LOCKERBIE ACADEMY
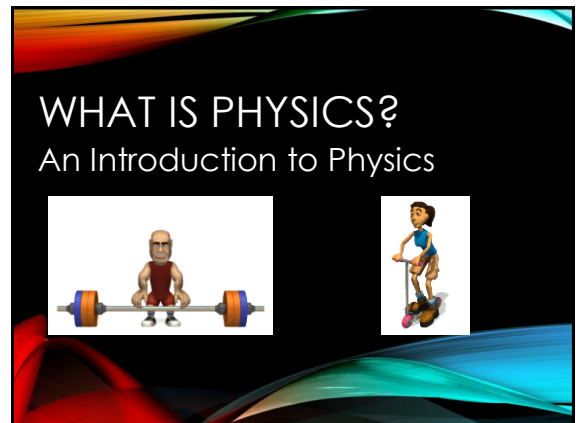
TRANSPORT UNIT

FORCES/DYNAMICS

Push

Pull

1

READY RESPECTFUL SAFE

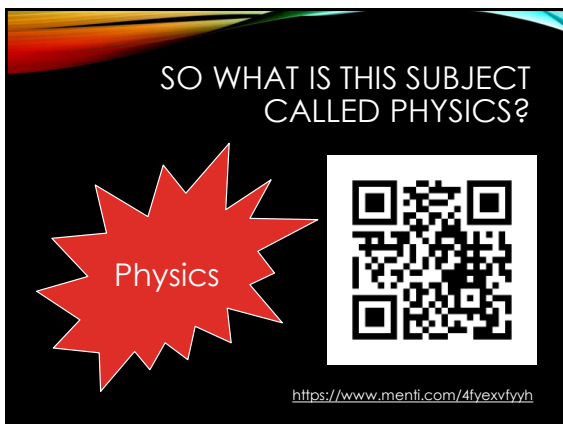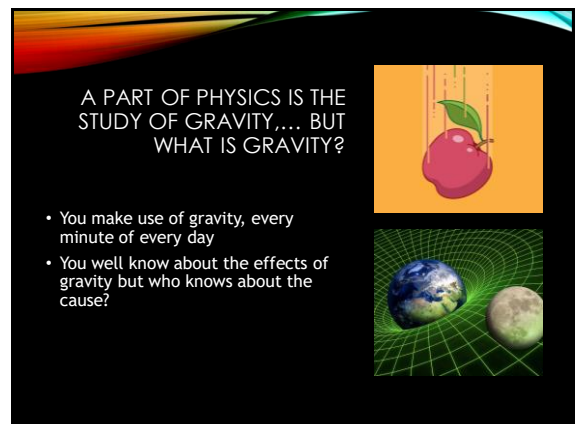| Ready	Respectful	Safe
Enter the room quietly, calmly and on time;	Raise your hand, and wait for permission before speaking.	Follow the teacher's instructions.
Come prepared for the work with jotters and pen or pencil etc.	Allow people to get on with their work.	Follow the laboratory rules
Complete all homework and hand it in on time	No Put Downs	Do not touch equipment that is not part of your work
Pay attention	Not deface jotters, desks folders, etc.	
	Pay attention	
	At the end of a lesson, *when told to do so*, pack away quietly, place stools under the desk and leave in an orderly manner.	

2

THIS PERSON IS **RESPONSIBLE** FOR YOUR LEARNING!

3

WHAT IS PHYSICS?
An Introduction to Physics

4

SO WHAT IS THIS SUBJECT CALLED PHYSICS?

Physics

https://www.menti.com/4fyexvfyyh

5

A PART OF PHYSICS IS THE STUDY OF GRAVITY,... BUT WHAT IS GRAVITY?

- You make use of gravity, every minute of every day
- You well know about the effects of gravity but who knows about the cause?

6

Slide 7

DO YOU FEEL THAT SOMETIMES THE WORLD IS JUST GOING TOO FAST?

How fast?

The Galaxy Song

7

Slide 8

HOW FAST?

speed = distance / time,
...where the distance travelled, is the circumference of the Earth and the time is one day (the time for the Earth to spin once on its axis).

• Earth/Diameter = 12,742 km

• Earth/Diameter = 7,917.5 miles
speed in miles per hour= Circumference/24 hours
speed = π x d / 24
speed = (3.14 x 7,918)/ 24
= approx. 1000 mph

8

Slide 9

WHAT IS PHYSICS?

