LOCKERBIE ACADEMY

TRANSPORT UNIT

FORCES/dyanmics

S1-S3 Road Safety & PHYSICS

BACKGROUND

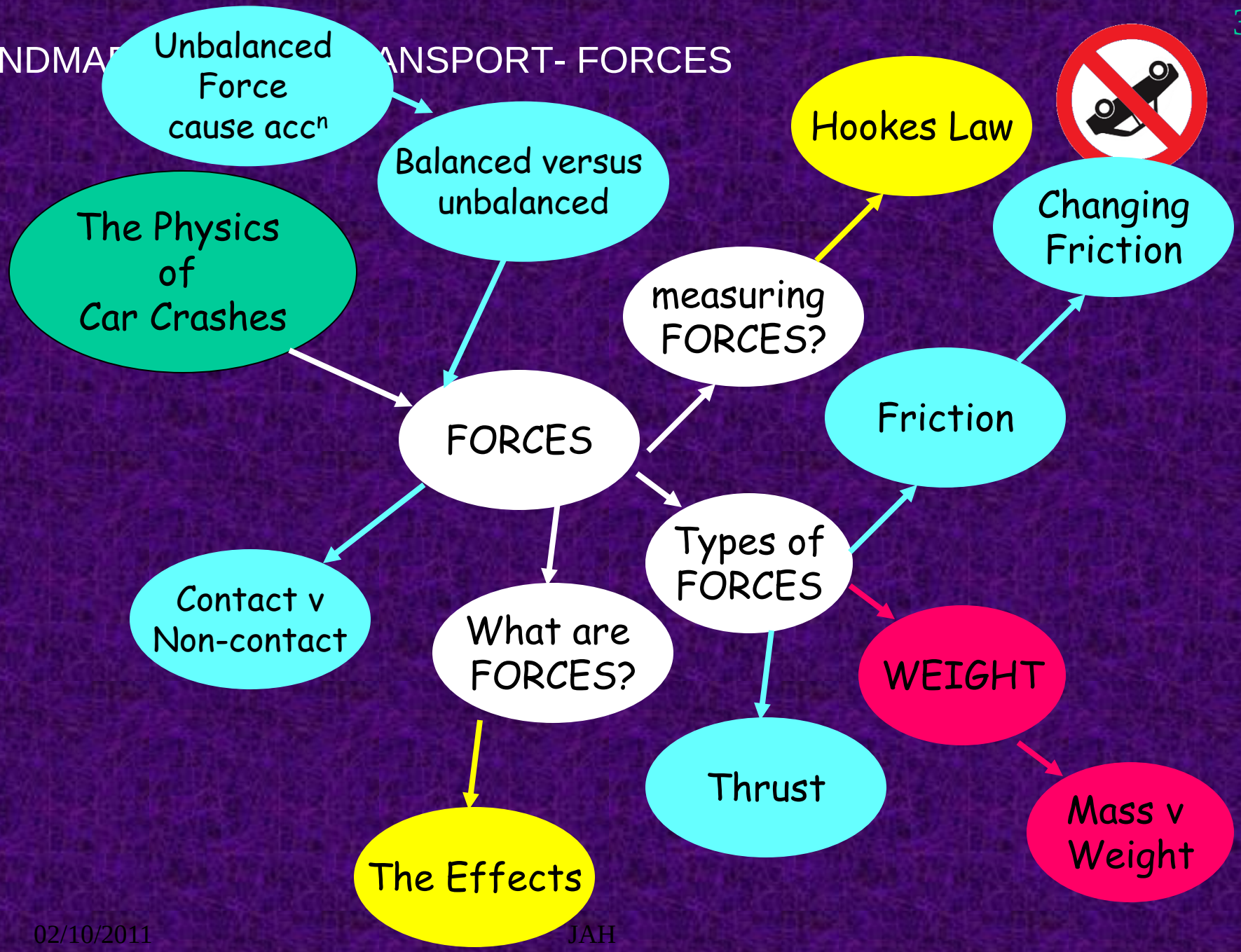
bbc news background

For an everyday activity, travelling by road is probably the riskiest thing many of us do on a regular basis.

On average, some seven people are killed every day on the roads in Great Britain. Hundreds more are injured, many of them seriously, often with life changing consequences.

In the past 10 years, the death toll has amounted to 32,298. As such road crashes are the largest single cause of accidental death for people aged between 5 and 35 years.

MINDMAP TRANSPORT- FORCES



WHAT WE WILL BE COVERING

- ✓ WHAT IS A FORCE?
- ✓ Forces around us
- ✓ EFFECTS OF A FORCE?
- ✓ Contact versus non contact forces
- ✓ MEASURING FORCES
- ✓ Balanced or Unbalanced
- ✓ The Effect of Forces investigation
- ✓ Frictions investigation
- ✓ Frictions investigation part 2

Unit plan- Continued

- ✓ Forces and speed
- ✓ forces, including
  weight, friction, upthrust,
- ✓ acceleration
- ✓ Newton's Laws of Motion
- ✓ & momentum if you can handle it!
- ✓ The Effect of Forces investigation
- ✓ Frictions investigation
- ✓ Frictions investigation part 2
- ✓ Recap

S1 Physics Transport

WORDBANK

Copy the following words into your jotter and literacy logs

Back to mind map

Which of these signs are about Forces?

WHAT IS A FORCE?

ASK A STUDENT!

- WHAT IS A FORCE?

Timer- Dr WHO

WHAT YOU THOUGHT

Forces

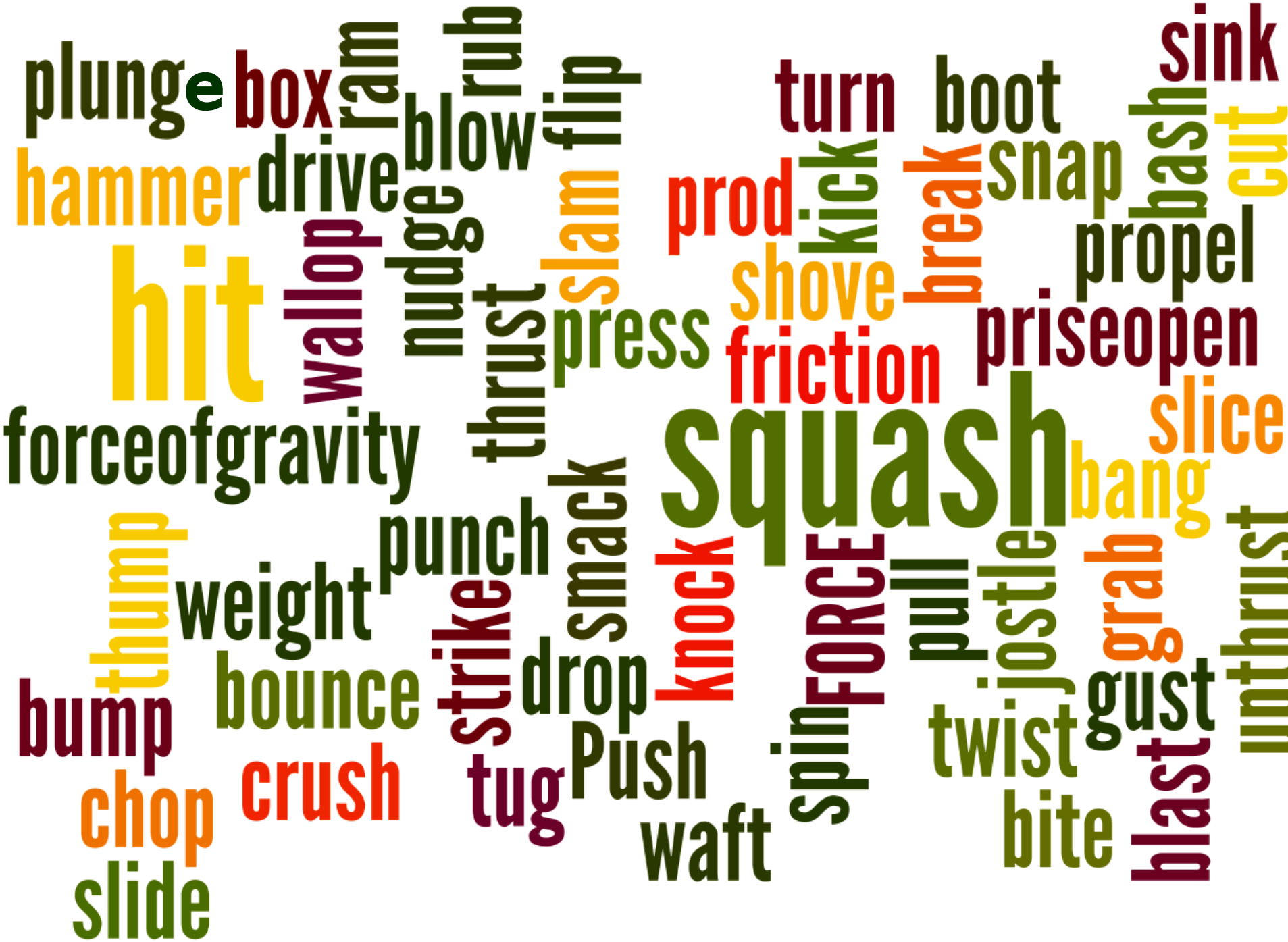
- A FORCE is a PUSH or a PULL.
- Forces can't be seen, but the effect of a force can be seen.
- They are measured in newton – N
- They always act in a certain direction
- A newtonbalance , spring balance or forcemeter is used to measure forces.

ASK A STUDENT!

- NAME SOME FORCE WORDS?

Timer- Countdown

WHAT YOU THOUGHT


plunge
box
ram
rub
blow
flip
turn
boot
sink
hammer
drive
nudge
slam
prod
kick
break
snap
bash
cut
propel
hit
wallop
thrust
press
shove
friction
priseopen
forceofgravity
squash
slice
bang
punch
smack
knock
FORCE
pull
jostle
grab
untrust
thump
weight
strike
drop
bounce
bump
spin
twist
gust
crush
tug
Push
chop
waft
bite
blast
slide

EFFECTS OF A FORCE?

TASK

CAREFULLY, DO NOT DESTROY THE OBJECTS

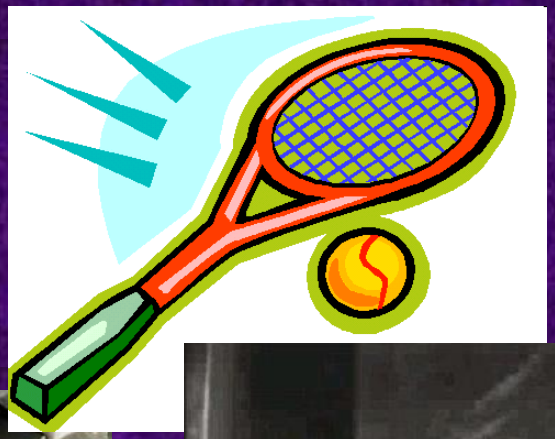
Take one of the objects from the tray and apply different FORCES to it.
List the force word that you would use to explain the force.
Record the effect on the object.

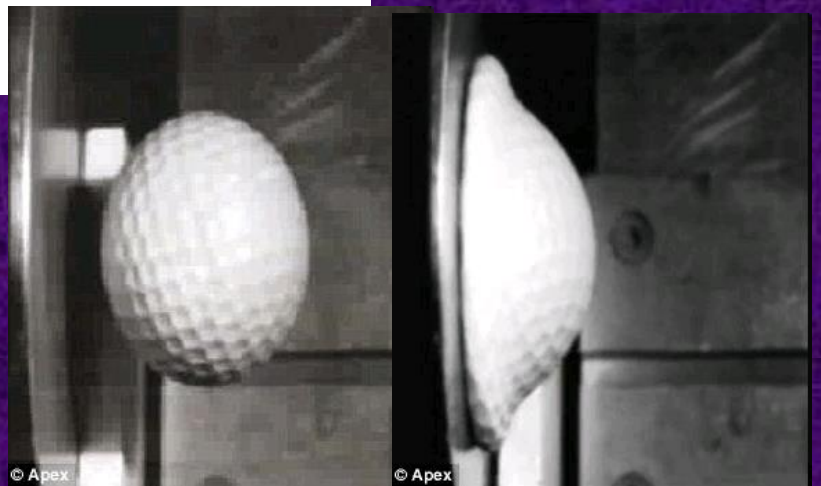
Object	Force	Effect

timer- the avengers

BEWARE

It seems amazing but you cannot see Forces. You can only see their effects.



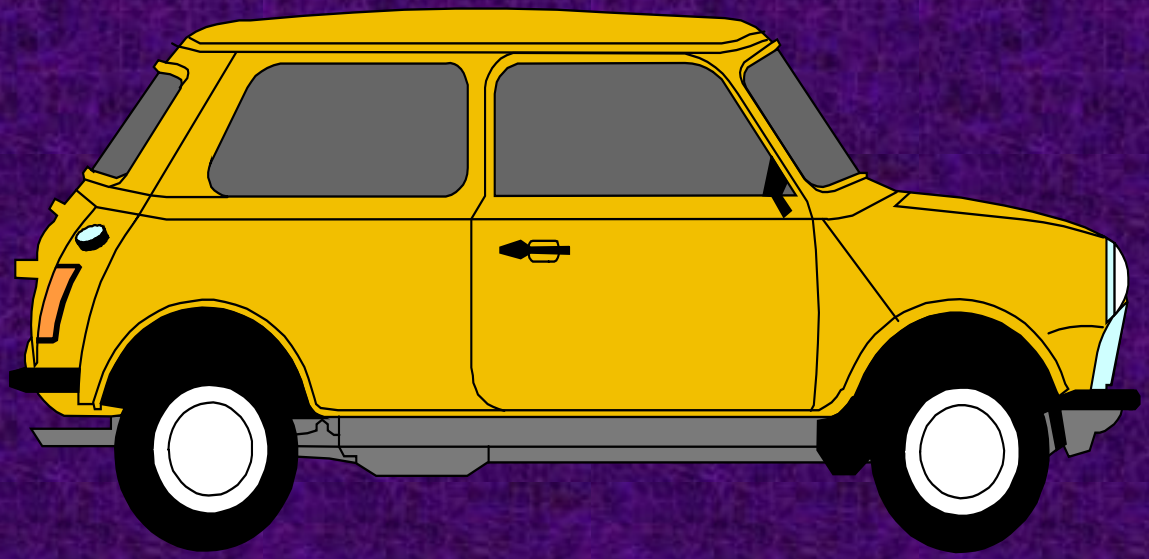


Forces change an object's

- speed,
- shape,
- direction of movement.

Squash that golf ball

- Write down some FORCES that act on a car when driving or in a car crash.



GO ON A FORCE WALK WITH YOUR TEACHER

- TAKE YOUR TEACHER ON A FORCE WALK!

Forces change an object's

- speed,
- shape,
- direction of movement.

All of these are seen during a car crash

ASK A STUDENT!

- LIST SOME FORCES and NAME THE EFFECT?

Timer- Hawaii-5-0

Examples of forces

Weight, friction, upthrust

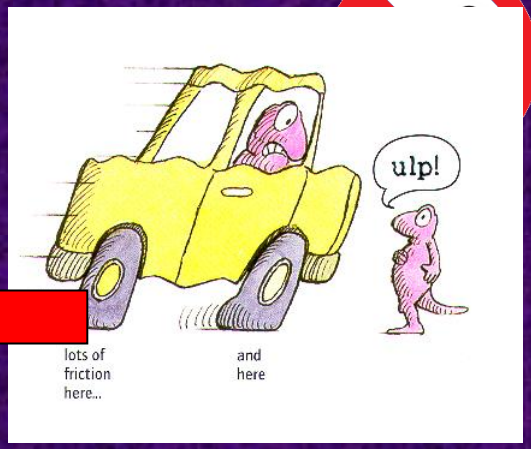
We can divide forces into 2 groups

Think
Pair
Share

CONTACT FORCES
NON CONTACT FORCES

Contact Forces

Friction

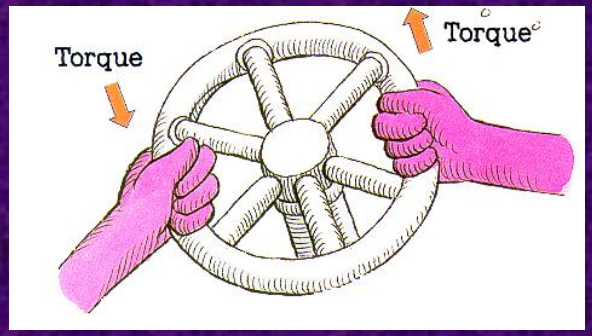


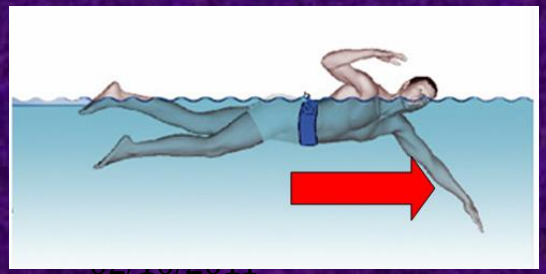
Tension (Pull)

Air Resistance

Applied Force (Push)

Spring Force (Twist)

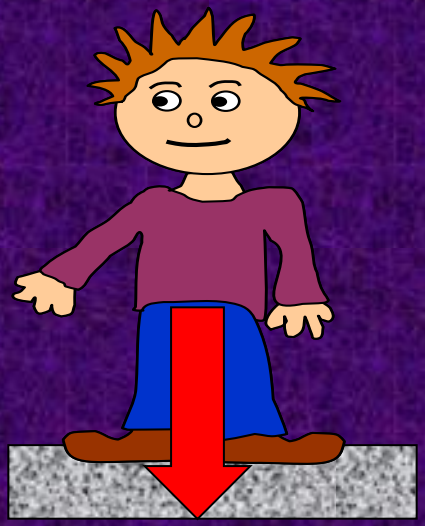




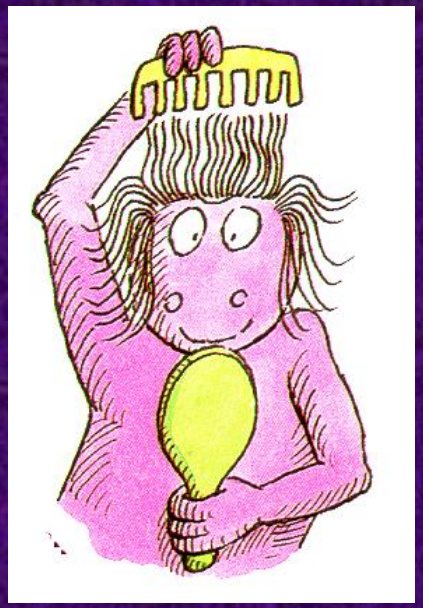
Water resistance

Non Contact Forces

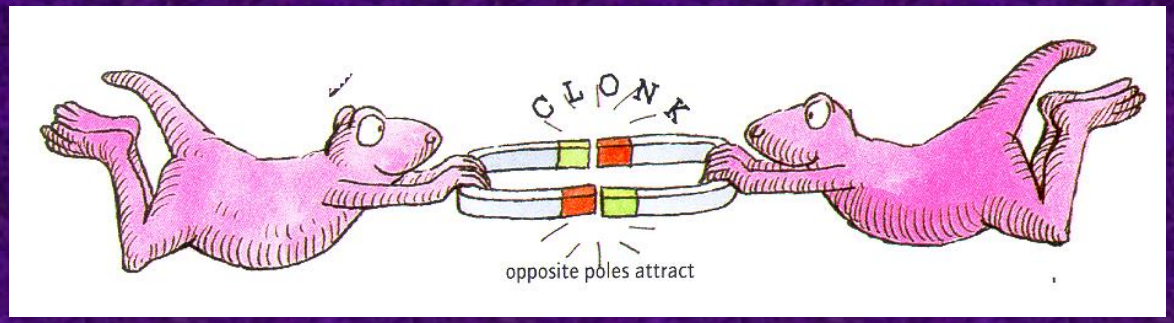
Weight



Static Electricity



Magnetic force

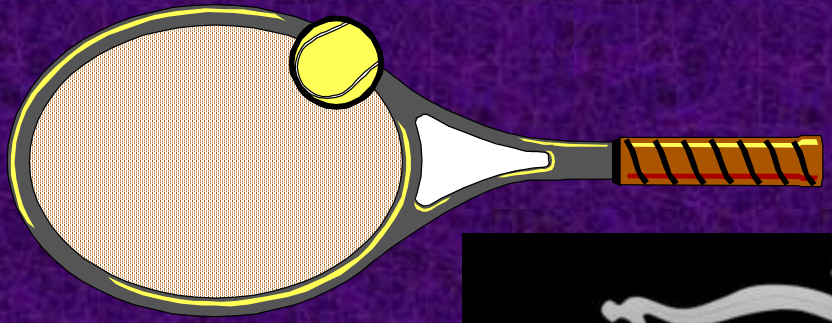


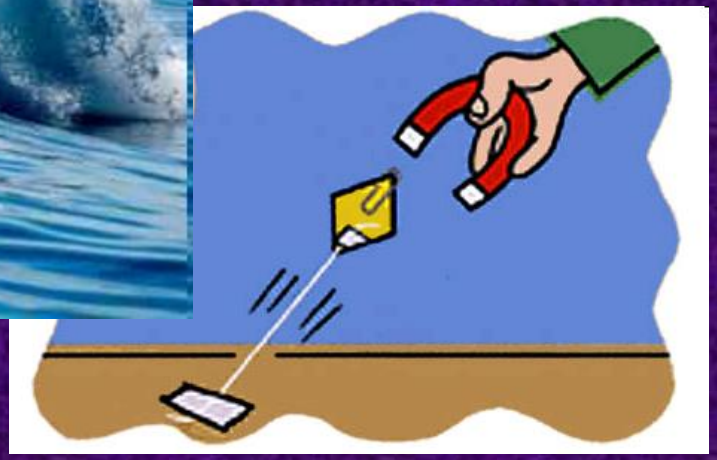
What type of force can you think of?

