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Grouping materials

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Natural and Processed Materials

Key concept

The properties and structure of materials are interrelated.

Purpose

Activities in this module are designed to help students understand that materials can be grouped according to different properties. Students have opportunities to:

- handle materials grouped according to properties;
- create analogies to assist understanding of the properties of materials;
- make comparisons between groups of materials;
- describe materials based on understandings of properties;
- identify and control variables in experiments with materials;
- use scientific terminology when referring to properties.

Overview of activities

The following table shows the activities in this module and the way in which these are organised in **introductory**, **developmental** and **culminating** phases.

Introductory ►

Treasure hunt
Property match

Developmental ►

Invisible solutions
Oh, what a feeling!
To see or not to see!
Soft or hard or what?
Will it float?

Culminating

Let's sort it out!



Core learning outcomes

Natural and Processed Materials

This module focuses on the following core learning outcomes from the Years 1 to 10 Science Syllabus:

- 1.1 Students describe observable properties of familiar materials (including solids and liquids).
- 2.1 Students group materials on the basis of properties (including solubility, texture and hardness).

Core content

Natural and Processed Materials

This module incorporates the following core content from the syllabus:

Properties of materials

- colour, lustre, texture, transparent, translucent, opaque, density, solubility, strength, hardness, flexibility

Assessment strategy

Natural and Processed Materials

Suggestions for gathering information about student learning are provided in each of the activities in this module. Once sufficient information has been collected, judgments can be made about students' demonstration of outcomes. Typical demonstrations of this module's intended outcomes are provided here to indicate the pattern of behaviour to look for when making judgments.

1.1 Students describe observable properties of familiar materials (including solids and liquids).

Students may:

- describe the observable properties of familiar materials using basic terminology;
- describe an object in terms of the properties of the materials from which it is made.

Natural and Processed Materials

2.1 Students group materials on the basis of properties (including solubility, texture and hardness).

Students may:

- explain the basis for grouping particular materials or objects, using scientific terminology to label the groupings;
- use simple explanations to communicate why materials or objects are grouped together;
- choose a method of grouping familiar materials based on their properties;
- relate different properties — for example, high lustre and smooth texture.

Background information

Current scientific conceptions

Definitions

A **variable** is something to change in an experiment, which will influence outcomes.

Lustre is the state or quality of shining by reflecting light. Common terms relating to lustre are 'glitter', 'sheen' and 'gloss'.

Texture refers to the general structure of a material as conveyed by the sense of touch. Common terms relating to texture are 'rough', 'smooth', 'sticky' and 'grainy'.

Transparent refers to the property of transmitting rays of light through a substance so that objects situated beyond or behind can be distinctly seen.

Translucent refers to the property of transmitting light imperfectly, such as with frosted glass, where the object behind or beyond is not distinctly seen.

Opaque refers to the property of not being able to transmit light.

Density is the property of matter representing its mass per unit volume or compactness.

Solubility is the property of being able to be dissolved. The particles of the substance that is dissolved (solute) spread out between the particles of the substance in which it is dissolved (solvent). This change is a physical change, not a chemical change. A solution may be coloured, but it is transparent.

Flexibility is the property of being bent easily.

Hardness is the property of being able to resist abrasion.

Strength is the property of being able to resist a force or strain.

Elastic materials have the property of recovering their shape after a force has been applied to them.

Some of these terms have a meaning in everyday language which is different from the scientific meaning. For example, rock is described as 'hard', meaning that it is able to resist a force. The resistance of a rock to abrasion is not a property commonly considered.

Sinking and floating

An object immersed in a liquid is acted on by two forces:

- its weight acting vertically downwards;
- an upthrust acting vertically upwards.

If the weight acting downwards is greater than the upthrust, the object will sink in the liquid.

If the weight acting downwards is less than the upthrust, the object will rise in the liquid.

If the two forces are equal, the object will float at the point where this occurs. This point may not be at the surface of the liquid.

The upthrust can be shown to be equal to the weight of liquid displaced by the object. A completely immersed cork displaces a weight of water greater than its own weight, since the cork is less dense than water. A lump of metal placed in water will sink because it does not displace a weight of water equal to or greater than its own weight. However, if the metal is hammered into a sheet and made into the form of a boat, it will displace a weight of water equal to its own weight, and so it will float. A variety of factors determine whether an object will float. These include weight, shape and density (mass per unit volume).