9

• Physics is the subject that delves into our beautiful and wonderfully made universe.
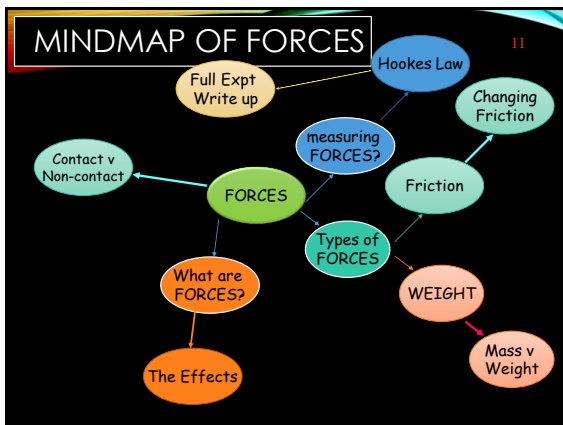• We try to look at the world and work out its rules.

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9

Slide 10

HOMEWORK

10

•**Forces title Page**
•**What I learned about myself in S1 Science**

10

Slide 11

MINDMAP OF FORCES

11

Full Expt Write up

Hookes Law

measuring FORCES?

Changing Friction

Contact v Non-contact

Friction

FORCES

Types of FORCES

What are FORCES?

WEIGHT

The Effects

Mass v Weight

11

Slide 12

WHAT WE WILL BE COVERING

✓ WHAT IS A FORCE?
✓ Forces around us
✓ EFFECTS OF A FORCE?
✓ Contact versus non contact forces
✓ MEASURING FORCES
✓ The Effect of Forces investigation
✓ Mass v Weight
✓ Frictions investigation

12

MASS & WEIGHT

Before we deal with Forces, we near to clear up an important confusion in Physics/ Science.

13

ASK A STUDENT!

- What is Mass?
- What is Weight?

Timer- Dr WHO

Think Pair Share

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14

MASS AND WEIGHT- LEVEL 3

- The **mass** of an object is **the amount of matter** that is in the object. (kg)
- the **weight** of an object is the **force of gravity** that acts on that object. (N)
- ➔Mass is related to how much *stuff* in an object and **weight is related to the pull of the Earth**

15

MASS AND WEIGHT- LEVEL 4

- *Mass is a measure of the amount of matter (stuff) 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.

16

SUMMARY

Mass is measured in kilograms (kg).

Wherever you go your mass remains the same.

17

Mass and Weight

18

- 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!

18

3

Slide 19

MASS AND WEIGHT

- 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>

19

Slide 20

WHAT IS A FORCE?

20

Slide 21

ASK A STUDENT!

- WHAT IS A FORCE?

Timer- Dr WHO

Think Pair Share

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21

Slide 22

WHAT YOU THOUGHT

22

Slide 23

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.
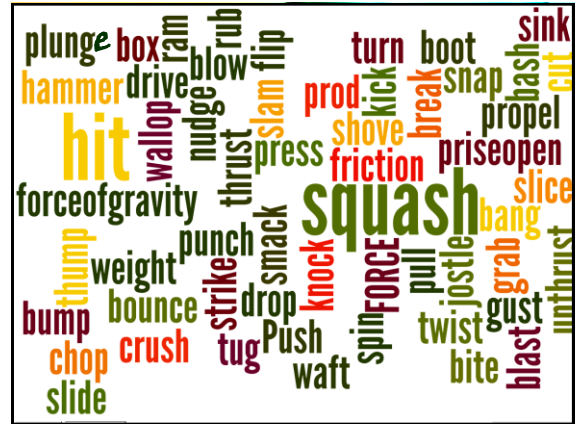
23

Slide 24

ASK A STUDENT!

- NAME SOME FORCE WORDS?

Timer- Countdown

Think Pair Share

24

4

25

WHAT
YOU
THOUGHT

25

---

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

26

27

EFFECTS OF A FORCE?

27

TASK **28**
- THE EFFECTS OF A FORCE

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

28

BEWARE **29**

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

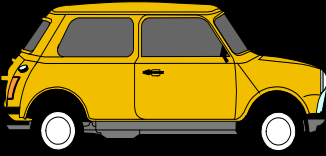Squash that golf ball

29

Forces change an object's **30**
- speed, (cause an acceleration)
- shape,
- direction of movement.

