7. Lumps or powder?

1.5 hours

Children learn that some materials must be physically changed to enable them to be used as ingredients for applications such as sun care products. They learn that different levels of UV protection can be provided by using different types and amounts of ingredients in sunscreen products and go on to test a series of sunscreen products and rank in order of protection level.

OBJECTIVES

- To demonstrate that mixing is a reversible change
- To compare and group together everyday materials on the basis of their properties
- To take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate

RESOURCES

(Per group of 4 children unless otherwise stated)

- Role badges (Appendix 1)
- Stop clock or stopwatch
- 4 small transparent pop bottles or cups
- Teaspoon of: sugar cubes, granulated sugar, caster sugar, icing sugar 300 ml vegetable oil or sunflower oil
- 2 teaspoons
- 100 ml measuring cylinder

INTRODUCING THE ACTIVITY

Use the website area Safe in the sun - Sun Protection. This web page provides the starting point and background for the activities in this theme. A video clip of the industrial scientist in A Lumpy Problem is used to introduce Activity 7. The teacher then summarises the problem. The main ingredient for sunscreen comes from the manufacturer in the form of big white lumps of solid material, which need to be changed into a powder. The teacher asks the children why they think this is and takes feedback from the class. The teacher explains that, as the real ingredient is very expensive, they will be testing, in cooking oil, solids which mimic those used in industry. In their groups, the children predict which of the samples is best suited to be mixed into a liquid sunscreen. The children are encouraged to explain the reason for their prediction by responding to questions such as:

Which properties of your chosen solid make it better for mixing into the liquid?

In sunscreens, why do we need to make sure the solids/powders are well mixed in the liquid?

ACTIVITY

The children decide upon roles and responsibilities for the investigation (Appendix 1). They add each sugar sample in turn to separate measured volumes of oil and gently shake or stir for 20 seconds; they start the stopwatch and when they believe the majority of the sugar has sunk to the bottom of the plastic container, the stopwatch is stopped and the time noted. They decide an appropriate way in which to record their results.

It is likely that, in most cases, a timed result will only be possible for granulated and caster sugar. Icing sugar is likely to partially suspend in the oil, demonstrating that this would be the best form of solid to use for mixing into oil. Sugar cubes sink quickly to the bottom of the pot preventing accurate timing. For a readable measurement, taller containers could be used, the sugar cubes slightly broken down, or the time taken

for the cubes to drop without any stirring could be measured. Sample results, using 1 teaspoon of each sugar and 75 ml oil each time, are shown below. The table shows the time taken for different sugars to sink in oil (using an 8 cm tall pot).

Sugar Used	Time taken
Time taken	1 min 50 secs
Caster	2 min 35 secs
Cubes	Too quick to measure
Icing	Sugar left in suspension

PLENARY

Teacher and children then discuss the results from the class activity:

Which materials mixed best in the liquid?

Are there any unusual results?

Did the groups obtain similar results?

Which of the samples would the children recommend for the sunscreen and why?

The third screen of the website area A Lumpy Problem shows the children a selection of solids in liquid and provides an opportunity for the children to compare their results with those demonstrated in the animation on screen.

AMBASSADOR ROLE

An ambassador from a local company could act as an initiator to the activity, by introducing the challenge to the children and showing them a sample of ungrounded ingredient. The ambassador could outline his or her job and explain the skills required to carry out the role, explaining that scientists in industry often have to find solutions to problems. Finally, the ambassador could discuss the children's results in the plenary session and ask for their recommendations.

BACKGROUND INFORMATION

The classroom activities are based upon processes in which some materials are changed to make them more suitable for applications such as sun care products. The activities focus upon two main areas: Research and development science, involving the break-up of clumps of particles, and 'applications and claims' science, introducing the concepts of formulating products and testing how well they perform.

Industry produces ingredients called metal oxides for use in a number of applications, and particularly in sun care products such as lotions, sprays and sticks.

When the metal oxide is made, it needs to be filtered from water. After filtration, it is a white 'cake', still containing a lot of water. When the cake is dried it forms large solid clumps. These clumps need to be ground into a powder to (i) stop the solids from sinking to the bottom of a bottle of sunscreen and (ii) give an optimum amount of protection against UVA and UVB radiation.

Appendix 1

Role Badges

All of the classroom sessions involve children working together in groups of four.

Each child is responsible for a different job or role within the group and wears a badge to identify this. The images below may be photocopied onto card and made into badges, by slipping them in to plastic badge sleeves. Keep sets of badges in 'group' wallets, to be used on a regular basis in your other science lessons.

Children should be encouraged to swap badges in subsequent lessons; this will enable every child to experience the responsibilities of each role.

Administrator keeps a written and pictorial record for the group

Resource Manager collects, sets up and returns all equipment used by the group

Communications Officer collects the group's ideas and reports back to the rest of the class.

Health and Safety Manager takes responsibility for the safety of the group, making sure everyone is working sensibly with the equipment.

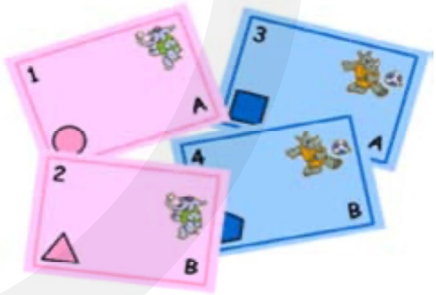
Where groups of 5 are necessary, the following role can be used:

Personnel Manager takes responsibility for resolving disputes within the group and ensuring the team works cooperatively

Appendix 2

Discussion strategies

The following strategies are used extensively as part of the Discussions in Primary Science (DiPS)[1] project, and have been proven to be successful when developing children's independent thinking and discussion skills.



Talk cards

Talk cards support the teacher in facilitating these discussions, with the letters, numbers, pictures and shapes enabling the teacher to group children in a variety of ways.

The example provided here shows one set for use with four children. The set is copied onto a different colour of card and talk groups are formed by children joining with others who have the same coloured card.

Children can then pair up by finding a partner with the same animal or a different letter eg. elephant, rhino or a + b pair. Each TALK pair would then have a card with a different number or shape.

The numbers or shapes may then similarly be used to form alternative groupings and pairings.

Note: The example talk cards are provided in MS Word format so you may make changes if you wish.

ITT (Individual Think Time)

Each child is given time to think about the task individually before moving into paired or group work.

Talk Partners

Each child has a partner with whom she/he can share ideas and express opinions or plan. This increases confidence and is particularly useful where children have had little experience of talk in groups.

A > B Talk

Children take turns to speak in their pair in a more structured way, e.g. A speaks while B listens B then responds. B then speaks to A while A listens and then A responds to B.

Snowballing

Pupils first talk in pairs to develop initial ideas. Pairs double up to fours to build on ideas. Fours double up to tell another group about their group's ideas.

1 For more information go to www.azteachscience.co.uk

Envoying

Once the group have completed the task, individuals from each group are elected as 'envoys', moving on to a new group in order to summarise and explain their group's ideas.

Jigsawing

Assign different numbers, signs or symbols to each child in a group. Reform groups with similar signs, symbols or numbers, e.g. all reds, all 3s, all rabbits and so on. Assign each group with a different task or investigation. Reassemble (jigsaw) the original groups so that each one contains someone who has knowledge from one of the tasks. Discuss to share and collate outcomes.