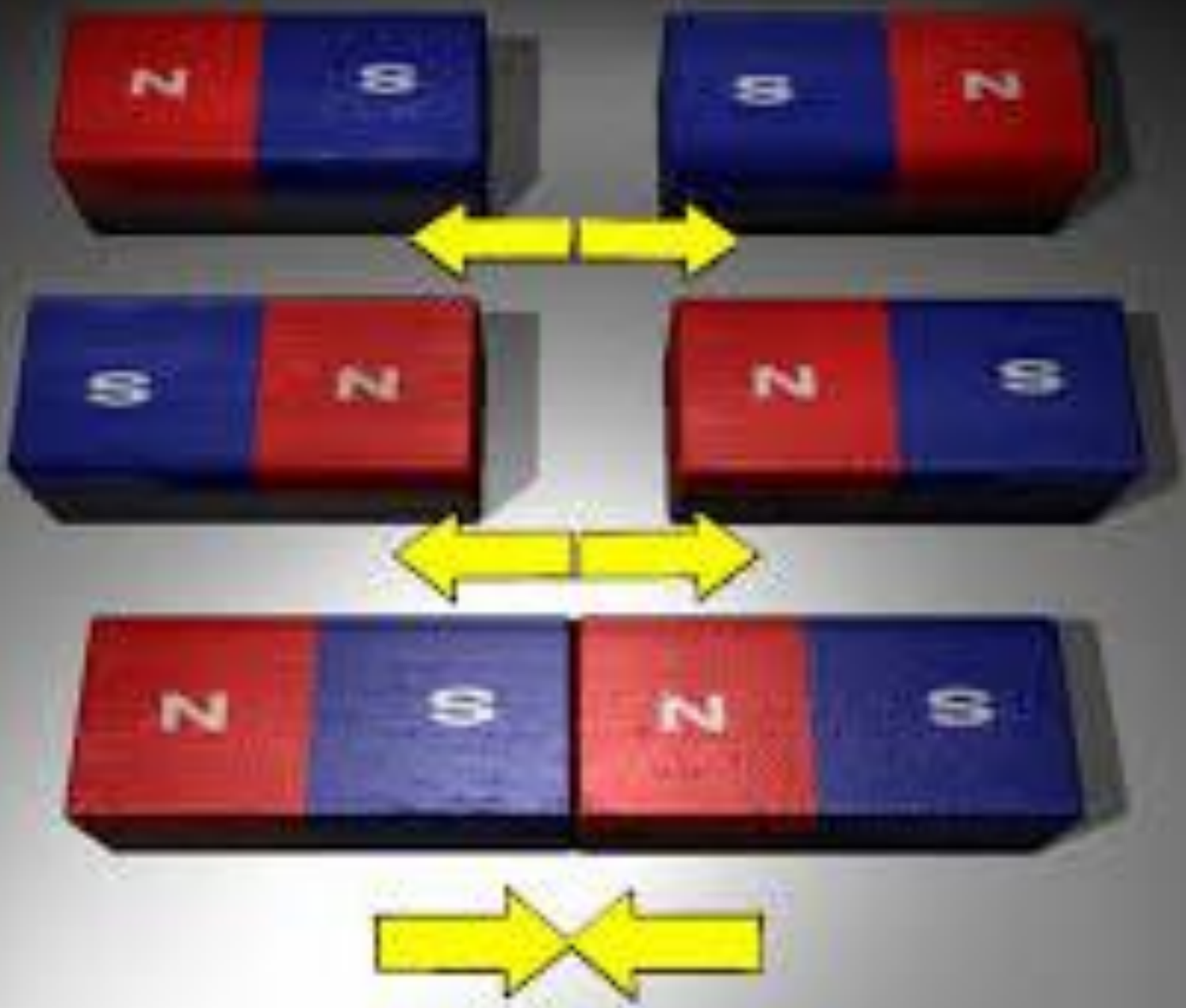
- In order to decrease friction / air resistance / water resistance, objects that need to reach high speeds have a streamlined shape.