Squash that golf ball

30

31

32

33

34

35

36

Slide 37

WE CAN DIVIDE FORCES INTO 2 GROUPS

Think Pair Share

CONTACT FORCES
NON CONTACT FORCES

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Slide 38

Contact Forces

Friction

Tension (Pull)

Air Resistance

Applied Force (Push)

Spring Force (Twist)

Water resistance

ulp!

Torque   Torque

JAH

38

Slide 39

Non Contact Forces

CLONK
opposite poles attract

39

Slide 40

WHAT TYPE OF FORCE CAN YOU THINK OF?

Non- Contact Forces	Contact Forces
	Friction
	Tension (Pull)
	Air Resistance
	Applied Force (Push)
	Spring Force (Twist)

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

40

Slide 41

WHAT CAUSES THESE FORCES

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41

Slide 42

Activity: Write out which force fits with each picture

CONTACT   NON CONTACT

Weight   Air resistance   Pull

Upthrust   Friction

Water resistance   Push

42

7

43

44

45

46

47

48

49

50

FORCES SPECS

Forces cannot be seen but their effects c

51

FORCES SPECS

• View forces through the special Forces Specs!

52

If forces came ready-labelled science might be easier.

1.1

53

A shopper carries his shopping home.

How does this situation appear through forces spectacles?

1.2

54

55

56

57

58

59

60

Slide 61

MEASURING FORCES

61

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

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Slide 62

62

HOOKES LAW

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Slide 63

63

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63

Slide 64
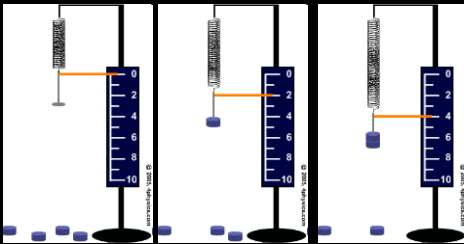
PROCEDURE

- 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 metre stick reading, the number of masses (1) and the extension of the spring.

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Slide 65

65
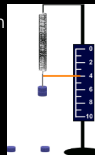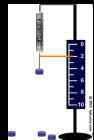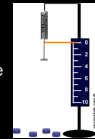
- Repeat this for 5 masses
  Plot the number of masses on the horizontal axis, since it is the input (or independent) variable. The extension of the spring is the output (or dependent) variable and you should plot it on the vertical axis.

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Slide 66

66

TABLE FOR HOOKE'S LAW

Mass (g)	Force (N)	Length (cm) 1	2	3	Average Length (cm)	Extension
0						
100						
200						
300						
400						
500						

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Slide 67

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

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Slide 68

1.9

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Slide 69

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	Extension (cm) 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

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Slide 70

70

Slide 71
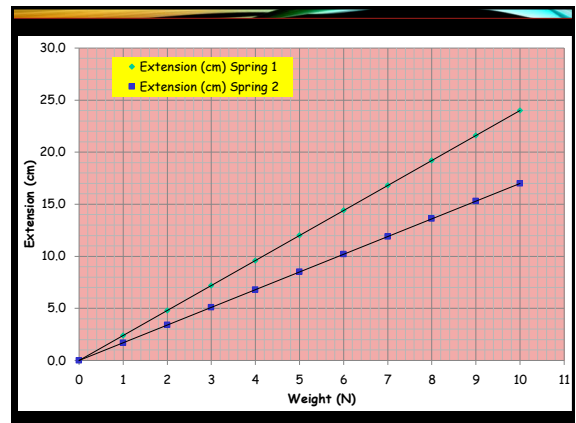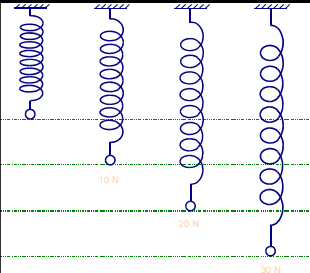
HOOKE'S LAW CONCLUSION

