Knowledge Organiser – How Science Works

Types of Variable

Independent – the variable that is changed

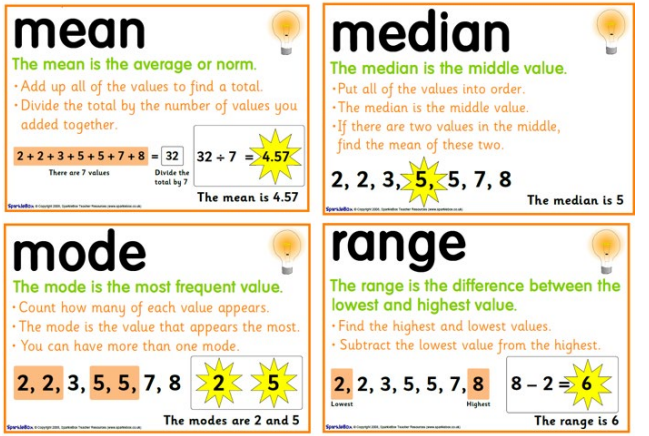
Dependent – the variable that is measured

Control – the variables that stay the same

Types of Data

Categoric – values that are labels e.g. type of plant

Continuous – values are numbers e.g. temperature



Types of Error

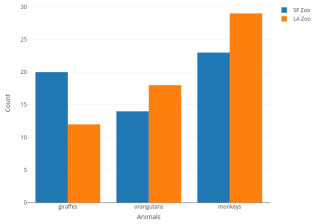
Systematic – a problem with the method or equipment used. E.g. using a beaker to measure the volume of a liquid instead of a measuring cylinder.
The effect cannot be reduced by taking repeat readings.

Random – whenever something is measured a random error is made. E.g measuring with a ruler.
The effect can be reduced by taking repeat readings.

Zero – caused by a piece of equipment not reading zero when it should. E.g. a balance. Either reset the piece of equipment or deduct the false reading from all measurements.

Bar Chart

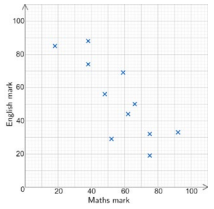
Type of graph plotted for one piece of **categoric** data and one piece of **continuous** data



Scatter Graph

Type of graph plotted for two pieces of **continuous** data

Has a **line of best fit**. This may be a **straight line** or a **curve** (not join the dots)



Key words

Accurate – close to the true value

Anomalous – a result that doesn't fit the pattern

Precise – small amount of spread around the mean

Resolution – the smallest reading on a piece of measuring equipment

Reproducible – if the same results are obtained by different people for the same investigation

Range – the biggest and smallest values of the independent or dependent variable e.g. 0-10 N

Baking Soda & Vinegar Volcano

Introduction

Use baking soda and vinegar to create an awesome chemical reaction! Watch as it rapidly fizzes over the container and make sure you've got some towels ready to clean up.

The baking soda (sodium bicarbonate) is a base while the vinegar (acetic acid) is an acid. When they react together they form carbonic acid which is very unstable, it instantly breaks apart into water and carbon dioxide, which creates all the fizzing as it escapes the solution.

What you'll need:

- Baking Soda (make sure it's not baking powder)
- Vinegar
- A container to hold everything and avoid a big mess!
- Paper towels or a cloth (just in case)

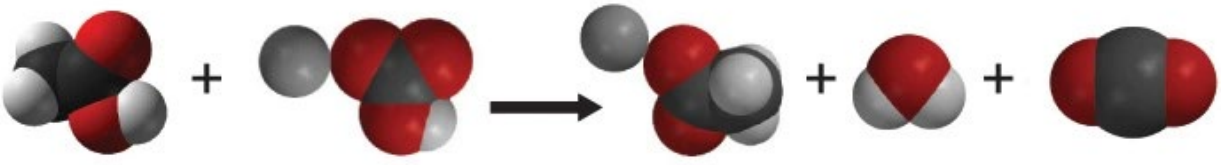
Instructions:

- Place some of the baking soda into your container.
- Pour in some of the vinegar
- Watch as the reaction takes place!

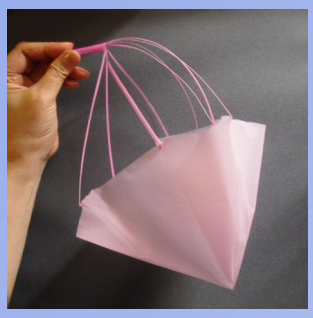
What's Happening

The baking soda (sodium bicarbonate) is a base while the vinegar (acetic acid) is an acid. When they react together they form carbonic acid which is very unstable, it instantly breaks apart into water and carbon dioxide, which creates all the fizzing as it escapes the solution.

For extra effect you can make a realistic looking volcano. It takes some craft skills but it will make your vinegar and baking soda eruptions will look even more impressive!