Students' prior understandings

Students' prior understandings may differ from current scientific conceptions in a range of ways.

Some students may:

- think that objects are grouped only according to easily visible characteristics like size, colour or shape;
- think that the heavier the object, the easier it is to sink;
- use simple, descriptive words to communicate their ideas about properties (for example, 'bendy', 'disappears') rather than scientific terminology.

Teachers can enhance students' understandings by:

- encouraging them to use 'less familiar' properties as a basis for grouping objects — for example, flexibility, the ability to transmit light;
- engaging students in discussion at various stages of investigations;
- modelling correct use of language.

Terminology

Terms associated with the properties of materials are essential to the activities in this module — for example:

colour	heavy	solid
density	light	solubility
dissolve	liquid	solution
flexibility	lustre	strength
float	opaque	texture
gas	sink	translucent
hardness	softness	transparent

Students may already be familiar with some of these terms and understand their meanings and use in scientific contexts. If so, the activities in this module will provide opportunities for them to evaluate current usage. If not, these activities will provide opportunities for students to develop their understandings.

School authority policies

Teachers need to be aware of school authority policies that may be relevant to this module.

Safety policies are of particular relevance to the activities that follow. It is essential that demonstrations and student activities are conducted according to procedures developed through appropriate risk assessments at the school.

Support materials and references

Queensland Department of Education 1981, *Primary Science Sourcebook: Activities for Teaching Science in Year 3*, Brisbane.

Victorian Department of Education 1999, *ScienceScope 1: Units of Work for the Early Years*, Addison Wesley Longman Australia, Melbourne.

ACTIVITY

Treasure hunt

Introductory

Focus

This activity provides opportunities for students to demonstrate their prior understandings of grouping materials according to different properties. Students do this through handling and describing familiar objects.

Materials

- items commonly available in the classroom (e.g. chalk, Plasticine, straws, fabric, books)
- coloured pens and pencils
- paper

**Working scientifically**

Time: 45 minutes

Handling materials
Describing
Illustrating

- ▶ Each student chooses an object and describes its properties in everyday language.
- ▶ Students form groups with others who have objects with similar properties.
- ▶ In groups, students draw pictures of their objects on a large sheet of paper. They list words that describe **all** the objects in the group and then words that are specific to their own objects. Students display their charts in the classroom.
- ▶ In the class group, students discuss other ways of grouping the objects and suggest words that could be used to describe these groupings.

**Gathering information about student learning**

Sources of information could include:

- students' contributions to discussions;
- students' descriptions of objects and properties;
- students' charts with illustrations and descriptions;
- students' grouping of objects.

ACTIVITY

Property match

Introductory

Focus

This activity provides opportunities for students to demonstrate their prior understandings of grouping materials according to different properties.

Materials

For each learning centre:

- Resource Sheet 1, 'Describing materials: Property cards'
- sets of materials:
 - playdough or Plasticine
 - paper
 - plastic wrap
 - wood
 - fabric squares (variety)
 - aluminium foil
 - sand or soil
 - sugar
 - cotton wool
 - water
 - honey

For each group:

- chart paper
- poster pens

Teaching considerations

Set up learning centres for this activity, each with a set of materials and a set of property cards (made from Resource Sheet 1).

Guide students to match the materials and the property cards, and to link the properties of a material — for example:

aluminium foil: shiny — smooth — light

**Working scientifically**

Time: 45 minutes

Handling materials
Looking for patterns
Making observations
Playing
Creating analogies
Making links
Creating presentations



Resource
Sheet 1

- Students listen while the teacher reads the words and phrases on Resource Sheet 1 and explains the properties these represent. The teacher models how to match a property card with a material and then how to create an analogy between the properties of a material and something familiar — for example, cotton wool is soft and fluffy and feels like a furry toy animal.
- In groups, students move to the learning centres where they match materials and property cards. They discuss and create analogies to describe the properties of the materials.

► Students share their analogies with the class. Guided by the teacher, students discuss the different ways the properties of one material were described. They list the properties beside each material — for example:

aluminium foil: shiny — smooth — light — cannot see through it

They continue in this way until all the materials have been described.

► In groups, students make a chart displaying the materials (or pictures of the materials) and words that describe their properties. Alternatively, each student draws an object on a sheet of paper, states the materials it is made from and describes its properties. Students then compile their work in a class book. They can read the completed book and discuss the ideas it contains.



