Activity 1: Food Indicators

Introduction

One property of liquids is their pH level. This tells us if something is acidic, a base (or alkaline) or if it is neutral (neither acid nor alkaline). The pH scale goes from 1 to 14 with 1 the strongest acid and 14 the strongest base. A pH of 7, at the centre of the scale, indicates a neutral liquid. One way to measure the pH of a liquid is to use an Indicator. Indicators change colour with changing pH. Some Indicators are one colour in acids and a different colour in bases. Other Indicators go through a whole range of colours depending on the strength of the acid or base. In this activity you will investigate some natural food substances that are Indicators.

Safety Information

Do not taste any of the liquids that you will be using for this experiment and ensure you wash your hands thoroughly at the end of the session.

What you need:

Different pH indicators (eg red cabbage water, red onion water, cranberry tea or juice, turmeric)
Colour charts for each indicator
A range of different household liquids to test (eg lemon juice, lemonade, water, bicarbonate of soda solution, washing liquid)

What to do:

- Choose one of the household liquids and pour a little into a clear or white container.
- Choose one of the Indicators and add a few drops to the liquid
- Use the colour chart for your Indicator to decide if your liquid is an acid, a base or is it neutral?
- Can you work out if it is a weak or strong acid or base?
- Repeat using a different Indicator in the same liquid. Did you get the same result?
- Now try the other liquids with different Indicators

Can you put the liquids in order of pH level, starting with the lowest pH?

What's going on?

Scientists use Indicators to test whether liquids are acids or alkalis (also known as bases). There are many different Indicators and all the ones you are using here are made from natural materials such as fruit, vegetables and spices easily found on the High Street. All Indicators change colour depending on the liquid that they are in but the colours are different for different Indicators.

Extra

You can soak a piece of 100% white cotton in a solution of turmeric powder in water. Leave it to dry so that it is now a bright yellow piece of cotton. Using a paint brush dipped in vinegar, paint part of the cloth. What happens? Then paint the cloth with a solution of Sodium Bicarbonate in water. What happens?

What you can do at home

Why not have a go at making your own Indicators using red cabbage or red onions? Can you use other natural ingredients to make Indicators?

Activity 2: Gaviscon Worms

Introduction

Have you, or someone you know, ever suffered from indigestion? This can be caused by having too much acid in the stomach which escapes into the oesophagus, or food pipe. You can take medicines to ease the symptoms. One common medicine is called Gaviscon. In this activity you will see how Gaviscon works.

Safety Information

Do not taste any of the liquids that you will be using for this experiment and ensure you wash your hands thoroughly at the end of the session.

What you need:

Calcium Chloride granules
Water
Gaviscon (and/or sodium alginate)
Clear plastic cups or beakers
Syringes or squeezy bottles
Plastic Tweezers
Paper towels
Plastic bags

What to do:

- Make up a Calcium Chloride solution by dissolving XXg of granules in XXl of water
- Pour some solution into a clear container
- Use a syringe to squirt a stream of Gaviscon into the Calcium Chloride solution
- Watch as a worm is formed
- After a few minutes the worm will rise to the top – this may need acid so try vinegar
- Use the tweezers to remove the worms
- Pat them dry and put in the plastic bag for children to take home

What's going on?

Gaviscon contains a chemical called Sodium Alginate which reacts with the Calcium Chloride to form Calcium Alginate. Calcium Alginate is insoluble in the Calcium Chloride solution and forms the gel like skin of the worms. The squishy insides of the worms are unreacted Sodium Alginate.

In the stomach the Sodium Alginate in the Gaviscon forms a gel on contact with chemicals similar to Calcium Chloride in the stomach. In the presence of stomach acid – Hydrochloric Acid – the gel rises to the top of the stomach and forms a barrier between it and the base of the oesophagus, thereby stopping any acid escaping and causing discomfort. Over time the gel barrier is broken down by the mechanical actions of the stomach contracting during normal digestion.

Extra

Calcium Alginate is used for wound dressings, especially on slow healing wounds such as leg ulcers and severe burns.

Chemists are currently researching the use of Calcium Alginate for drug encapsulation. This

means that a drug, or medicine, is trapped inside a blob of Calcium Alginate which is then swallowed. Once inside the body the Calcium Alginate releases the drug.

What you can do at home

Calcium Chloride, Sodium Alginate and Calcium Alginate are all commonly used food additives.

Sodium Alginate is the chemical name of the additive E401 and is used as a thickening agent. It is used as a stabiliser for ice cream, yogurt, cream, and cheese. It is naturally found in brown saeweed.

Calcium Alginate is the chemical name for additive E404 and is also used as a thickening agent. It is commonly used in ice cream and jam. Like Sodium Alginate, it naturally occurs in brown seaweed.