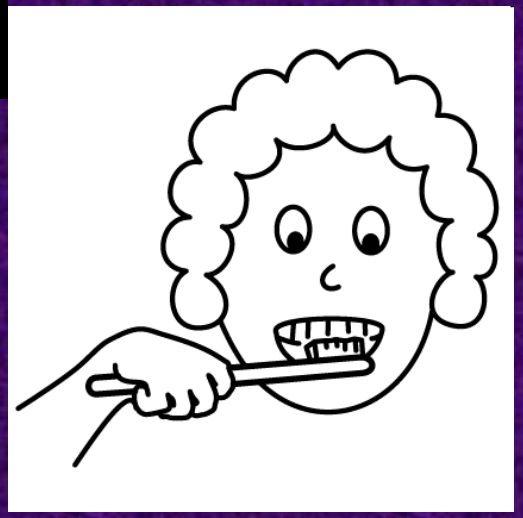
Non- Contact Forces	Contact Forces
Force of Gravity (WEIGHT)	Friction
Magnetic Force	Tension (Pull)
Electrical Force	Air Resistance
	Applied Force (Push)
	Spring Force (Twist)

http://www.physicsclassroom.com/class/newtlaws/u2l2b.cfm

WHAT CAUSES THESE FORCES?







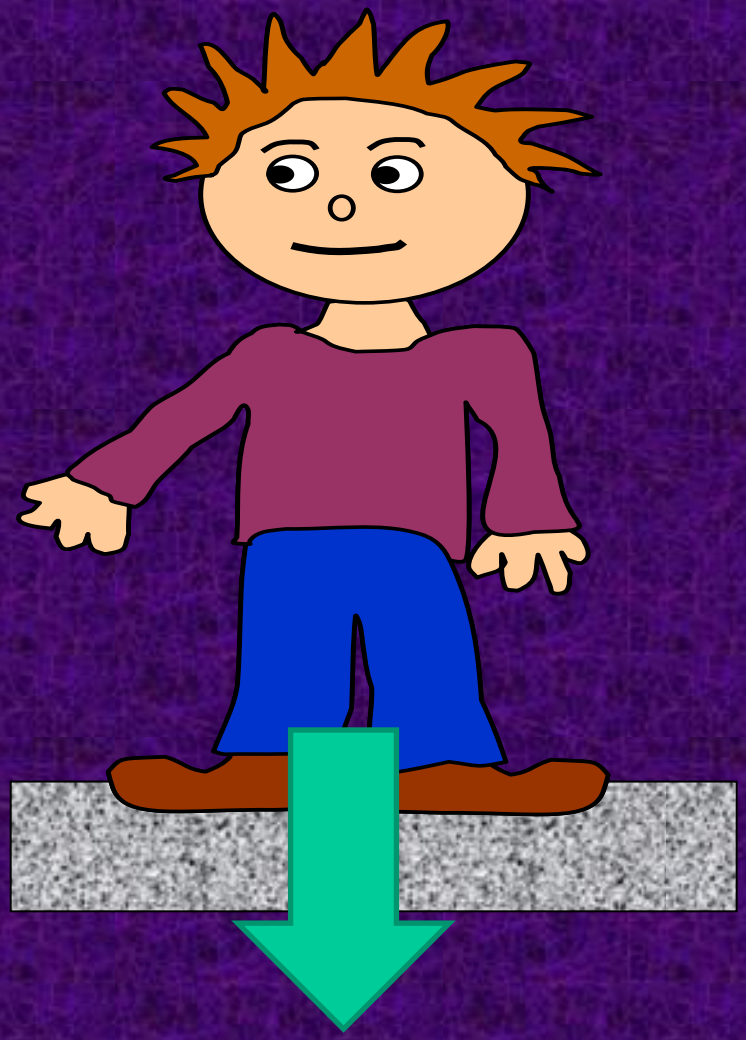
Activity: Write out which force fits with each picture

Use the white board and write the force that acts on the picture and state whether they are CONTACT or NON CONTACT