Gathering information about student learning

Sources of information could include:

- students' matching of materials and properties;
- students' analogies;
- students' linking of terms to properties;
- students' charts or contributions to the class book.

ACTIVITY

Invisible solutions

Developmental

Focus

This activity provides opportunities for students to develop and communicate their understandings about grouping materials according to the property of solubility.

Materials

For each group:

- at least 2 teaspoons each of salt, sugar, coffee, cocoa
- pieces of bread (1.5 cm²)
- pieces of Plasticine (marble-sized)
- plastic teaspoons
- beakers
- water
- stirrers

Teaching considerations**Solutions**

A solution is produced when one substance (the solute) dissolves in another (the solvent). The solvent with which people are most familiar is water. Increasing the amount of water will influence dissolving if a saturated solution (one in which no more solute can dissolve) has been produced in the original amount of water. For solids, increasing the temperature of water will increase the amount of solute able to be dissolved.

Students with vision impairment

Some students with vision impairment may need assistance for this activity. Seek advice from their support teacher.

**Working scientifically**

Time: 45 minutes

Performing investigations
Identifying and controlling variables
Measuring
Creating diagrams

► Students identify and discuss familiar solids that dissolve in water — for example, sugar. They suggest where the solid ‘goes’ when it dissolves. Students discuss and clarify their understandings of the terms ‘soluble’, ‘solution’ and ‘dissolve’.

► In groups, students add some common solids to water and observe changes that occur. Students place a teaspoon of each solid into a small quantity of water and stir. They observe whether the solids dissolved and the time taken for dissolving. Students then compare the properties of solids that dissolved and those that did not. Results can be recorded in a table like the one below:

Table of solids dissolving

Solids that dissolved	Solids that did not dissolve

- ▶ Guided by the teacher, students explore the idea of changing one variable in their investigation — for example, quantity or temperature of the water.
- ▶ Using the same materials, students investigate how changing one variable affects dissolving. They record the results in an extended version of the previous table or in a new table.
- ▶ Students create diagrams with labels to show the effect of changing the variables.
- ▶ Students state something they know now that they did not know at the beginning of the activity.



Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' observations, records and comparisons made during investigations;
- students' diagrams about the effects of changing variables;
- students' statements about new understandings.

ACTIVITY**Oh, what a feeling!***Developmental***Focus**

This activity provides opportunities for students to investigate materials and group them according to the property of texture.

Materials

- fabric squares of different textures (e.g. cotton, nylon, cheesecloth)
- playdough or Plasticine
- aluminium foil squares
- cotton wool balls
- wood (variety of types, both painted and natural)
- stones and minerals (different types)
- pre-cut card strips and poster pens

Teaching considerations**Classroom organisation**

Set up separate learning centres for each object or material and organise students into groups for cooperative work.

In this activity, students make up and answer each other's questions about the properties of texture evident in the displayed objects and materials. Groups move round the learning centres and, at each one, answer the questions posed by the previous group and devise a set of questions for the next group. Direct students through the learning centres and ensure they have sufficient time to complete the tasks. Students may need support from adult helpers while writing their questions and responses.

Terminology

Model the use of terms associated with the property of texture through teacher talk and by displaying word banks and creating word walls.

Guest speaker

To enhance students' awareness and understanding of the property of texture, invite a student or an adult with vision impairment to speak to the class. This may help students realise that texture can be an important source of information about materials and objects.

**Working scientifically**

Time: 45 minutes

Formulating questions
Handling materials
Making comparisons
Making links
Creating presentations

► The teacher models a questioning technique about the properties of objects and materials — for example:

- What is its colour?
- Is it shiny?
- How does it feel?

► Students suggest words that describe the property of 'texture' — for example, rough, smooth, soft, hard. With teacher guidance, they use the words in context to describe familiar objects or materials. The teacher records and displays the words for students to refer to later.

- ▶ In groups, students move to the learning centres, devising and answering questions about the displayed objects and materials.
- ▶ In the class group, students discuss their observations. They make links between colour, texture and lustre.
- ▶ In groups, students sort and classify the objects and materials used in this activity according to their properties. Students create a presentation to show their groupings and discuss the reasons for organising the objects and materials in this way.

**Gathering information about student learning**

Sources of information could include:

- students' contributions to discussions;
- students' questions and answers;
- students' presentations.

