



INVESTIGATE AROUND THE WORLD


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Carne Ortonobes

IES Bigues I Riells

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Investigate around the World

Teaching Aims

- To introduce materials and their classification according to their properties.
- To introduce particle theory and how the particles model can be used to explain differences between solids, liquids, gases and changes of state.

Aims of the unit

- To recognize solids, liquids and gases by their properties.
- To classify some difficult materials.
- To learn about how particles are arranged in solids, liquids and gases.
- To understand a simple model of matter made up of particles.
- To use model particles to explain changes of states such as melting and solidifying.

Learning outcomes

At the end of this unit students will be able to:

- Describe a simple particle model to recognise the nature of matter:
 - ✓ Arrangement, proximity, attraction and motion of particles in solids, liquids and gases.
 - ✓ The relationship between heating and movement of particles.
- Use the simple particle model to explain:
 - ✓ why solids and liquids are much less compressible than gases,
 - ✓ why changes of state occur.
- Follow processes and instructions.
- Explain, write and discuss their ideas.
- Work autonomously.

4C_s curriculum

a) Content

- Properties of solids, liquids and gases
- Particle theory
- Changing state:
 - i. The state of a substance
 - ii. State of a substance at room temperature

b) Cognition

- Classify materials as solid, liquid or gas and justify their classification.
- Identify some sentences with the properties of solids, liquids and gases.
- Have a discussion about and analyse and explain why some materials are difficult to classify.
- Summarise the properties.
- Associate a representation of particles with different states.
- Draw a flow diagram for three states.
- Interpret diagrams.
- Reinforce the idea that learning involves asking questions and checking understanding.
- Complete a frame about substances and particles.
- Key point identification, note taking, summarising and presenting.
- Discriminate different steps in an experiment about changes of state,
- Summarise the process followed when doing the experiment.
- Experiment, explain the results, analyse and conclude.
- Read a text and answer a question.
- Make a drawing summarizing changes of state.
- Explain what happens when we heat butter.
- Explain the relation between particle movement and energy.
- Design an experiment to show the relationship between heat and changes of state.
- Compare processes and summarize all these activities in a poster and explain to the rest of the class.
- Use the acquired knowledge on the subject to complete a grid and some sentences.

c) Communication

- Language of learning:
 - Present tense (affirmative, negative and questions sentences)
 - Past Tense
 - Future Tense (Predictions and hypothesis)
 - Where, when, why, who, what, which, how?
 - There is... and there are...
 - Prepositions from, of,...
 - If...(then)...+ grammar of if –clauses
 - Modal verb (instructions in the LAB)
 - Specific vocabulary

- **Language for learning:**
 - Strategies for reading and understanding a text.
 - Strategies to improve classroom talk:
 - Encourage student questioning
 - Allow for student talk
 - Survey the class
 - Ask for summary to promote active listening and speaking.
 - Poster with instructions
 - Poster with discipline
 - Poster with equipment and materials
 - Frames to facilitate discussion.
 - Tasks and demands.
 - Mini presentations
 - Describing a sequence of events. (First, then, next, finally).
 - Analysis and conclusion:
 - I have found out...
 - What I thought would happen was ...
 - If I ..., My graph shows than ...

- **Language through learning:**
 - Vocabulary extension
 - Books
 - Handouts
 - Laboratory
 - Internet
 - Software

d) Culture. Global warming

- Work in groups of four to answer questions about climate change and prepare a presentation in power point for the rest of the class.