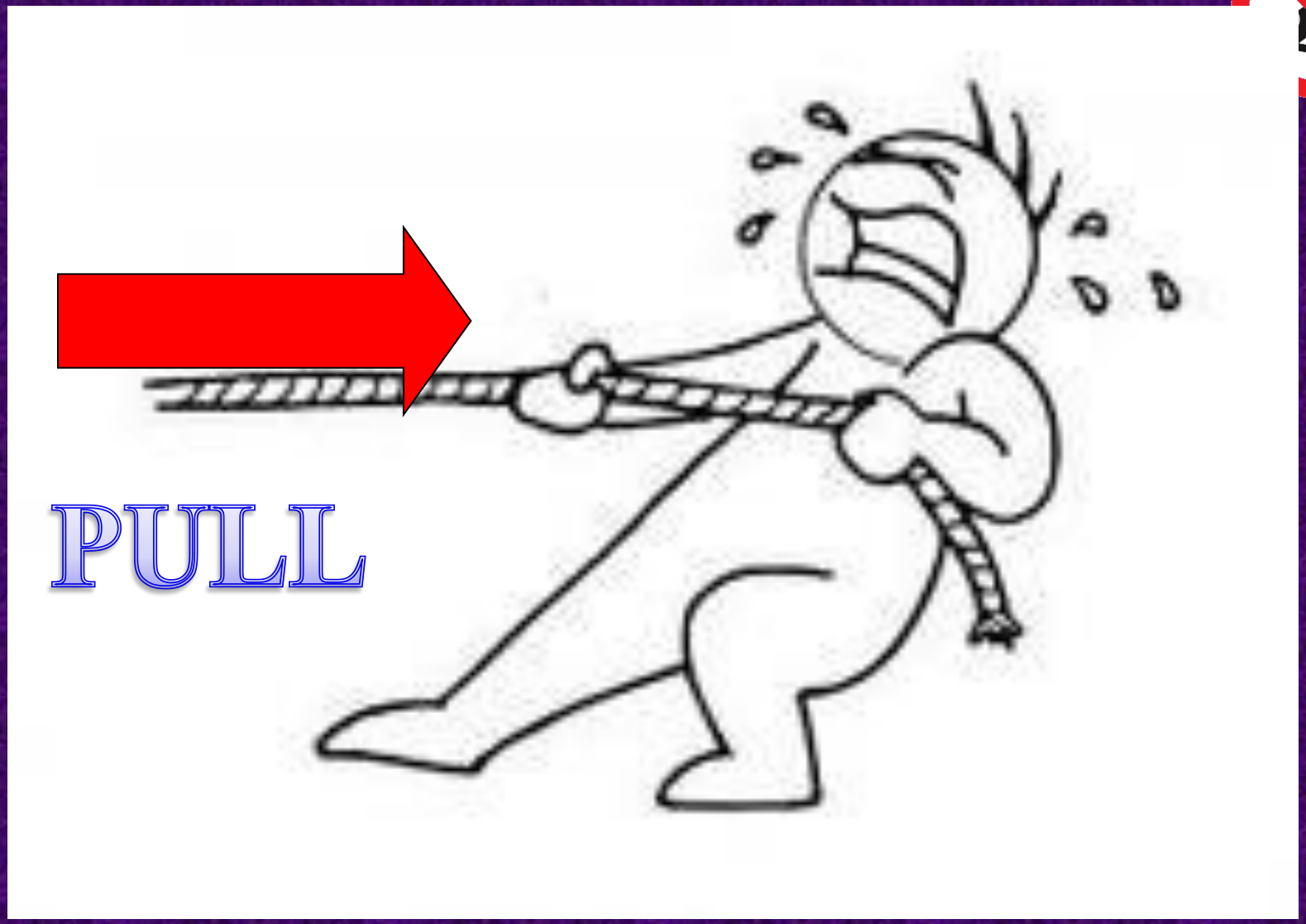
Weight ***Air resistance*** ***Pull***

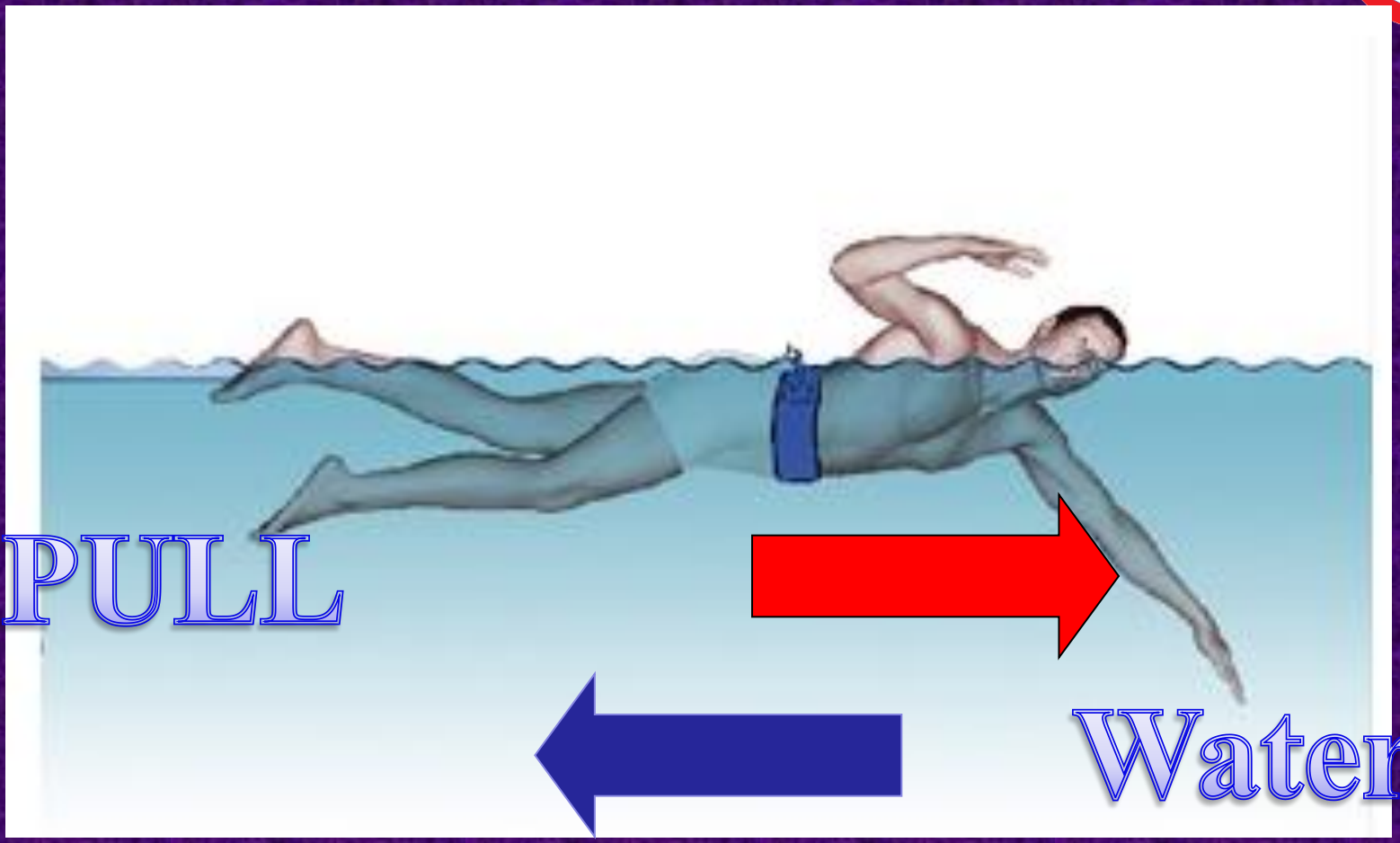
Upthrust ***Friction***

Water resistance ***Push***



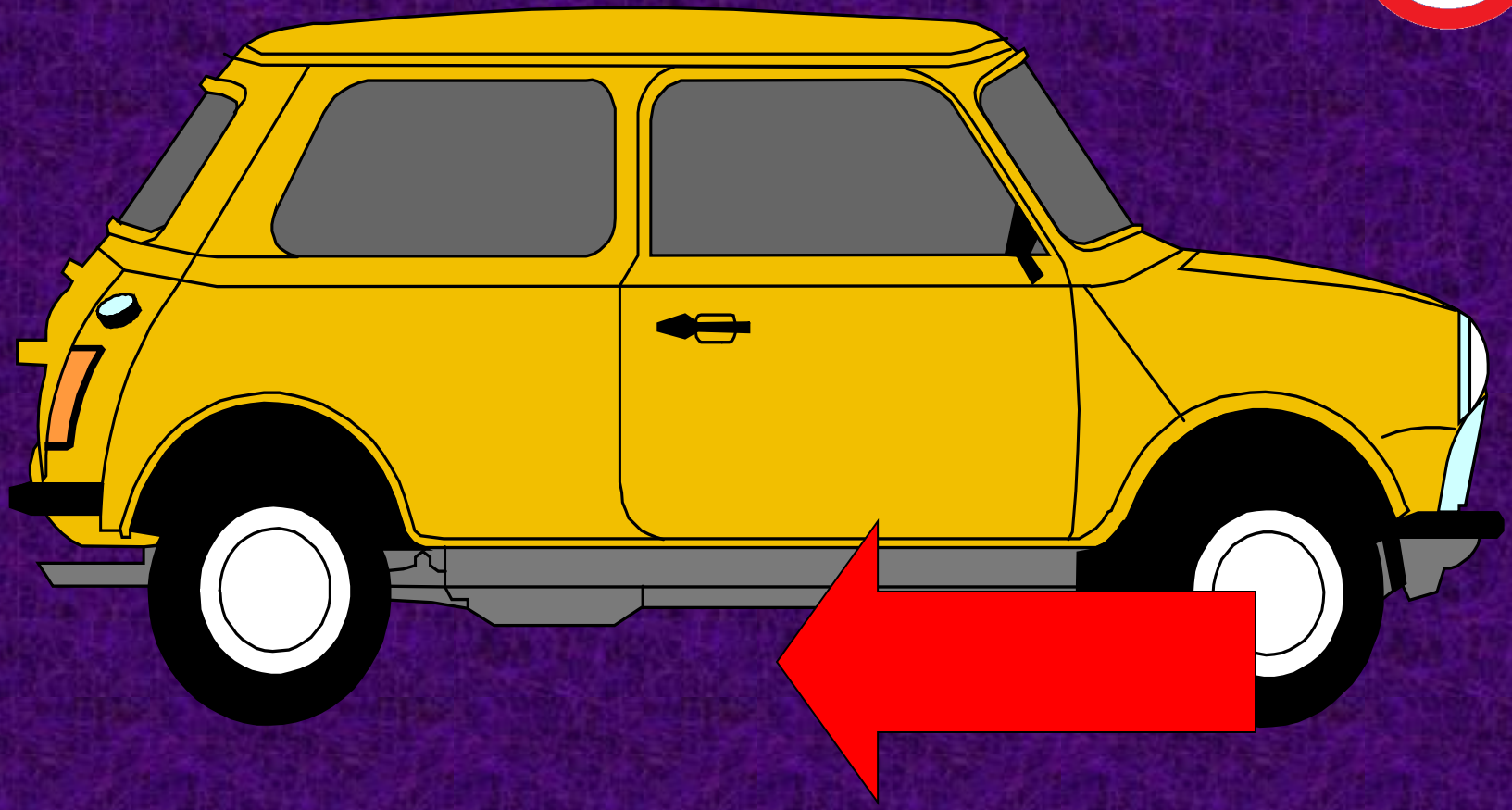
Weight


PULL

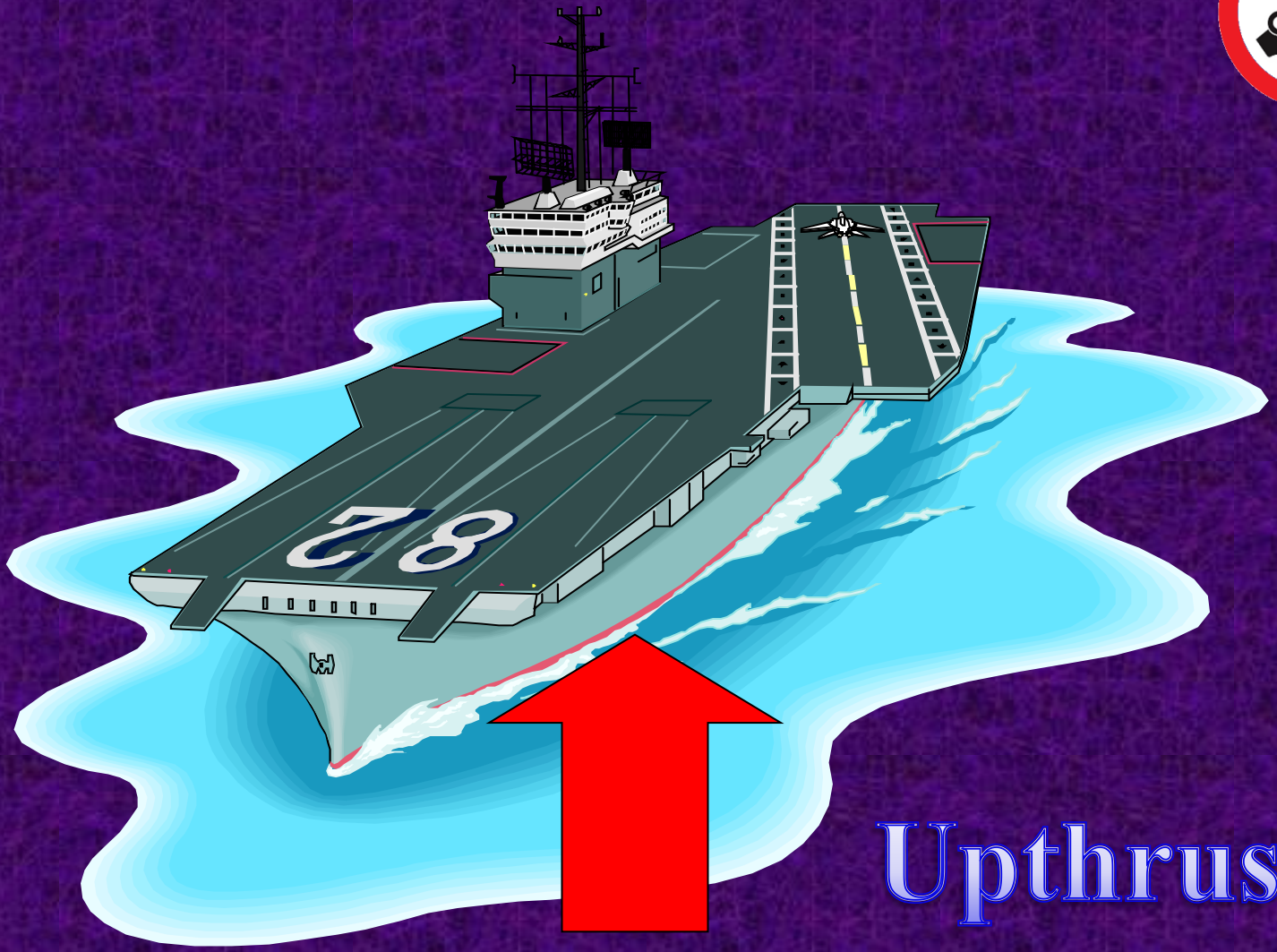


Resistance

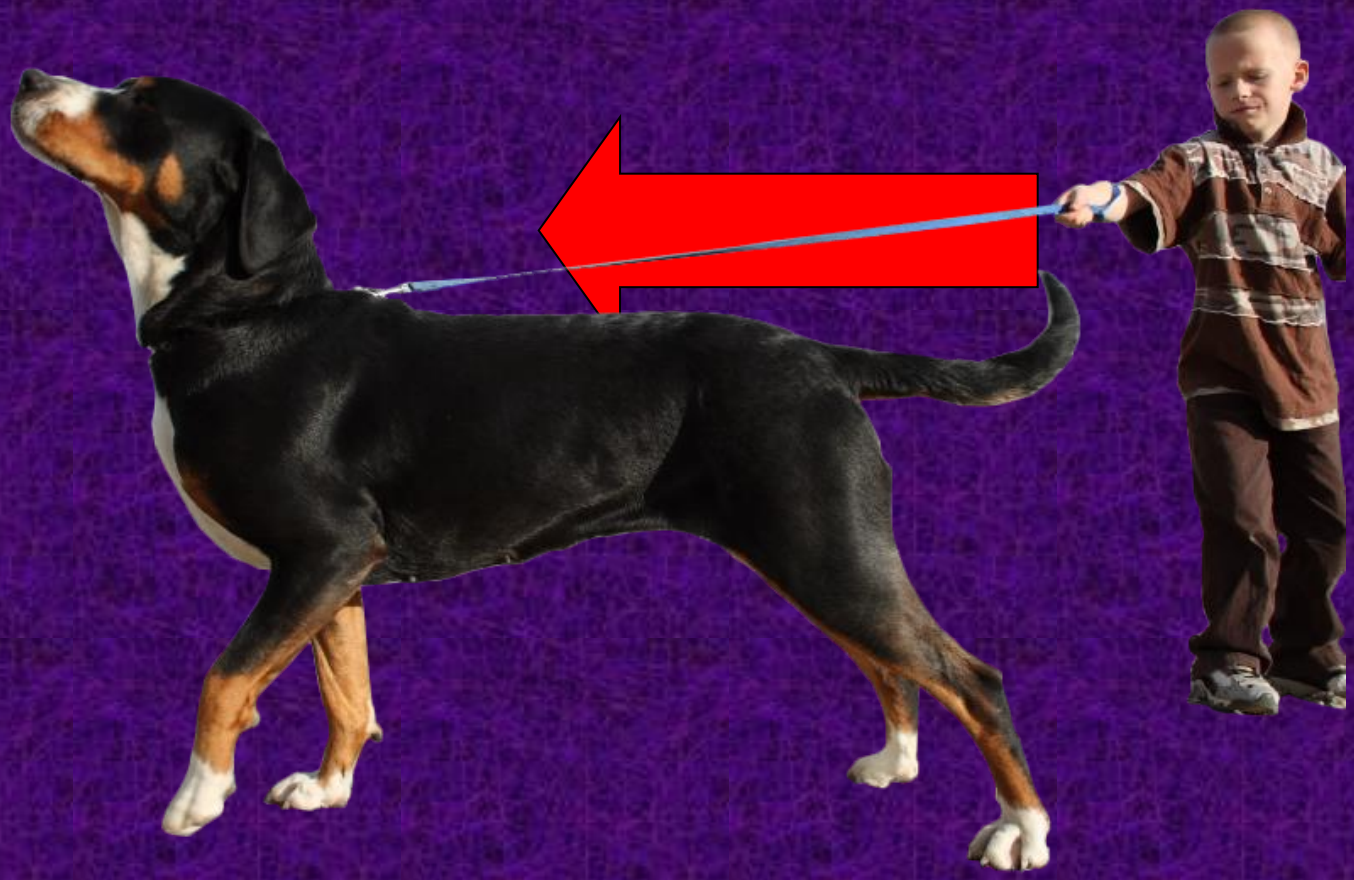
Air Resistance



FRICTION



Upthrust

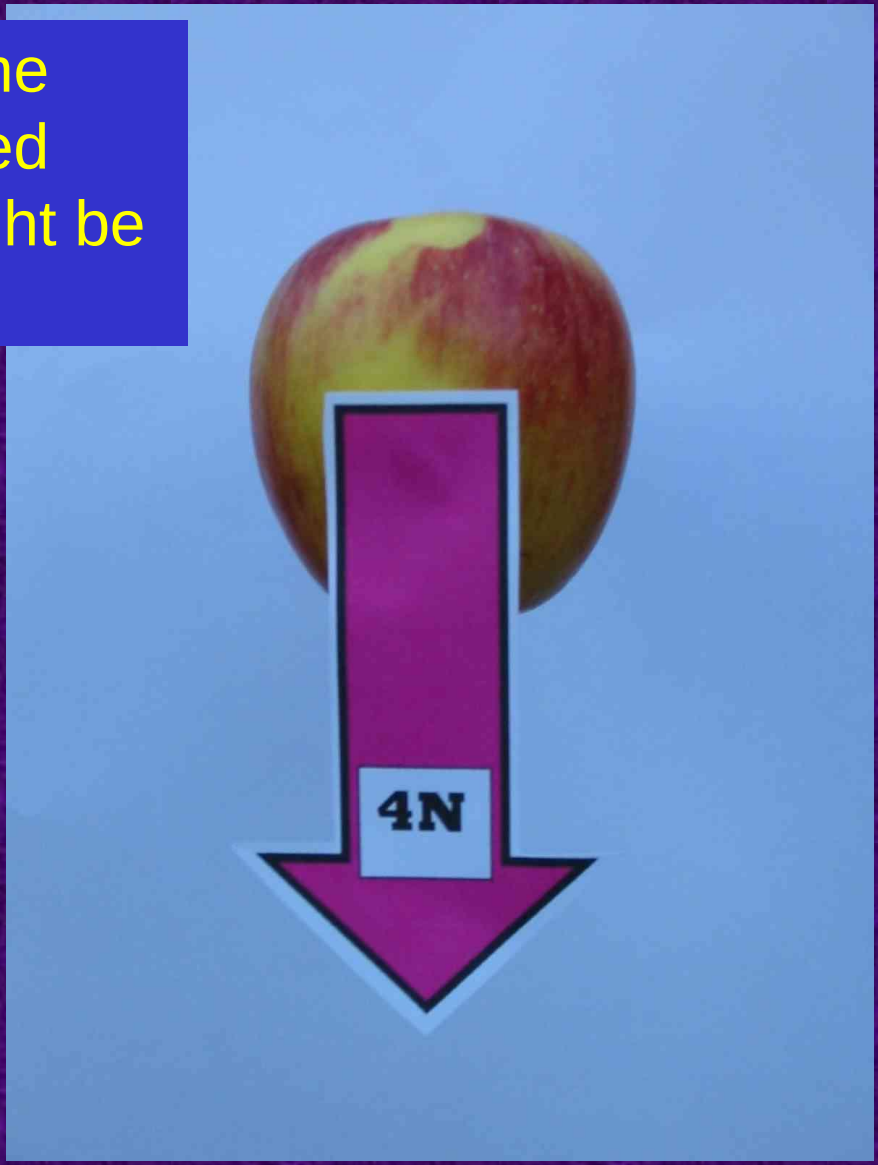


FORCE Specs!

FORCES SPECS

- View forces through the special Forces Specs!

If forces came ready-labelled science might be easier.

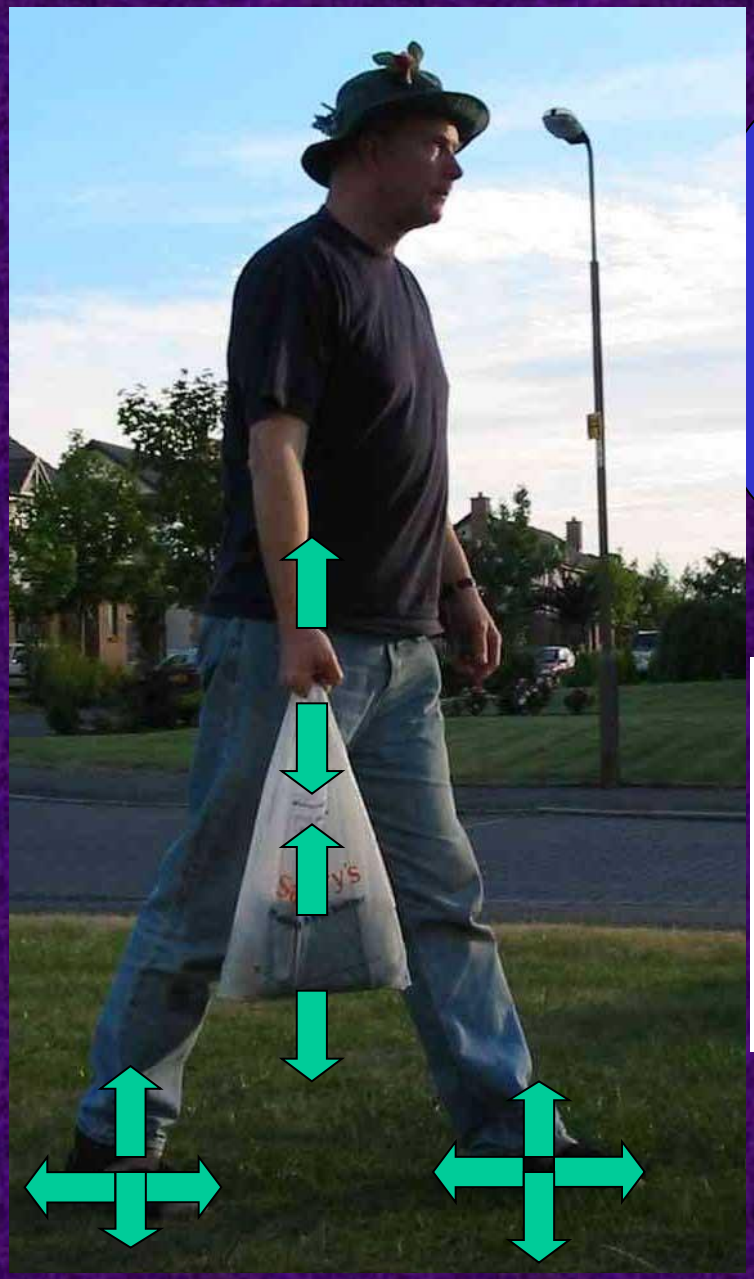


1.1

A shopper carries his shopping home.

How does this situation appear through forces spectacles?

1.2



There are forces acting everywhere. Here are just a few of them.

1.3

Let's consider the forces acting on the hand.

Can you identify the forces which act on the hand?

1.4

A support force from the arm muscles acts on the hand

A force (the weight of the bag) acts on the hand

1.5

Now consider the forces acting on the shopping.

1.6

The stretched plastic bag supports the shopping with an upward force.

The Force of Gravity acts on the shopping with a downward force.

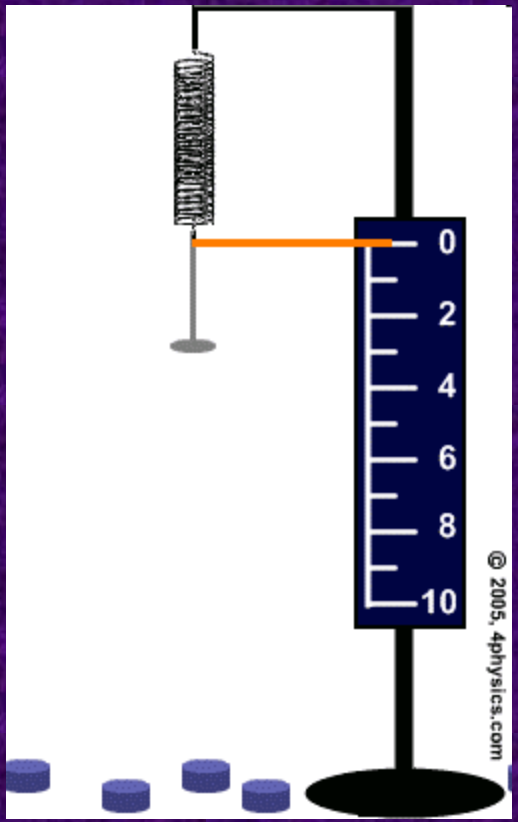
The simplest model shows the shopping as a single mass.

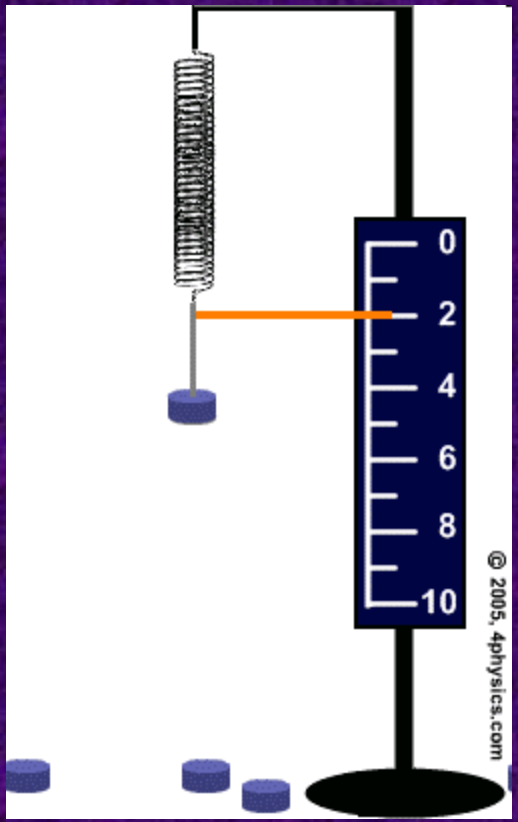
Measuring FORCES?

Measuring forces

- We can use one of the effects of a force to measure forces.
- This is called HOOKES LAW

Hookes law


0
2
4
6
8
10
© 2005, 4physics.com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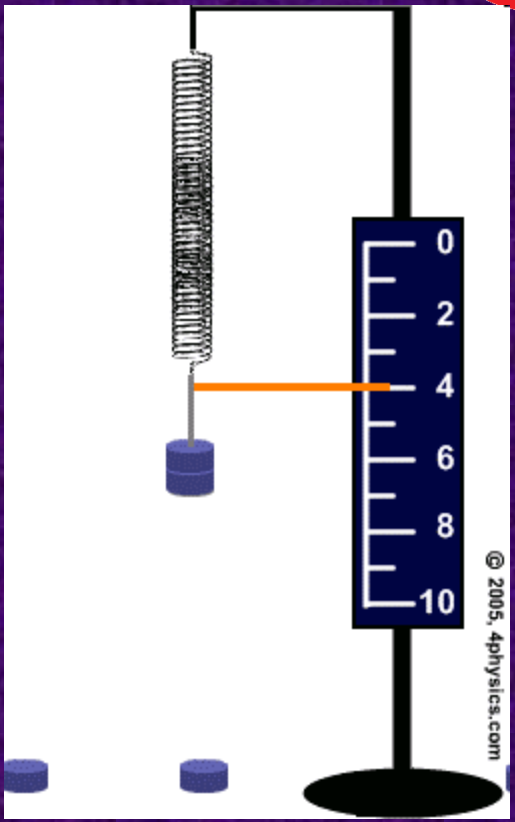
0
2
4
6
8
10
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Procedure

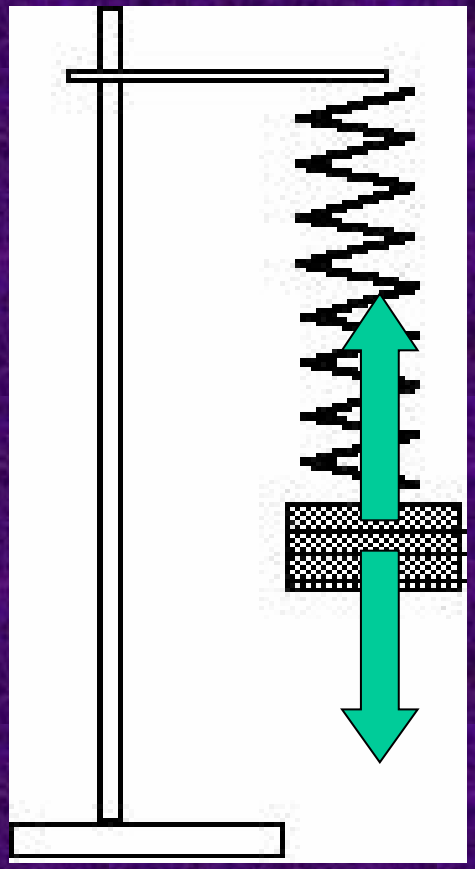
- Hang a spring from a clamp stand make sure it cannot fly off.
- Clamp the metre stick vertically in the clamp, alongside the spring.
- Record the metre rule reading level with the bottom of the spring. The number of masses hanging from the spring is 0 and the extension of the spring is 0 cm.
- Hang a mass hanger from the bottom of the spring. Record the new metrestick reading, the number of masses (1) and the extension of the spring.

Procedure

- Repeat this for 5 masses
  Plot the number of masses on the horizontal axis, since it is the input (or independent) variable. The extension of the spring is the output (or dependent) variable and you should plot it on the vertical axis.

extension

- Repeat the experiment with sweet laces and see if the experiment gives the same results.
- DO NOT EAT THE LACES!
- AVOID SUGAR COATED LACES



The spring exerts a force upwards on the mass.

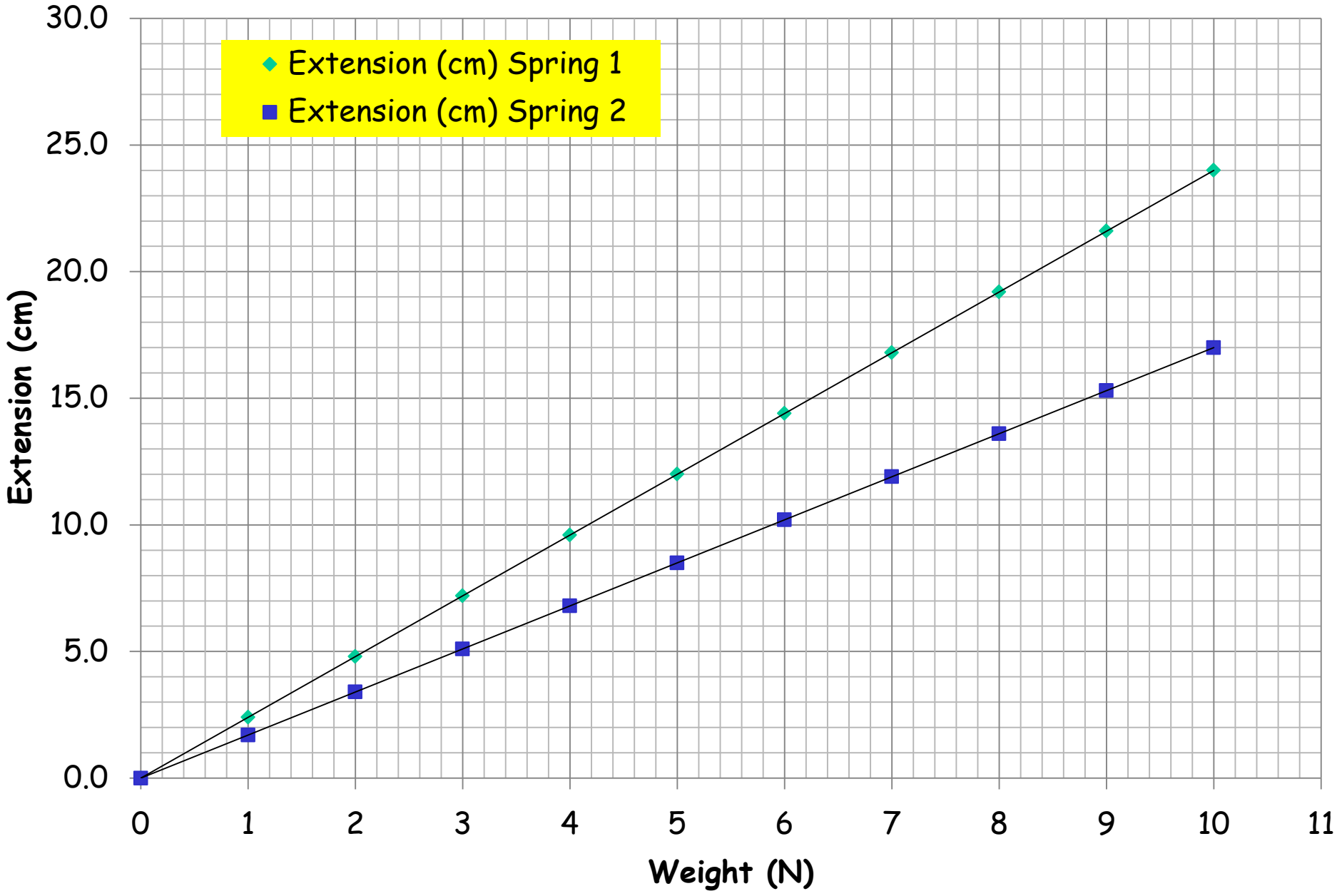
The Force of gravity exerts a force downwards on the mass.

