**Overall List of Equipment**

Plastic Petri dishes

Eye droppers

Fly Screen mesh or fine mesh sieve

8 different bubble mixtures, labelled

Glycerin

5 cent coins

Stop Watches

Rulers

Worksheets

**Equipment at school**

Thread

Paper clip

Tissue

Bowl

**Shopping List:**

Food colouring

Plastic Cups

Plastic plates

Skin milk

Cream

Lemonade

Milk

Straws

Vegetable Oil

Vinegar

Pepper

Pipe Cleaners

**Surface Tension and Bubbles**

**Objectives:**

To make chemistry interesting to students by showing them it is part of the real world, rather than being confined to reagent bottles and test tubes in the classroom laboratory. Students observe and do experiments showing them the surface tension of water, how detergents change this and how micelles form. They then make bubbles and observe the shape of the bubbles, their iridescent color, relative thickness of the top and bottom of the bubble, movement of water within the bubble, and longevity of bubbles.

The students will be able to:

1. Discover what "surface tension", means

2. Hypothesize the outcome of the experiments,

3. Analyze experimental data and conditions,

4. Relate the polarity of the water molecule to the behavior of soaps and detergents.

5. Compare the size of bubbles

6. Compare the life span of bubbles, learn about gravity and that water evaporates very rapidly

7. Compare shapes and colors of bubbles

**Background:**

This project is based upon molecular force and the degree of surface tension, which depends on the amount of energy in the intermolecular forces. Liquids, like water, which are **polar** – have a positive and a negatively charged end, produce strong intermolecular forces and have a strong **surface tension**.

All molecules attract. In particular a molecule of liquid water attracts all the surrounding water molecules and is also attracted by them. *Inside* liquid water all of these attractive forces balance out (ie the liquid is stable as a liquid). At the surface, however, water molecules are attracted by the molecules below and to the side of them but there are only air molecules above. The air is a gas and the gas molecules are on average much further away from a surface water molecule than the other water molecules in a liquid (molecules in a liquid are closer together than those in a gas). As a result the liquid water molecules below the surface yield a force pulling the surface water molecules down *into* the liquid. There is also a sideways, force as water molecules on the surface attract each other. This makes the water surface act like *cling wrap* (the surface is called a **meniscus**) as it wraps up the liquid water. The surface force is called **surface tension**. You can *see* surface tension when a wet insect tries to climb out of the water: the surface tension pulls it in. Other insects, like water striders, exploit surface tension to stride or skate across the surface without sinking.

Forces on a surface:

Soap bubbles are made up of soap or detergent molecules and water molecules. A soap or detergent molecule has a small polar (charged) head and a long nonpolar (uncharged) tail. The charged head group is attracted to polar molecules like water and the uncharged tail is repelled by water (it likes fat or greasy substances).

Micelle

dirt/

When you put a detergent into water, it forms a layer on top of the water. The charged head groups like water and stick into the water but the uncharged tails don’t like water and stick into the air. This is why molecules like detergents are called**surfactants*,*** or **surf**ace **act**ive **a**ge**nts**. Replacing the water molecules on the surface with detergent molecules lowers the surface tension of the water. Indeed the ability of detergents to remove dirt is due partially to this decrease in water's surface tension: the lower surface tension makes it easier for the water to **wet** (or penetrate) into fabric.

If you keep putting detergent into water it will cover the surface completely and eventually move into the liquid water. Within liquid water, detergent molecules arrange themselves into little globules, called **micelles**, or layers, called **membranes**. In a micelle or membrane all the tails are pointing together towards the inside and all the head groups are pointing outwards towards the water. When detergents meet dirt (or oil or grease…) they surround the dirt with their tails pointing towards the dirt meet dirt and their heads pointing toward the water. Agitation (eg the washing machine) encourages the head groups to carry the dirt up to the surface of the water (scum on the surface) where it can be rinsed away. Soap bubbles are formed by soapy membranes. The membranes around cells are formed by phospholipids – biological soap molecules.the head groups to carry the dirt up to the surface of the water (scum on the surface) where it can be rinsed away. Soap bubbles are formed by soapy membranes. The membranes around cells in your body are formed by phospholipids – biological soap molecules.

