



States of water

SEQUENCE 1

Age group	6-9 y.o.
Prior knowledge	None
Material needed	The water state box, plastic bottle
Subjects	The Aggregation States of Water
Skills involved	<ul style="list-style-type: none">- Recognize the aggregation states of water.- Identify the properties of water in different states of aggregation.
Time to carry out the sequence	1 hour

Step 1: Introduction

For a short introduction to the subject, you can look at the image of planet EARTH (The photo is from outer space).

Water it is the only substance that commonly appears as a solid, a liquid, and a gas within the normal range of earth's temperatures. This makes water a good model for discussing the solid, liquid, and gas states of matter.

Step 2: Initial concepts

If the subject has not yet been discussed with the pupils, it might be interesting to gather their initial ideas by asking them questions like:

1) Why is planet EARTH called "The blue planet"?

(Over 71 percent of the Earth is covered with water. Therefore from outer space it appears blue and so Earth is called the 'Blue Planet')



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2) Why does the Earth look blue and white from space?

(The blue part is water. Water covers most of Earth. The white spots and swirls are ice and clouds. The brown, yellow and green parts are land.)

In your opinion, what are those fluffy things floating across the sky?

No, they are not cotton balls. They are actually dust particles and small droplets of water (sometimes in the frozen form) that make up what we call clouds.

3) What are the clouds made of?

Clouds can consist of dry air mixed with liquid water drops, ice particles, or both. Low, shallow clouds are mostly made of water droplets of various sizes. Thin, upper level clouds (cirrus) are made of tiny ice particles.

Take note of the students' hypotheses so you can return to them later.

Step 3: Discovering the content of the box

This step aims at having pupils look at the box content: the material and the notice. Children should have enough time to discover and familiarise themselves with the box.

In the box the children will discover the three states of water.

- A big cube of ice melts
- Ice turns into liquid water
- After the complete melting, the water is boiled, producing water vapors.

The children will analyze the physical properties of water in the three states of aggregation:

* By looking and touching the ice, they will study the properties of water in solid state – shape and volume. It is a form of matter having a rigid structure and firm shape.



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* By pouring water from one vessel to another, they will study the properties of water in liquid state – shape and volume. They are substances flowing freely with no permanent shape but a definite volume.

* By looking the water vapors, they will study the properties of water in gas state – shape and volume. Gas is a state of matter which does not have a shape but takes the shape of the container you put it in.

Step 4: “Build” the water states of aggregation

With the help of the materials in the box, you can identify the properties of water in different states of aggregation.

Try to identify the properties of water in different states of aggregation using what they have learned from the box.

*Conclusion:

Water in solid state has definite volume and shape.

Water in liquid state has a definite volume but no definite shape.

Water in gas state has neither a definite volume nor shape.

Step 5: Extension/reinvestment

Form several teams.

Each team has to write (or tell, depending on the level of the pupils) their own story (along the lines of the storytelling elements) of a FAMILY: “We are THE DROPLET FAMILY”, respecting the properties of water in different states of aggregation.

The first team writes the story of a FAMILY: “We are THE DROPLET FAMILY - ICE COUSINS”, we live at the South Pole, in a cold place and we are always stick together.

THE DROPLET FAMILY - ICE COUSINS is water in its solid form.



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- 1) THE DROPLET FAMILY - ICE COUSINS keeps its shape, even if it's removed from the container.
- 2) THE DROPLET FAMILY - ICE COUSINS are locked into place and cannot move or slide past one another.
- 3) THE DROPLET FAMILY - ICE COUSINS do vibrate a little bit.
- 4) THE DROPLET FAMILY - ICE COUSINS has definite volume

The second team writes the story of a FAMILY: "We are THE DROPLET FAMILY - LIQUID COUSINS" , we live in the ocean and we like to flow a lot.

- 1) THE DROPLET FAMILY - LIQUID COUSINS do not have a definite shape but acquire the shape of the vessel in which it is placed.
- 2) THE DROPLET FAMILY - LIQUID COUSINS has a definite volume.
- 3) THE DROPLET FAMILY - LIQUID COUSINS can flow from a higher level to lower levels.

The third team writes the story of a FAMILY: "We are THE DROPLET FAMILY - GAS COUSINS", we live in the clouds and we are very far one to each other.

1. THE DROPLET FAMILY - GAS COUSINS has no definite shape(takes the shape of its container).
2. THE DROPLET FAMILY - GAS COUSINS has no definite volume.
3. THE DROPLET FAMILY - GAS COUSINS move in random motion with little or no attraction to each other.

*Conclusions:

Water in solid state have very less intermolecular space = you can ice skate.

Water in liquid state has more intermolecular space = you can swim in the water.

Water in gas state has the most intermolecular space =you can run in a foggy atmosphere



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SEQUENCE 2

Age group	9-12 y.o.
Prior knowledge	concepts about the aggregation states of water.
Material needed	The states of water box, plastic bottle
Subjects	The Aggregation States of Water.
Skills involved	<ul style="list-style-type: none">- Recognize the aggregation states of water.- Identify the Irregular Water Dilatation
Time to carry out the sequence	1 hour

Step 1: Research

Usually, water is considered the most common liquid because of its abundance on Earth. But in fact it is quite the opposite: its anomalous properties make it the most atypical liquid.

Ask the students to identify the aggregation states of water (based on their knowledge or by trying to guess). If they have no ideas, do a little research. This is also an excellent time to learn how to do a good internet search (use keywords, search engines, and trust a source).

Step 2: Discover the box

Give the students time to observe the different parts of the box and ask them what they think can be done with the material.

Create the box using the materials provided.



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Step 3: Formalisation

Look back at what they have done with the box.

Complete a simple diagram with the aggregation states of water correlated with the absorption of the heat.

Step 4: Extension/reinvestment

From this sequence, you can start a sequence to discuss when the water heats up, it undergoes the same process of expansion as most bodies. Its molecules separate and expand into water vapour.

However, when cooled a single process occurs: as its temperature drops, this liquid begins to compress.

But when it reaches 4°C , it expands. Finally, when it reaches 0°C , the temperature necessary for its freezing, its volume increases up to 9%.

This is because the frozen water molecules are grouped in structures different from those of other materials, which leave large spaces between them. Therefore they occupy a greater volume than the water in liquid state.

A daily example in which this phenomenon can be observed is the preparation of ice in ice cubes. When the ice cubes are filled with liquid water, it is impossible to fill them above the edge because it would obviously be spilled.

However, when removing the ice it is possible to observe how it protrudes from the ice cubes. Proving that the volume of this has increased during the freezing process.

The storytelling elements can also be used to create a model of the ice that has been put into a drink floats in the glass.

But it can also be observed in great natural phenomena like the layer of ice that is formed on the water in winter and even in the existence of the icebergs.



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The importance of irregular water expansion

The irregular dilation of water is not only a scientific curiosity. It is also a phenomenon that has played a fundamental role in the development of life on Earth, both inside and outside the water.

In aquatic life

In bodies of water like lakes, it is possible to observe that when winter arrives the upper layer of water freezes. However, the water below is kept in the liquid state.



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