1.9

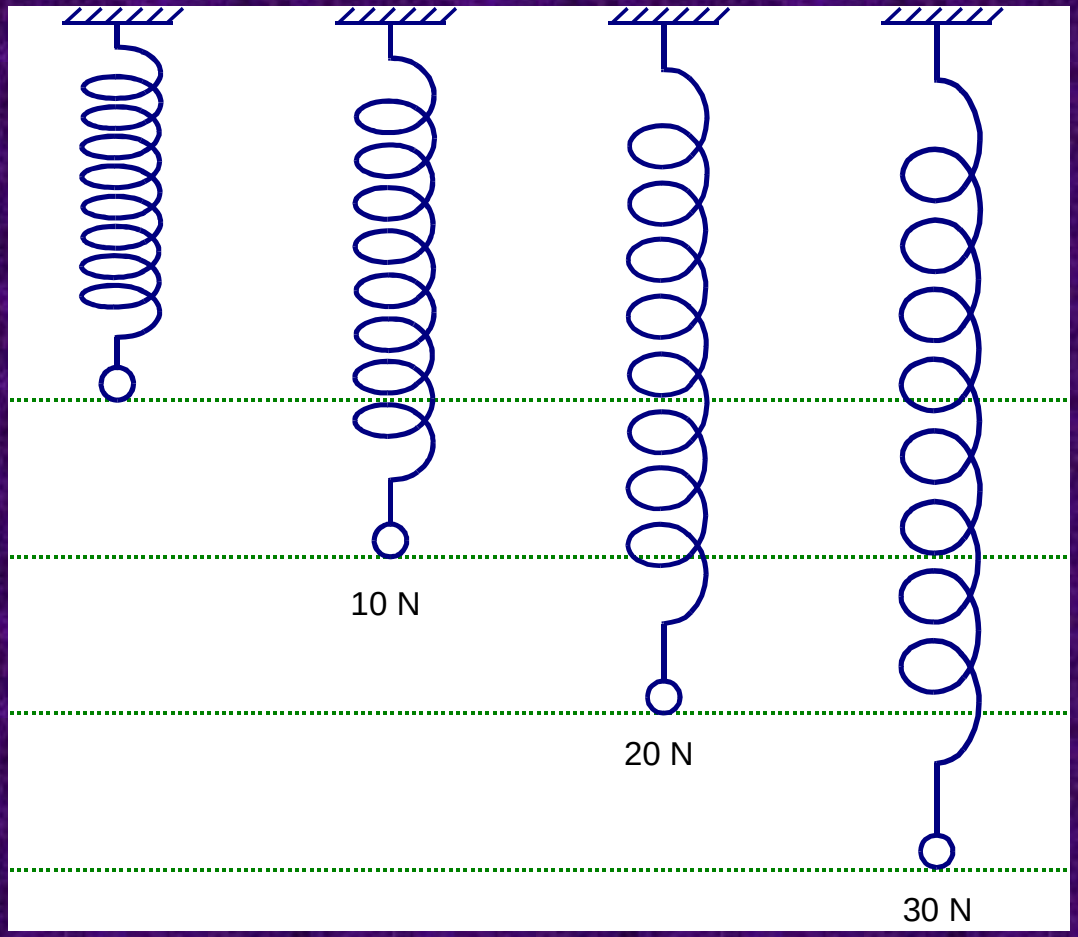
Homework: Spring experiment

This data is in the homework sheets. Draw a graph using the data in this table so you will be able to compare the two springs.

Weight (N)	Extension (cm)	
	Spring 1	Spring 2
0	0.0	0.0
1	2.4	1.7
2	4.8	3.4
3	7.2	5.1
4	9.6	6.8
5	12.0	8.5
6	14.4	10.2
7	16.8	11.9
8	19.2	13.6
9	21.6	15.3
10	24.0	17.0

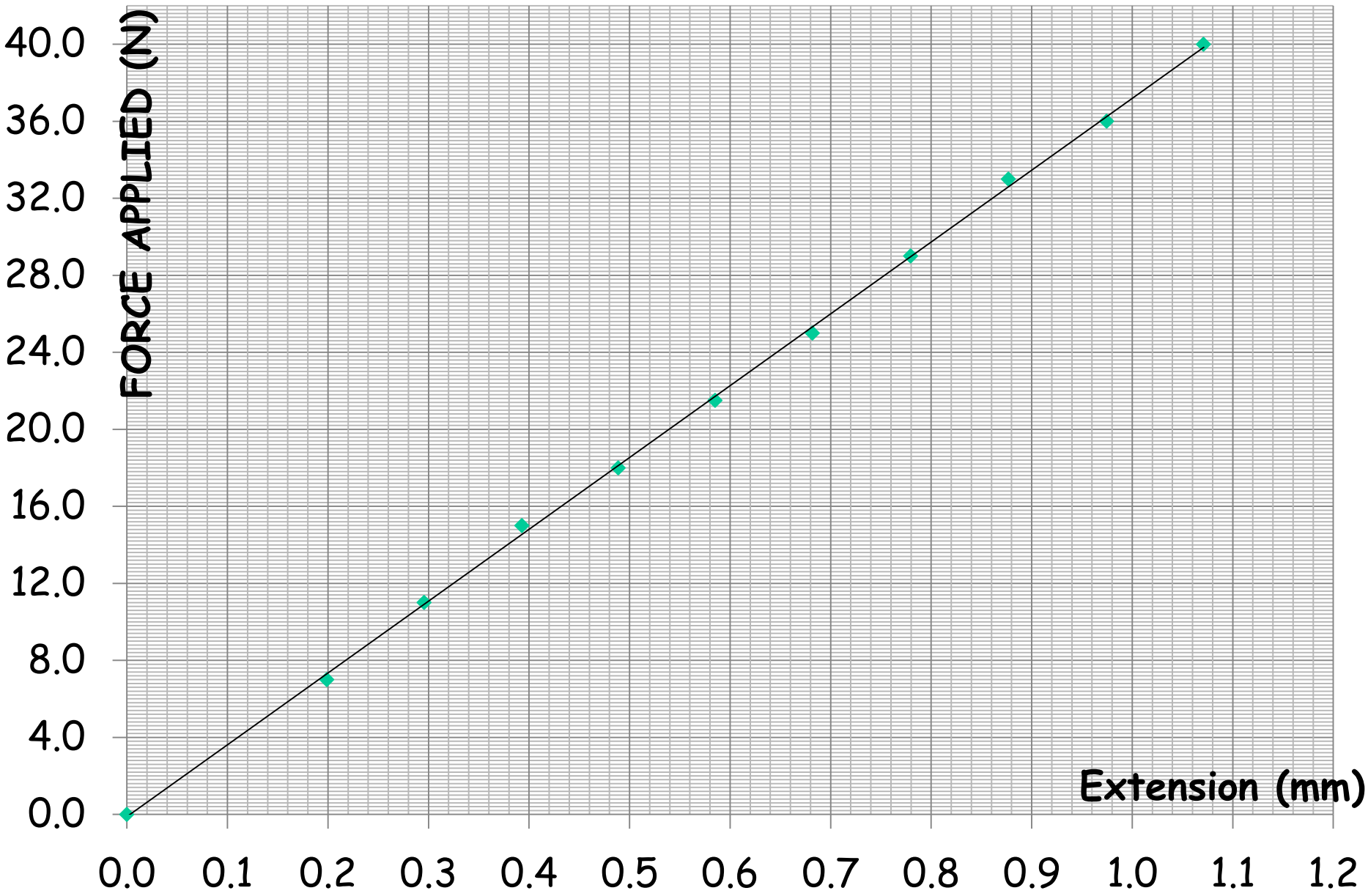

Extension (cm) Spring 1
Extension (cm) Spring 2
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Extension (cm)
0
1
2
3
4
5
6
7
8
9
10
11
Weight (N)

HOOKE'S LAW CONCLUSION

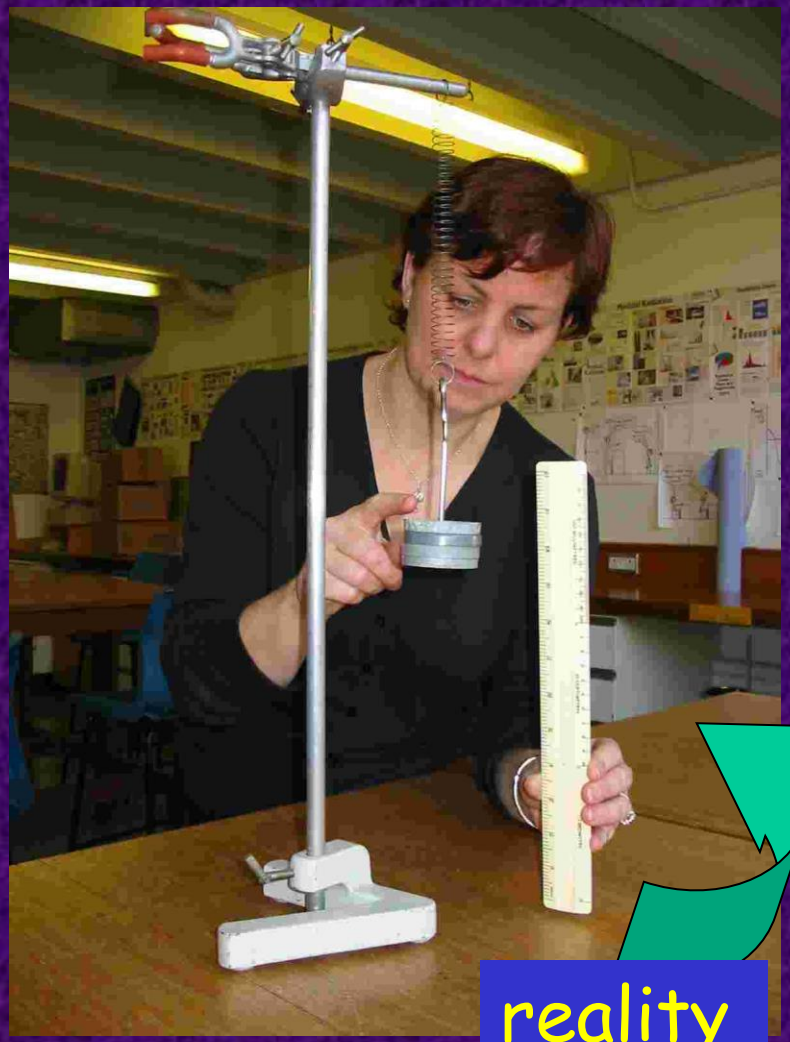


- Double the force and you double the stretch.
- Hmm- we can use this!

Force Applied (N)	New Length (mm)	Extension (mm)
0.0	18.0	0.0
0.2	25.0	7.0
0.3	29.0	11.0
0.4	33.0	15.0
0.5	36.0	18.0
0.6	39.5	21.5
0.7	43.0	25.0
0.8	47.0	29.0
0.9	51.0	33.0
1.0	54.0	36.0
1.1	58.0	40.0


FORCE APPLIED (N)
40.0
36.0
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
Extension (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2

OK, let's consider the forces acting on the mass. Look through forces spectacles and simplify this situation.



reality

model

The two forces act on the mass. They have a cancelling effect and the result is a mass ‘in equilibrium’.

This is as simple as the modelling process can get.

1.10

Spring balance / newton meter

- The instrument for measuring forces is the Newton Balance, spring balance or Forcemeter.

- Forces are measured in units of NEWTONS (N)

Newton Balance, spring balance or Forcemeter

Measuring WEIGHT/ FORCE

WEIGHING really is FINDING YOUR WEIGHT!

- When we "weigh" something, either hanging an object from the scales or placing the object on a scale, we are actually measuring the force of gravity on that object. The object is pulled down by the Earth and we measure that force. HOWEVER we record the answer in units of MASS.
- The following experiment shows you how!

Weight and mass – what's the link?

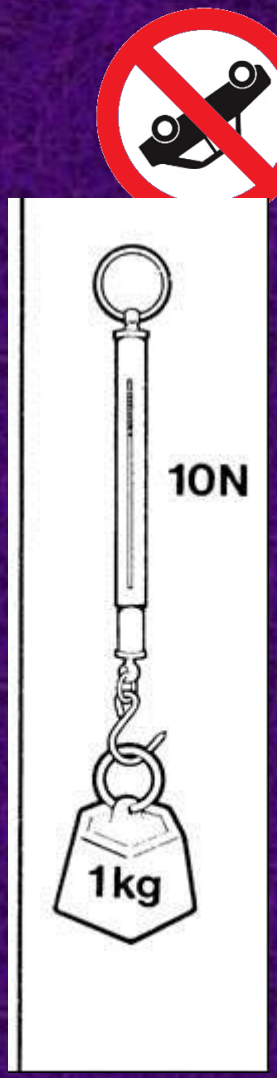
- In this experiment, you'll find out the link between weight and mass
- Copy the table below to record your readings.
- Hang different masses from newton balances.
- Record the weight from the newton balance.

Mass hung on newton balance (kg)	Weight on newton balance (N)
0.1	
0.2	
0.3	
0.4	
0.5	
0.6	

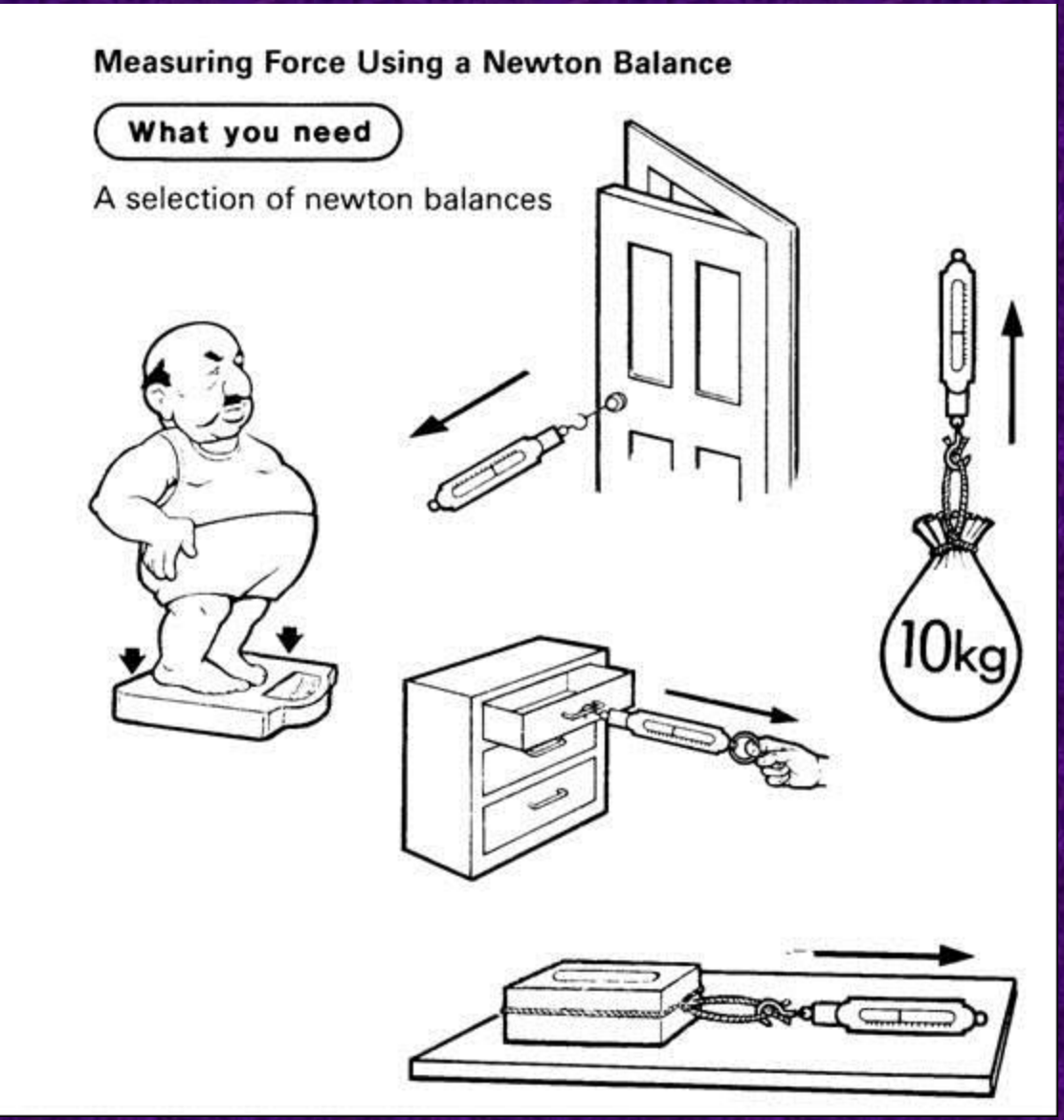
- Weight is a force which is caused by the pull of gravity.
- You have found that on Earth the pull of gravity on a kilogram is about 10 newtons.
- The weight of 1kg is approx. 10 N or 9.8 N
- The ratio of weight to mass is given the symbol g

  $g = 10\ N/kg$ or $9.8\ Nkg^{-1}$

  g is called "gravitational field strength" it is your weight per unit mass.



Measuring forces-- Using a NEWTON BALANCE to measure Forces.



- Find the force to lift your bag
- Find the force to open a door /drawer / zip /
- Find the force to pull the toy cars.
- Record your results in a table

MEASURING FORCES –use these or find some of your own

TASK	Predicted force	Measured force
	(N)	(N)
Lifting a school bag		
Opening a door		
Pulling up a zip		
Opening a cupboard		
starting a planned moving		
pulling an empty shoe		

Estimating the size of FORCES?

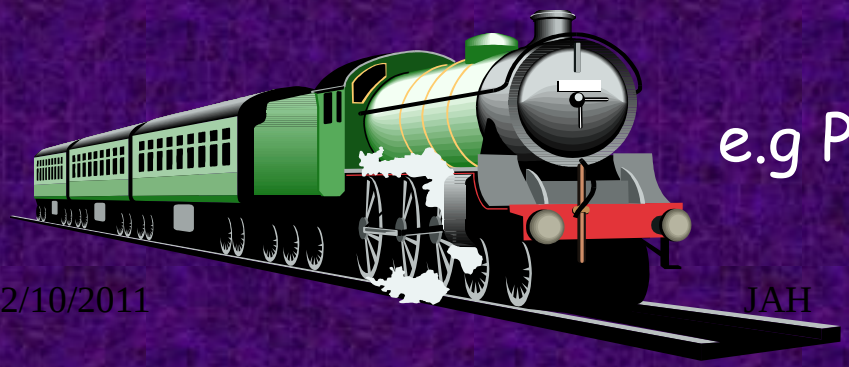
Estimating forces

Match these different situations to the most likely force.