UNITS

Unit 1: SOLIDS, LIQUIDS AND GASES

- **Properties**
- **Particle theory**
- **Changing state:**
 - a) **The state of a substance**
 - b) **The state of a substance at room temperature**

Unit 2: MIXTURES and PURE SUBSTANCES

- **Solutions**
- **Heterogeneous mixtures**
- **Others types of mixtures**
- **How do we know if a substance is pure?**

Unit 3: MIXTURES and THEIR SEPARATION

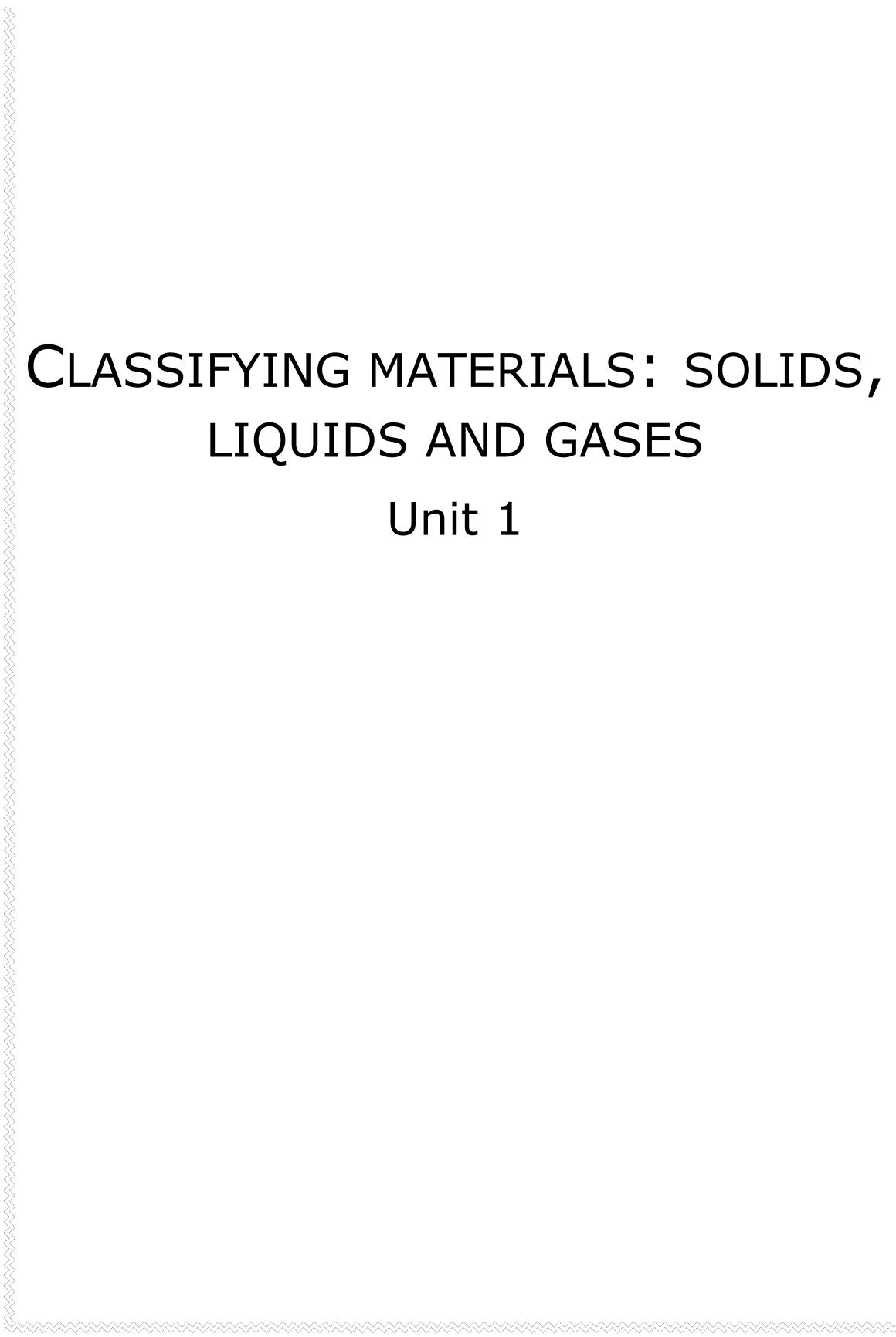
- **Filtration**
- **Decantation**
- **Evaporation**
- **Distillation**
- **Chromatography**

Unit 4: INSIDE THE MATTER

- **Atoms and elements**
- **The periodic table**
- **Compounds**
- **Naming compounds**

Unit 5: CHEMICAL REACTIONS

- **Physical changes and chemical changes**
- **Observing chemical changes**
- **What is a reaction?**
- **Reactants and products**
- **What happens in a reaction?**
- **Equations and equations symbols**
- **Types of reactions**
- **Unhelpful reaction**



CLASSIFYING MATERIALS: SOLIDS, LIQUIDS AND GASES

Unit 1

Classifying materials: SOLIDS, LIQUIDS AND GASES

Session 1

Timing: 1 hour

AIMS:

- To recognize solids, liquids and gases according to their properties.
- To learn how particles are arranged in solids, liquids and gases.

