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QUICKSAND

Focus: Chemistry

A 'colloid' is made up of tiny, solid particles suspended in water. Some colloids are also 'non-Newtonian fluids'. If a hard or quick force is applied to a non-Newtonian fluid, it will become more viscous and behave as a solid. When a gentle or slow force is applied, it will behave as a liquid. Quicksand is a non-Newtonian fluid. If you ever find yourself sinking in a pool of quicksand, the slower you move, the more chance you'll have of escaping!

AIM ***For students to investigate the properties of non-Newtonian liquids.***

Equipment:

- $150cm^3$ custard powder or cornflour
- $250cm^3$ plastic beaker or bowl
- $100cm^3$ measuring cylinder
- $75cm^3$ water
- stirring rod (not glass)
- newspaper or bin bags

Instructions:

1. Cover your work area with newspaper or a bin bag.
2. Put the custard powder or cornflour into the bowl.
3. Add a drop or two of food colouring.
4. Add water slowly, mixing the custard powder/cornflour and water with your fingers until all the powder is wet.
5. Keep adding water until the mixture feels like a liquid when you're mixing it slowly.
6. Try tapping on the surface with your finger or a spoon. When the mixture is just right, it won't splash, it will feel solid. If your mixture is too powdery, add a little more water. If it's too wet, add more custard powder or cornflour.

Discuss:

1. Sink your fingers slowly into the mixture then try to pull them out quickly. What happens? Why?
2. Take a blob and roll it between your hands to make a ball, then stop rolling. What happens? Why?
3. Smack your mixture hard with a spoon. Does it splash? Why?
4. Could you walk on it if there was enough available? Why do you think this?

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ICE-CREAM
Focus: Chemistry

Just like we use salt on icy roads in the winter, salt mixed with ice causes the ice to melt. When salt comes into contact with ice, the freezing point of the ice is lowered. By lowering the temperature at which ice is frozen, we are able to create an environment in which the milk mixture can freeze. The fat particles in the milk smash into each other and make big molecules of ice cream!

AIM *To investigate the impact of salt on the freezing point of water.*

Equipment:

- Measuring jug
- 125cm^3 milk
- 125cm^3 whipping cream
- 50g sugar
- 1/4 teaspoon vanilla essence
- 75g salt
- approx. 750cm^3 of ice
- large ziplock bag
- small zip lock bag
- gloves
- washing up bowl
- Kitchen scales
- spoon, bowl and toppings
- selection of fruit pieces

Instructions:

1. Place the small zip lock bag into a bowl on the scales and set the balance to 0.00g.
2. Add 50g sugar, 125cm^3 cream and 125cm^3 milk into the small bag.
3. **Seal the bag.**
4. In the larger bag place the ice.
5. Measure 75g of salt and place into the large bag containing the ice.
6. Place the sealed small bag inside the larger bag containing ice and salt then seal the larger bag.
7. Over a washing up bowl. Gently rock the large bag from side to side (hold it by the top seal / use gloves so you do not damage your hands).
8. Rock for 20-25 mins or until the contents have solidified into ice cream.
9. Once the ice cream has solidified, open the large bag, remove the smaller bag, open and serve the contents.
10. Add toppings, if you wish, and enjoy!
11. The ice can be placed in the sink to melt, do not touch the ice with your bare hands.

Discuss:

1. Does anything happen to the texture or the ability of the ice cream to freeze by adding fruit?
2. Does the type of fruit change the texture of the ice cream?

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CHOCOLATE TESTING

Focus: Chemistry

'Polymorphism' is the ability of a structure to take on many different crystalline forms, i.e. the atoms are the same but they are arranged differently. Chocolate contains cocoa butter, which is a fat, and can come in at least six different crystalline forms. When chocolate is melted and re-hardened it sets into a different structure, which gives it a different taste, texture and melting point. It's a bit like using the same Lego bricks to build different structures; some are stronger, and some look better.

AIM ***To investigate the different properties of different chocolate samples.***

Equipment:

- 2 identical bars of chocolate (e.g. the thin Dairy Milk bars)
- kettle
- boiling tube
- 250cm³ beaker
- timer
- thermometer
- results table
- graph paper
- pencil
- ruler

Instructions:

Prior to the club, melt one chocolate bar (in its wrapper) on a windowsill or on a radiator etc. then place in a fridge. Once solidified, return to room temperature.

Taste Tests

Note any differences in the taste, texture & 'snap' of the chocolate that has been melted / re-hardened and the one that has not. (N.B. Do this outside of a lab for H&S purposes).

Melting Point Tests

Wear eye protection; 50°C water will cause burns.
Repeat the stages below for each chocolate bar.

a. Put some hot water (at no more than 50°C) into the beaker.
b. Place enough chocolate to cover the bulb of a thermometer when melted, into a boiling tube & take its temperature.
c. Put the boiling tube into the beaker and start the timer.
d. Stir continuously with the thermometer. Every 20 seconds for five minutes, use a results table to record the temperature of the chocolate. Note any other changes.

Recording Your Data

Draw a graph to show your results. Use the horizontal axis, to show the number of seconds & the vertical axis to show the temperature of the chocolate. Indicate the melting point of the sample.

Discuss:

1. Can you describe any differences in taste and texture between the two samples?
2. Do you think the samples had the same structure? Why?