Design and Test a Parachute



Introduction

Learn about air resistance while making an awesome parachute! Design one that can fall slowly to the ground before putting it to the test, making modifications as you go.

What you'll need:

- A plastic bag or light material
- Scissors
- String
- A small object to act as the weight, a little action figure would be perfect

Instructions:

- Cut out a large square from your plastic bag or material.
- Trim the edges so it looks like an octagon (an eight sided shape).
- Cut a small whole near the edge of each side.
- Attach 8 pieces of string of the same length to each of the holes.
- Tie the pieces of string to the object you are using as a weight.
- Use a chair or find a high spot to drop your parachute and test how well it worked, remember that you want it to drop as slow as possible.

Reflection Questions

Is something confusing me?

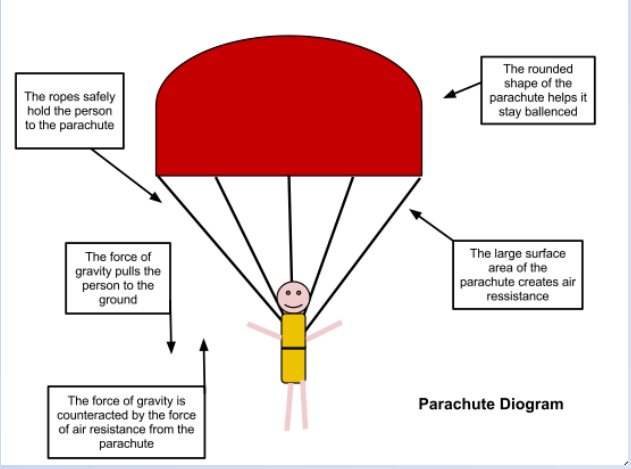
Could I explain this to someone else?

What factors do you need to think about when designing a parachute?

What's Happening

Hopefully your parachute will descend slowly to the ground, giving your weight a comfortable landing. When you release the parachute the weight pulls down on the strings and opens up a large surface area of material that uses air resistance to slow it down. The larger the surface area the more air resistance and the slower the parachute will drop.

Cutting a small hole in the middle of the parachute will allow air to slowly pass through it rather than spilling out over one side, this should help the parachute fall straighter.



Parachute Diogram

Escaping Water

Introduction

Water can certainly move in mysterious ways, get the water from one cup to make its way up hill and back down into a second empty cup with the help of paper towels and an interesting scientific process.

What you'll need:

- A glass of water
- An empty glass
- Some paper towels

Instructions:

- Twist a couple of pieces of paper towel together until it forms something that looks a little like a piece of rope, this will be the 'wick' that will absorb and transfer the water (a bit like the wick on a candle transferring the wax to the flame).
- Place one end of the paper towels into the glass filled with water and the other into the empty glass.
- Watch what happens (this experiment takes a little bit of patience).

Reflection Questions

Is something confusing me?

Could I explain this to someone else?

What's Happening

Your paper towel rope (or wick) starts getting wet, after a few minutes you will notice that the empty glass is starting to fill with water, it keeps filling until there is an even amount of water in each glass, how does this happen?

This process is called 'capillary action', the water uses this process to move along the tiny gaps in the fibre of the paper towels. It occurs due to the adhesive force between the water and the paper towel being stronger than the cohesive forces inside the water itself. This process can also be seen in plants where moisture travels from the roots to the rest of the plant.

Capillary action happens when 3 forces called cohesion, adhesion, and surface tension work together, so let's look at these forces and how they cooperate to cause capillary action.

Invisible Ink with Lemon Juice

Introduction

Making invisible ink is a lot of fun, you can pretend you are a secret agent as you keep all your secret codes and messages hidden from others. All you need is some basic household objects and the hidden power of lemon juice.

What you'll need:

- Half a lemon
- Water
- Spoon
- Bowl
- Cotton bud
- White paper
- Lamp or other light bulb

Instructions:

- Squeeze some lemon juice into the bowl and add a few drops of water.
- Mix the water and lemon juice with the spoon.
- Dip the cotton bud into the mixture and write a message onto the white paper.
- Wait for the juice to dry so it becomes completely invisible.
- When you are ready to read your secret message or show it to someone else, heat the paper by holding it close to a light bulb.

Reflection Questions

Is something confusing me?

Could I explain this to someone else?

What's Happening

Lemon juice is an organic substance that oxidizes and turns brown when heated. Diluting the lemon juice in water makes it very hard to notice when you apply it the paper, no one will be aware of its presence until it is heated and the secret message is revealed. Other substances which work in the same way include orange juice, honey, milk, onion juice, vinegar and wine. Invisible ink can also be made using chemical reactions or by viewing certain liquids under ultraviolet (UV) light.