Detergent

Water

Air

Bubbles consist of air surrounded by films of soapy water. The detergent molecules line the interface between the air and the water. Their head groups are dissolved in the water and their tails point towards the air. The detergent molecules serve three purposes in the creation of bubbles. (1) They lower the surface tension of the water. For example, when water sprays from a tap small bubbles form, but they burst almost immediately because the high surface tension of the water pulls the water molecules in the bubble back into the main body of the water. The bubble wall gets too thin to remain intact and it quickly bursts. In soapy water the surface tension is much lower (by about 1/3) so the molecules of the bubble are less stressed and the bubble can survive longer. (2) The detergent molecules are very elastic and allow the bubbles to deform without breaking. The forces between detergent molecules are much weaker than those between water molecules and this makes the surface more elastic and more able to deform. (3) The detergent molecules also slow the evaporation of the water film and so extend the life of the bubbles.

Over time the water in the soap film will migrate, under gravity, to the bottom of the film or bubble and the film at the top will become thinner and eventually burst. The bubble’s life can be extended by adding substances to the water to make it thicker, or more viscous. These additives are things like glycerin and can include sugar, honey and gelatine (glycerin can be obtained from a pharmacy or cake decorating supplier and is used commercially to keep products such as make-up, fruit and cake icing moist). Bubbles will also pop if they touch the ground, clothing or a dry finger because the film will **wet** the surface.

**Basic Bubble Recipes**

Two common recipes are:

* Recipe A: 1 to 3 parts liquid dishwashing detergent + 6 parts water
* Recipe B: 1 to 3 parts liquid dishwashing detergent + 6 parts water + 1 to 4 parts glycerin (Too much glycerin makes the bubble mixture too heavy and prevents the formation of bubbles).

You will have best results if you let the soapy solution rest for a couple of days, but if you are impatient, you can use it immediately. A cold solution makes longer lasting bubbles so keep the bubble mixture in the fridge for best results. To minimize evaporation make bubbles in shady areas when the air is as still as possible. They will also last longer if the air is very humid, for example after a storm. Stay in open areas so the bubbles won't run into dry objects and keep you bubble tools really wet with bubble solution to make the thickest films possible.

**Apparatus needed:**

Water Pepper

Petri dishes Piece of fly screen mesh

Paper clip Silk thread

Pan or bowl Detergent

Eyedroppers Glycerin

Straws Rulers (or marked sheets of paper)

Pipe cleaners Plastic plates

Milk Skim milk

Lemonade Vegetable oil

Cream Vinegar

Food colouring

Paper towels/mop to clean up any mess

Basic Bubble mixture

Optional: powdered gelatin, golden syrup

**Safety Considerations:**

If solution gets in a student's eyes, instructors should wash the student's eyes with clear water.

You should have a bottle of vinegar and a mop or paper towel handy to clean up any spills on the floor. Newspapers can also be used to clean up.

After the investigations, students should wash their hands to remove any soap solutionI

**Strategy:**

For each demonstration below:

* Describe what you are going to do.
* Ask the students to write their predictions of what they think is going to happen in their notebooks or on a worksheet.
* Do the experiment.
* Ask the students to describe what actually did happen (notebook).
* Ask the students to try to explain what happened (notebook).
* Think of ways to test whether the students’ explanations are correct (notebook).

**Demonstrations to be done by the teacher**

1. Float a paper clip on water in a Petri dish. You can do this by carefully placing the paper clip onto the water, or, as an almost foolproof alternative, place the paper clip on a fragment of tissue, float the tissue on the water, and as the tissue gets wet and sinks, the paper clip will stay floating.

**Why is the paper clip floating?**

**This shows that the surface tension of the water is “strong” enough to hold up the paper clip.**

Get the students to squat down to get eye level with the water. Observe what is happening. Is the paper clip a little bit down in the water? Or does the paper clip totally rest on top? Can they see kind of a surface or skin-like appearance on the very top of the water?

Ask the students what they think will happen if a drop of detergent is added to the Petri dish. Now add a drop of detergent to the Petri dish away from where the paper clip is. The paper clip will instantly sink.

**Why does the paper clip sink? What did the detergent do?**

Share ideas. If no one comes up with it, share that when we added the drop of detergent, we interrupted the pull and tug of the water molecules on top and below. This broke up the force and skin-like surface on top, so the paper clip dropped. **If you like: the detergent spreads over the surface of the water and reduces its surface tension, the surface tension is no longer “strong” enough to hold up the paper clip.**

2. Make a loop of 5" of silk thread. Float in a low, wide container of water. Touch a bit of wet soap or put a drop of detergent into the water inside the silk loop. What happens to the thread?

