

# **Amazing Science**

Lesson 1: Introduction to Hands-on Science and Group Work

## **Brief description**

This lesson is designed to introduce the class to the cooperative group work system and to begin class planning for future science lessons. The amazing demonstrations and activities will motivate students to negotiate a set of safety and behaviour rules which can be displayed on wall charts for future reference.

Duration:	60 to 90 minutes
Year Level:	Middle to upper primary
Topics:	Natural and processed materials
Preparation:	20 minutes
Extensions:	ART – Create wall charts with class rules for reference



## Overview

Whole class	Teacher demonstrations	(30 min)
	Discuss safety precautions and behaviour	
	Introduce and designate group work jobs	
Small groups	Activity 1 – Toothpick Trick	(30 – 45 min)
	Activity 2 – Mesmerising Milk	
Whole class	Discuss activities	(30 min)
	Negotiate safety and behaviour rules	
	Plan next science lesson	
Art Extension	Create wall charts	(optional)



## **Materials and equipment**

### Teacher demonstrations

Select demonstrations (from downloaded Teacher Demonstrations PDF document). Each demonstration employs simple and readily available household equipment and materials.

### Small group activities

Total Qty	Description		
6	plastic cups	(1 per group)	
6	eyedroppers (or plastic straws)	(1 per group)	
6	small dinner or plastic plate	(1 per group)	
2 litres	full cream milk (normal or UHT)	(200ml per group)	
30	student worksheets (photocopy)	(1 per student)	



## **Objectives**

### Students' prior knowledge

No prior knowledge is required or assumed for this lesson.

### Science skills

- Students will: make careful observations of each activity
  - describe their observations
  - make inferences based on their observations
  - design possible further experiments to confirm their inferences
  - discuss the meaning of scientific terms such as inference, hypothesis, variables and experiments in a class discussion

### Science concepts

Toothpick trick:

- wood swells when it becomes wet
- each toothpick 'opens' as it swells
- the arrangement of the toothpicks creates a star

#### Mesmerizing Milk:

The scientific explanation is discussed separately in the Teacher's Notes section. This activity however is not intended not to directly teach science concepts, but rather as a motivational activity which demonstrates some important aspects of science.

- scientists attempt to explain observations by conducting controlled experiments
- many phenomena have yet to be fully understood
- scientist usually emphasise results which need verification or further experimentation

## **Positive attitudes**

- Students will: work cooperatively using the small group work job system
  - negotiate a set of rules for behaviour in future science lessons during a class discussion about the activities
  - handle equipment and materials responsibly
  - dispose of waste from the activities responsibly



## Preparation

Download the Teacher Demonstrations document from the Surfing Scientist Website and select one or several demonstrations to perform.

- Designate an area in the classroom as the Science Store (if one does not exist already)
- Gather materials and equipment and place in Science Store (see Materials list)
- Photocopy (and laminate if desired)
  - Group Work Job Badges

(available online in PDF format)

- 2 sets of Group Work Posters
- 30 Worksheets (available online in PDF format)



## Procedure

## Introduction (Whole class / 15 – 20 min)

#### Teacher demonstrations (available online)

• To motivate your students and focus their attention for this lesson, perform one or several demonstrations and explain any safety precautions you are taking

Amazing demonstrations are provided at ABS Science online in the Teacher's Section of the Surfing Scientist website complete with presentation suggestions and safety notes.

• Anticipate lively discussion and excitement after each demonstration!

#### Safety discussion

- Encourage students to identify the importance of safety during hands-on lessons EG Taking care with liquids to avoid spills which could make floors slippery
- Request that students take the same safety precautions if they repeat the demonstrations or activities at home

#### Introduce activities, group work jobs and the Science Store

- Introduce and discuss the hands-on activities
- Encourage students to identify the benefits of the group work system (provided at ABC Science online in the Teacher's Section of the Surfing Scientist Website) EG Classroom traffic is reduced if only Equipment Officers collect and return equipment
- Reassure the class that everyone will have a turn at each job during the term

### Hands-on activities (Small groups / 30 – 45 min)

#### Job badge draw and worksheet distribution

• To avoid delays and randomly allocate groups and jobs, each student collects a worksheet and draws a job badge from the hat. Allocate to groups as follows:

Each new job joins the first group until all the vacancies have been filled

If the first group has no vacancy for a job drawn, a new group is formed

If two groups have a vacancy for the same job, the drawer is allocated to the first group

EG If Groups 2, 3, and 4 all have vacancies for a Communications Officer, the drawer is allocated to Group 2. The next Communications Officer will join Group 3 and so on.