History of invisible ink

The history of invisible ink goes back more than 2,000 years and was used by the ancient Greeks and Romans. The first record of it comes from Pliny the Elder in the first century AD, who mentioned using the milk of the tithymalus plant as an invisible ink in his Natural History. Invisible ink continued to be used during the Renaissance; statesmen used it in their letters, and Ovid references the practice in his Art of Love. Giovanni Battista della Porta, an Italian polymath, developed a formula for invisible ink that consisted of an ounce of alum and a pint of vinegar. Once painted on the shell of a hard-boiled egg, it would seep through and transfer the message onto the egg's albumen. The writing could only be seen once the egg was peeled.

Mixing Oil and Water

Introduction

Some things just don't get along well with each other. Take oil and water as an example, you can mix them together and shake as hard as you like but they'll never become friends.....or will they? Take this fun experiment a step further and find out how bringing oil and water together can help you do your dishes.

What you'll need:

- Small soft drink bottle
- Water
- Food colouring
- 2 tablespoons of cooking oil
- Dish washing liquid or detergent

Instructions:

- Add a few drops of food colouring to the water.
- Pour about 2 tablespoons of the coloured water along with the 2 tablespoons of cooking oil into the small soft drink bottle.
- Screw the lid on tight and shake the bottle as hard as you can.
- Put the bottle back down and have a look, it may have seemed as though the liquids were mixing together but the oil will float back to the top.

Reflection Questions

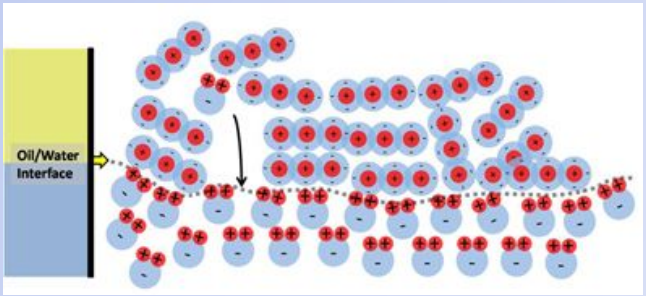
Is something confusing me?

Could I explain this to someone else?

What could you do to try and get oil and water to mix together?

What's Happening

While water often mixes with other liquids to form solutions, oil and water does not. Water molecules are strongly attracted to each other, this is the same for oil, because they are more attracted to their own molecules they just don't mix together. They separate and the oil floats above the water because it has a lower density.



The water molecules attract each other, and the oil molecules stick together. That causes oil and water to form two separate layers. Water molecules pack closer together, so they sink to the bottom, leaving oil sitting on top of the water.

Test Your Dominant Side

What you'll need:

- A pen or pencil
- Paper or a notepad to write your findings on
- An empty tube (an old paper towel tube is good)
- A cup of water
- A small ball (or something soft you can throw)

Instructions:

Eye tests:

- Which eye do you use to wink?
- Which eye do you use to look through the empty tube?
- Extend your arms in front of your body. Make a triangle shape using your fore fingers and thumbs. Bring your hands together, making the triangle smaller (about the size of a coin is good). Find a small object in the room and focus on it through the hole in your hands (using both eyes). Try closing just your left eye and then just your right, if your view of the object changed when you closed your left eye mark down 'left', if it changed when you closed your right eye mark down 'right'.

Hand/Arm tests:

- Which hand do you use to write?
- Pick up the cup of water, which hand did you use?
- Throw the ball, which arm did you use?

Foot/Leg tests:

- Run forward and jump off one leg, which did you jump off?
- Drop the ball on the ground and kick it, which foot did you use?

Introduction

Check out this cool experiment that will teach you more about how your body and brain work together. Test your dominant side by completing a series of challenges. Which hand do you write with? Which foot do you kick with? Do you have a dominant eye? Do you throw with one side of your body but kick with the other? Are you ambidextrous? Answer these questions and much more with this fun science experiment for kids.

What's Happening

So what side do you favor? Are you left handed or right handed? Left footed or right footed? Is your right eye dominant or is it your left?

Around 90% of the world's population is right handed. Why most people favor the right side is not completely understood by scientists. Some think that the reason is related to which side of your brain you use for language. The right side of your body is controlled by the left side of your brain, and in around 90% of people the left side of the brain also controls language.

Others think the reason might have more to do with culture. The word 'right' is associated being correct and doing the right thing while the word 'left' originally meant 'weak'. Favoring the right hand may have become a social development as more children were taught important skills by right handed people and various tools were designed to be used with the right hand.

Around 80% of people are right footed and 70% favor their right eye. These percentages are lower than those who are right handed and this could be because your body has more freedom of choice in choosing its favored foot and eye than that of its favored hand. In other words you are more likely to be trained to use your right hand than your right foot and even more so than your right eye.