Activity 1: What are materials like?

Material

- Solid block
- 1 beaker. 1 glass, 1 cup
- Orange juice
- 3 syringes from 10 to 20 cm³ with sealed end
- Sand, water, air

Activity development

- Students are shown different materials to brainstorm their properties.
- Students are shown a piece of wood and are asked:
What's this? Can it change shape?
- Students are asked to compare the block of wood to the three containers with orange juice:
Does a liquid take up the shape of its container? Find out more.
- Students are asked to push the plunger of the syringe full of sand:
Can it be squashed? Try the same test for syringes full of water and air.
- Students are asked to complete the grid 1 below:

GRID 1

PROPERTY	SOLID	LIQUID	GAS
Easy to pour			
Easy to squash			
Fixed shape			
Fixed volume			

PowerPoint: SOLIDS; LIQUIDS AND GASES

Students are shown a PowerPoint presentation to revise the concepts: the properties of solids, liquids and gases.

Activity 2: Checking States

- Pair work
- Students are given a different handout A and B
- Students sit face to face. Student A starts reading the first sentence and student B says if the property refers to a solid, a liquid or gas. Student A writes the answer next to the sentence. After that, student B does the same and they change roles till the end.
- When they finish they check answers and complete grid 2.

Handout: Checking States**Student A**

- They have a definite volume =
 - They have a definite shape =
 - They are easily squashed =
 - They don't flow =
 - They match the shape of the container =
 - They have a very low density =
-

Handout: Checking States**Student B**

- They flow easily =
- They have a high density =
- They always fill the container they're in =
- They become the same shape as the container =
- They are not easily squashed =
- They have medium density =

GRID 2**SOLIDS, LIQUIDS AND GASES HAVE DIFFERENT PROPERTIES**

Properties	Solids	Liquids	Gases
VOLUME			
SHAPE			
DENSITY			
COMPRESSIBILITY			
EASE OF FLOW			

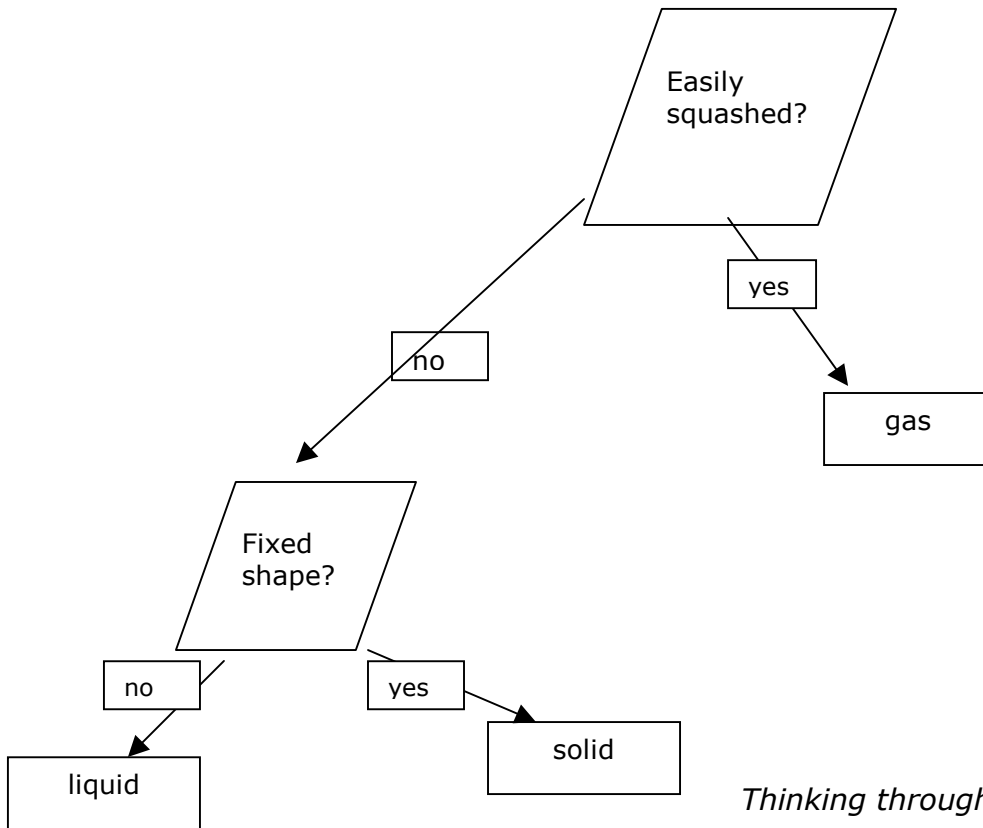
Activity 2: Classifying solids, liquids and gases