**It becomes a circle.**

Why does the thread become a circle?

**The soap or detergent spreads out over the surface of the water and reduces the surface tension inside the loop, but not outside. The detergent wants to cover as much surface area on top of the water as possible – for a given area coated with detergent, the circle has the smallest possible circumference OR for a given perimeter the circle encloses the largest possible surface area.**

What would happen if detergent were added to the outside of the loop rather than the inside?

**The thread would form a blob on the surface of the water.**

3. Sprinkle black pepper over the surface of water in a Petri dish. What happens?

The pepper forms a “glob” on the surface of the water.

Why does the pepper sits in a glob/lump on top of the water?

**The pepper is made up of non-polar molecules that don’t interact with the water but do interact with each other. The pepper initially clumps together to stay as far away from the water as possible and as close to the other pepper grains as possible.**

Add a drop of detergent to the center of the Petri dish. What happens?

**The the pepper spreads out over the surface of the water.**

Why does the pepper spread out?

**The detergent spreads out over the surface of the water and reduces the surface tension of the water but, more importantly, the non polar end of the detergent molecules interacts with the pepper, spreading it over the surface.**

4. Support a piece of window flyscreen over a pan or bowl. Slowly pour water onto the screen. What happens?

**Plain water will bead up on the screen.**

Why is it hard for the water to go through the screen?

**The surface tension of the water “seals” off the small holes in the mesh**

Now pour over water with detergent in it. What happens?

**The detergent mixture will fall through the mesh.**

Why does adding detergent make it easier for the water to go through the mesh?

**The detergent lowers the surface tension of the water so it is no longer “strong” enough to “seal” the holes in the mesh.**

**Student activities:**

1. Surface Tension

Put the students into groups of at least two. Give each group an eyedropper and a five cent coin. Ask them to predict how many drops of water/soapy water will fit on the coin without spilling, they will also investigate another liquid: milk, . Distribute plastic cups of water and water+detergent (it doesn’t really matter how much detergent) and give each group two eye droppers and two five cent coins. First have the student find out if the plain water will spill off the five cent coin. After the students have a chance to observe the surface tension of the water on the coin; **the surface tension of the water will form a “dome” of water over the coin** – get them to draw this in their experimental note books or on the worksheet, ask them to count the number of drops of water and of soapy water they can put on the five cent coin making sure that the drop on the end of the eye dropper does not touch the liquid on the five cent coin. One student can drop and the other can count and observe. Get them to write this number in their notebooks and to repeat this 3 times, switching roles if they want. Were they surprised at how many drops they could add?

Ask them what would happen if they added a drop of detergent to the plain water on one of the five cent coins. Get them to test their prediction.

**The detergent lowers the surface tension of the water so it is not strong enough to stay in a dome and it will run off the five cent coin.**

Get the students to repeat this with another liquid: milk/lemonade/oil/orange juice and come back and combine the results.

Questions to ask them:

* What is surface tension?
* Do you think that the surface tensions of the liquids are the same?
* Why do you think a bug can stay on top of the water?
* Why can the five cent coin hold more drops of some liquids than of others?
* How does surface tension and density differ?
* Were your predictions correct? If not why do you think it was different?
* Can you think any ways you have experienced surface tension?

2. Magic Milk

Give each student a Petri dish with milk in it. Put drops of red, yellow and blue food colouring in the milk to make a triangle. Ask the students to predict what will happen when detergent is added to the middle of the Petri dish.

Get them to put 4-5 drops of detergent into the middle and record what they see. They can draw a picture in their notebooks or on the worksheet.

Ask them what they think is happening.