ACTIVITY**To see or not to see!***Developmental***Focus**

This activity provides opportunities for students to investigate and group materials according to the properties of being transparent, translucent or opaque.

Materials

For each pair of students:

- set of small squares of various types of material (e.g. plastic wrap, plastic used for covering books, tracing paper, coloured paper, white crepe paper, white photocopy paper)
- photocopy of any small, clear picture
- variety of other materials (e.g. wood, calico, nylon fabric, clear glass, frosted glass)

Teaching consideration

Number the materials so that they can easily be identified. Also decide with students how to name and label the materials.

**Working scientifically**

Time: 45 minutes

Handling materials
Looking for patterns
and meaning
Making comparisons

- ▶ Students list materials they can see through and discuss where these are used.
- ▶ Working in pairs, students take each square of material in turn and place it over the picture. They decide whether the picture is:
 - clearly visible through the test material;
 - distorted;
 - not visible at all.

They record their results and place the materials into three separate groups.

- ▶ In the class group, students discuss labels for the three groups they have created and why some class members may have placed materials in different piles.
- ▶ Students discuss the terms 'transparent', 'translucent' and 'opaque' and relate these to the groupings they have made.
- ▶ Students consolidate their understandings by investigating other materials and adding them to the appropriate groups.

**Gathering information about student learning**

Sources of information could include:

- students' contributions to discussions;
- students' grouping and labelling of materials.

ACTIVITY**Soft or hard or what?***Developmental***Focus**

This activity provides opportunities for students to describe and group materials according to physical properties.

Materials

For each pair of students:

- straw or raffia
- rubber band
- elastic strip
- playdough
- wire
- rigid plastic
- flexible plastic
- cane (like that used for basket making)
- metal strip
- marble
- chalk
- small stone
- spongy ball
- spaghetti (uncooked)
- toothpick/wooden skewer/
paddlepop stick

**Teaching consideration****Safety**

Inform students about safe practices for handling rubber bands or objects with sharp ends.

**Working scientifically**

Time: 60 minutes

Collecting information

Exploring phenomena

Handling materials

Looking for patterns and meanings

Making plans

Dealing in an orderly manner with the parts of a complex whole

Drawing conclusions

Clarifying ideas and concepts

Creating tables

- ▶ Students discuss their understandings of the terms 'flexible', 'rigid', 'elastic', 'non-elastic', 'soft', 'hard', 'weak' and 'strong'.
- ▶ Students discuss ways of testing the sample materials to find out if these have the properties listed above. They also discuss criteria for making their decisions.
- ▶ Students discuss ways of recording the results of their tests — for example, placing ticks in a table like the following:

Physical properties of materials

Material	Flexible	Rigid	Elastic	Non-elastic	Soft	Hard	Weak	Strong

- ▶ Working in pairs, students carry out the tests and record their results.
- ▶ Students use information from their investigations to sort the materials into groups. They record their reasons for selecting these groups.

► In the class group, students discuss their results, comparing the different methods used to group the materials. They identify:

- any changes in the materials as a result of their testing;
- difficulties in grouping the materials;
- relationships identified between properties.

Discussion questions could include:

- Did the properties of the playdough change as you were carrying out the tests?
- What happened to the chalk as you tested it for strength?
- Which materials had only one property identified?
- Which material had the largest number of different properties?
- Were all the soft materials also flexible?
- Were any of the hard materials elastic?
- Which properties always appeared together?
- Which properties never appeared together in the one material?

► Students discuss other properties of the sample materials and compile a list of words that describe these properties.

Additional learning

► Students discuss the properties of materials they have been investigating and identify familiar situations where these properties might be useful.



Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' testing and grouping of materials.

ACTIVITY**Will it float?***Developmental***Focus**

This activity provides opportunities for students to investigate materials that float or sink.

Materials

For each group:

- corks (approximately 2 cm³)
- aluminium foil (squeezed into a cube approximately 2 cm³)
- Plasticine (good quality, squeezed into a cube approximately 2 cm³)
- different types of wood, including balsawood (pieces approximately 2 cm³)
- marble or small stone (approximately 2 cm³)
- small cubes of plastic foam (approximately 2 cm³)
- paperclip
- basin or tidy tray
- beakers
- cooking oil
- water
- 2 permanent marking pens (different colours)

Teaching considerations

The sample materials will float at different levels in water and oil. Water levels on the sides of the floating objects could be marked in one colour and oil levels in another. If an object floats in the liquid rather than on the surface, its position could be marked on the side of the container.