Aim:

- To raise awareness about the difficulty of classifying materials and about common misconceptions.
- To take part in discussions.
- To encourage students to answer questions, write a conclusion and think about it.

Scientists use keys to classify things into different groups. A key can be created by taking some characteristics of the different classifying groups, and asking simple questions that require yes or no answers.

This is a simple key to classify things into the three states of matter:



Thinking through SCIENCE

Material

- Two beakers, one half-filled with sand (or an hourglass)
- An eraser
- Jelly
- Toothpaste
- Rubber gloves
- A piece of sandstone

Activity development

- Show/Give students the materials mentioned above.
- Ask students to use the key above to classify them.
- Hand them the table 1 below and ask them to complete it.
- Provide the writing frame below to be completed.

Table 1

2) The classification of some of these materials may surprise you. Which classification has surprised you and why?

Questions I need to answer are...	Answers	Extra details
<p>Is sand a solid or a liquid?</p> <p>Can it be poured?</p> <p>Hasn't it a fixed shape?</p> <p>Do small grains behave as a liquid?</p> <p>Look at a piece of sandstone: Can it be poured?</p> <p>Can an eraser be squashed?</p> <p>Does the eraser change shape temporarily or permanently?</p> <p>Are materials like jelly and toothpaste easy to classify?</p> <p>Why?</p> <p>What is a rubber glove made of?</p> <p>Has rubber a fixed volume?</p> <p>Again, is a glove a single substance?</p> <p>Do you think that because it contains air it can be easily squashed?</p>		

Writing Frame 1

Write your conclusion with the help of this frame and the words given:

Density, materials, fixed, shape, classify, container, same, fixed, why, gases, poured, mixtures, small, squashed, solids, difficult, volume, temporally, single, shape.

I want to explain _____ some _____ are difficult to classify.

Sand can be _____ and does not have a _____.

This is because it is formed by _____ grains.

Jelly and toothpaste are _____ ant they are

To _____ because they are _____.

Rubber gloves and eraser can be _____ . Just _____

Change _____. They are made from the _____ material and this is certainly does not have a _____.

This is because it is not a _____ substance.

Classifying materials: SOLIDS, LIQUIDS AND GASES**Session 2****Timing: 1 hour****AIM:**

- **To introduce the Particle Theory**

Role-play Activity: Particles

This activity is intended to show how particles move,

Activity development

- Students pretend they are a:
 - a. Solid particle:
 1. Get together with your classmates and stand in rows of five.
 2. Put your left hand on the shoulder of the person to your left.
 3. Put your right hand on the shoulder of the person in front.
 4. Stand in neat rows and jiggle very slightly when you hear the music.
 - b. Liquid particle:
 1. Move a little.
 2. Drop your arms and move your legs and your hands when you hear the music.
 3. Stay close to each other.
 - c. Gas:
 1. Spread out so that you are far apart.
 2. Move around the room in different directions when you hear the music; when you crash with someone move away.
- Students answer the following questions:
 1. When you were a solid, how did you move? How close were you to the other particles?
 2. When you were gas, how did you move? How close were you to the other particles?
 3. What were the two main differences between being a solid and a liquid?
 4. When did you have the most energy?

