Leader's Guide
Learning About Solids, Liquids and Gases, Second Edition

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Produced by ***Video Education Australasia***

Program Summary

This program introduces students to the concept that all material is made of matter. Students examine a range of solids, liquids and gases and develop vocabulary and definitions to describe the three different states of matter. Differences are then identified, and this information is used to group materials into categories. The program also examines the difficulties in classifying materials, and how heat can affect matter and change it from one form to another.

Pre-screening Preparation*:

- Preview the program before screening it for the students; this allows you to establish any pause points for discussion
- A pre-screening activity has been included for students to prepare them, and give you an understanding of their prior knowledge in order to build upon it.
- The post-screening science activities further extend students' understanding.
- These activities could also be used as an assessment tool. Background information is also provided to assist with explanations if required.

**Note: Activities should be practiced prior to using with students*

Pre-screening Activities

Introduce the concept that all material is made from matter and that matter can be solid, liquid or gas. Ask if anyone has heard of the word 'matter'? Explain that everything that is seen, felt or smelled is made of matter. Matter can be solid. Matter can be liquid. Matter can be gas. Anything that takes up space is called matter. Have students give examples of each.

Concept map: Have students can complete a concept map to demonstrate their understandings of solids, liquids and gases. If possible, have a variety of objects that are made up of different matter or hold matter. Allow students to explore these materials.

After students have handled the materials, ask them to explain what properties make the materials different. Listen to their explanations. Encourage students to think of descriptions of solids, liquids and gases, for example, 'is hard', 'changes shape', 'keeps its shape', 'you can pour it', 'you can see it', 'you can smell it', 'it is runny', 'it spreads out'. The descriptions can be listed under the three headings of *solids*, *liquids*, *gases*. Revisit these descriptions once the post activities have been completed to see if any students have a different understanding of matter.

Have students develop individual statements to define solid, liquids and gases. Then have them work in pairs to refine their statements. Have the pairs join together into small groups, combining their knowledge to create the final definitions. Groups can share and discuss their thoughts. You can use their data to create a class list of statements and questions regarding matter. By discussing students' responses you can build on their existing conceptual ideas.

Viewing the Program

When screening the program for your class, if you feel it is necessary to stop and clarify a point, give further examples or define terms – then do so. The full value of the program will come from how you use it for your individual grade.

Post-screening Activity

SOLIDS- Allow the students to handle, investigate the properties, and compare various solids.

- Students can record their observations on a table.
- Describe what the solid (wood, metal, cloth, paper, glass, rubber, clay, rock, plastic, plant parts) feels like.

- Look at the solids under a microscope. What can students see with the magnifying devices? What do students observe about the structures of the different materials? How do the magnifying devices change the way the materials look? What can students see that they could not see without the magnifying devices?
- Allow students to use their own words to describe their observations. This is a good way to gauge their understanding. Students could also draw what they see under the magnifying glass or microscope.

LIQUIDS- Make available a range of liquids in clear containers for students to explore. What differences are there between the liquids? Can students think of ways to classify them (color, use)?

Viscosity- Liquids can be defined through their viscosity (runniness). Have students predict which liquid they believe will move the fastest and slowest down a smooth angled surface (a dropper will be needed for fair testing). A number of liquids can be compared. Liquids could be 'raced' or timed individually. Graphs could be used to represent the speed of the liquids.

Density- Some liquids are denser than others, which cause layers when they are combined. Jars can be filled with liquids of different densities (this must be completed slowly and carefully). This will create many layers. Some of the liquids can first be colored with food coloring. Glycerine, water and oil form layers if poured very carefully.

Why won't the liquids mix? What are the liquids? Ask if they can shake and mix the colors. What happens when the bottle is still? Set students the problem of finding out why some liquids don't mix.

GASES- Gas takes up all of the space in a container. Students can be shown that air, which is a gas, takes up space when a balloon is blown up. Can students offer suggestions about where gas is used? Some examples include in soft drinks, aerosol cans, pump packs, and at service stations.

A simple experiment combining vinegar and bicarbonate soda will show how a gas is formed through its reaction. Visually the gas taking up space can be observed by having a balloon connected to the experiment container.

Many gases may be detected by smell—students with gas ovens at home may be able to talk about times they have smelled gas.

Place a jar with a smelly substance at the back of the classroom. Have the students indicate when they can smell the substance. Call out the time it takes to reach all students. Discuss with students how a gas can move in all directions.

Extension Activities

Oobleck
In this activity students are given substances that have properties of both liquid and solids, such as a colloid. They examine the properties and are challenged to explain their solid and liquid characteristics.

Explain to students that a mixture of water and cornflour behaves differently depending on the force used in stirring it. Provide students with cornflour, water, mixing bowls and spoons.

- Mix 1½ cups of cornflour with a cup of water in a bowl and gently stir until the mixture is a paste.
- What happens when the mixture is stirred quickly? What happens if the mixture is slapped with a spoon? What is the result? Pour some of the mixture from a spoon, try and cut it with a pair of scissors.
- Allow the students to handle the Oobleck (they will have a great time). Make sure they gain an appreciation of the different texture/hardness of the mixture by moving it around in their hands.
- When does the mixture behave like a liquid? When does the mixture behave like a solid?

What Am I?
Using the knowledge gained from the program and learning activities, students could create 'What am I?' posters. For example: 'I am runny, slippery, green, and make bubbles. I am a liquid'. (Dishwashing soap)
The terminology they use will be a key indicator as to their overall understanding.

Background Information

Solids, liquids and gases are all different states of matter and behave in different ways. Solids are made up of molecules that stay together - the molecules are not able to move around freely - this is why solids have a fixed shape. Liquids move around more freely and in all directions. The molecules they are made up of slide over each other and can bump into each other - this enables liquids to spread out and take up space in a container. The molecules that make up gases move quickly and freely - they can spread out in air. Air is a gas mixture, which shows that a gas can spread in other gases. Many liquids can spread in other liquid but not all can, for example, oil and water.

Vocabulary
appearance, atoms, classify, color, condensation, density, disappear, fiber, freezing (solidification), gas, grain, hard, hot, invisible, liquid, magnify, material, matter, molecules, natural, particles, pattern, processed, property, rubbing, runny, shape, smell, soft, solid, spread, structure, substances, texture, thick, thin, viscosity, wet

Useful Websites

Properties of Matter (Thematic Unit- games, graphics, definitions)
http://www.naschools.net/teachers/aapicard/index.htm

What is Matter?
http://www.nyu.edu/pages/mathmol/textbook/whatismatter.html

Fundamental Properties of Matter
http://www.sirinet.net/~jgjohnso/matter.html

Various sites related to solid, liquid and gases
http://science.howstuffworks.com/search-google.php?terms=solid+liquid+gases

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Audience level
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