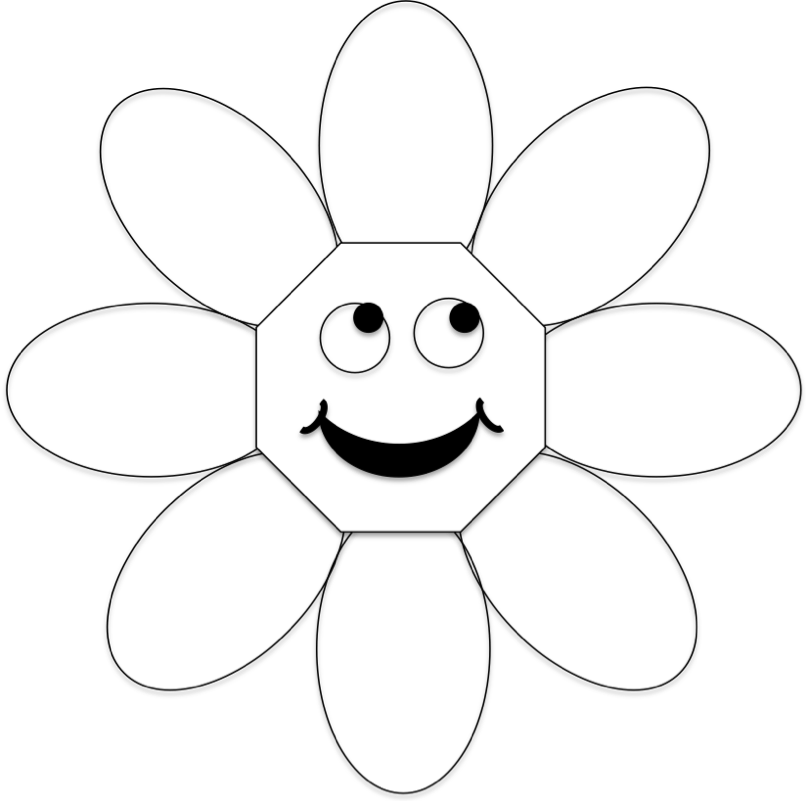
**The detergent coats the fat in the milk making it into globules called micelles. As the globules form the watery part of the milk swirls and the red, yellow and blue colours are mixed together.**

What is the important thing in this experiment – the milk or the detergent? Get them to repeat the experiment with no detergent, with water rather than milk, with skim milk and with cream. Which works best?

What do they think will happen if they used vinegar instead of detergent?

3. Capillary action

Cut out a flower from the template. You can get your students to colour it in if you like. Fold the flower so the petals cover up the smiley face. Put some water into a Petri dish and ask the students to predict what will happen when they put the folded up flower on top of the water. Now get them to float the folded flower on the water and watch what happens, get them to record this in their notebook or on a worksheet. Ask your students what they think has happened. For example you can get them to see if the paper is wet (does the dry flower unfold by itself).

**The water molecules interact with the fibres in the paper, being pulled into the fibres by capillary action. As paper unfolds as the fibres swell with water.**

Capillary action is how plants pull water from the ground up into their leaves.

**Demonstration:**

Take a white carnation or a stick of celery with leaves attached. Carefully split the stem into two halves, placing one half in a cup with water and red food colouring, the other half into a cup with water and blue food colouring. It will take a couple of hours (maybe longer) for the red and blue food colouring to make it to the flower or the celery leaves.

**Bubbles**

**1. Size of bubbles**

This activity presents a plan for varying the amount of glycerin while keeping the amount of water and dishwashing liquid the same. From the basic bubble mixture 8 bubble solutions have been made. Here is one suggestion you can do lots of others, eg use different brands of detergent, put gelatine, golden syrup, sugar… in some, have some fresh and some old….

1. Formula one = 0 drops of glycerin

2. Formula two = 10 drops of glycerin

3. Formula three = 20 drops of glycerin

4. Formula four = 30 drops of glycerin

5. Formula five = 40 drops of glycerin

6. Formula six = 50 drops of glycerin

7. Formula seven = 60 drops of glycerin

8. Formula eight = 70 drops of glycerin

Show the students the glycerin. Ask the students if they have any expectations about the experiments. Which mixture do they think will make the largest bubbles? Which mixture do they think will make the longest lived bubbles?

Divide the students into 8 groups, with at least two children in each group. One student will blow the bubbles, the other will measure how big they are. For each of the 8 solutions, get a student to use a drinking straw to blow the largest bubble possible, while the other student measures the diameter of the bubble using a ruler or a marked sheet of paper. The diameter is from the tip of the straw to the furthest part of the bubble. A third student can write the results into the notebook. Repeat this at least 10 times and record the overall largest bubble and the average size of the bubble.