Students are asked to draw a flow diagram for the three stages. This is called **changes of state**.

1. Activity (sheet 2)

Marbles in a box

See students' handout

You will need:

- Marbles and boxes (Tupperware)

Identify the diagrams with a solid, liquid or gas

Finally write a conclusion after answering some questions

2. Activity

Scrambled groups

- a) The class is divided into groups of three. Each group is given a topic.***
- b) The students read the text and memorize the most important information.***
- c) The teacher gives each person a letter; for example, in a group of 27 students, there will be nine groups of three. The first five groups are given letters A, B, C and the last four, the letters D, E, F. This determines which new group each student will move into.***
- d) All the As form a group, all the Bs form a group, all the Cs and so on. This means that each of the new groups has one member from each original group.***
- e) Complete the sheet with the experience and collaboration of the entire group.***

SOLIDS

In a solid, the particles are held together. There are strong forces of attraction between them and they have fixed positions in a regular arrangement. The particles in a solid cannot move around, and they can only vibrate from side to side.

As the particles don't move from their position, all solids keep a definite shape and its volume stays the same. They cannot flow like liquids.

Solids cannot easily be compressed because the particles are already packed very closely together.

Solids are usually dense, as there are lots of particles in a small volume.

LIQUIDS

In liquids, the particles are almost as close together as they are in solids. There are some forces of attraction between the particles. The particles in liquids are still held together, but not as strongly as in solids. They are free to move past each other, but they do stick together. The particles are constantly moving in all directions.

Liquids don't keep a definite shape and they flow and fill the bottom of the container but they do keep the same volume.

Liquids don't compress easily because the particles are packed closely together.

Liquids are quite dense, as there are a lot of particles in a small volume.

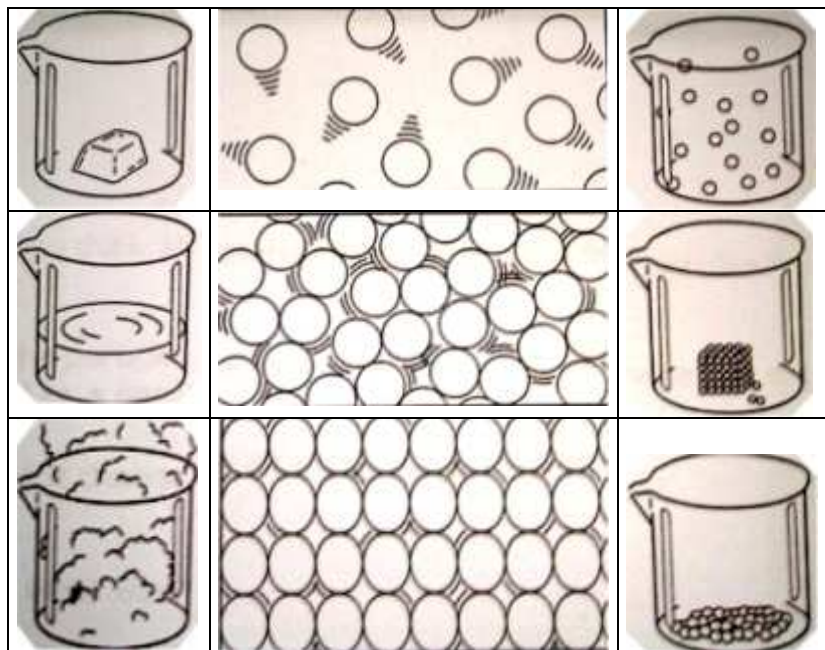
GASES

In gases, the particles are very far apart. There are very weak forces of attraction between the particles. They are free and can move quickly in all directions.

Gases don't keep a definitive shape or volume and will always expand to fill any container. Gases can be compressed easily because there is space between the particles.