Write these nos. in your jotter

Choose from:

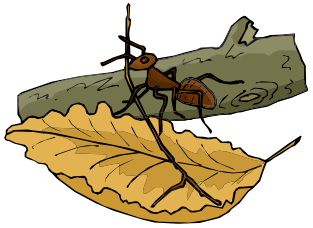
- 0.1 N
- 2 N
- 20 N
- 650 N
- 1800 N
- 10,000 N
- 1,500,000 N
- 200,000,000 N



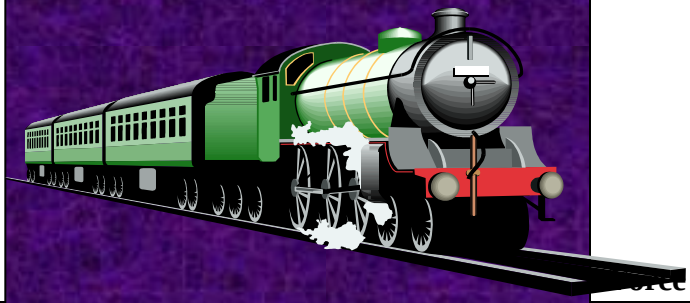
e.g PULLING A TRAIN

0.1 N, 2 N , 20 N, 650 N, 1800 N, 10,000 N, 1,500,000 N, 200,000,000 N

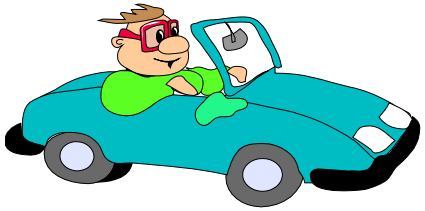
How much can an ant lift?



Force =



Engine force in a sports car



Force =

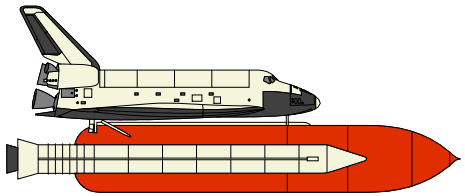
Weightlifter

Force =

Lifting your own weight

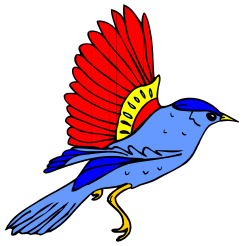
Force =

Space Shuttle engines



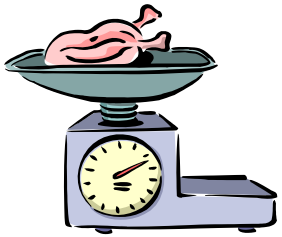
Force =

Force to keep a small bird in the air



Force =

Weight of a chicken



Force =

Measuring MASS and WEIGHT

- Use scales to measure the MASS of some SMALL objects
- Now use a spring balance to find the weight of the same objects.

- What conclusion can you make about an object's weight compared to it's mass?

Write your results into a table like this:

Object	Mass (kg)	Weight (N)
Eg Pencil case		

Mass & weight

Mass and Weight- LEVEL 3

- The **mass** of an object is the amount of matter that is in the object
- the **weight** of an object is the force of gravity that acts on that object

➔ Mass is related to how much *stuff* in an object and weight is related to the pull of the Earth

Mass and Weight- LEVEL 4

- *Mass is a measure of the amount of matter in an object.*
- Mass is caused by the number of particles in an object. Particles are too small to be seen so we deal with larger bundles called kilograms.
- To be honest mass isn't really understood by scientists. Maybe it could be something you could win a NOBEL PRIZE for!

ADD PICTURE

Level 3

- ***Mass is measured in kilograms (kg).***
- ***Wherever you go your mass remains the same.***

Mass and Weight- LEVEL 3

- E.g if you had a big (1 kg) box of Roses chocolates on the Earth the *amount* and *number* of chocolates would be the same wherever you took those chocolates.

There would still be a 1 kg box of chocolates with the same number of mini dairy milks etc., providing that you don't eat the chocolates!

Mass and Weight- LEVEL 3

In the same way if a girl has a mass of 40 kg (about 6 stone 4 pounds) on the Earth, her mass is still 40 kg up in a plane, on the moon or out in space. <u>Her mass stays the same.</u>

Mass and Weight- LEVEL 3/4

Weight not gravity

What's the difference? Mass and Weight- LEVEL 3/4

- What's the difference?
- We often say things like:
- "My weight is 55 kilograms"
- "This bag weighs 2 kilograms"

- The problem is, we're using the wrong word – at least as far as Physics is concerned.

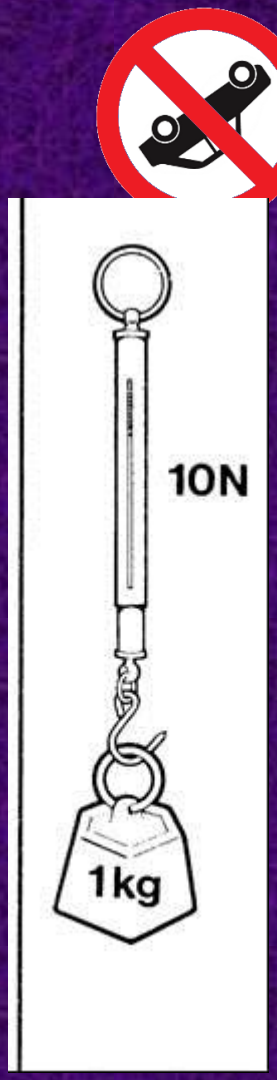
CONFUSING NOTES- Level 3/4

WEIGHT & MASS causes problems in the lab.

- **What you call your weight, measured in *kilograms* should really be called *mass*. This can be confusing.**
-
- **All we ask is that when you are being scientific try to remember that it is mass that is measured in kilograms.**
-
- **This is like the confusion that happens when you use the word battery to mean cell.**

- Weight is a force which is caused by the pull of gravity.
- You have found that on Earth the pull of gravity on a kilogram is about 10 newtons.
- The weight of 1kg is 10 N

- The ratio of weight to mass is given the symbol g
  - g = 10 N/kg



Example:
What is the weight of an object of mass 4 kg?

$$\text{Weight} = \text{mass} \times \mathbf{g}$$

$$\mathbf{W} = \mathbf{mg}$$

$$\mathbf{W} = 4 \times 10$$

$$\mathbf{W} = 40 \text{ newtons}$$

The weight is 40 newtons.

Object	Mass (kg)	Weight (N)
A bag of sugar	1	
A bag of potatoes	10	
Yourself		
A car	1000	

Practice Questions

1. A bag of sugar has a mass of 1kg, what is the weight?
2. A bag of potatoes has a mass of 5kg, what is the weight of the potatoes?
3. A loaf of bread has a mass of 0.5kg, what is its weight?
4. An apple has a weight of 1N, what is the mass of the apple?

Practice Questions

5. A small car has a weight of 8000N what is the mass of the car?
6. What is the mass of a small S1 pupil who has a weight of 450N?
7. What is the weight of Ruaridh's pen if it has a mass of 200g

•

Weight or Mass? - Windows Internet Explorer

://www.mathsisfun.com/measure/weight-mass.html

File Edit View Favorites Tools Help

Glow Mail | Weight or Mass? | Class Timer

Weight or Mass?

Q: Aren't "weight" and "mass" the same?

A: Not really.

An object **has mass** (say 100 kg).

This makes it heavy enough to **weigh** 100 kg

Gravity causes Weight

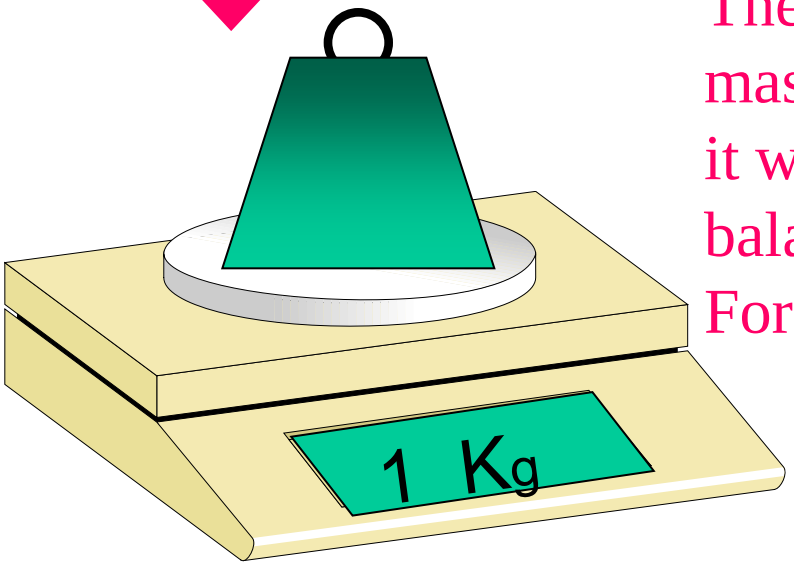
An objects **weight** is how hard gravity is pulling on it.

We think the weight is the same everywhere ... because we all live on the surface of the planet Earth!

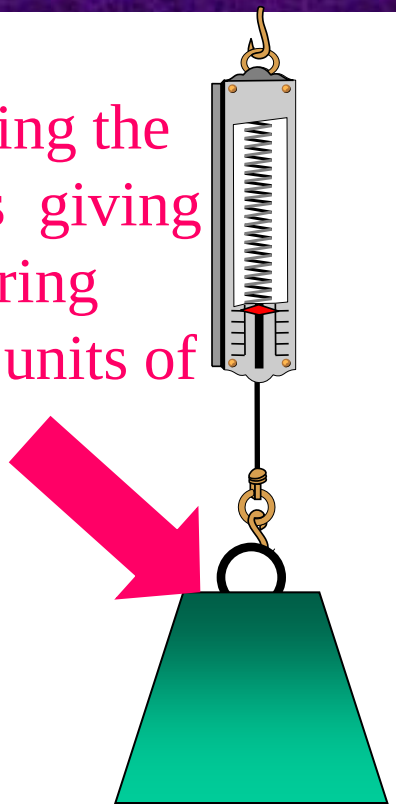
But if the object were far out in space it would just float around, exerting no force on the scales.

Weight and Mass –

This is still the pull of the Earth
Making the 1kg mass stay on the scales.
The scales are calibrated to take this force
and display a value 10 times LESS than this
Force



The Earth is pulling the mass downwards giving it weight. The spring balance displays units of Force



a WEIGHT of 10N

Measuring force & Weight

1. What causes weight?
2. What is the relationship between weight and mass?
3. Would this be different on other planets?
4. Write a formula relating weight to mass.

HOMEWORK/ RESEARCH

- a) Find out about some aspect of space travel. For example training astronauts, eating in space etc.

OR

- b) Find out more about gravity. For example, what causes it, does it change on other planets, what are black holes.

OR

- c) Try to describe a room or an activity without gravity. (ignore the lack of air)

SUMMARY

Weight is the force due to gravity on an object.

An object with a very large mass, eg the Earth, the moon, pulls other objects eg humans, towards it. This pull is called the force of gravity or WEIGHT.

TRY THESE EXAMPLES- **What to do –Level 3**

- In these sentences, the underlined words are wrong. Rewrite the sentences and correct the mistakes.

1. My <u>weight</u> is 50 kilograms.

2. <u>Mass</u> is caused by the pull of the Earth.

3. Because <u>mass</u> is a force, it is measured in <u>kilograms</u>.

4. This box has a <u>mass</u> of 70 newtons.

What's the difference? Level 3/4

- Mass is the amount of stuff that makes up an object. It's measured in kilograms.

- Weight is the force of gravity acting on an object. It's caused by the Earth pulling down on the object. Because weight is a force, we measure it in newtons.

- Mass is measured in kilograms.

- Weight is force caused by the pull of the Earth. It is measured in newtons.

Losing – and gaining – weight

People often say they want to lose weight. What they really mean is that they want to lose some of their mass.

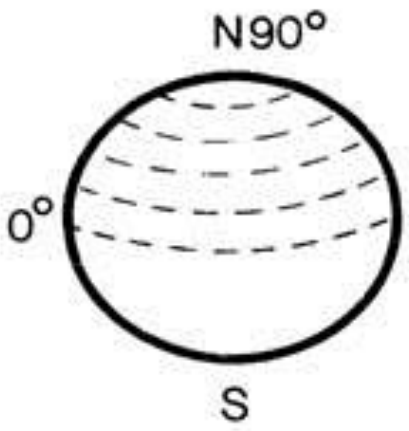
- One of the best ways of losing weight is to travel to the Moon. This is because the Moon's gravity is weaker, and doesn't pull you down with such a big force. This is why astronauts on the Moon can jump quite high, even though they are wearing big spacesuits.

- What other things would be easier on the moon and are there any other forces that would be different?

GOING FURTHER LEVEL 4/5

- The weight of unit mass is known as the gravitational field strength. This is given the symbol **g**.

The Earth is not a perfect sphere and because of this the gravitational field strength varies over its surface.



Latitude (degrees)	**g** (Nkg^{-1})	Place
0	9.78	Equator
30	9.79	Jamaica
45	9.81	France (Bordeaux)
60	9.82	Norway (Oslo)
90	9.83	North Pole

The value of **g** for Scotland is about 9.82 Nkg^{-1} but this is usually rounded off to 10 Nkg^{-1}.

over

GOING FURTHER LEVEL 4/5

- Other planets also have gravitational fields which exert forces.
- The gravitational field strength at the surface of some objects in our solar system are shown in the table.

Planet	g (Nkg^{-1})
Mercury	3.7
Venus	8.8
Earth	10.0
(Moon)	1.6
Mars	3.8
Jupiter	26.4
Saturn	11.5
Uranus	11.7
Neptune	11.8
Pluto	4.2

What to do

Calculate what your weight would be on each of the planets.
Present your results on a sketch of the Solar System.

Losing – and gaining – weight

- But when you're on the Moon, your mass doesn't change. Remember, mass is the amount of stuff there is in you – travelling to the Moon doesn't change that.

://www.mathsisfun.com/measure/weight-mass.html

WHAT YOU THOUGHT

Revisions quiz

1. What three things can forces do?
2. What unit are forces measured in?
3. Who is the unit named after? Give his full name.
4. What do you measure forces with?
5 What force is needed to lift an apple – 1 N, 20 N or 100 N?
6. Is mass or weight measured in kilograms?
7. Weight is a force. This means it is measured in:
8. What causes weight?
9. If you travel to the Moon, does your mass change?
10 If you travel to the Moon, does your weight change?

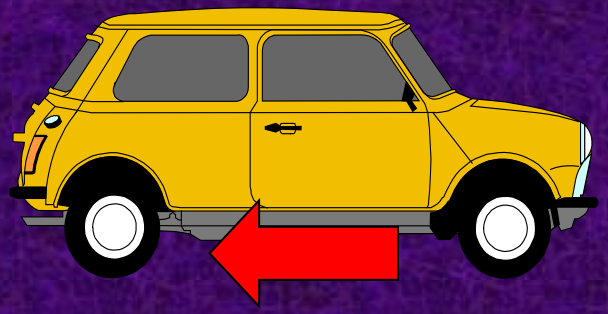
Revisions quiz - My score out of 18: _____

11. On which planet is your weight greatest?
12. On Earth, how many newtons are there for each kilogram of mass?
13. A dog has a mass of 7 kg. What is its weight?
14. A girl has a mass of 42.5 kg. What is her weight?
15. A train has a mass of 12,500 kg. What is its weight?
16. A bag has a mass of 500 grammes. What is its weight?
17. What's wrong with these sentences?
    1. **"The bag of apples "weighs 3 kg."**
    2. And this sentence? "**In deep space, astronauts**

- **have no mass."**

friction

Friction

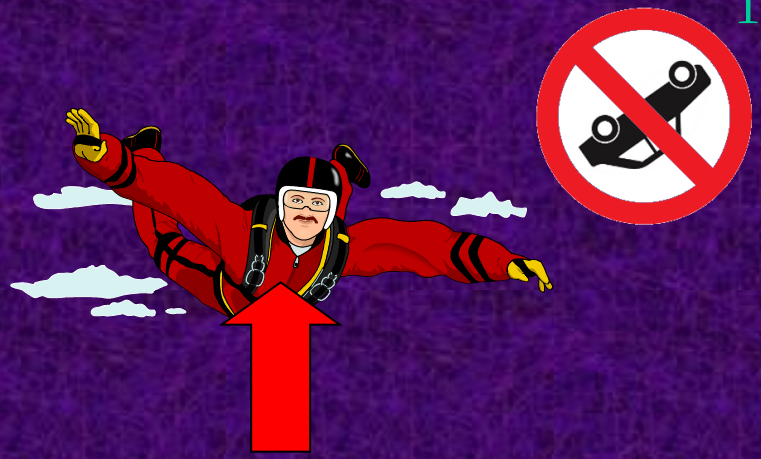


Friction is a very specific type of force which opposes motion. There are many types of friction, but all are caused by a moving object rubbing against something else. Frictional forces will always act in the opposite direction to the direction of motion.

Air friction/ resistance is the force of air being pushed out of the way of a moving object.

e.g. When you put your hand out the window of a moving car you feel a force pushing your hand. Be careful! DANGER

Air resistance



It is the force that slows things down when they are moving through air.

It pushes against a moving car or against the body of a person falling from the sky.

Go through the powerpoint on PARACHUTES (Physics)

Friction **Surface friction**

When an object is dragged across a surface, there is a strong frictional force. This is affected by the surfaces. Generally, smoother or wetter surfaces will have less friction.

E.g. Pushing a box along a carpet or along ice.

Friction- ANSWER THESE IN A TABLE IN YOUR JOTTER

With the person next to you

- Think of two examples where we try to minimise friction.

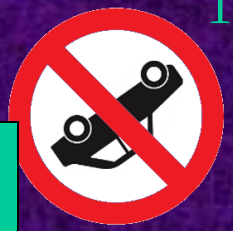
- Think of one example where we try to increase friction.

With the other people at your table…

- Discuss how we reduce or increase friction in the examples you used

- Can you think of any situations where an object can be moving, but not be affected by any friction?

LABEL THE places where there is FRICTION



Friction
-good or bad

Useful or Not so useful?

Walking or running

Useful or Not so useful?

Brake pads rubbing against a wheel

Useful or Not so useful?

Using a parachute when Sky diving

Useful or Not so useful?

Gloves for goalkeeping

Useful or Not so useful?

Spacecraft re-entering the Earth's atmosphere making heat.

Useful or Not so useful?

Friction between a boat and the water

Useful or Not so useful?

Friction causing car tyres to become bald

Useful or Not so useful?

In all moving parts in machinery making heat

Friction good

- braking
- walking
- space craft re-entry
- running
- writing
- sky-diving (drag)
- opening bottles
- cutting things
- putting spin on an object
- rock climbing
- steering wheel
- striking matches
- cats using to drink
- slugs
- conveyor belts
- sports
- sharpening knives
- holding things
- grip for tyres/shoes

Friction bad

- sledging
- skiing
- ice skating????
- shooting (drag slows the bullet)
- snowboarding
- putting on clothes (chaffing)
- swimming
- wears down tyres
- engines wear away
- slide
- F1 racing !!!!
- ceramic brakes!!!
- in space things don't stop easily
- boats
- rotating machinery slowed down and wears away

REDUCING FRICTION

- Look at different ways to reduce Friction
  - Lubricants
  - Rollers
  - Small ballbearings
  - Cushions of Air

Try some experiments to change friction

Reducing Friction

What you need

Air pucks, tray with polystyrene beads and puck, linear air track and vehicle, mass and rollers, 2 hinges.

What to do

Carry out some experiments in which friction is reduced.

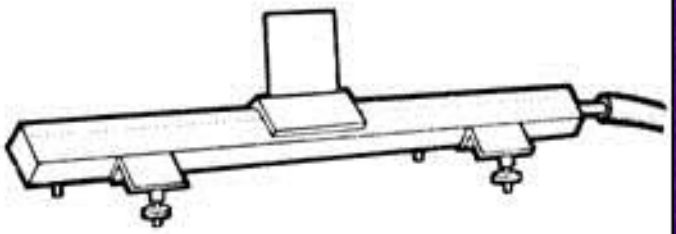
1.

Push the puck

(a) without the balloon

(b) with the balloon filled with air

2.



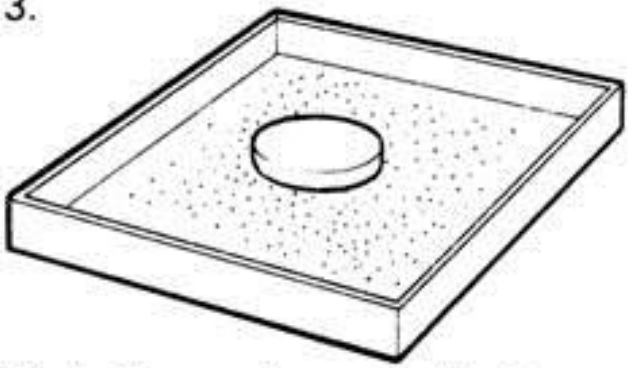
Push the vehicle

(a) without the air on

(b) with the air on

Try some experiments to change friction

3.