**2. Life span of bubbles**

In the same groups, get the students to use the straw to blow bubbles approximately 5 cm in diameter. Use a stopwatch to time how long it takes for the bubble to burst and record this in the notebook. Also get the students to record anything they see happen to the bubble before it bursts. Do this at least 10 times and calculate the overall average time. Repeat this for bubbles approximately 10 cm in diameter (if they can make them).

Now see how the weather affects the life span of the bubbles. Repeat one of the experiments (5 cm or 10 cm) in a sunny spot, a shady spot and a windy spot (if nothing else, under the air conditioner).

Bring the students back together and compare and record all of the results.

* Which mixture made the biggest bubbles?
* Which bubbles lasted the longest time?
* Do bubbles last longer in the sun, the shade or in the wind?
* What is the role of the glycerin in the bubbles?
* Would powdered gelatin or golden syrup work the same way as glycerin?

**3. What substances make bubbles?**

Using a drinking straw and a ruler (marked sheet of paper) see if the students can make bubbles with water, milk, skim milk and cream. Which of these makes the best bubbles?

**4. Shapes of bubbles**

Each group is given some formula “8” bubble mixture and 4 pipe cleaners. Get the students to bend the pipe cleaners into bubble wands with a circle, square, heart and triangle at the end. Get the students to predict the bubble shapes from the 4 pipe cleaner wands. Blow bubbles inside and outside. Record the inside and outside bubble shapes and compare these to the bubble shapes made by blowing through the straw.

Tetrahedron:

Materials: 3 drinking straws trimmed to be a bit shorter than the pipecleaners, 3 half-size straws and 6 pipecleaners.

Put three pipecleaners together and twist them tightly at one end. Slip the 3 drinking straws onto the pipecleaners, bending the pipecleaners at the bottom to form “feet”. Insert the other three pipecleaners through the three half-size straws. Make a triangle with them by twisting their corners together. Twist base and top together at corners, using the “feet”.

Cube:

Materials: Six standard drinking straws, each cut in half and twelve pipecleaners.

Put three of the pipecleaners together and twist them tightly at one end. Make four sets of three twisted pipecleaners. Slip half-straws onto each pipecleaner; bend the pipecleaner to form “feet”. Make each set look like the capital letter “T”, bending the top of the “T” into a right angle. Use two sets of “T”s to form a square with two extended sides. Repeat the procedure with the other two sets. Make one square bottom of the cube by twisting up the extended straws; make the other square the top by twisting the down the extended straws.

What bubble shapes do the students think the “tetrahedral” and “cube” bubble wands will make?

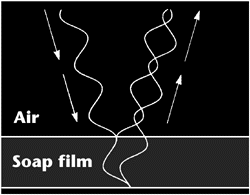
To make bubbles, all sides of the wand must be submerged, the room must be free from drafts and, for the best chance of success, the temperature shouldn’t be too hot, about 22-24° C. Record the bubble shapes inside the tetrahedral and the square bubble wands as well as the shapes of bubbles blown out of these wands.

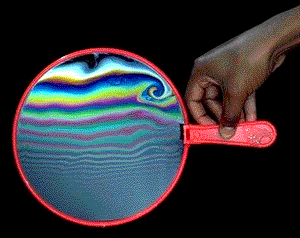
What shape are the blown bubbles? Why?

**(A sphere, for a given volume of air inside the bubble – the bubble size – has the smallest possible surface area so uses the least possible bubble mixture)**

**5. Colours in bubbles (for older students)**

Bubbles appear to have swirly colour in them.

White light is separated into colours as it reflects from two surfaces of a thin film (eg a bubble or an oil slick). Each colour reflects from both the outer and inner surfaces of the bubble film. Because the bubble has some thickness, this light is slightly out-of-phase and the two reflecting rays can interfere. If the interference is constructive the colour becomes more intense, if it is destructive the colour effectively cancels out and we can’t see it. As the bubble gets thinner (eg under gravity) the two reflected rays of light coincide and cancel and the bubble loses its colour. Bubbles are a cheap and very easy way to demonstrate that light is made up of colours and that colours can interfere.

The alternating bands of light and dark on this soap film are actually bands of color, produced by the reflection and interference of light waves. The colors depend upon the film's thickness. The film shown here is thinnest at the top, becoming thicker toward the bottom. As the film's thickness changes, the colors also change, forming regular bands

If you let a bubble hang from a bubble wand for a while, the interference colors begin forming horizontal stripes - because the bubble film is thicker at the bottom than at the top, forming a wedge shape. As the bubble drains, the wedge of bubble solution gets thinner and thinner. The black film which then appears at the top of the bubble is a harbinger of an upcoming disaster. The bubble is now so thin only a few moments remain until. . .POP!

