



**ZIP**  
**WORLD**

.....  
**SCHOOLS**  
.....

**PENRHYN QUARRY**



# WE'RE GOING ON AN ADVENTURE !

## PENRHYN



## QUARRY TOUR

## QUARRY FLYER



We will be taking a tour on one of Zip World's giant trucks around what was once the world's largest slate quarry, as well as flying 200 metres through the air from the top of the Penrhyn Quarry adventure terminal in a dual zip line adventure.



Gravity pulls objects towards the centre of the Earth. The force created by gravity attracting an object is called weight.

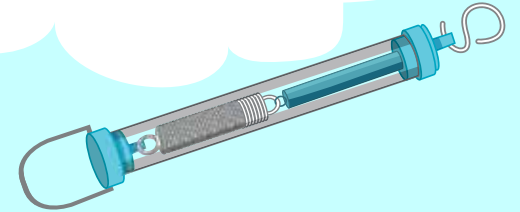
Forces can also change an object's shape (deformation) – through tension or compression.

Forces work in pairs.

Forces can change an object's motion – its speed or direction.

# WHAT DO YOU ALREADY KNOW ABOUT FORCES?

Forces are measured in newtons.



Forces can be contact forces (where they need to touch each other) or non-contact forces such as magnetism or gravity.



When objects fall or move, they push air particles out the way; this is called air resistance, or drag.

Larger surface areas create more resistance and slow movement.

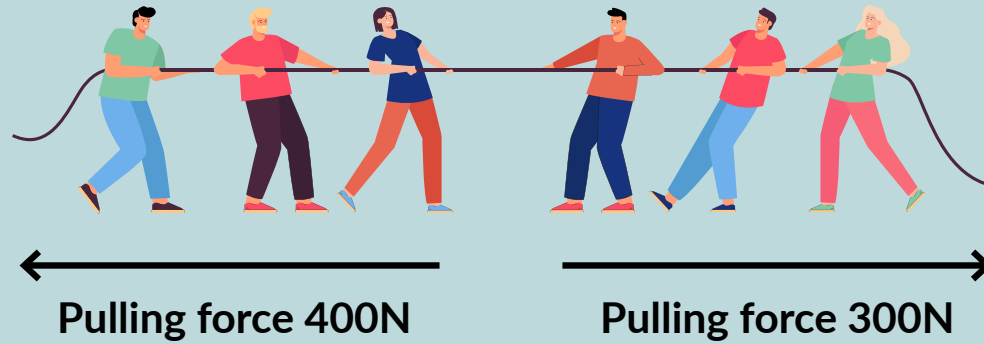
Friction is created when two surfaces are in contact with one another. Smoother surfaces cause less friction.

# HOW DO WE SHOW FORCES ?

- Which way does the engine move the truck?
- Are there any forces working against this movement?
- What direction are the forces in?
- How big are they?

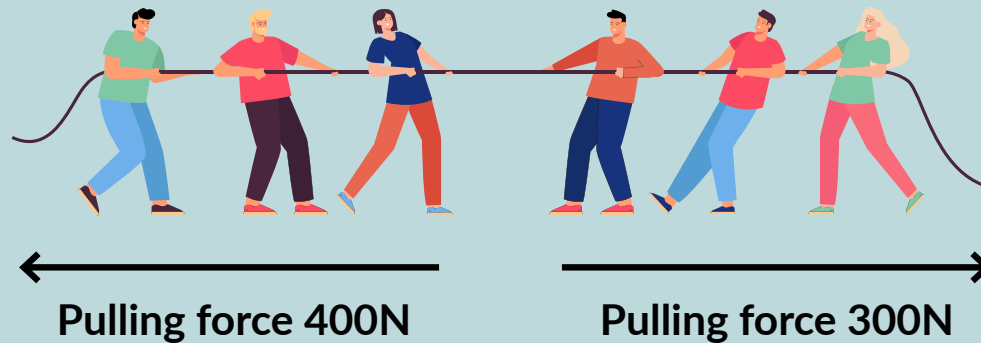
A force arrow must  
be straight

Remember - the longer  
the arrow, the greater the  
force!



When your friends pull equally on the rope, what can you say about the forces in action?

## TUG OF WAR



When one side pulls harder than the other, what can you say about the forces and the effect they have?

# BALANCED FORCES

When opposing forces are balanced, we say the object is in a state of equilibrium. This means that the object remains unchanged – so whatever the object WAS doing, it carries on doing. This applies whether it was stationary or already moving.



**So if an object was**

stationary before the pair of balanced forces act on it, then it remains stationary (because the forces have effectively cancelled out and disappeared).