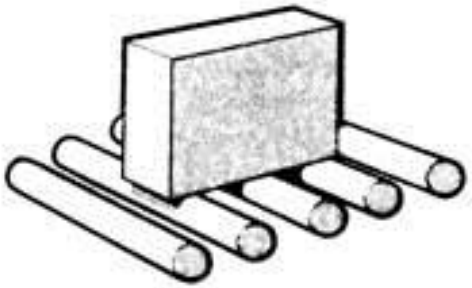


Push the puck across the tray

(a) without polystyrene beads

(b) with the beads

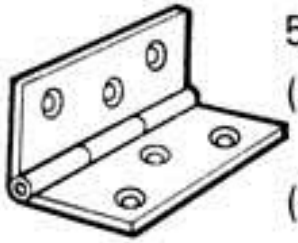
4.



Push the mass

(a) without the rollers

(b) with the rollers



5. Open the hinge

(a) which has *not* been oiled

(b) which has been oiled

Questions

1. Describe how friction has been reduced in the experiments.
2. Describe some uses of where the above ideas are used to reduce friction in everyday life.

over

- Decreasing Friction
- lubrication eg oil, wax, grease, soap
- streamlining
- more aerodynamic
- reduce mass
- rollers
- layer of air
- polystyrene beads
- smooth surface
- ice
- water on road
- LORRY BOARD

- Increasing Friction
- less aerodynamic
- greater surface area
- spoilers
- increase mass
- surface rough eg sand
- gritting roads
- stickier surface
- rougher tyres

The Force of Friction

- When we **move** one surface over another, the **rough**, **uneven** parts **rub together**.

- This creates a **force** which tries to **slow down** or **stop** the **movement**. This **force** is called **friction**.

- The **smoother** the surfaces rubbing together, the **l** _ _ _ _ the **friction** – Movement is **e** _ _ _ _ _. The **rougher** the surfaces rubbing together, the **h** _ _ _ _ _ the **friction** - Movement is **more d** _ _ _ _ _ _ _ _.

Measuring Frictional Forces

Aim

To measure the force required to overcome friction on two different surfaces.

Method

A Newton balance is used to measure the horizontal force required to pull a schoolbag along a surface. The force applied is steadily increased until the bag moves.

Results

Surface	Force (N)
Carpet	
Desk	

Conclusion

Which surface caused the least friction?

How else do you think you could reduce friction in this case?

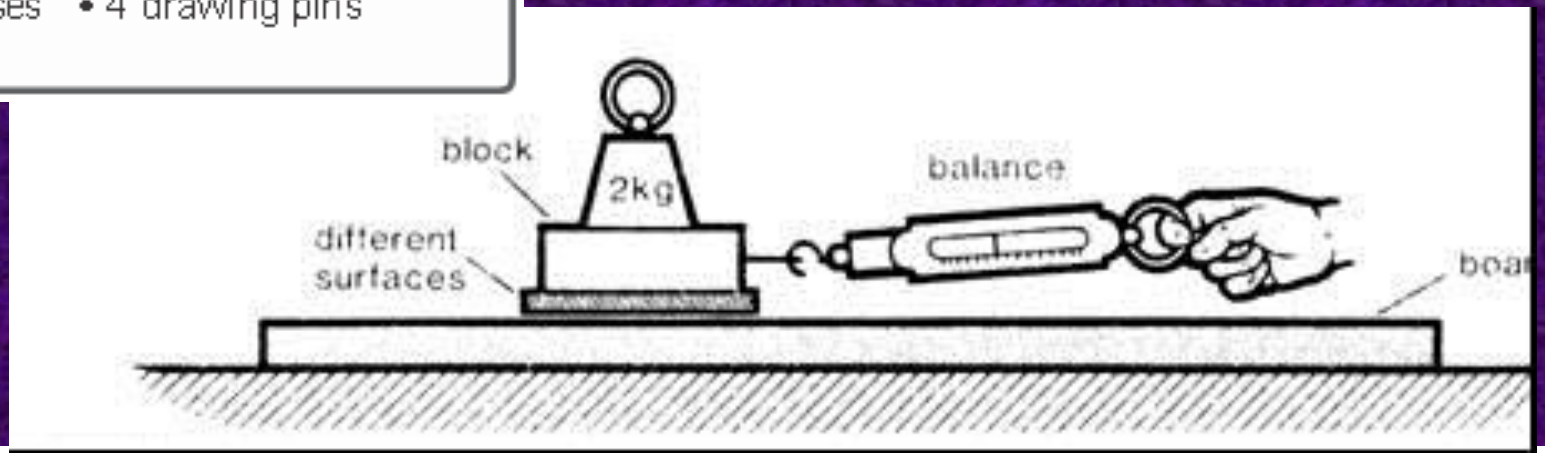
How could you increase it?

Measuring friction

Apparatus

Choose your apparatus from this list.

- squares of different types of materials
- force meter
- wooden blocks of different sizes, each with a hook
- 100 g masses
- 4 drawing pins



Planning

1 Decide which factor you are going to investigate. Describe how you would carry out an experiment to find out how this factor affects the friction between a block of wood and the bench.

2 Explain how you will make sure your investigation is fair. (think about what you want to change and what you will keep the same)

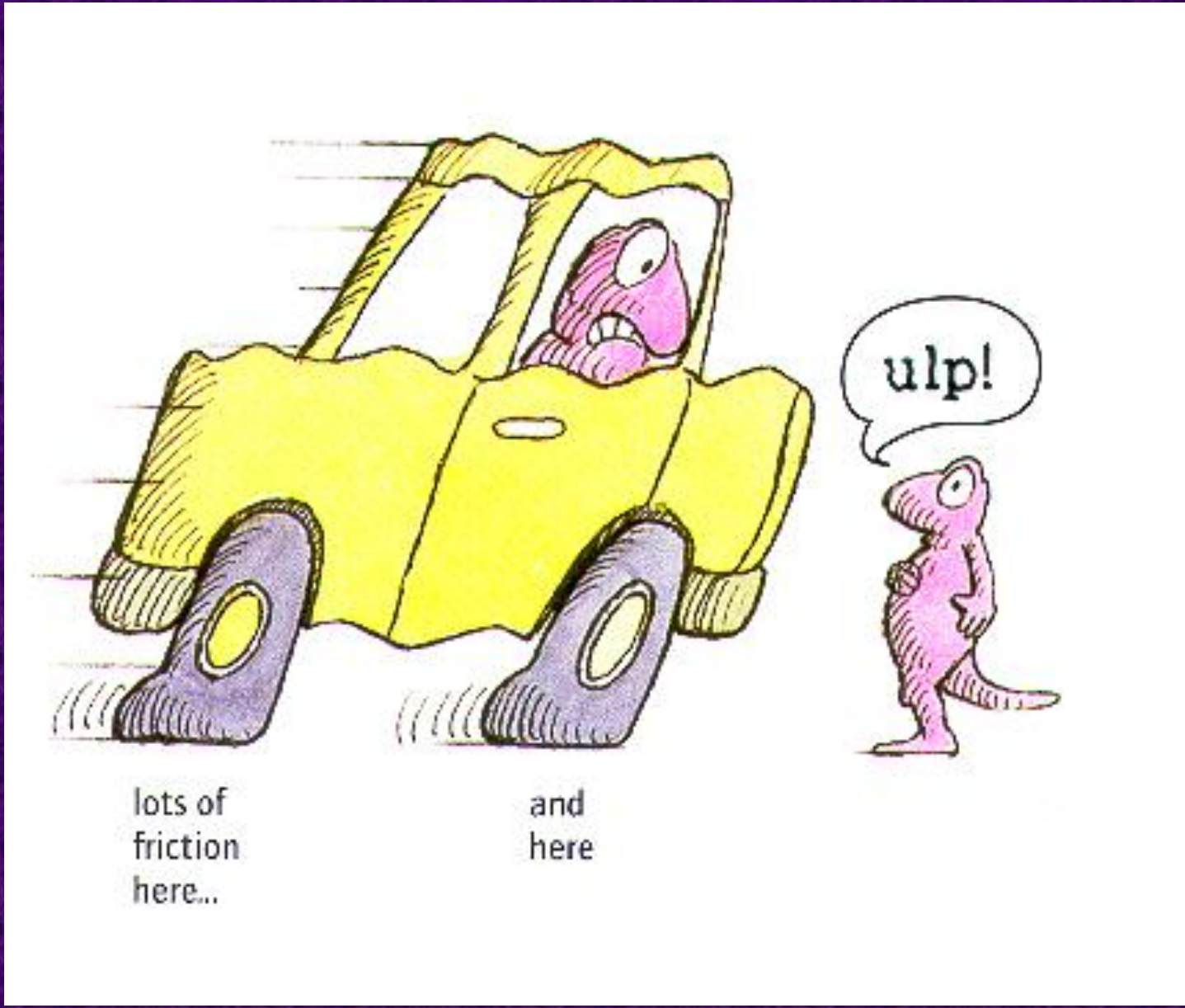
Friction investigation results table

Material	Force needed to pull (N)			Mean force needed (N)
	Pull 1 (N)	Pull 2 (N)	Pull 3 (N)	

Friction is the force that helps you to walk along without sliding about as if you were on ice. It is the force that resists things rubbing against each other. There is less friction between smooth surfaces so things slide easily across a polished table or on surfaces such as ice.

Rough surfaces like sandpaper will not slide together unless they are pushed hard as there is more friction. Friction is useful because it makes feet and car tyres grip the road. However, it can be a nuisance in machines where the moving parts rub against each other and wear away the machine, such as in a bike. Oil reduces the friction and allows the touching part to move more easily

Literacy Extension- Summarise this passage


ulp!
lots of friction here...
and here

FRICTION and CAR CRASH TESTS

- After any accident the police test the road surface to find out the COEFFICIENT of FRICTION.

Friction

1) What is friction?

2) Give 3 examples where it is annoying:

3) Give 3 examples where it is useful:

4) What effect does friction have on the surfaces?

STREAMLINING

STREAMLINING- **Does the shape matter?**

- Think about a sports car.
- What about a speedboat?
- How about a javelin
- Or even a shark?

•All these things are specially shaped to reduce friction. This is called streamlining.

STREAMLINING- **Does the shape matter?**

- All these things are specially shaped to reduce friction. This is called streamlining.

- **Streamlining reduces the effect of air friction on an object.**

- **Streamlining reduces the effect of drag (water friction) on an object.**

STREAMLINING- **Does the shape matter?**

- Collect **Shape in water** sheet.
- This has all the details you need to carry out the experiment.
- Copy the table to record your results.
-

Shape	Time to fall through water (s)
Ball	
Disc	
Cigar	

STREAMLINING

How does shape affect speed?

- Collect **Shape in water** sheet. This has all the details you need to carry out the experiment.
-
- Copy the table to record your results.

Shape	Time to fall through water (s)
Ball	
Disc	
Cigar	

STREAMLINING

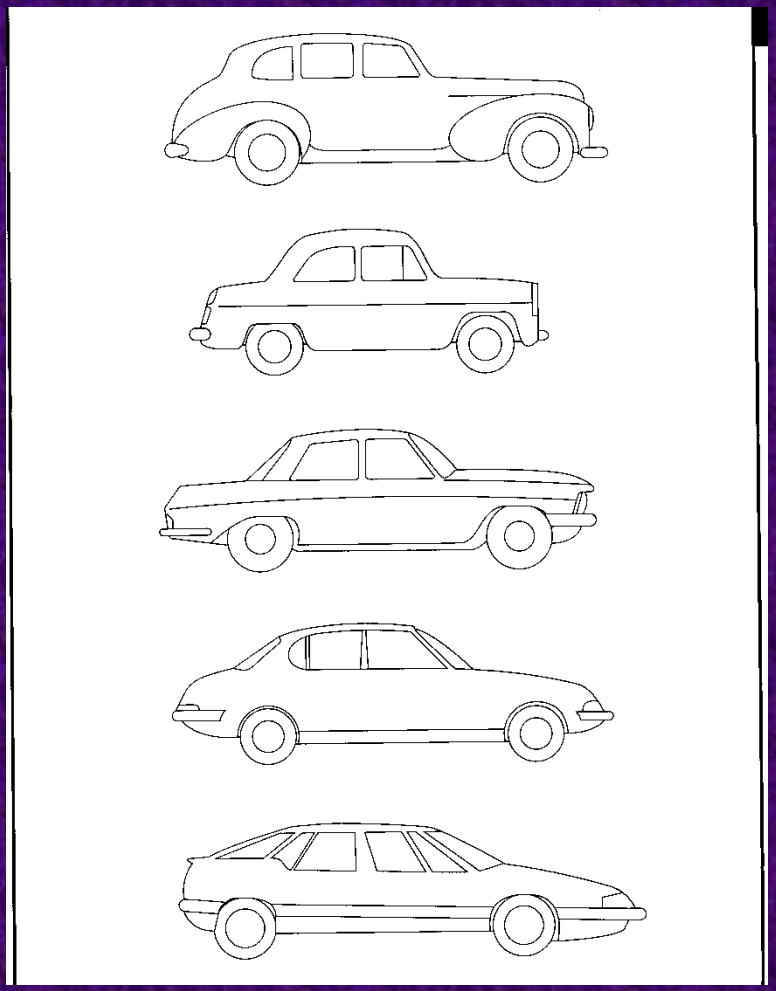
- Draw and label a diagram of the equipment you used.
- Now describe what you did in your experiment.
- Explain how you kept the experiment fair.
- Draw a bar graph showing your results.

- **Conclusion**
- The shape that travelled fastest through the water was the _____ shape.
- This means it has good s_____.

- Now design a shape that you think will take the shortest time to fall between A and B.
- Make your shape from the piece of plasticene that your teacher will give you.
- Each group will have their shape timed in the 'Streamline Challenge'.
-

STREAMLINING

- These illustrations show how the shape of cars has changed over the last 100 years. Cars have become closer to the ground and much more streamlined. A lot of this is because of aerodynamic testing



Cars and streamlining

Back in the 1900s, cars looked like this.

- Now cars look more like this.

Why bother?

- This is **streamlining** – shaping a car to reduce air friction.

Streamlining and Cars

- There are three main reasons for streamlining.

✓ Streamlining means cars can go _____.

✓ Streamlining means cars use less _____.

✓ Streamlining means cars look _____ .

How is it done?

- To streamline a car, designers try to give it a smooth shape. They try not to have too many bits sticking out, like mirrors and aerials.
- Look through the features listed here. Copy the ones that help to improve the streamlining of a car.
-

  * Recessed means that they don't stick out.

How is it done?

Rear spoiler

Low-profile tyres

Smooth shape

seatbelts

Electric windows

Recessed* door handles

Central locking

Air-bags

Recessed* mirrors

How is it done?

- Draw your own, streamlined, car of the future here. Make sure you include those important streamlining features

Road crashes & Friction

Tyres, run off zones, icy conditions, surfaces, sporty shapes

In your groups plan an investigation to find out more about one of the variables below.

Tyres, run off zones, icy conditions, road surfaces, or if possible sporty shapes

Plan-- Write out your

- Aim - (We aim to find out…..)
- Method
- (Step by step guide to your investigation)
- What are you changing? What are you keeping the same?
- Diagram- (draw your set up)
- Results- (record your answers)
- Conclusion-(what you found out)
- Evaluation- (do you think your results are realistic?)

FORCES as a VECTOR

Forces

Two things make up a force

1. its size, how strong a push or pull is, and

2. its direction, which way it pushes or pulls.

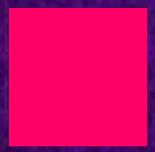
We draw forces as arrows.

1. The length of the arrow shows how strong the force is and

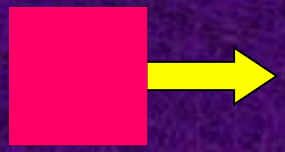
2. The way it points shows the direction of the force.

What do forces do?

Here is my object



We apply a force

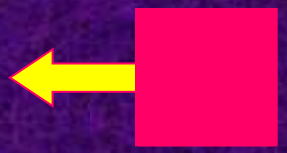


The size of the arrow represents the size of the force.

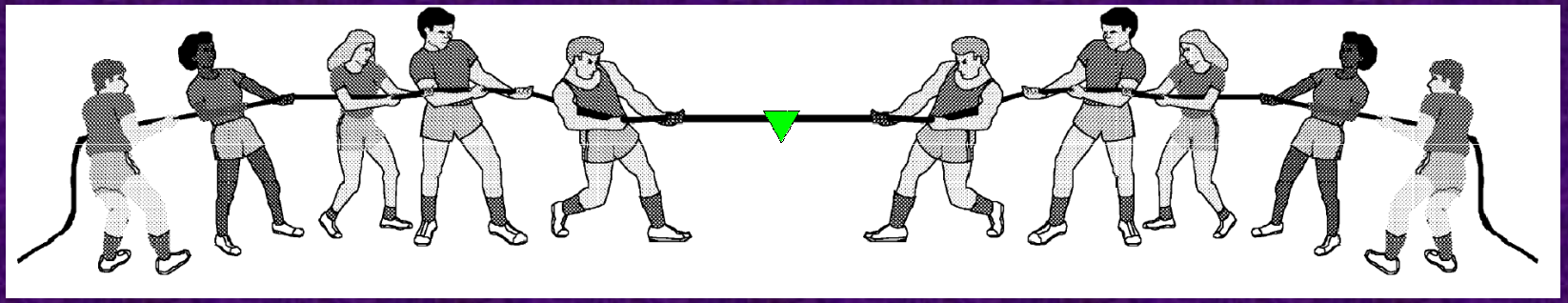
This object has a bigger force acting on it.

HOW WILL WE CHANGE WHAT WE SEE?

If we want the object to slow down again, we need to apply a **braking force** in the opposite direction.



BALANCED & Unbalanced FORCES?



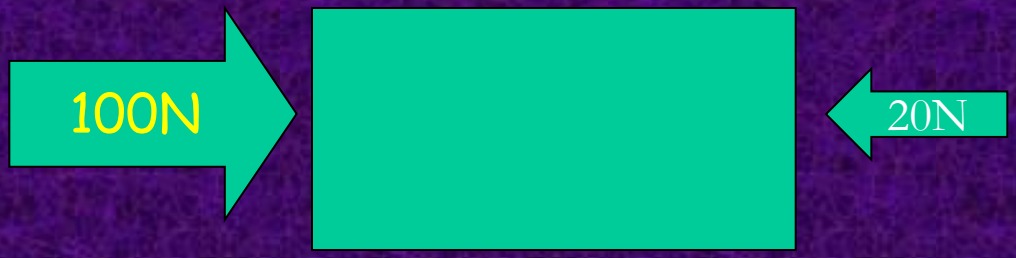
- ***For the effects of a force to be seen the forces must be unbalanced.***

Balanced Forces

- Forces are balanced if they are the same size but in opposing directions:

Unbalanced Forces

- When forces working in opposite directions are unequal they are unbalanced:



- Which direction will the box move?