Calcium Chloride is the chemical name for E509 and it is a natural salt, found in sea salt and rock salt. It has many food related uses: As a firming agent, calcium chloride is used in canned vegetables and in firming soybean curds into tofu. It is commonly used as an electrolyte in sports drinks and other beverages, including bottled water. The extremely salty taste of calcium chloride is used to flavour pickles without increasing the food's sodium content. It is frequently added to sliced apples to maintain texture. It is also sometimes used in cheesemaking.

Search through your food cupboards at home and read the Ingredients list. How many contain E401, E404 or E509?

Activity 3: Hydrogels

Introduction

We are familiar with the three classic phases of matter – solid, liquid and gas. However, there are some familiar materials that don't really fit into any of these categories. Two examples are jelly and hair gel. These are both hydrogel materials. In this activity you will investigate hydrogels.

Safety Information

Do not taste any of the liquids that you will be using for this experiment and ensure you wash your hands thoroughly at the end of the session.

What you need:

Magic snow
Hair gel
Plastic cups or beakers
Water

What to do:

Experiment 1

- Put XXg of magic snow in a large beaker.
- Use a pipette to slowly add water.
- How much water will the magic snow absorb?

Experiment 2

- Place a tablespoon full of hair gel in a plastic cup or beaker.
- Sprinkle some salt onto the gel.
- What happens?

What's going on?

Hydrogels are materials that can absorb a large quantity of water. The magic snow crystals have no water in them to begin with but can absorb a very large amount of water which changes its volume. Some hydrogels can absorb up to 1,000 times their dry weight in water. The hair gel is a hydrogel that has absorbed water. By adding salt to it, the chemical bonds that hold the water in place inside the gel break and the water is released. MORE HERE??

Extra

Hydrogels are examples of smart materials. A smart material is one which changes its shape (or some other property) in response to changes in its environment. Different hydrogels can be made to change shape in response to changes in pH, temperature, salt concentration and many other factors.

What you can do at home

Maybe you have some hydrogel materials at home. Common examples are jelly, hair gel, soft contact lenses, the inside of nappies, wound gels and plant water granules. Remember – do not add salt to any of these without an adult's permission as they will be destroyed!

Activity 4: UV Effects

Introduction

Ultraviolet is a type of energy produced by the sun. We call it ultraviolet light but we can't actually see it like we can see other light. Most of us know that too much UV on our skin is harmful and we wear suncream to protect ourselves.

UV is harmful to our skin because it causes chemical reactions in our skin that leave it damaged.

UV causes chemical reactions in other materials and we will see the effect of some of them in this activity.

Safety Information

Do not taste any of the liquids that you will be using for this experiment and ensure you wash your hands thoroughly at the end of the session.

What you need:

What you need:

UV lamps or torches

UV reactive materials – tonic water, washing powder, white paint, £5 note, credit card

Black box??

Suncream

Paper

UV beads

SOLARSHIELD Clothing + ordinary clothing for contrast

Ripe and unripe banana

What to do:

Experiment 1

- Shine the UV light onto each of the objects in turn.
- What difference can you see?

Experiment 2

- Put a blob of sunscreen onto your hand and rub it into both palms.
- Immediately make two handprints on a sheet of white paper.
- Shine UV light onto the paper. What do you see?

Experiment 3

- Shine UV light onto some of the UV beads. What happens to the beads?
- Choose a piece of fabric and use it to cover some of the UV beads. Place one bead on top of the fabric for comparison – this is your control bead.
- Shine the UV light onto the piece of fabric for 10 seconds.
- Remove the fabric and check the beads.

What's going on?

Experiment 1

All these objects emit a visible coloured light when they absorb UV light. This is called Fluorescence.

Experiment 2

Sunscreens protect our skin by absorbing, or blocking, UV light rays before they can reach our skin. The black colour of the cream shows that all the UV light is being absorbed.

Experiment 3

UV beads change colour when exposed to UV light. Some fabrics can block some or all of the UV light while others don't have any protective effect.

Extra

UV light is part of the Electromagnetic Spectrum and is between the visible light and X-rays. The term Ultra Violet means 'beyond violet'. There are three types of UV rays: UVA, UVB and UVC. All UVC rays from the sun are absorbed by the atmosphere and some UVB rays are absorbed, especially on cloudy days.

Although humans can't see UV light, some animals, including birds, reptiles and insects are able to see it. Many fruits, flowers, and seeds stand out more strongly from the background in ultraviolet wavelengths as compared to human color vision.

UV light is widely used in food production and water treatment to kill bacteria.

What you can do at home

If you enjoyed these UV experiments, you can do them in more depth as part of Mission Starlight, a global experiment run by the Royal Society of Chemistry where you investigate how to protect astronauts from harmful UV rays. You can use the experiment as a project to earn a CREST Award. Details at http://www.rsc.org/learn-chemistry/resource/res00002073/starlight-a-global-experiment-on-uv-protection

Did you know...

Ultraviolet light is part of the Electromagnetic Spectrum