Moving at 20 mph

**And if an object was**

already moving before the pair of balanced forces act on it, then it just carries on moving at its previous speed and direction.

If this quarry truck is travelling at a constant speed but then the engine produces an extra 10N of forward force but there is also an additional 10N of air resistance, the speed will not change.



# UNBALANCED FORCES



The object might change direction.

The object might stop if it had been moving.

The object might start to move if it had been stationary.

**BUT AN UNBALANCED FORCE ALWAYS CAUSES SOME CHANGE.**

**BUT WHAT SORT OF CHANGE?  
PUT YOUR HAND UP WITH IDEAS.**

The object might speed up.

The object might also be stretched, squashed or twisted.

The object might slow down.

The object might start to rotate.



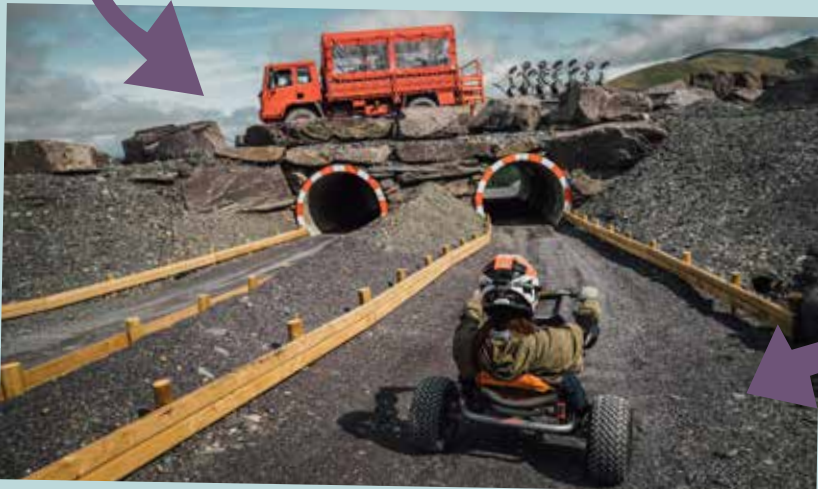


# BALANCED OR UNBALANCED ?



This rider is accelerating down the hill.

This quarry truck has been travelling downhill at 20mph the whole way.



This kart rider is travelling at a constant speed.

This quarry truck is stationary.







# BALANCED OR UNBALANCED ?

This kart is speeding up as it travels down a steep incline.



This rider is starting to accelerate, having just stepped off the platform



These riders have reached their maximum speed.



These riders are standing, posing for a photo before their ride.