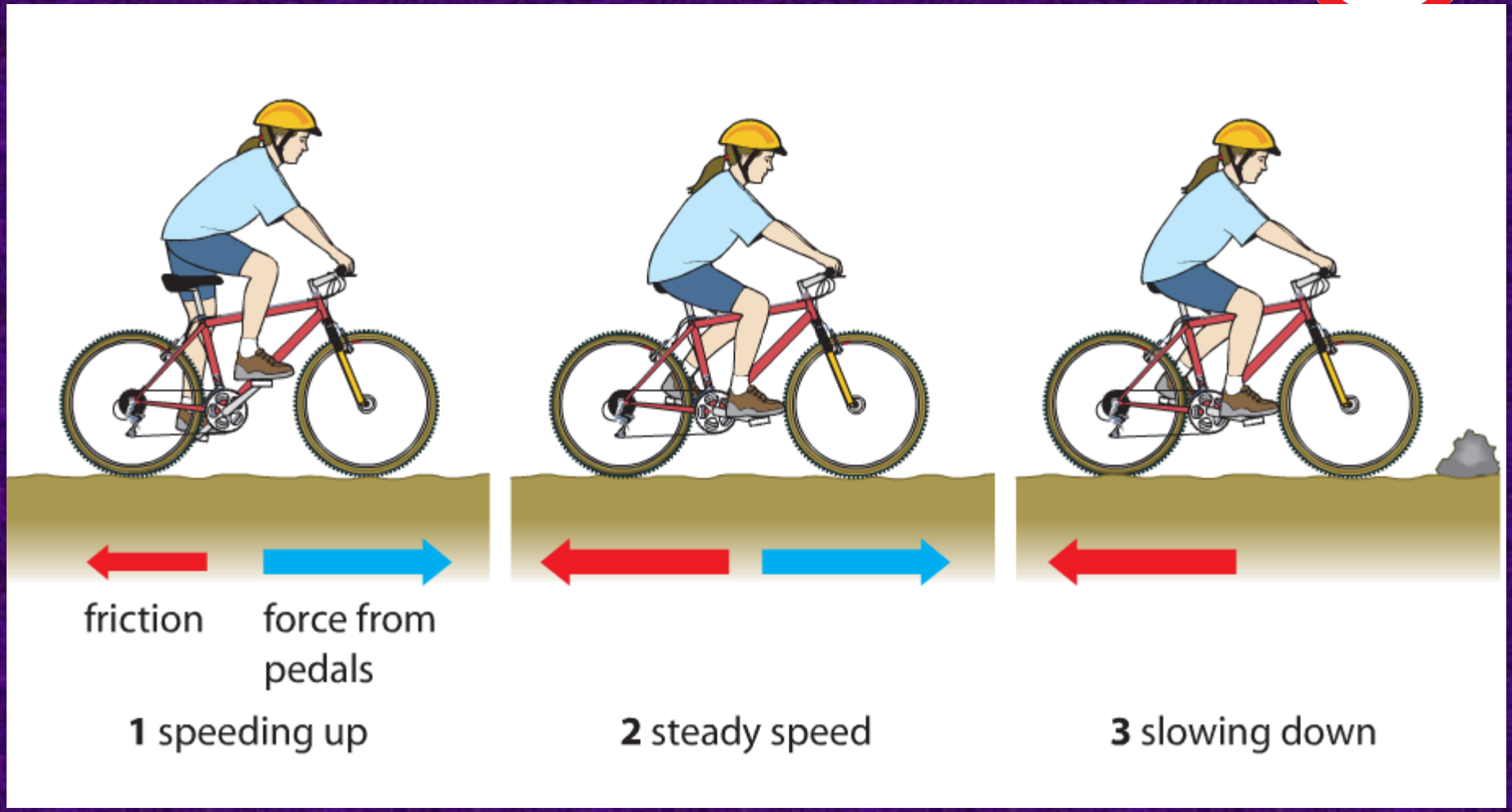
Resultant Force

- If two forces are unbalanced there is a resultant force.
- It could replace all the others to give the same effect.
- The difference between two forces is the resultant force.

What is the resultant force?

Hint: work out the difference between the two forces.

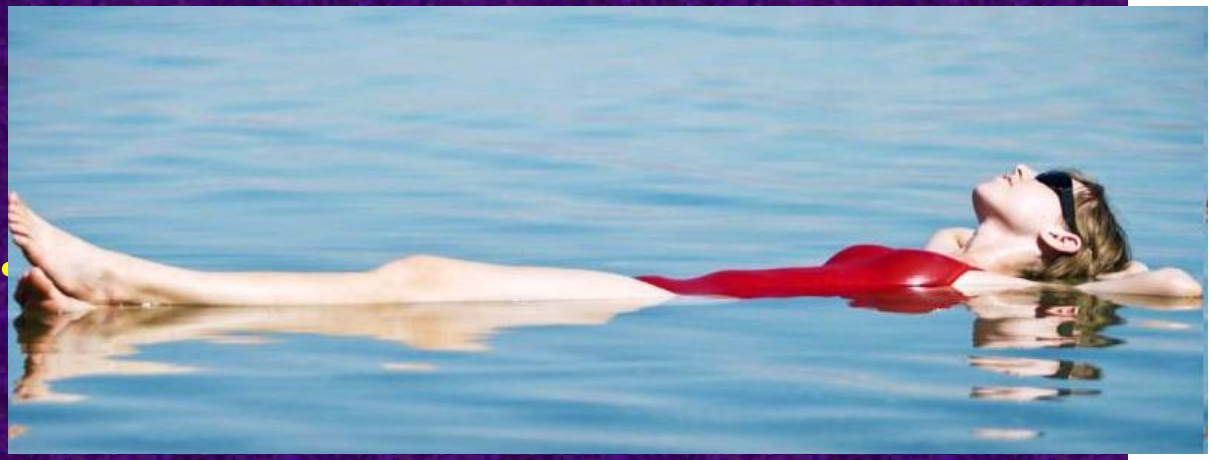
The resultant force is 100N – 20N = 80N


friction
force from pedals
1 speeding up
2 steady speed
3 slowing down

upthrust

Don't Even Sink About It!

- Does a can of coke float?



- Does salt water really make that much difference?

- Buoyancy can be a difficult concept for students. It's all about density

S1 Physics Transport

WORDBANK

Copy the following words into your jotter and literacy logs

Back to mind map

WORDBANK

- UPTHRUST is the upward force exerted on an object by the surrounding fluid (liquid or gas) in which the object is immersed.
- Buoyancy Force is another name for UPTHRUST

fluid - a substance that has no fixed shape And can easily flow (liquid or gas)

EXPERIMENTS Using the experiment sheets try one or more of the following experiments

1. Floating raisins
2. Floating and sinking cans of coke
3. Shapes and floating
4. Salty seas
5. ADVANCED (SCQF level 6)- The Fisherman's Anchor Problem
6. Making Lava Lamps

<u>Remember</u> as part of your Introduction to Science you found the density of a pebble.

- Why do we wear PFDs (personal flotation devices, also known as life jackets) when we ride on a boat? How is the Knock Nevis, the largest ship in the world and weighing 647,995 tons when fully loaded with petroleum, able to float with no problem? It all has to do with buoyancy force.

- Buoyancy acts against weight. If the density of the object is greater than that of the surrounding fluid, the object sinks. If the densities are equal, the object is neutrally buoyant and hovers in the fluid. If the density of the object is less than that of the surrounding fluid, the object floats.

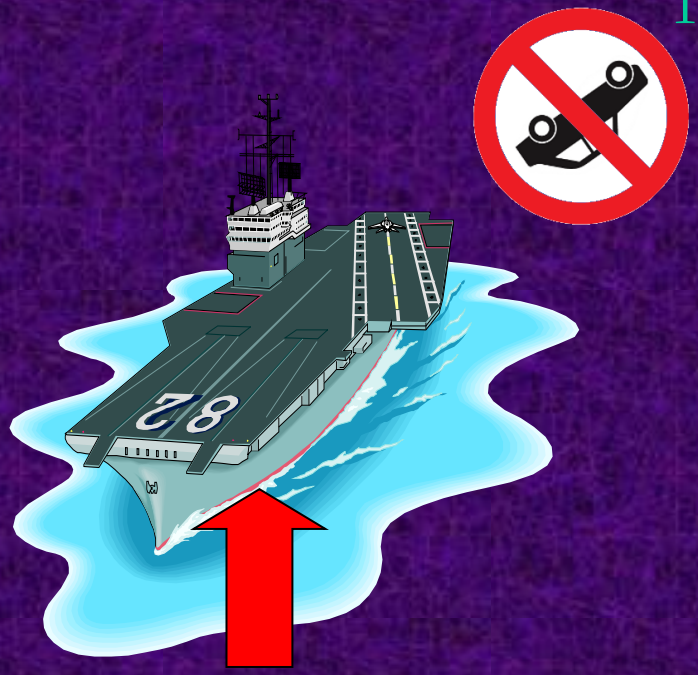
- So although the human body can typically float in water because of the air in the lungs, a person wearing a properly-fitting, well-maintained PFD, the density of which is extremely low, is practically guaranteed to float.

- Density is defined as the mass per unit volume of an object ($\rho = m / V$). Remember that mass is not the same as weight. A small but heavy object, such as a lead fishing sinker, is denser than a lighter object of the same size, such as a cork. The same holds for a bowling ball vs. a soccer ball. Both are relatively the same size, however, the bowling ball has much more matter. Mass is how much matter is there is in an object, and is measured in kilograms (kg). Weight is the size of the gravitational pull on an object, and is measured in units of force, such as (kgm/s^2), Weight is calculated by multiplying mass and acceleration due to gravity.

So how exactly does a huge cargo ship stay positively buoyant, even when fully loaded?

- The key is to ensure that the volume of the ship is large enough to displace the mass of the ship. In the 3rd century BC, the Greek mathematician Archimedes realized that when he got into his bathtub, his body displaced the water making it rise and spill out of the tub. His discovery led to two laws of buoyancy that are still the basis of today's shipbuilding. His first law states that any floating object displaces a volume of water whose mass is equal to the mass of the object. The second law describes the effect a boat's shape has on how well it floats.

Upthrust



It is the force that pushes things up in water.

It helps boats and swimmers and keep them on top of the water so they don’t sink

Newton's 3 laws of motion

Physics Transport

FORCE

Back to mind map

Newton's Laws of motion

Isaac Newton wrote 3 laws about the motion of objects.

1. Unless you apply an unbalanced force to an object, it will keep doing whatever it was doing before.

2. Force = mass (kg) x acceleration (m/s^2)

3. If you push something it pushes back on you

Forces and Isaac Newton

- Newton's first law of motion: An object's speed will only change if a force is applied.
- Newton's second law of motion: Speed or acceleration is proportional to the force.
- Newton's third law of motion: Every action has an equal and opposite reaction.

- **NEWTONS THREE LAWS OF MOTION**
- Newton's First Law states:
- A body will remain at rest or travel at a constant speed in a straight line, unless acted upon by an unbalanced force.
-
- A body will remain at rest or travel at constant velocity, unless acted upon by an unbalanced force.

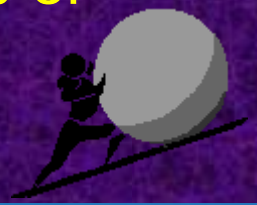
All Complicated Forces Explained

1. Balanced forces cause objects to stay at rest or travel at a constant speed.

A bullet travelling through space just keeps on going.

2. Unbalanced Forces cause objects to speed up or slow down.

I'd rather push a Mini than a 4X4!



3. To every Action Force there is an equal and opposite Reaction Force.

If you shove me I'll shove you back (at the same time)!

Newton's 1st law of motion

The BEST IDEA EVER

- http://www.youtube.com/watch?v=jwPc0kK9VHU&feature=endscreen&NR=1

Common Pupil Myth

An object which does not move has no forces acting on it.

Why is Newton's first law difficult to understand?

Friction?

Starting point:

Forces can produce changes in

- Speed
- Direction
- Shape

Starting point:

Forces can produce changes in

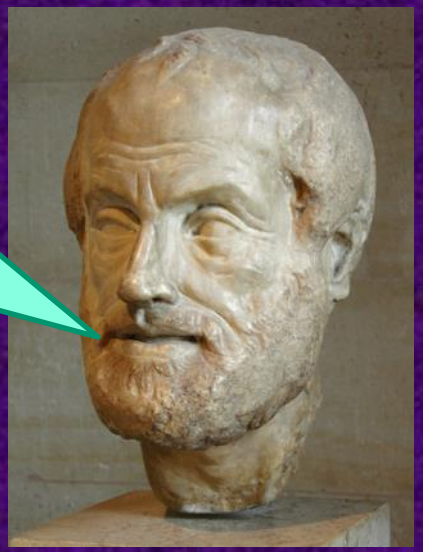
- Speed → start, stop, speed up, slow down
- Direction
- Shape

Forces “starting and stopping” is OK with most people.

Change in speed is bit a little trickier….

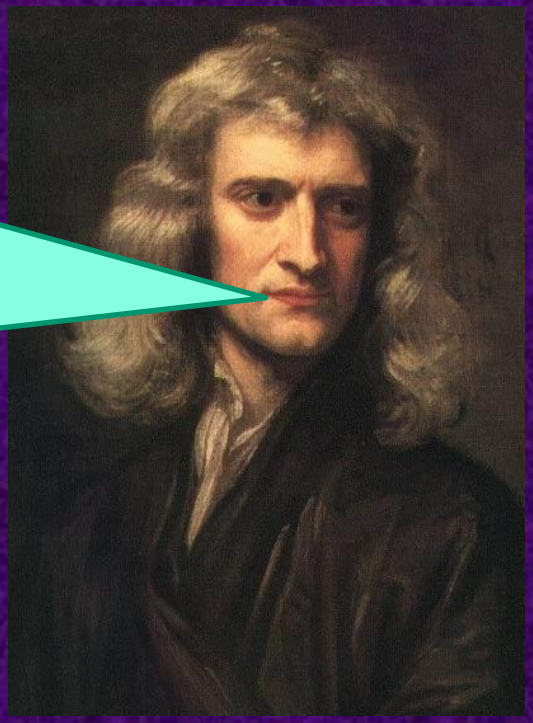
Some **wrong** ideas:

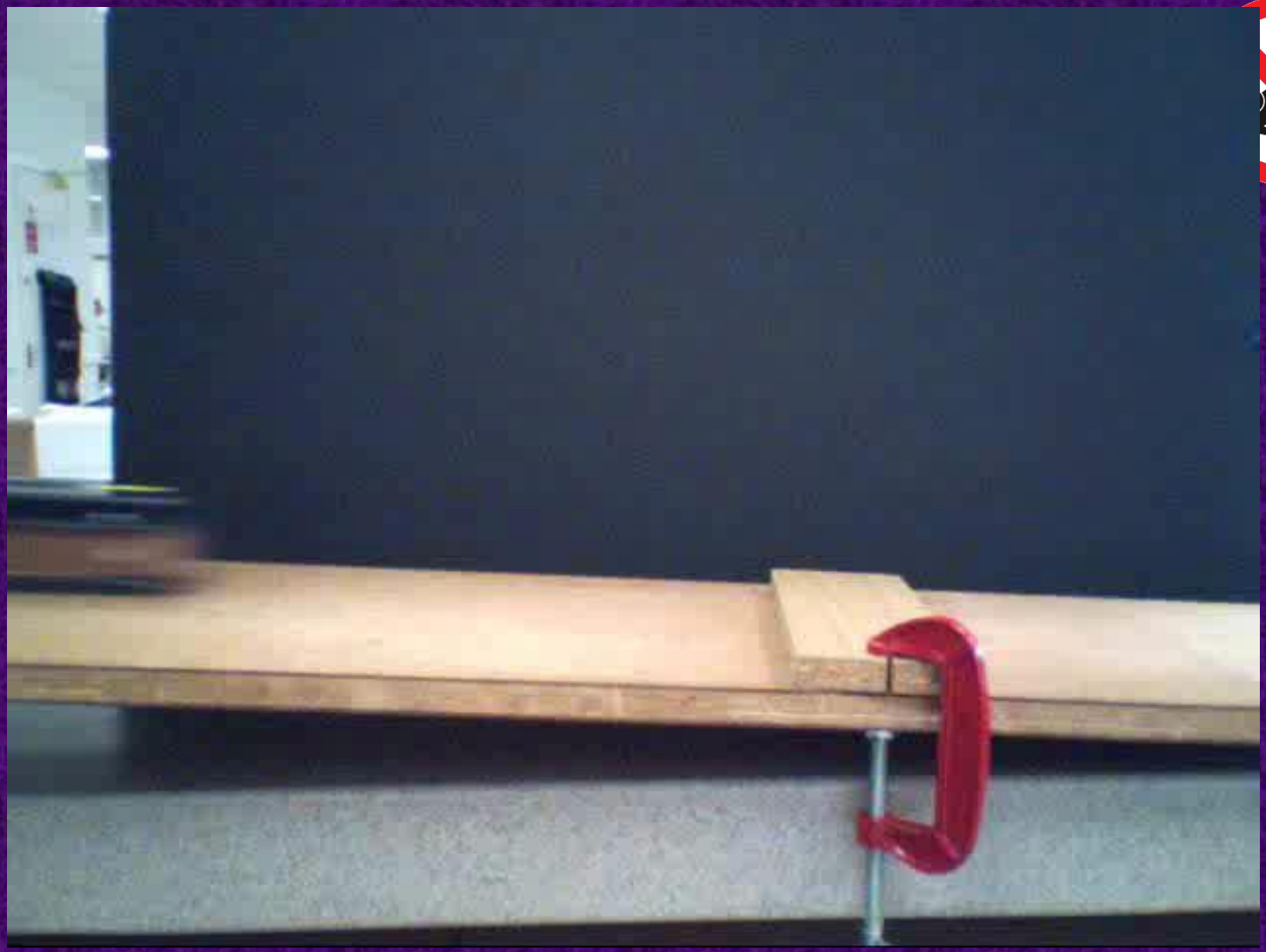
Nothing moves unless you push it. [it is moved by a mover]
Speed is proportional to motive force.
Men have more teeth than women.



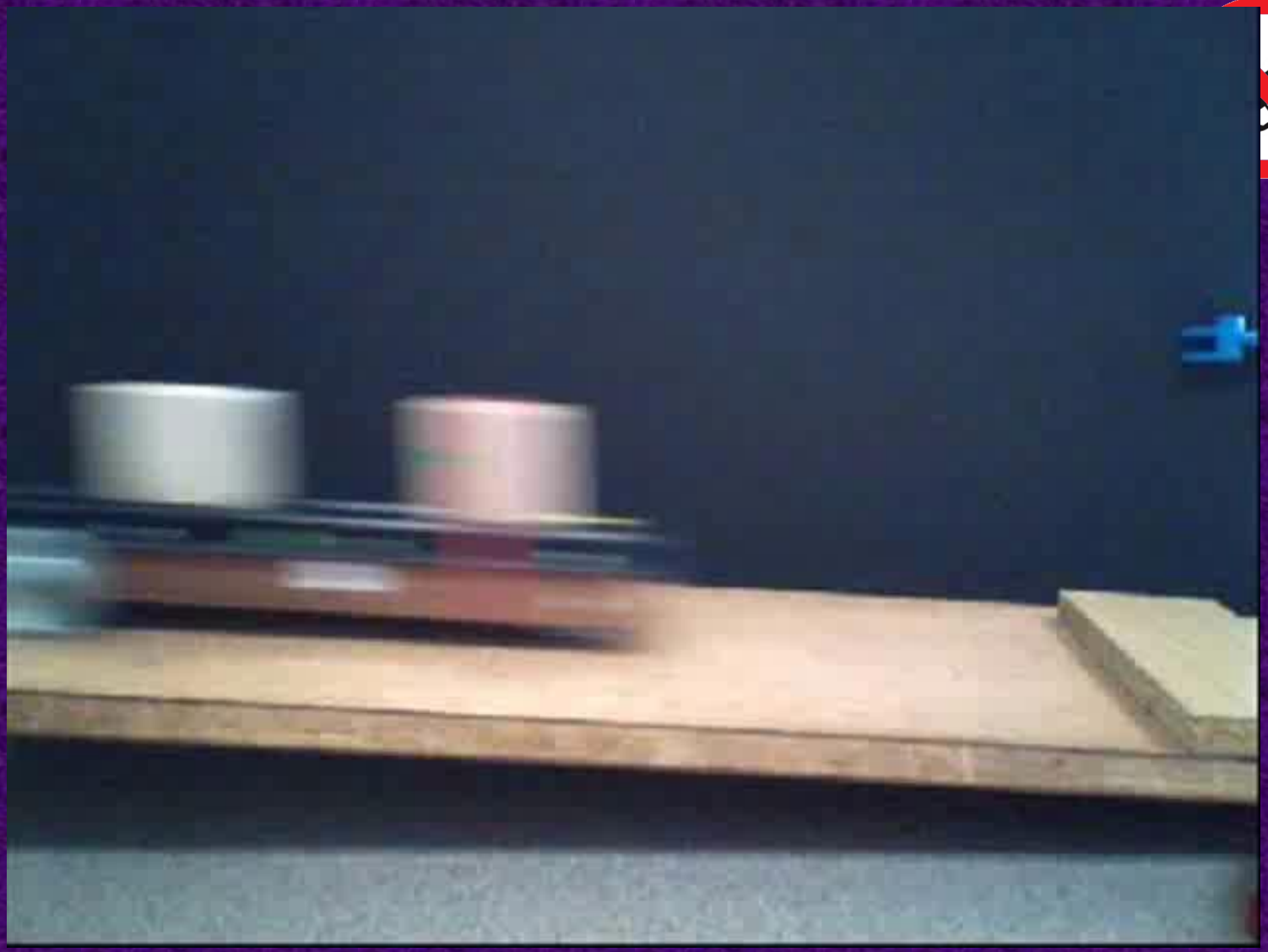
Newton's First Law

An object will remain at rest or continue at a steady speed in a straight line unless an (unbalanced) force acts on it.





play



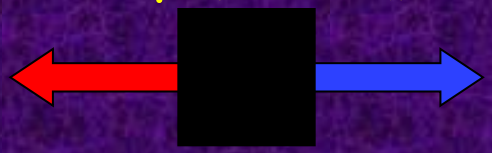
play

Newton's First Law

An object will remain stationary or move at a constant speed in one direction unless an **unbalanced force** acts upon it.