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

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Slide 72

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

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75

SPRING BALANCE / NEWTON METER/ NEWTON BALANCE

76

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

77

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Slide 79
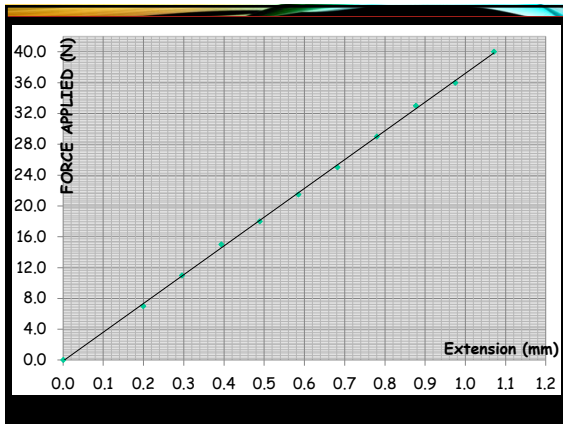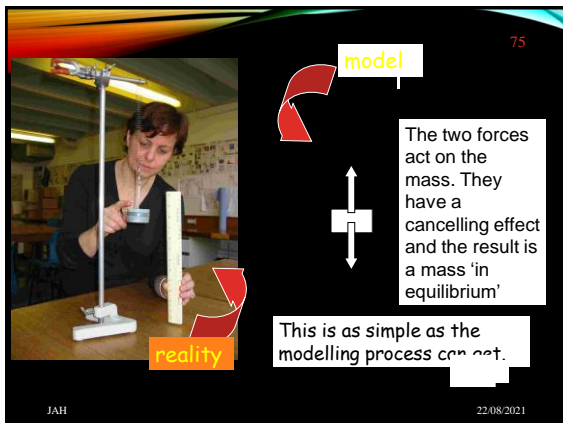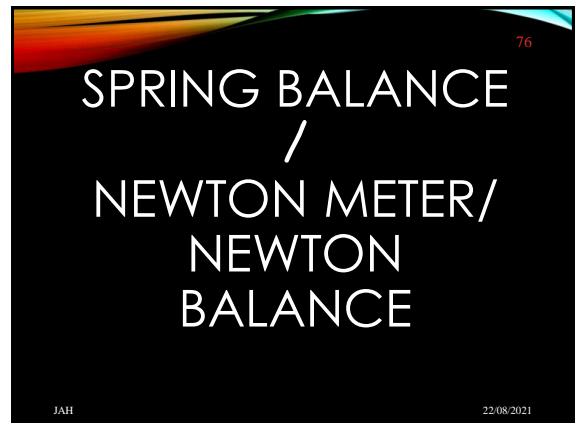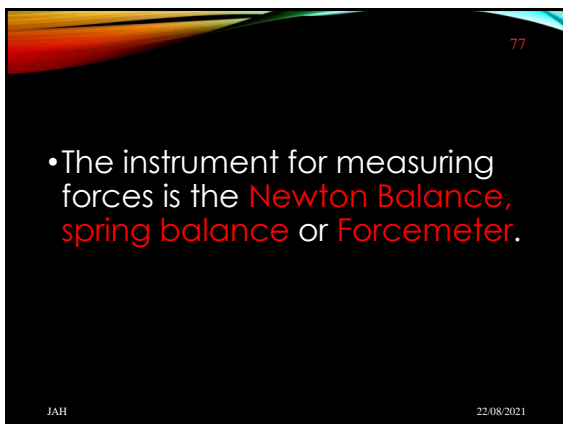
Measuring Force Using a Newton Balance

What you need

A selection of newton balances

10kg

• Record your results in a table

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Slide 80

MEASURING FORCES –USE THESE 80
OR FIND SOME OF YOUR OWN

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

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Slide 81

81

MEASURING WEIGHT/ FORCE

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81

Slide 82

82

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!

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Slide 83

WEIGHT AND MASS – WHAT'S THE LINK? 83

• 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	

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Slide 84

84

• 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 on Earth

• The ratio of weight to mass is given the symbol g

10N

1kg

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84

14

Slide 85

ESTIMATING THE SIZE OF FORCES?

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Slide 86

ESTIMATING FORCES

Match these different situations to the most likely force.