The particles of gases do not keep a regular pattern.

Gases have very low densities, because there are not many particles in a large volume.



Summary - Solids, liquid, gases

Description of the substance

Description of the particles

SOLIDS		
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LIQUIDS		
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GASES		
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ROLE PLAY: Particles

Aim: To learn about particles, in a fun context, through modelling

Activity Development:

Pretend you are a:

Solid particle

1. **Get together with your classmates in rows of five.**
2. **Put your left hand on the shoulder of the person to your left.**
3. **Put your right hand on the shoulder of the person in front.**
4. **Stand in neat rows and jiggle very slightly when you hear the music.**

Liquid particle

5. **Move a little more.**
6. **Drop your arms and move your legs and your hands when you hear the music.**
7. **Stay close to each other.**

Gas particle

8. **Spread out so that you are far apart.**
9. **Move around the room indifferent directions when you listen the music;when you crash with someone move away.**

Answer these questions:

- **When you were a solid, how did you move? How close were other particles?**
- **when you were gas, how did you move? How close were the other particles?**
- **What were the two main differences between being a solid and a liquid?**
- **When did you have the most energy?**
- **Draw a flow diagram for the three stages. This is called changes of state.**

Marbles in a box (sheet 2)

Movement of the particles

Frame

How to show the movement of particles by shaking some marbles in a box

You will need:

A box and marbles

2. **First**, for a solid, tilt the box slightly so that the marbles run down to one end.

Show that particles are packed closely together and take up a fixed volume and shape

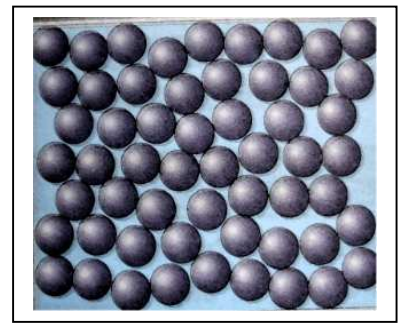
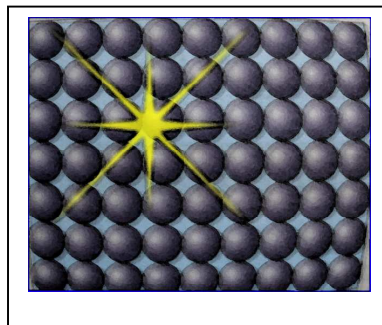
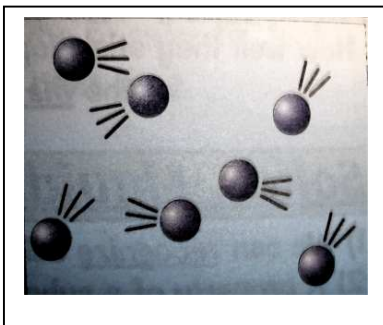
2. **Then**, for a liquid, more vigorous movement of the box cause the particles to swap positions and "flow" around the box.

They are still very close together but they don't have a fixed shape.

1. **Next**, for a gas, remove most of the marbles and vigorously shake the box.

The particles are far apart and moving very quickly

Finally, identify which of the three diagrams shows the particles in a box containing a solid, liquid and gases.



Classifying materials: SOLIDS, LIQUIDS AND GASES**Session 3****Timing: 1 hour****AIMS:****Changes of state*****Activity 1******Power point to introduce the content******Activity 2******Experiment about changes of state***

Aim: Melt a solid by heating it and then we will let the liquid cool slowly.

What do you think will happen?

Before doing this experiment, order the following steps, and then fill in your planning sheet.

Measure 100 cm³ of water in a beaker
Put the Bunsen under the beaker and switch it on
Heat up the water beaker until 75°C. Switch off your Bunsen
Put a spatula of butter in a test tube
Introduce the test tube with butter in a warm water bath and start your stop clock
Leave the substance to cool
Take the temperature every minute as it cools and record it in the table
Plot a graph of your results

Investigation planning sheet

Date _____

Name _____

Class _____

What are you trying find out?