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POLYMER WORMS

Focus: Chemistry

Sodium alginate is one of the structural polymers that help to build the cell walls of plants like brown seaweed and kelp. It can be extracted for a wide range of uses. Alginate is a common food additive, E400, used as a thickener, stabiliser and gelling agent. Calcium alginate (a cross-linked polymer) is used in wound dressings for slow healing wounds like leg ulcers, which can continue to bleed and weep for a long time. Part of the blood clotting mechanism involves calcium ions and on contact with blood the calcium alginate releases calcium ions in exchange for sodium ions. These extra calcium ions can help the blood to clot and encourage healing. It is easy to remove any excess calcium alginate when the dressing has to be changed.

AIM ***To investigate whether polymer worms can be useful.***

Equipment:

- $10cm^3$ sodium alginate suspension or Gaviscon®
- 2 x dropping pipette
- 1 x forceps
- 2 x $150cm^3$ beakers
- $100cm^3$ sodium chloride solution
- $100cm^3$ calcium chloride solution
- Labels for the beakers

Instructions:

1. Put on eye protection
2. Put the calcium chloride solution into one of the beakers and the sodium chloride solution into the other. Label the beakers clearly.
3. Using the pipette, squirt the sodium alginate or Gaviscon® into the calcium chloride solution. You are aiming to make 'worms,' although you can make beads if you prefer.
4. Using forceps, remove a few of your worms straight away and put them into the beaker of sodium chloride solution.
5. Swirl both beakers gently and observe what happens to the worms in each one. You can remove and squeeze the worms as well as observing their appearance. You will need to wait a few minutes for all the reactions to be complete.

Discuss:

1. What happens when the sodium alginate is dropped into the calcium chloride solution?
2. What happens to the polymer worms when you add them to the sodium chloride solution?
3. What could be used to rinse excess calcium alginate from a wound when a calcium alginate dressing is removed?
4. Research 'cross-linking polymers'.

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CUSTARD BOUNCY BALLS
Focus: Chemistry

Polymers are made up of many molecules all strung together. How things made of polymers look, feel and act depends on what kinds of molecules they're made up of and how they're put together. Some are rubbery, like a bouncy ball, some are sticky and gooey, and some are hard and tough, like a skateboard. The glue used in this activity (PVA) is a polymer. The custard powder contains mostly starch which is a polymer made up from glucose. The borax acts as a cross-linking agent and binds the two polymer chains together.

AIM ***To investigate whether it is possible to make a bouncy ball out of custard.***

Equipment:

- PVA glue
- Plastic cups
- Spatulas
- Pipette
- Stirring rods
- Borax powder (irritant)
- Borax solution (1 spatula of borax to 10cm^3 water)
- Measuring cylinder
- Custard powder
- Cornflour
- Food colouring

Instructions:

1. Put on eye protection and cover your work area.
2. Make up a borax solution of 1 spatula of borax powder in 10cm^3 of warm water.
3. Pour 15cm^3 PVA glue into a plastic cup.
4. Add 2 spatulas of dry custard powder and 1 spatula of borax powder.
5. Add a drop (0.5cm^3) of the borax solution and stir vigorously. Keep stirring until the mixture is smooth.
6. Scoop out the mixture, shape it into a ball and roll it in your hands for 2 mins. The ball should start feeling more elastic.
7. Test the ball see how well it bounces.
8. Repeat the process to make 2 other balls:
   a) by replacing the custard powder with cornflour and a drop of food colouring.
   b) by adding 1cm^3 borax solution, 2 spatulas of dry borax power and two spatulas of custard powder to the glue.

Discuss:

1. What did you discover? What makes the best bouncy ball, custard or cornflour?
2. What is the highest bounce your class recorded? Why do you think this ball was most bouncy?
3. What happened to the final ball? Why?

Tweet or email your ultimate bouncy ball method, conclusions or your findings to:

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RAINBOW REACTION

Focus: Chemistry

Universal Indicator is used to show whether something is acid or basic. By changing colour, it can measure pH from 1 to 14. Hydrochloric acid causes the indicator to turn red. The sodium carbonate solution is a base, so it causes the indicator to turn blue. The sodium carbonate is more dense than the hydrochloric acid. You may have already completed an experiment in class where you have observed that an acid can be neutralised by an alkali of equal strength. This activity demonstrates a neutralisation reaction.

AIM *To illustrate the pH scale for acids and alkalis.*

Equipment:

- 50cm^3 burette with bung
- syringes to dispense up to 20cm^3
- 0.1mol dm^{-3} sodium hydroxide solution (irritant)
- 0.1mol dm^{-3} hydrochloric acid (irritant)
- 0.1mol dm^{-3} sodium carbonate solution
- universal indicator solution (flammable)
- eye protection

Instructions:

1. Wear eye protection
2. Make sure that the tap of your burette is closed.
3. Add around 10cm^3 of sodium hydroxide solution to the burette followed by a few drops of universal indicator. Insert the bung and carefully invert the burette once to mix the indicator.
4. Add around 20cm^3 of hydrochloric acid followed by around 1cm^3 of sodium carbonate solution. Insert the bung and carefully turn the burette upside down, while holding on to the bung. Be careful as gas will form and could spray over you.
5. You should see rainbow colours ranging from deep purple through blue and green to orange and red. But if you don't, turn the burette upside down again (carefully). You might need to adjust the volumes of hydrochloric acid and sodium carbonate solution to get the desired effect.

Discuss:

1. Which volumes of hydrochloric acid and sodium carbonate gave the best colour range?
2. What do you think would happen if you used more concentrated acid/alkalis?
3. What do the different colours throughout the solution show?
4. Were you able to see every pH number?

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