Write these nos. in your jotter

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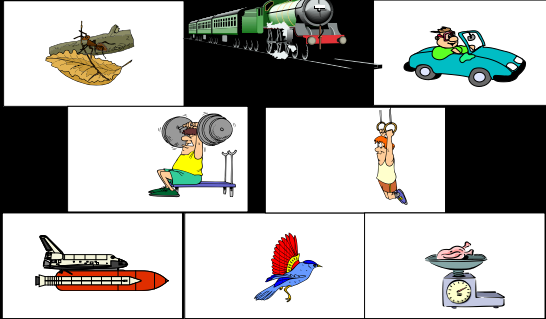
- 0.1 N
- 2 N
- 20 N
- 650 N
- 1800 N
- 10,000 N
- 1,500,000 N
- 200,000,000 N

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Slide 87

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

87

Slide 88

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?

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Slide 89

Write your results into a table like this:

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

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Slide 90

Mass and Weight- LEVEL

WEIGHT NOT GRAVITY

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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 – at least as far as Physics is concerned.

JAH

91

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.**

JAH

92

- Weight is a force which is caused by the pull of gravity.
- You have found that on Earth the

- The weight of 1kg is 10 N

- The ratio of weight to mass is given the symbol

10N

1kg

JAH

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

Weight = mass × g

$W = mg$

$W = 4 \times 10$

$W = 40$ 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	

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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?

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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

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97

WEIGHT AND MASS

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

1 Kg

a WEIGHT of 10N
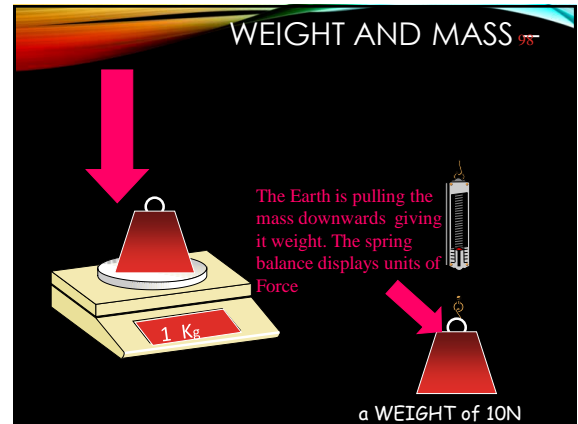
98

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.

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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)

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100

SUMMARY
Weight is the force due to gravity on an object.

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

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101

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 weight is 50 kilograms.
2. Mass is caused by the pull of the Earth.
3. Because mass is a force, it is measured in kilograms.
4. This box has a mass of 70 newtons.

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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.

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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 , and doesn't pull you down with such a big force. This is why astronauts on the , even though they are wearing big spacesuits.
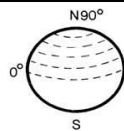
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105

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.

EVEL 4/5

N90°

0°

S

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

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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.

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LOSING – AND GAINING – WEIGHT

•But when you're on the Moon, your mass doesn't change. Remember,
travelling to the Moon doesn't change that.

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

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WHAT YOU THOUGHT

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108

18

REVISION QUIZ 109

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?

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REVISIONS QUIZ
110

MY SCORE OUT OF 18: _____

11. On which planet is your weight greatest?
12. How many newtons of force are there caused by Earth, 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. "In deep space, astronauts have no mass."

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111

FRICTION

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111

FRICTION 112

Opposes means goes against, in the opposite direc

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.

Friction is a FORCE which OPPOSES motion

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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

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114

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)

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Slide 115

FRICTION SURFACE FRICTION 115

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.

JAH

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Slide 116

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?

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Slide 117

LABEL THE PLACES WHERE THERE IS FRICTION

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Slide 118

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FRICTION -GOOD OR BAD

02/10/2011   JAH   22/08/2021

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Useful or Not so useful?

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Walking or running

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USEFUL OR NOT SO

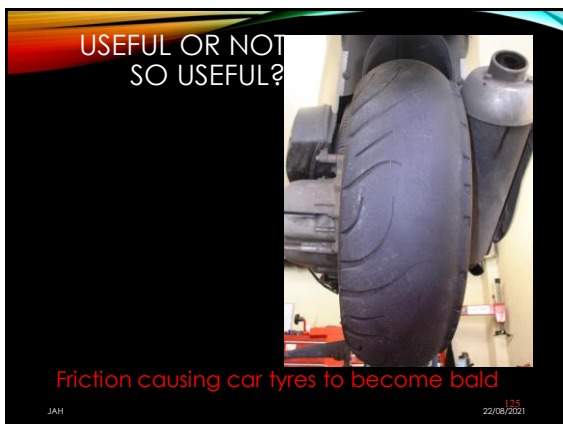JAH   22/08/2021

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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

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REDUCING FRICTION

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

Investigate

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TRY SOME EXPERIMENTS TO CHANGE ... ON

Reducing Friction

What you need

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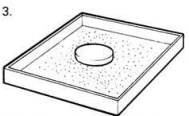
What to do

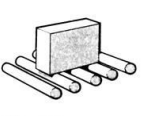Carry out some experiments in which friction is reduced.