Magnetic Force

- **Magnets are objects that produce an area of magnetic force called a magnetic field.**
- **Magnetic fields by themselves are invisible to the human eye.**
- **Each magnet has a north and a south pole.**
  - **North pole + North pole → Repulsion**
  - **South Pole + South Pole → Repulsion**
  - **North pole + South Pole → Attraction**

Different Types of Magnets


N
S
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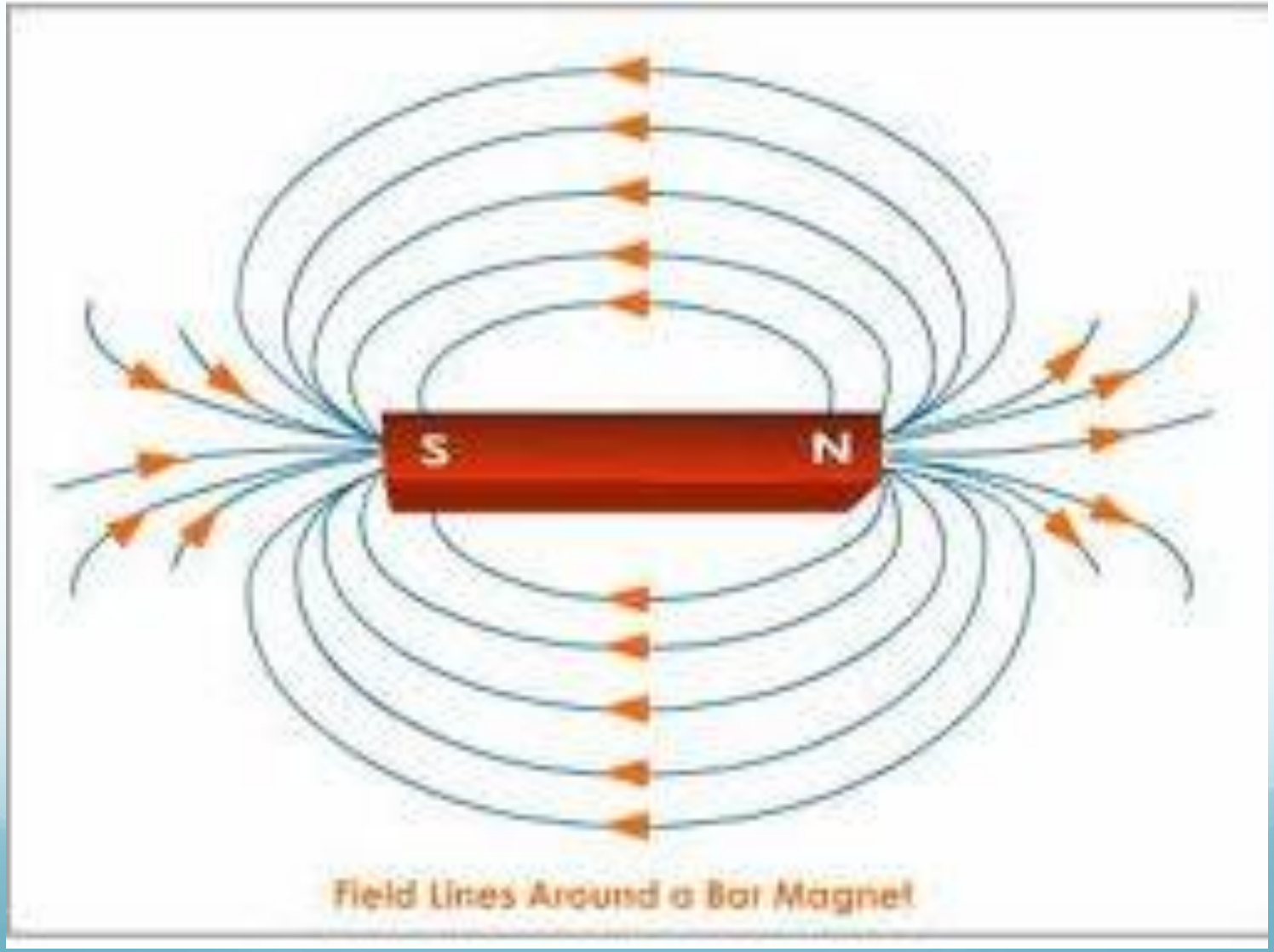
N
S