I am trying to find out ...

How are you going to find out? Write a method for your experiment and draw a diagram.

First of all I will ...

Next...

Then I will...

I will measure...

I will observe...

I will need...

Finally I ...

Diagram

Results (attach your tables and graphs)

Analyse and conclude

I have found out ...

What I thought would happen was ...

If I compare my results with my prediction, I can see that ...

My graph shows that ...

This is because...

Evaluate

I found it easy to ...

Although, it was hard to ...

My results ...

Unit 1. Classifying materials: SOLIDS, LIQUIDS AND GASES
Resources **Timing: 1 hour****AIMS:**

Changes of state

Activity 1

Power point to introduce the content

Activity 2

Experiment about changing state

Aim: Melt a solid by heating it and let the liquid cool slowly.

What do you think will happen?

Before doing this experiment, order the following steps, and then fill in your planning sheet.

Measure 100 cm³ of water in a beaker
Put the Bunsen under the beaker and switch on
Heat up the water beaker until 75°C. Switch off your Bunsen
Put a spatula of butter in a test tube
Introduce the test tube with butter in a warm water bath and start your stop clock
Leave the substance to cool
Take the temperature every minute as it cools and record it in the table
Plot a graph of your results

Investigation planning sheet

Date _____

Name _____

Class _____

What are you trying find out?

I am trying to find out ...

How are you going to find out? Write a method for your experiment and draw a diagram.

First of all I will ...

Next...

When I will...

I will measure...

I will observe...

I will need...

Finally I ...

Diagram

Results (attach your tables and graphs)

Analysis and conclusion

I have found out ...

What I thought would happen was ...

If I compare my results with my prediction, I can see that ...

My graph shows that ...

This is because...

Evaluate

I found it easy to ...

Although, it was hard to ...

My results ...

Unit 1. Classifying materials: SOLIDS, LIQUIDS AND GASES

Session 4

Timing: 2 hours

AIMS:

Changes of state, energy and particle movement

1. Activity

Work in groups of four

Hand the text and the activities

First, read the text and then do these activities:

1. Explain what a change of state is (knowledge)
2. Could you make a drawing summarizing changes of state? (Comprehension)
3. Explain what happens when we heat butter (Application)
4. Explain the relationship between particle, movement and energy (Analysis)
5. Design an experiment to show the relationship between heat and change of state (Synthesis)
6. Compare the processes that take place when you heat 100 g of ice and 100 g of butter. Reach some conclusions. (Evaluation)
7. Summarize all these activities in a poster and explain your work to the rest of the group.

Changes of state

Water is the only substance that we can find at home in the three states: Solid, liquid and gas.

We can take water as an example of how to study the changes of matter.

What is a change of state?

- A change of state is when a substance changes from one state of matter to another.
- In a change of state the particles don't change, just their arrangement or their energy.

In a solid, the particles are joined together and very close to each other and they cannot move very far. We say that they are vibrating. When a solid is heated, its particles gain more energy, and the particles move more and the forces that hold the solid together weaken. This makes the solid expand.

At certain temperatures, the particles have enough energy to break free from their positions; the fixed particles of matter begin to move around, flowing over each other. The result is the change to a liquid state. The shape becomes indefinite. This is called **melting**, and this is what happens when a solid turns into a liquid. The opposite is **freezing**. The particles slow down as they get colder. They get closer together and form a solid.

In a liquid, the particles are not lined up in rows, so they take up a bit more space. They are not joined very tightly. The particles in a liquid can move about more than the particles in a solid. They can slide over each other.

When energy is applied to a liquid, the particles get even more energy. This energy makes the particles move faster, which weakens and breaks the unions (bonds) holding the liquid together. The result is the change to a gas state. The shape is indefinite, and the volume becomes indefinite. This is called **vaporization**, and this is what happens when a liquid turns into gas. The opposite of this is condensation. The particles slow down as they lose thermal energy. They get closer together and form a liquid.

There are some substances that can go from being a solid, directly to the gas state; this is called **sublimation**. Solid carbon dioxide, commonly known as Dry Ice, bypasses the liquid state altogether when it changes to gas.