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

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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 →

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

- less aerodynamic
- greater surface area
- spoilers
- increase mass
- surface rough e.g. sand
- gritting roads
- stickier surface
- rougher tyres

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THE FORCE OF FRICTION

move
rough, uneven   rub together

force
stop   movement.   force   slow down   friction

smoother
friction
rougher
friction

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MEASURING FRICTIONAL FORCES 133

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   **Conclusion**

Surface	Force (N)
Carpet	
Desk	

Which surface caused the least friction?

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

How could you increase it?

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MEASURING FRICTION

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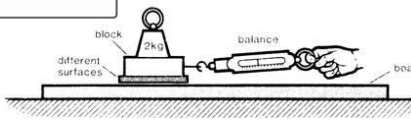
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INVESTIGATION ON FRICTION

Apparatus
Choose your apparatus from this list.
• squares of different types of materials
• force meter • wooden blocks of different sizes, each with a hook
• 100g 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)

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Friction investigation results table

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

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Literacy Extension - Summarise this passage

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

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lots of friction here...   and here

ulp!

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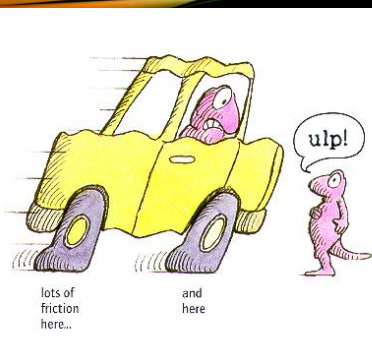
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FRICTION AND CAR CRASH TESTS

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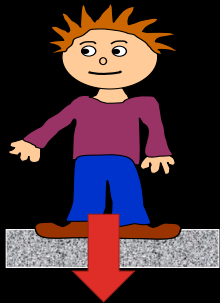
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FRICTION

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?

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Weight

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FORCES AS A VECTOR

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Forces

Two things make up a force

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

2. its direction,

We draw forces as arrows.

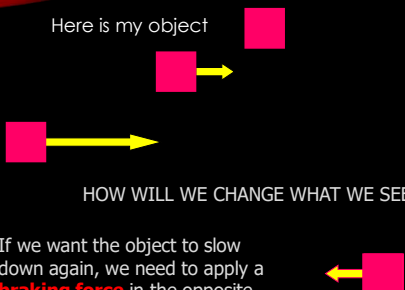length   strong

way it points   direction

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WHAT DO FORCES DO?

Here is my object

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.
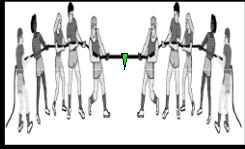
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BALANCED & UNBALANCED FORCES?

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

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BALANCED FORCES

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

40N   [box]   40N

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UNBALANCED FORCES

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

100N   [box]   20N

▪ Which direction will the box move?

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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.

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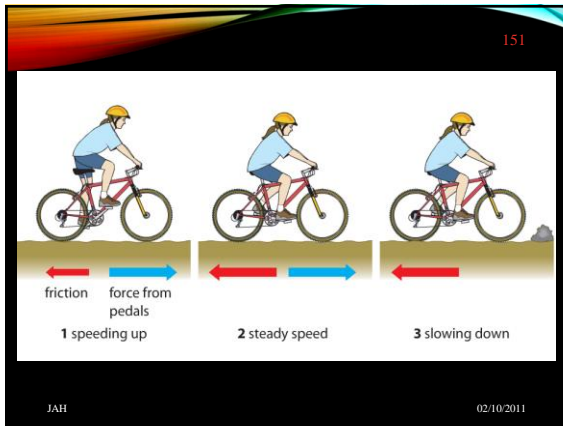
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WHAT IS THE RESULTANT FORCE?

100N   [box]   20N

Hint: work out the difference between the two forces.
The resultant force is 100N – 20N = 80N

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