#### Small group activities

- All group members cooperate to prepare a Work Station by grouping desks
- All group members read the worksheet instructions
- Equipment Managers collect materials required from Science Store
- Group Supervisors ensure group adheres to instructions and completes activities
- Records Officers keep careful notes of results where necessary
- Equipment Managers clean and return equipment to the Science Store
- Remainder of group cleans Work Station and returns desks to normal locations

#### **Early finishers**

• Plan ahead for early finishers – Communication Officers of groups who finish early should ask teacher for further instructions EG Repeat activities the group would like to see again, continue unfinished work from another subject, or read quietly while waiting for other groups to finish

## Conclusion (Whole class / 15 – 20 min)

#### **Class discussion about activities**

• Lead a discussion about the activities by asking questions such as:

"did you expect to see the results you saw?" "could you explain the results you saw?" "did you come up with any new questions about these activities?" "has anyone got a suggestion for other interesting activities like these?"

#### Planning future science lessons

- Ask the class if they are keen to do more hands-on science activities Although it is unlikely, ask anyone who says no to explain why not
- Explain that some hands-on activities require much more preparation and ask if the class is prepared to assist (eg by gathering materials from home)
- Explain that preparation should be shared equally within reason
  EG Some items such as soft-drink bottles or ice-cream containers may not become available to a student in time for a lesson while others may be able to bring in more than one
- To assist you with planning a science program that will interest the class, ask if any science topics are of particular interest and discuss how these could be investigated EG Individual, small group or whole class projects? The results of individual and small group projects could be shared with the class on a presentation day
- Discuss what you have planned for the next science lesson and ask students to bring in any household items required

If you are planning to do the Octopus's Garden lesson, ask students to save used soft-drink bottles during the week and bring them to the Science Store

#### Negotiate a set of rules and consequences for future science lessons

• Lead a discussion about safety rules for future activities based on behaviour during this lesson

EG Were there any spills or accidents today? If so, could they have been avoided?

• Ask leading questions to encourage students to identify rules for behaviour and consequences, and note these on the board – for example:

"did having a specific job help you to work together?" "did you feel your responsibilities were important to the group?" "could we improve the group work system?" "how should we deal with people who are not doing their job?" "how should we deal with people who take over other people's jobs?" "how can we improve the safety for everyone during hands on activities?" "do you think it is important to be able to work together in groups?"

## Art extension (Optional / 45 – 60 min)

#### Create decorative wall charts stating negotiated rules

As a graphic art exercise, each student could design a decorative wall chart stating some or all the rules and consequences negotiated by the class. You could begin this session by studying various poster designs and deciding what kind of layout and graphic elements would be appropriate to the wall chart's function.

There are more extension suggestions in Teacher's Notes section



## **Teacher's notes**

## Toothpick trick

This trick will amaze students and their parents because it is so incredibly simple. It works with any kind of toothpick or matchstick made from wood.

#### Instructions



Neatly snap five toothpicks in the middle so they make a sharp V-shape. Ensure the tip of the V is neat and free of splinters.



2

Arrange the toothpicks like this. The more symmetrical the arrangement, the better the result.



3

Squeeze a drop of water into the centre making sure it touches each toothpick ... and watch what happens next!

#### How it works

Most types of wood swell when wet and shrink as they dry out again. Water rushes into the broken part of the toothpicks causing it to expand and open out the V shape. This becomes more obvious if the activity is repeated with just one toothpick. Arranging five toothpicks in a circle, causes the ends of the toothpicks come into contact and push against each so that the whole arrangement opens out into a five-pointed star.

#### A bit more about wood

The scientific word for wood is xylem. It is made up of various types of tissue which provide strength and a transport system for water and dissolved minerals from the roots up to the leaves. *Capillary action*\* combined with *transpiration*\* from the leaves provides the force required to transport water vertically. In some plants, wood grows faster in summer causing visible rings which can be counted to determine the age of the tree. Cut longways, these rings cause the beautiful grain visible in wood.