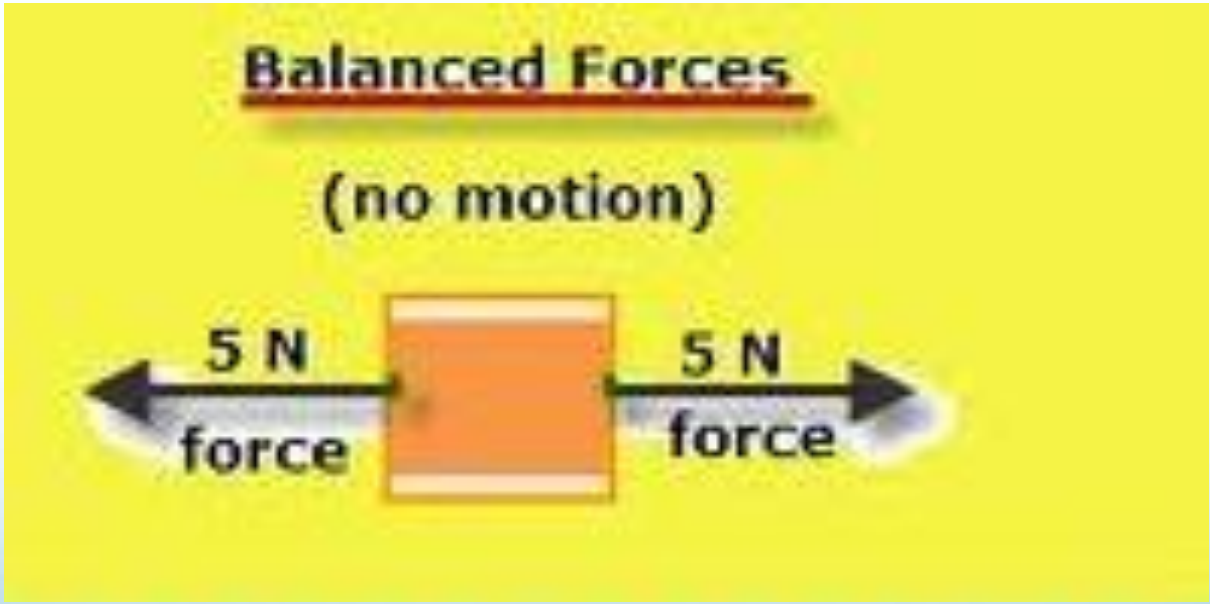
Magnetic Fields



Field Lines Around a Bar Magnet

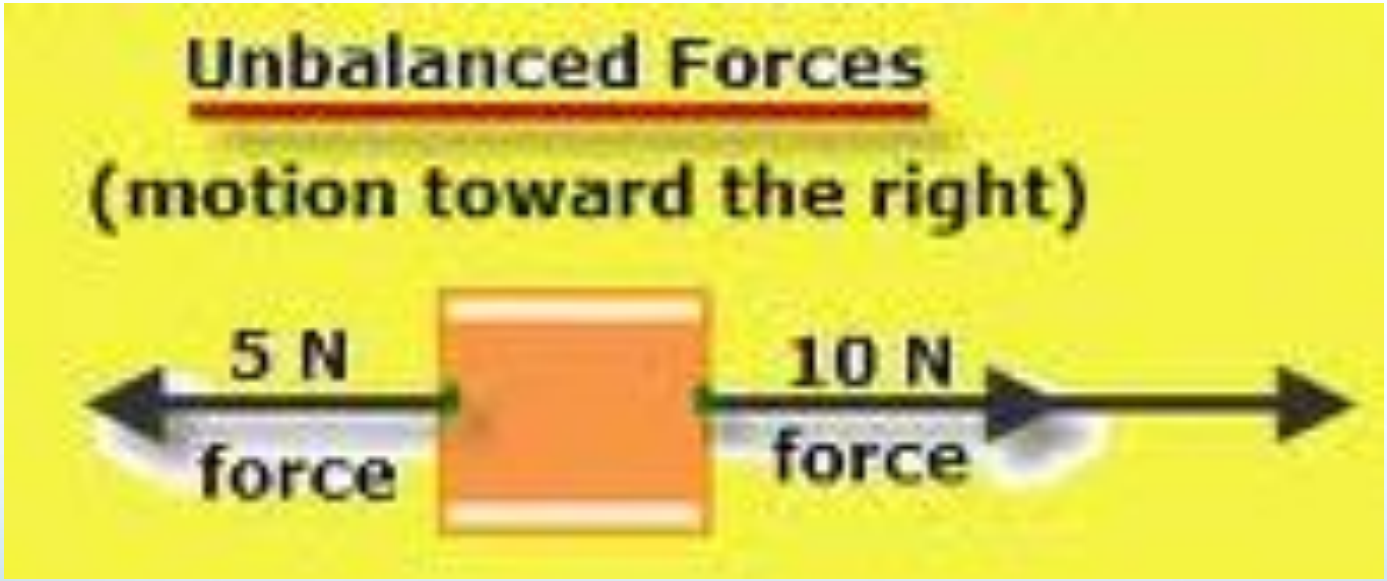
Balanced Forces

- If both equal and opposite forces are acting on an object, we say that the forces are **BALANCED**. There is no resultant force, hence **no movement**.