Get the students to observe and describe what happens to the bubble colours if you let the film stay on one of the bubble wands and slowly fall under gravity.

**Surface Tension Demonstrations – Worksheet**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Surface Tension is the sideways and downwards force on the surface of a liquid. This force is very strong in a liquid like water.**

What do you think will happen with the paper clip and the water?

What does happen to the paper clip and the water?

Can you explain what you see?

What do you think will happen when detergent is added to the water?

What does happen when detergent is added to the water?

Can you explain what you see?

What do you think will happen when a loop of silk thread is put on top of the water?

What do you think will happen when detergent is added to the inside of the loop?

What does happen when detergent is added to the inside of the loop?

Can you explain what you see?

What do you think would happen if detergent were added to the outside of the loop rather than the inside?

What do you think will happen if you sprinkled some pepper onto the surface of some water?

What does happen?

Can you explain what you see?

What do you think will happen if some detergent was added to the water?

What does happen?

Can you explain what you see?

What do you think will happen when water is poured over some fly screen?

What does happen?

Can you explain what you see?

What do you think will happen when detergent is added to the water?

What does happen?

Can you explain what you see?

**Number of Drops on a Five Cent Coin worksheet**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How many drops of plain water do you think you can put on a five cent coin?

How many drops of water+detergent do you think you can put on a five cent coin?

Put the five cent coins on top of some paper towel to mop up any mess. Record the number of drops you can put on the five cent coin before the water spills off the coin. Carefully do this making sure the drop from the eye dropper does not touch the dome of liquid over the coin, a drop should not touch the water on the coin before detaching from the dropper.

Do this three times. Then pick another liquid from milk, lemonade and vegetable oil and fill in the appropriate column. Take an average of the number of drops for the three attempts. Use other groups’ results to fill in the results for the other liquids.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of drops | Plain Water | Water + detergent | Milk | Lemonade | Vegetable Oil |
| Try 1 |  |  |  |  |  |
| Try 2 |  |  |  |  |  |
| Try 3 |  |  |  |  |  |
| Average |  |  |  |  |  |

Were you surprised at how many drops you could add to the coin?

What do you think will happen if you add a drop of detergent to the coin with the plain water?

Why can the five cent coin hold more drops of some liquids than of others?

Which liquid do you think had the highest surface tension? Why?

**Magic Milk worksheet**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What do you think will happen when detergent is added to the middle of a Petri dish of milk with drops of yellow, red and blue food colouring in the corners?

Draw a picture of what the Petri dish looks like before and after you add the detergent.

|  |  |
| --- | --- |
| Before adding detergent | After adding detergent |
|  |  |

Can you explain what you see?

What happens with milk and no detergent, with water and detergent, with skim milk and detergent with cream and detergent?

Which works best?

What do you think will happen if you used vinegar instead of detergent?

**Capillary Action worksheet**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cut out a flower from the template. You can colour it in if you like. Fold up the flower petals so they cover the smiley face.

What do you think will happen when you float the folded up flower on top of the water?

What does happen when you float the folded up flower on top of some water?

Can you explain what you see?

What do you think will happen to the carnation or the celery with the stalk cut in half and put in red and blue coloured water?

What does happen (this might take a few hours)? Draw a picture of what you see.

Can you explain what you see?

**Size of Bubbles worksheet**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

You will have one of the 8 different bubble mixtures. Fill the results in for your bubble mixture.

Which bubble mixture do you have?

Which mixture do you think will make the largest bubbles?

Use a drinking straw to blow the largest bubble possible, this might take a couple of practices. Measure the diameter of the bubble: measure the distance from the tip of the straw to the far edge of the bubble, using a ruler or a marked sheet of paper. Repeat this at least 10 times and record the overall largest bubble and the average size of the bubble under the column in the table for your bubble mixture. Add in the averages and the biggest bubble size from the groups using the other bubble mixtures.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Diameter of bubble in cm | | | | | | | |
| Attempt | Mixture 1 | Mixture 2 | Mixture 3 | Mixture 4 | Mixture 5 | Mixture 6 | Mixture 7 | Mixture 8 |
| 1 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |
| Average |  |  |  |  |  |  |  |  |
| Biggest Bubble |  |  |  |  |  |  |  |  |

Which mixture made the biggest bubbles?