*Capillary action* is the result of the strong surface tension of water causing it to rise vertically up narrow capillaries. The height to which water will rise in a capillary depends on its size and the material it is made from. Capillary action can be observed by dipping the bottom of a strip of paper towel into water.

*Transpiration* is basically a form of controlled evaporation. Plants maintain their moisture levels by opening and closing tiny holes in the leaves called stomata, which controls the rate of evaporation.

#### A practical problem:

Some wooden doors swell in very humid weather and become jammed. This can become such a problem that the edges of the door need to be trimmed with a planer.

#### Water transport in celery (extension suggestion)

To show that water is transported through wood, make a 10 cm slice along the stem of a piece of celery with leaves still attached. Rest one half of the stem in a glass of water with red food colouring, and the other in a glass of water with blue food colouring. Leave for a few hours. The leaves on one side will turn deep red and on the other they will turn deep blue.



### **Mesmerising Milk**

This activity truly is mesmerising. The simple ingredients set off a spectacular liquid kaleidoscope of colour and motion. But rather than teaching specific scientific content, the purpose of this activity is to demonstrate that even simple, everyday materials can behave in beautiful and amazing ways which we cannot fully explain!

#### Instructions



Pour milk into the plate to a depth of approximately 5mm and allow to settle for 20 seconds.

Add one to three drops of each food colour to the milk in separate locations.



Squeeze a small drop of detergent onto the edge of the plate and watch carefully as it runs down into the milk.



The instant the detergent reaches the milk, things start to happen. After a little while, you will notice colours from the opposite side of the plate appearing near and shooting away from the detergent.

Allow at least one minute before adding detergent to another part of the plate.

#### Why is it still a mystery? Some points to discuss with your class

#### It's okay not to know the answer to everything!

The fact that this activity remains a mystery is an extremely valuable lesson in itself because it demonstrates that phenomena which appear simple at first can actually be quite complicated and difficult to explain (for instance, try explaining why the sky is blue, or why colours are reflected from bubbles). Scientists are not ashamed about not fully understanding everything and usually do their best to emphasise aspects of their research that have not yet been accurately explained. Many scientific research papers simply describe observations for which explanations are yet to be found. Unfortunately, this aspect of science often gets overlooked which can contribute to a great fear of the subject. So this simple, amazing and fun activity serves a valuable purpose in reminding students that science cannot explain every thing they see, but it can certainly try.

#### Milk is a complex mixture

Most people know that milk contains some fat. If raw milk is left to stand, the fats float to the surface and can be skimmed off. What's left still contains some fat which does not rise as quickly because it is in the form of tiny globules which have a membrane (or coating) which prevent or slow down the formation of large clusters the way visible vegetable oil does in water. These globules are broken down to make them even smaller during a process called 'homogenisation' in which the milk is simply forced through a tiny hole under great pressure. During this process, the 'native' membrane (ie the one that is there in raw milk) is lost but another one is soon formed as other proteins in the milk interact with the globules. These membranes and their properties are still the subject of much research along with a long list of other natural chemicals (proteins and sugars) present in milk. So you see, even good old milk is more complicated than what a brief description might lead you to believe.

#### Published explanations are not yet verified

Numerous explanations for this activity have been published, however none of these have been verified experimentally. The food colouring makes the motion in the milk clearly visible, but why this motion occurs is still a bit of a mystery. Many explanations suggest that detergent somehow 'breaks

up' the tiny fat globules present in milk causing swirling and mixing. But as discussed, these microscopic globules are not just simple little blobs of fat. How detergent affects them is described differently in various explanations. Some suggest they are broken down further while others suggest detergent molecules simply surround them forming a new outer membrane. Both seem plausible but neither seem to have been confirmed.

The effect of surface tension on milk is also usually discussed but how local variations in surface tension create swirling right through the milk is not clear in most explanations.

Finally, the fact that detergent readily dissolves into water is considered to have an effect. But other liquids may also dissolve into milk readily without causing the swirling that detergent does.

#### Why is milk white?

You probably know that fats and oils tend to be clear (often with a yellow tinge) and water is clear ... so you may wonder why milk is white. It is because the tiny globules of fat reflect light equally in every direction. We call this 'scattering' of light and because all the colours in white light are scattered evenly by the globules, milk appears white.