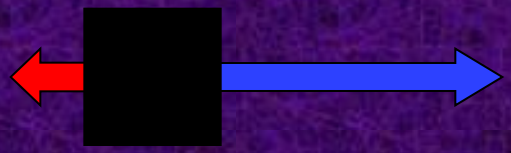
Balanced forces

When there are two or more forces acting on an object and they add up to a total force of zero, we say the forces are balanced.



Unbalanced forces

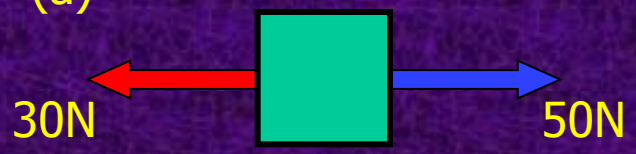
When an object is acted on by a force which will cause it to accelerate or change direction.



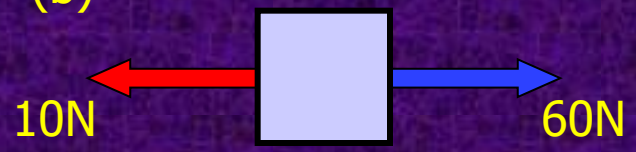
Newton's First Law

In each of the following calculate the unbalanced force and its direction.

(a)



(b)



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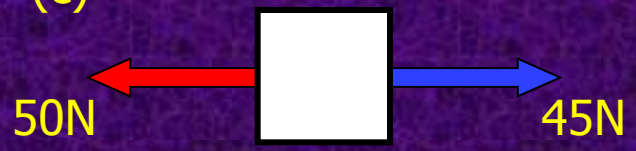

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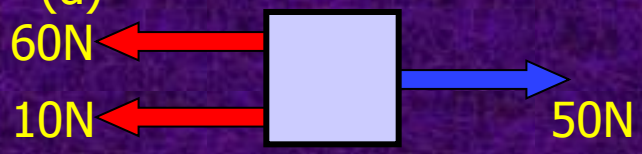

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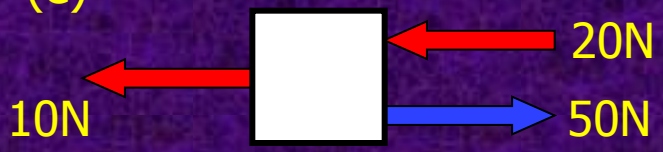

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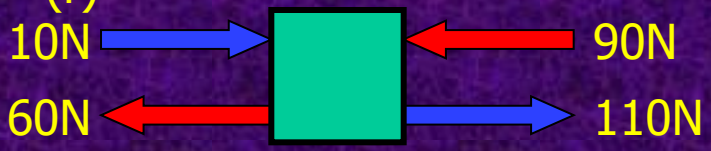

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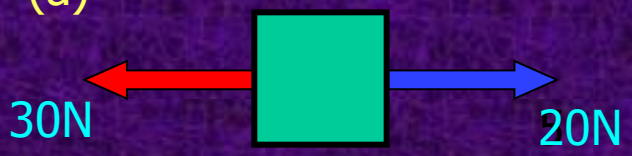

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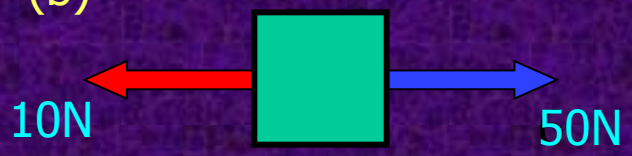

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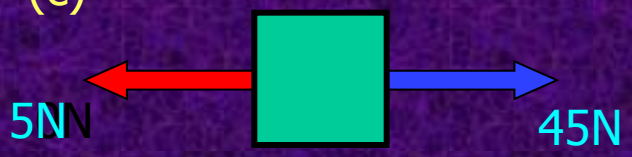

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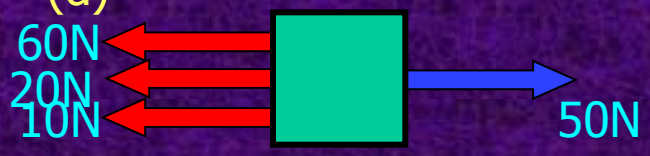

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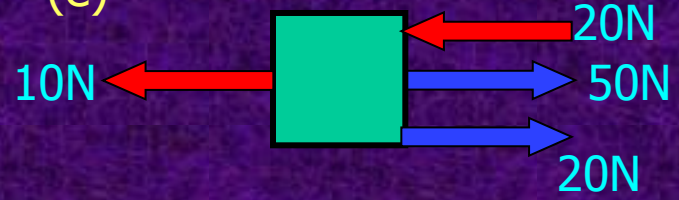

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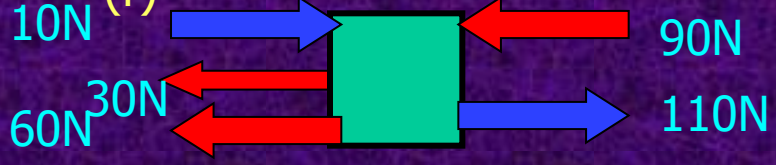


What do forces do?

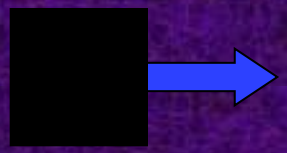
Lets assume we have an object to which we are going to apply forces.

With no forces acting on it, our object is stationary.

If we apply a force to the right for a short time, it will accelerate

But even when we stop applying the force, it will keep going at a constant speed

If we want the object to slow down again, we need to apply a braking force in the opposite direction.



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Egg seat belts

An example of newtons first law

Seat belts

Starter: Which car is the safest?

Newton's second law

Speeding up/ slowing down

Newton's Second Law

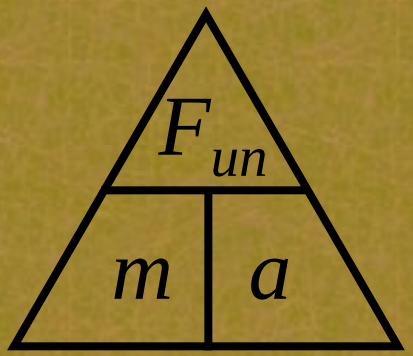
Newton's 2nd law allows us to analyse the motion of objects. Any unbalanced force causes an object to change velocity, or to change direction. This cannot happen without an unbalanced force.

F_{un} = Unbalanced Force (N)

m = Mass (kg)

a = Acceleration (m/s^2)

$$F_{un} = ma$$



2nd Law Questions

1. Calculate the force required to accelerate a 10kg cannonball at a rate of $180 m/s^2$.

2. A 100 kg person jumps out of an aircraft,
   a) Calculate his weight.
   b) What is his acceleration?
   c) What will his downward speed be after 15s?

3. A car starts from rest and accelerates to 20m/s in 18 seconds. If the car has a mass of 1350kg calculate:
   a) Its acceleration.
   b) The forward force being produced by the engine.

Check Your Answers

1. $F=ma = 10 \times 180 =$ **1800 N**

2.
   a) $W=mg = 100 \times 10 =$ **1000 N**
   b) $a=F/m = 1000/100 =$ **10 m/s**
   c) $v=u+at = 0 + 10 \times 15 =$ **150m/s**

3.
   a) $a=(v-u)/t = (20-0)/18 =$ **1.11 m/s**
   b) $F=ma = 1350 \times 1.11 =$ **1498.5 N**

Initial FORCES RESEARCH PROJECT

What have you learned?

INVESTIGATIONS

- Choose one of the investigations to choose from or design your own
- Friction and the driving surface
- Car tyre design
- Brakes how to make them better
- Being a crash test dummy
- Seatbelts are they worth it?
- Run offs what should they be made of?
- How and why lorry brakes smell at the bottom of a slope (height and speed_

Look at Road safety Campaigns, stopping distance, reaction timers, car accidents Discuss how cars can be designed to be safe. Where can improvements be made?

DISCUSSION- Choose one of the topics to discuss

- Should the speed limit on motorways be increased?
- What should be the punishment for drink drivers?
- The age for people to learn to drive should be increased/ decreased.
- The cost for Fuel in rural areas should be reduced
- We should learn to drive at school
- Driving lessons should be free and compulsory
- The insurance for young drivers is too expensive
- All cars in Scotland should have snow tyres in winter

YOUR TASK.

Working in teams you need to:

- 6. Record this value on your worksheet
- 7. time how long note down
- 8. record as tally marks on your worksheet every time each person in the group leaves the track
- 9. Find the average speed of the car for each person
- 10.Find the average velocity of the car for each person.
- 11.Using the ALBA package record the instantaneous speed of the vehicle at the specific place in the track (see the additional worksheet)

- TASK

We need to know the

1. distance your vehicle will travel
2. the average speed over the whole journey
3. the instantaneous speed of the vehicle as it goes round the roundabout (or alternative)

Did you know?

- 95% of road crashes are caused or partly caused by human error
- Being on a mobile phone can slow a driver's reaction time by an extra 50%.

Discussion Points

Car crashes are complicated events. Most are caused by a combination of:

- **human behaviour**
- **the environment (including road, time of day and weather)**
- **the vehicle.**

Each of these has an influence before, during and after a crash. This can be illustrated in a grid, known as a Haddon Matrix *(right)*.

Draw your own Haddon Matrix. For each box in the grid, list things that influence the likelihood of crashes occurring and how severe they will be.

In groups/pairs, pick an example of each factor (Human, Environment, Vehicle) and decide what influence it could have 'Before the Crash', 'During the Crash' and 'After the Crash'. Then consider what measures could be taken to reduce the likelihood of the factors you've chosen causing an accident, then present your conclusions to the rest of the class or group.

	Before the Crash	During the Crash	After the Crash
Human Factors	The driver is tired which means he is much more likely to crash.	The driver has fallen asleep, and so does not brake or swerve. This makes the crash very severe.	One of the occupants was elderly and less likely to recover from his injuries.
Environment Factors	It was a motorway in the early hours of the morning. The road surface was wet.	The crash was high speed as it was on a motorway and so more severe. But the crash barrier stopped the car crossing onto the other side of the road.	As the crash occurred on a motorway at night when there was little traffic, the emergency services were able to reach the scene quickly.
Vehicle Factors	The tyres were close to the legal minimum tread depth. This also made the crash more likely.	A passenger in the rear was not wearing his seat belt, and was thrown forward into the driver, causing fatal injuries to both.	The car's occupant compartment withstood the impact quite well and so the emergency services were able to extricate the casualties quickly.

Activity: On your worksheet side 1

- What are the forces that act on it?
- Are they Balanced or Unbalanced?

Tasks

Now draw the arrows to show the forces and tell if the object moves because of the forces (unbalanced) or stays where it is (balanced)

Activity Timer

- http://classtools.net/education-games-php/timer/

Activity: On your worksheet side 2

- Are they Balanced or Unbalanced?
- What will happen?

Tasks

Now fill in the gaps next to each picture and then draw your own balanced or unbalanced situation and tell what happens

Stopping a car…

Thinking distance

- Tiredness
- Too much alcohol
- Too many drugs
- Poor visibility

Braking distance

- Icy roads
- Wet roads
- Tyres/brakes worn out
- Driving too fast

Speed Worksheet: Label the graph

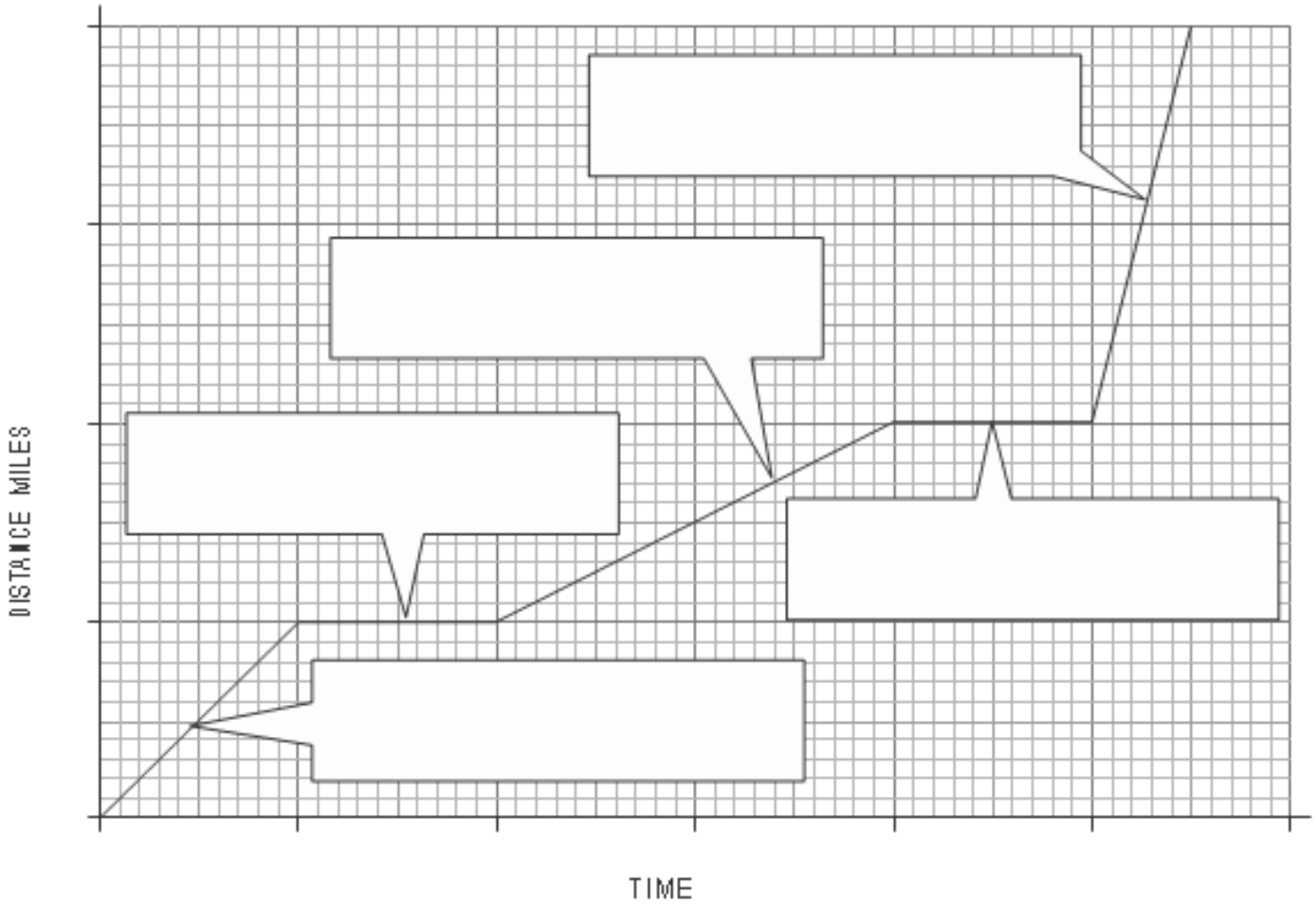
Sima and Julie wait at the bus stop.

Sima waits for her friend Julie to get ready.

Sima walks ½ mile to her friend's house.

Sima and Julie are on the bus going to school.

Sima and Julie walk slowly to the bus stop.



Plenary

Fill in the gaps with the words given:

Forces can change the shape, the _____ or direction of something which is moving.

Contact forces are friction, air resistance, _____ , _____ and upthrust.

Non-contact forces are magnetism, _____ and _____ electricity.

Plenary

We use a _____ to measure forces. The units for measuring forces are _____, or N for short.

Weight is a _____ that attracts objects towards each other.

_____ is the force of gravity pulling things _____ the Earth.

Weight is measured in _____, because it is a force.

Videos

Explanation of mass and inertia
Inertia ep1
http://www.youtube.com/watch?v=by-7kkAu2Pg&feature=related

Mass ep2
http://www.youtube.com/watch?v=uvy4nWh0KwE&feature=related

animations
http://www.misterteacher.com/whiteboard/forces.html#free

Experiment Newton's law of motion
http://www.youtube.com/watch?v=uOSBC0SXVR4&feature=fvw

http://www.youtube.com/watch?v=7Ix-eywqUOg&NR=1
http://www.youtube.com/watch?v=e9eoFl1nbkc&feature=related
http://www.youtube.com/watch?v=rBi1WwLjBA8&feature=related

- Complete the sheet to find the resultant forces.
- Decide whether the forces are balanced or unbalanced.

- Balanced forces have no resultant force.

- A resultant force means a change in motion:
  - There is a change in speed or direction

Log IT

- Make a note of each graph in your books.

- How does speed relate to the shape of the graph?
  - The steeper the slope, the faster the speed

Safety Features in Cars

- Safety cage
- Anti-lock Brakes
- Traction control
- Crumple zones
- Electric windows
- Seatbelts
- Air bags
- Paddle shift controls

Safety Features

These may be active or passive.

Active safety features directly improve the safety of a car. They have an immediate effect in saving lives in an accident. They include

-
-
-

Safety Features

Passive safety features indirectly increase the safety of a car. They contribute to safe driving but do not affect the safety of travellers in a car in the event of an accident. They include

-
-
-

How do active safety features work?

Seatbelts, air bags and crumple zones are useful in crash because they all…

- Change shape
- Absorb energy, and so
- Reduce injuries

Question: How do seatbelts save lives?

Answer: They reduce the force on the passenger.

Explain how they do this in terms of F = m x a

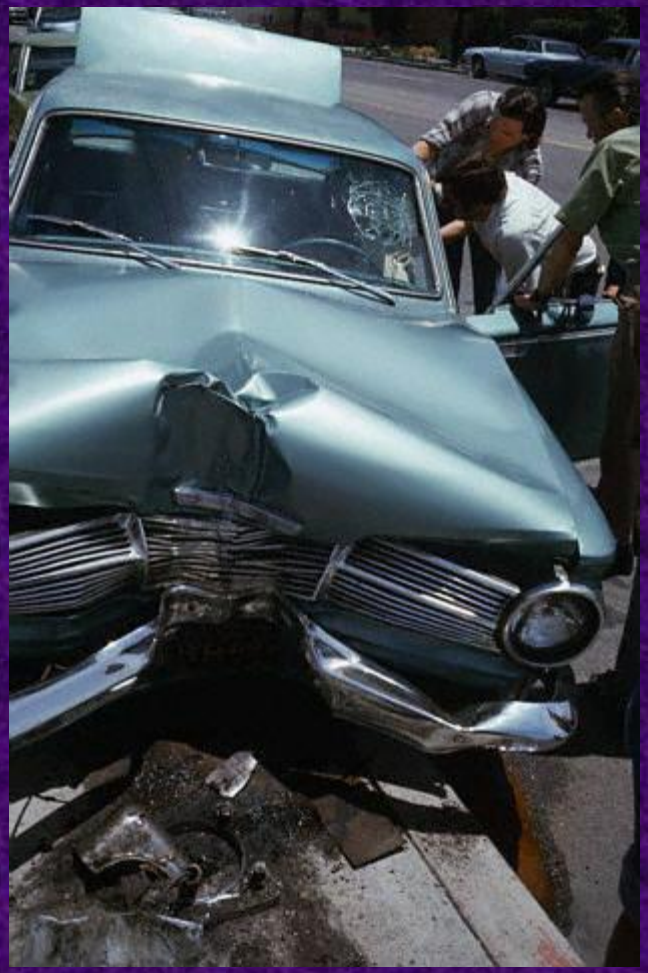
Question: How do escape lanes save lives?

Answer: They increase the stopping (collision) distance.

Explain how they do this in terms of F = m x a

Most safety devices work by

- Increasing the time to stop
- Increasing the distance needed to stop
- Decreasing the acceleration



Activity Timer

- http://classtools.net/education-games-php/timer/
- With sound

http://www.vickiblackwell.com/timer.html

- Other

http://www.teachitworld.com/index.asp?CurrMenu=357

Activity Timer

- http://classtools.net/education-games-php/timer/

http://classtools.net/education-games-php/timer/