Can you explain your answer?

**Life Span of Bubbles worksheet**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

You will have one of the 8 different bubble mixtures. Fill the results in for your bubble mixture.

Which bubble mixture do you have?

Which mixture do you think will make bubbles that last the longest?

Use a drinking straw to blow a bubble with a diameter of 5cm. Measure the distance from the tip of the straw to the far edge of the bubble to be about 5cm using a ruler or a marked sheet of paper. Use the stopwatch to time how long it takes before the bubble bursts. Repeat this at least 10 times and record the overall longest bubble life span and the average bubble life span under the column in the table for your bubble mixture. Add in the averages and the longest bubble life span from the groups using the other bubble mixtures.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 5cm Bubble life span in seconds | | | | | | | |
| Attempt | Mixture 1 | Mixture 2 | Mixture 3 | Mixture 4 | Mixture 5 | Mixture 6 | Mixture 7 | Mixture 8 |
| 1 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |
| Average |  |  |  |  |  |  |  |  |
| Biggest Bubble |  |  |  |  |  |  |  |  |

If you can blow bubbles bigger than 10 cm, repeat this for a 10 cm diameter bubble

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 10 cm Bubble life span in seconds | | | | | | | |
| Attempt | Mixture 1 | Mixture 2 | Mixture 3 | Mixture 4 | Mixture 5 | Mixture 6 | Mixture 7 | Mixture 8 |
| 1 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |
| Average |  |  |  |  |  |  |  |  |
| Biggest Bubble |  |  |  |  |  |  |  |  |

Which mixture made bubbles that lasted the longest?

Can you explain your answer?

Do bigger bubbles last longer than smaller bubbles?

Can you explain your answer?

Use the drinking straw and some water, skim milk, milk and cream. Try to make bubbles with each liquid. Which liquid made the best bubbles? Can you explain why?

**Shapes of Bubbles worksheet**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Bend the pipe cleaners to make bubble wands with a small circular shape at the end, a small square, a small heart and a small triangle.

Put some bubble mixture into a plastic cup.

Record the bubble shapes you predict from each bubble wand in the table and then blow bubbles inside and outside recording what shapes the bubbles actually were.

|  |  |  |  |
| --- | --- | --- | --- |
| Wand Shape | Predicted Bubble Shape | Bubble Shape blown inside | Bubble Shape blown outside |
| Circle |  |  |  |
| Square |  |  |  |
| Heart |  |  |  |
| Triangle |  |  |  |

Use the tetrahedral and cubic bubble wands.

What shape bubbles do you expect to see inside the wands (before you blow the bubbles).

What shape bubbles do you expect from the tetrahedral and cubic bubble wands?

What shape bubbles do you see? Why?

**Colour of Bubbles worksheet**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Take a plastic plate a straw and a piece of white paper.

Pour some bubble solution into the plate (put in a centimetre or more). Use the straw to blow bubbles onto the detergent in the plate. Look at the colour of the bubbles, bend the white paper around so you can see the colours better. Draw a picture of what you see.

Keep making bubbles and keep watching the colours. Why do you think there are so many colours in the bubbles?

What makes the dark bands in the bubbles?

What happens just before the bubble pops?

**How much do you know about bubbles?**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Budapest Bob, the bubble archaeologist is trying to find the giant rainbow bubble that contains the map to a treasure. In order to achieve this task, you must help him to find the map by going through a maze and completing each task.

These are the obstacles that he will encounter on the way:

1. What substance does he use to make the largest bubble in order to get him over the dangerous animals?

2. What substance does he need for the strongest bubble in order to escape the dragonfly?

A wizard blocks the path of Budapest Bob. In order to pass, he must answer the following questions:

A. How many colors will be seen in a bubble?

B. What order are the colors?

C. When handed several types of milk, what milk should he use for the strongest bubbles?

He now is near the end. He sees the large rainbow pointing toward the giant square bubble. He also encounters a robot that is blocking the path that will lead him to the treasure. How do you create a square bubble that will help Budapest Bob escape to safety.

You have arrived successfully at your treasure!