#### Science concepts to consider and discuss:

- Oil and water do not mix
- Oil floats on water (because it is less dense)
- Detergents emulsify fats into water because their molecules can attach to water molecules at one end, and oil molecules at the other
- Emulsifiers are substances which can mix fats into water to form an emulsion
- Emulsions are a suspension of either fat in water (small blobs of fat in water), or water in fat (small droplets of water in oil or fat)
- Surface tension the result of the attraction between water molecules and their nearest neighbours. It results in a meniscus because the molecules at the surface are being pulled from all sides and below but not from above.
- Detergents reduce surface tension in water

The strong surface tension of water prevents it from creeping into the tiny spaces between fibres in clothing. Reducing the surface tension in water helps penetrate these places to remove dirt. Because detergent can form bonds with both water and fat molecules, it can take away some oily stains as well.

## **Extension suggestions**

#### Make 'lava lamp' with water, vegetable oil and detergent

Fill a clear glass with water and add a few table spoons of vegetable oil. Mix some food colouring into about 30ml of detergent. Carefully drop small amounts of the coloured detergent onto the vegetable oil. The result is amazing to watch. The detergent is more dense than both the oil and water. As it passes through, the detergent drags some oil down to the bottom of the glass. Some of this oil separates and floats back to the surface again, sometimes dragging some detergent up again and so on.



#### Research milk on the internet

Visit dairy food information websites – many have a kids' section with useful information about milk homogenisation and other dairy food production methods.

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NAME:

## Working in groups

These two activities are really amazing because they are so incredibly simple. Have fun while you are doing them and remember to handle all the equipment and materials safely to avoid accidents and spills.

Before you begin each of these activities, read the instructions and have a brief discussion about what each member in your group needs to do. After you have prepared your workstation, the Equipment Manager can collect the materials required from the Science Store. Note that you may have to wait for the teacher to bring some materials to your workstation.

In these activities, you will all write some of your observations in your notebooks. The Records Officer should also take notes of any group discussions in case these come up during the class discussion at the end of the lesson.

## **Activity 1: Incredible Toothpick Trick**

**Equipment:** Toothpicks (about 40 will be plenty!) Eyedropper (or a straw to use as a pipette) Water (half fill a plastic cup)

#### Procedure:



1. Snap five toothpicks in the middle and arrange them like this.



2. Carefully squeeze a drop of water into the middle so that it touches all five toothpicks. Watch what happens next!

#### What's happening?

Can you describe what you saw with words alone? It's not that easy! Discuss this with your group and write a description together. The Records Officer should transcribe during the discussion so all th group members can copy it later.

Next, describe what you saw with the assistance of an illustration. You'll probably find it much easier to describe this way. Decide as a group how to draw what you saw.

Last of all, write down what you think is happening in your notebook. It's okay to guess try to you think of another experiment that might confirm your ideas? Think about how you might do this experiment? What would you want to measure? How would you measure it? What equipment would you need to do it? Or what sort of person could you ask to get more information (apart from your teacher!).

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## **Activity 2: Mesmerising Milk**

#### Equipment: Plate

Milk (wait for teacher to add if there is only one bottle) Eyedropper (or straw) Detergent (put a small amount in a plastic cup) Food colours (wait for your teacher to add food colours if there is only one set)

#### Procedure:



- 1. Pour the milk into the plate so that it is about 5mm deep.
- 2. Add a few drops of each food colour near the edge of the plate in different locations



- 3. Carefully squeeze a drop of detergent onto the edge of the plate and watch what happens when it rolls into the milk.
- 4. When things settle down, add another drop of detergent somewhere else.

#### What's happening?

There is a lot going on in that plate of milk. In your group, discuss what you know about milk. The records officer should write down anything all members of the group agree on. Some things you might want to consider:

What is in milk? What does homogenised mean? What does detergent do (think about what it is used for)? If you have permission, you could try it with just water but you will discover that no motion results when you add detergent. Does this help you figure out exactly what is going on? What sort of person might be able to you more about what's happening? What experiments could you do to try to figure out what's happening?

#### Finishing up

If you think you have finished early, the Communication Officer should check what the group should do next with the teacher.

When it is time to finish the activity, the group should clean the workstation while the Equipment Manager cleans and returns equipment to the Science Store.