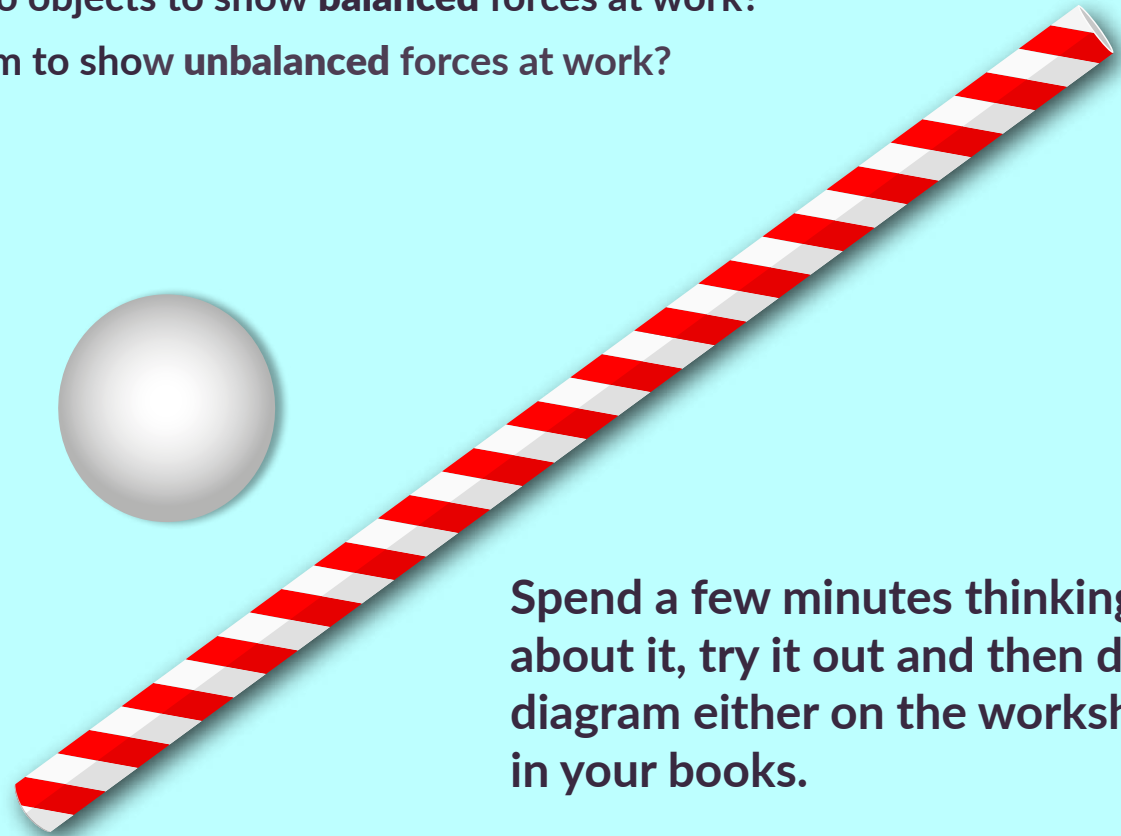
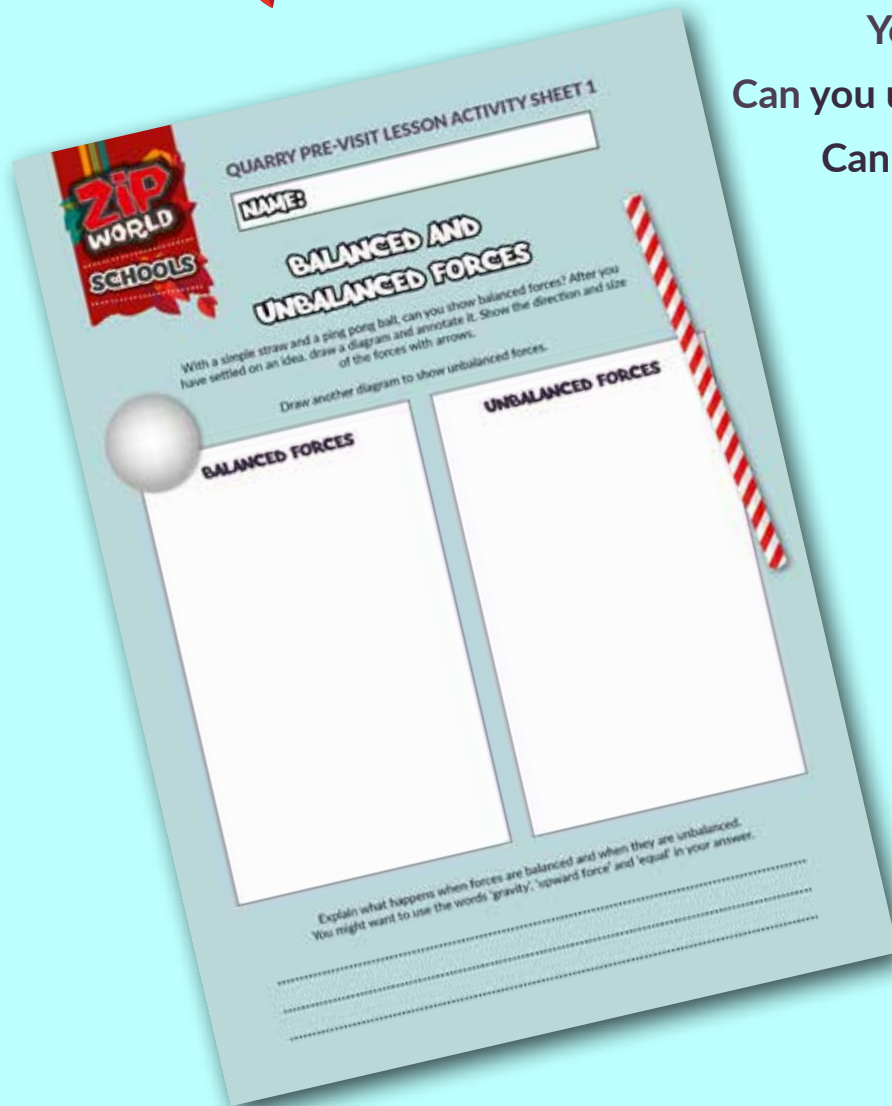


# YOUR CHALLENGE

You have been given a ping pong ball and a straw.

Can you use these two objects to show **balanced** forces at work?

Can you use them to show **unbalanced** forces at work?



Spend a few minutes thinking about it, try it out and then draw a diagram either on the worksheet or in your books.