Unbalanced Forces

- If two opposing, unequal forces are acting on an object, we will call them **UNBALANCED** forces. A resultant force result and thus **the object moves**.



Density

- The amount of atoms / molecules found in a certain volume.
- The equation for density is:

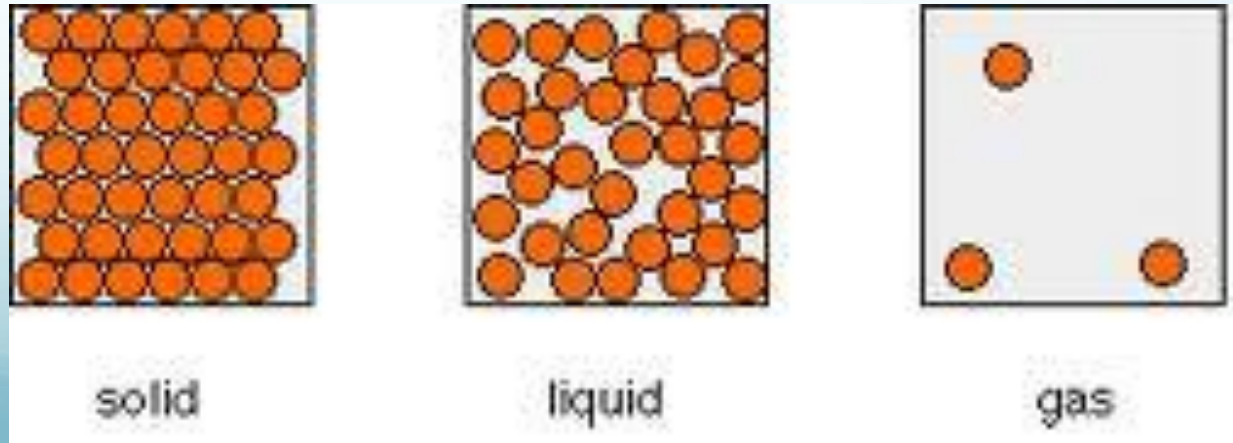
$$density = \frac{mass}{volume}$$

or, in short form:

$$d = \frac{m}{v}$$

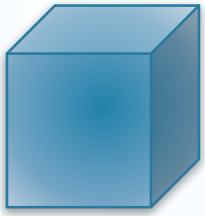
Density

- The units of density are grams per cubic centimetre, g/cm^3.
- Density can also be measured in kilograms per cubic metre, Kg/m^3.
- The arrangement of particles in solids, liquids and gases explain why gases have a low density, while solids are very dense.



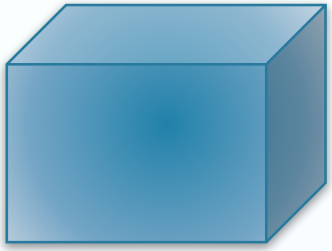
Density Examples

- Calculate the density of the following 3 cubes:



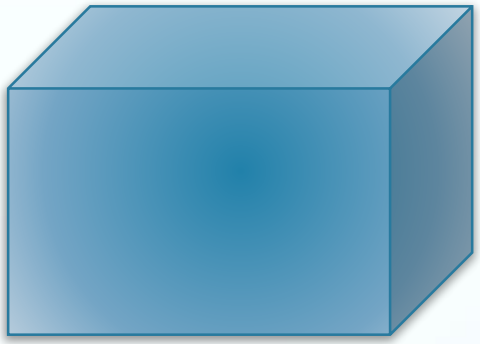
2cm

Mass = 100g



3cm

Mass = 500g



4cm

Mass = 1500g

Speed

- Speed determines how fast or how slow an object moves.

- This is a measure of how much distance is covered in a particular amount of time. It is calculated as follows:

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

Units:

Speed → m/s or Km/hr

Distance → m or Km

Time → s or hr

Formula triangle

Minutes → Seconds: x 60

Seconds → Minutes: ÷ 60

Kilometers → Metres: x 1000

Metres → Kilometers: ÷ 1000