The last change of state is matter going from gas directly to the solid state, which is called **deposition**. Water vapours in the air during winter fall in the form of snow, a solid.

Unit 1. Classifying materials: SOLIDS, LIQUIDS AND GASES

Session 5 Timing: 1 hour

AIMS: Revision of materials and their properties, particle theory and change of state.

1. Activity

Play Say and hear

Instructions to play

Sit in groups of 5

We'll play HEAR and SAY

Each group has 5 cards and each card has two columns with the headings HEAR and SAY

One person in your group has a card with an underlined word in the say column – this is a definition of something to do with KEY IDEAS about STATES OF MATTER. He or she starts and says the words aloud. The student who thinks he or she has the KEY IDEA defined by that statement in the HEAR column, says this aloud and then gives the definition for the next key idea (in the box directly opposite to the statement he or she has just read out).

The game finishes when the group reaches the instruction END.

Consolidation exercise

Spelling and listening

(Cada grup de 5 te un full diferent, però n'hi ha un que té una frase subratllada).

HEAR	SAY
Compressibility of liquids 2	There are strong forces of attraction between particles 3
Shape of liquids 10	There are very weak forces of attraction between the particles 11
Condensing 18	Gas turns into a solid 19
Density of liquids 7	Flow easily and diffuse 8

HEAR	SAY
When you increase the temperature 17	Gas turns into a liquid 18
Pressure increase	Fill the container they're in 1
Liquids particle theory 6	Have medium density 7
Density solids 12	Become the shape as the container 13

HEAR	SAY
Subliming 19	END
Volume gases 1	Not easily squashed 2
Easy of flow gases 8	Have a very low density 9
Melting 15	Liquid turns into a gas 16

HEAR	SAY
Boiling 16	The particles move faster 17
Compressibility gases 5	The particles are close together but they can move 6
Shape gases 13	It's particles gain more energy 14
Solids particle theory 3	Don't flow 4

HEAR	SAY
Ease of flow solids 4	Are easily squashed 5
When a solid is heated 14	The solid turns into a liquid 15
Gases particle theory 11	Have a high density 12
Density gases 9	Match the shape of container 10

2. Activity

STATES OF MATTER

Activities

Choose just one answer, a, b, c or d.

1. How are particles arranged in solids?

- a) close together
- b) very far apart
- c) fairly well separated
- d) fairly close together

2. How do particles move in a liquid?

- a) relative to each other, so liquids can flow
- b) very quickly, in all directions
- c) they vibrate about fixed positions
- d) they cannot move

3. Which state of matter has the strongest forces of attraction between particles?

- a) gas
- b) liquid
- c) solid
- d) steam

4. Which state of matter has a definite volume, but does not have a definite shape?

- a) gas
- b) solid
- c) steel
- d) liquid

5. Which state of matter is the easiest to compress?

- a) liquid
- b) water
- c) solid
- d) gas

- Complete the table below to show the state of the elements shown at room temperature (25°C)

ELEMENT	MELTING POINT (degrees °C)	BOILING POINT (degrees °C)	STATE AT ROOM TEMPERATURE
Chlorine	- 101	-35	
Bromine	- 7	59	
Rubidium	39	686	

- Complete the sentences below using these words:**

More, vibrate, particles, solids, gas, gas, volume, quickly, more/faster, expands, liquid.

In a solid the are close together. They have fixed positions, but they do When a solid is heated the particles move so they take up space.

The particles in a are quite close together, but they do move relative to each other. This means that liquid have a fixed but not a fixed shape. When a liquid is heated the particles move around more so the liquid Liquids expand more than on heating.

The particles in a are far apart and moving very In all directions. A Will fill any container in which it is placed.

Unit 1. Classifying materials: SOLIDS, LIQUIDS AND GASES
Session 6 **Timing: 4 hours**

Aim: Relationship between changes of state and global warming

Activity

WEBQUEST about Global Warming:

- **Climate change?**
- **Causes and effects**
- **Let's do something to save the Earth!**