If you want to extend your thinking about balanced and unbalanced forces, try these questions...

**Zip World Schools**

QUARRY PRE-VISIT LESSON ACTIVITY SHEET 2

NAME: \_\_\_\_\_

## FORCES AT ZIP WORLD

A force is balanced when two equal forces push or pull in the opposite direction, like a draw in a Tug of War. An unbalanced force is when one force is larger than the other. The object will then change its speed or the direction it is moving in.

1. Draw arrows on these pictures to show the direction and size of the forces acting on these quarry trucks that are...

...accelerating

...at constant speed

...decelerating

Which of the pictures above shows balanced forces? \_\_\_\_\_

2. What would happen next in these scenarios?

Friction

Weight

The forces are balanced/unbalanced so...

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

The rider tucks their arms into the sides of their body.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Zip World Schools**

QUARRY PRE-VISIT LESSON ACTIVITY SHEET 2

NAME: \_\_\_\_\_

## RESULTANT FORCES

Unbalanced forces result in a change in motion – the overall force on the object is called the resultant force. If forces are balanced, the resultant force is zero.

If the forces on an object are unbalanced...

- a stationary object starts to move in the direction of the resultant force
- a moving object changes speed and/or direction in the direction of the resultant force

It can be calculated by working out the difference between the opposing forces.

**Example**

The truck accelerates in this direction

The resultant force can be calculated:  
 $100\text{N} - 60\text{N} = 40\text{N}$  (to the right)