Conduct the activity in a wet area.

**Working scientifically**

Time: 45 minutes

Clarifying and challenging

Engaging with problems

Making observations

Predicting

Seeking reasons

Applying ideas and concepts

Formulating and elaborating ideas

Making comparisons

Clarifying ideas and concepts

- ▶ Students discuss the terms 'floating' and 'sinking'.
- ▶ In groups, students handle the sample materials and predict which ones will float and which will sink. They record and test their predictions. Students record the results of the tests and compare the results with the predictions.
- ▶ Students discuss changes they would make to their predictions if the materials were being floated in oil instead of water. They test these predictions and record the results.
- ▶ In the class group, students compare results from the two tests. They discuss the differences between oil and water and any influence these differences would have on the floating of materials.

**Creating presentations
Summarising and reporting**

► Students are challenged to find a way of making the Plasticine float while supporting a marble or small stone. In groups, they formulate a plan for solving this problem. They carry out the plan and demonstrate and explain their findings to the class.

► In the class group, students discuss the various solutions to the problem and the explanations of findings.

Additional learning

► Students conduct experiments comparing the ability of materials to float in salt water, fresh water, water to which detergent has been added, and milk.

**Gathering information about student learning**

Sources of information could include:

- students' contributions to discussions;
- students' predictions;
- students' comparisons and explanations of test results;
- students' solutions to the problem and their explanations.

ACTIVITY

Let's sort it out!

Culminating

Focus

This activity provides opportunities for students to consolidate their understandings about grouping materials on the basis of properties.

Materials

No particular materials are required.

Teaching consideration

The objects that students discuss and consider should be made from a variety of materials. The following are some suggestions:

- articles of clothing — hat, shoe, jumper, trousers;
- materials for writing and drawing — pen, pencil, crayon, paper, paint;
- play equipment — water play, playground equipment, bats/racquets and balls.

**Working scientifically**

Time: 30 minutes

- Students review the properties and terminology used to describe materials in activities during the module.
- In groups, students select an object from a list provided by the teacher. They list the parts of the object and the properties each part would require.
- Students suggest materials that could be used in the manufacture of the object and give reasons for their suggestions.
- Students prepare an annotated diagram of the object showing properties of the materials from which it is made. They present and explain their diagrams.

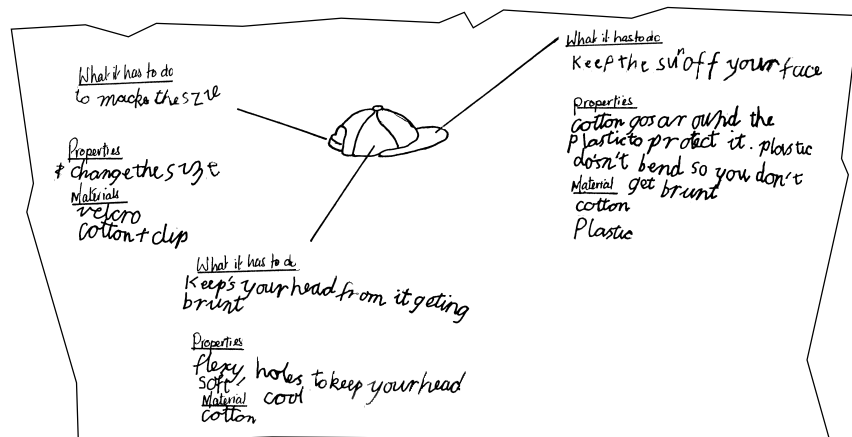


Diagram created by a student

**Gathering information about student learning**

Sources of information could include:

- students' contributions to discussions;
- students' diagrams and explanations.

Describing materials: Property cards



Resource Sheet 1

GROUPING MATERIALS • LOWER PRIMARY

opaque	light	soft
solid	disappears	soluble
dissolves	shiny	sinks
flexible	hard	heavy
translucent	bends	strong
liquid	floats	hard
fluffy	transparent	rough
smooth	sticky	runny

Acknowledgments

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This sourcebook module should be read in conjunction with the following Queensland School Curriculum Council materials:

Years 1 to 10 Science Syllabus

Years 1 to 10 Science Sourcebook: Guidelines

Science Initial In-service Materials

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