Resultant Force

\_\_\_\_\_

\_\_\_\_\_

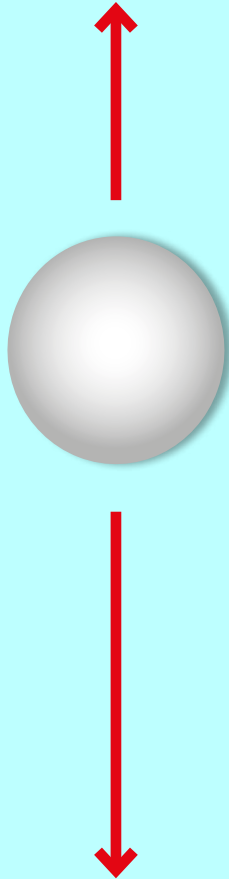
Resultant Force

\_\_\_\_\_

\_\_\_\_\_



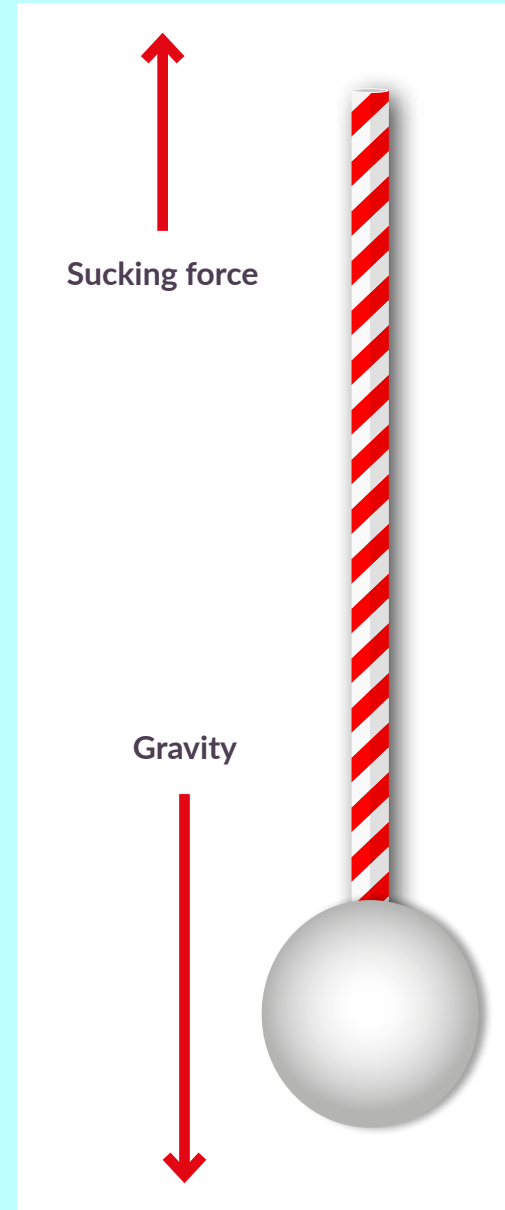
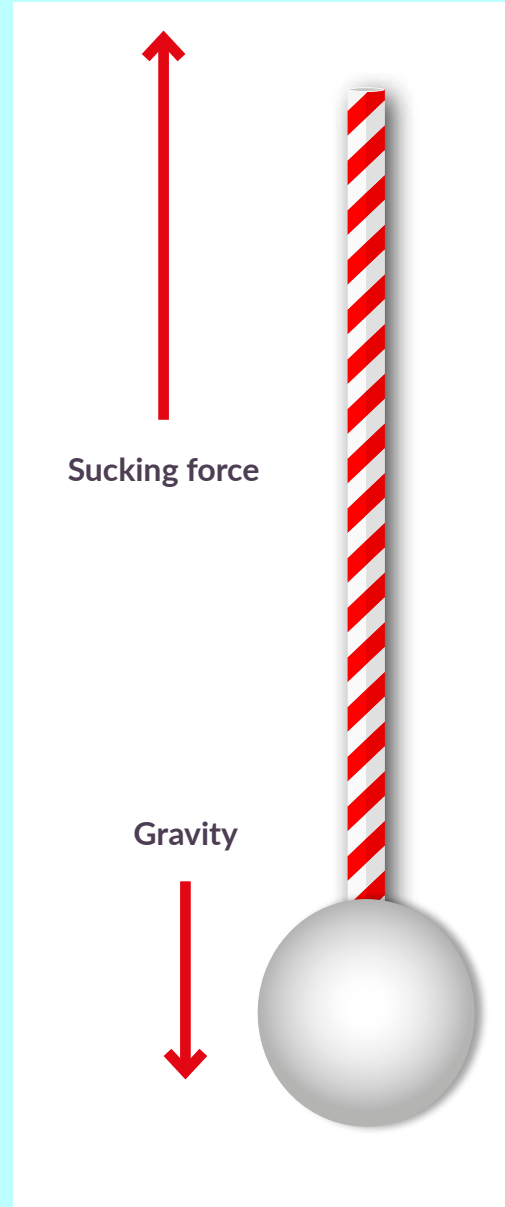
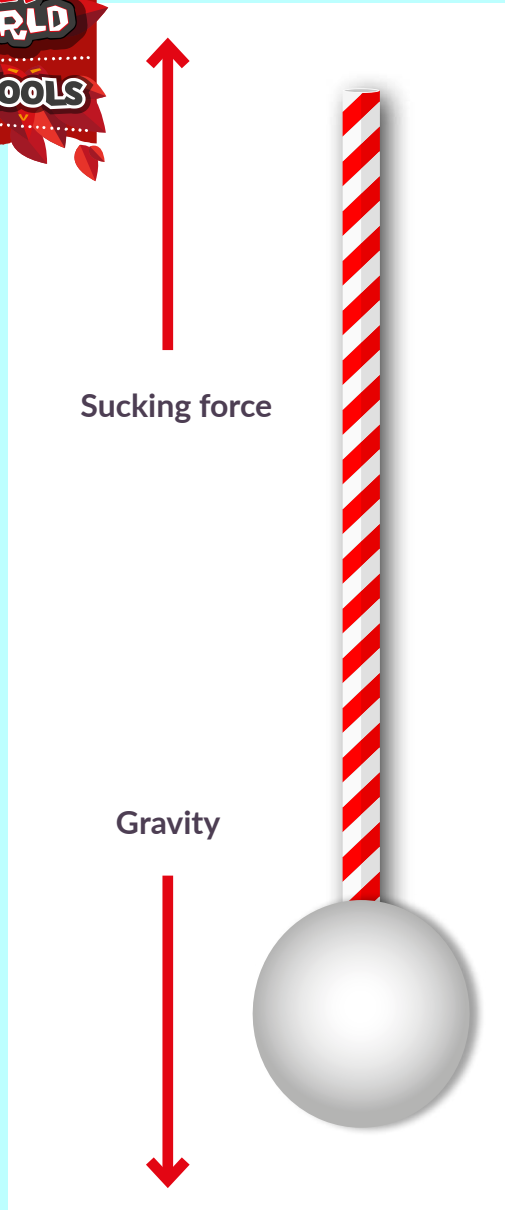
# PLENARY



As you drop the ball, gravity will pull it down.  
It will accelerate because of its weight.  
There is very little air resistance.

This is an example of unbalanced forces.

The resultant force is acting downwards.



Which diagram shows the sucking force/upward force being equal to the force of gravity?

Can you pass the ball to your partner without dropping it?! Have a go!

Why was this so difficult?



During your trip to Zip World, try to think about all the forces acting upon you as you zip down Quarry flyer and enjoy a bumpy ride around the world-famous quarry!

# ENJOY YOUR TRIP !

