The properties of water and life

Lesson plan and teacher's notes · Form 2 Biology · 1 period of 40 minutes

School	(write school name)	**Teacher**	(write name)
Date	(date)	**Class**	Form 2
Subject	Biology	**Enrolment**	Boys ___ Girls ___ Total ___
Time	40 minutes	**Topic**	The properties of water and life

Learners name the main properties of water and link each one to living things and everyday use. They explain cohesion, adhesion and surface tension, why water is the universal solvent, why ice floats, and why water resists changes in temperature. The lesson uses a simple dissolving activity with three cups.

Specific outcomes

By the end of the lesson, learners should be able to:

1. Name the main properties of water that support life
2. Explain cohesion, adhesion and surface tension
3. Explain why water is called the universal solvent
4. Explain why ice floats and why water resists changes in temperature
5. Link each property to an everyday use or to living things

Prior knowledge

- Water is used every day for washing, cooking, drinking and farming
- Plants make food by photosynthesis
- Solids, liquids and the idea of mass and volume

Teaching and learning materials

- three cups of water
- sugar, salt and sand
- a spoon
- chalk and board
- exercise books

References

Ministry of Education (CDC) Form 2 Biology syllabus and module; 25Schools learners' note: The properties of water and life.

Lesson development

Stage and time	Teacher activities	Learner activities
Introduction 5 min	Ask how water is used at home and on farms in Luangwa. Tell learners that water has special properties that make it so useful and that today each one is linked to life.	Give uses of water and copy the lesson title.
Development: universal solvent 12 min	Put sugar, salt and sand into three cups of water and stir. Ask which dissolve. Teach solute, solvent and universal solvent, and the link to carrying nutrients.	Predict, watch and record which substances dissolve, then name the solute and solvent.
Development: cohesion, adhesion and surface tensio 10 min	Explain cohesion, the skin of water called surface tension, and adhesion. Use the insect resting on the surface to show why some insects walk on water while a person sinks.	Define each term and explain the insect example in pairs.
Development: other properties 10 min	Teach transparency and photosynthesis, liquid at room temperature, neutral pH, density and why ice floats, and high heat capacity.	Complete a table matching each property with its use for life.
Conclusion 3 min	Ask for one property and one use. Set the homework.	Answer orally and copy the homework.

Teacher's content notes

Read these before the lesson. They are what you need to know, not what to copy onto the board.

Water as the universal solvent

Water dissolves many substances, so it is called the universal solvent. In a solution the substance that dissolves is the solute and the liquid that dissolves it is the solvent. Salt and sugar dissolve in water, but sand does not. Nutrients dissolve in water and are carried around the bodies of plants and animals. This also makes water useful for cleaning, cooking and drinking.

Cohesion, adhesion and surface tension

Water molecules attract each other, and this attraction is called cohesion. Cohesion makes the top of the water behave like a thin skin, which is surface tension. Some insects can walk on water for this reason, while a person sinks. Adhesion is the attraction between water molecules and other surfaces.

Transparency, room temperature and pH

Water is transparent, which means it lets light pass through, so aquatic plants can photosynthesise. Clear water lets more light through than muddy water. Water is a liquid

at room temperature, which is the normal indoor temperature that is comfortable for living things. Pure water has a neutral pH, which means it is neither acidic nor alkaline.

Density and heat capacity

Density is the mass of a substance in each unit of volume. Water becomes less dense when it turns into a solid, which is why ice floats on liquid water instead of sinking. Water also has a high heat capacity, which means it can absorb a lot of heat before its temperature rises. This helps keep living things and water habitats at a steadier temperature, and it makes water useful in cooling systems.

Questions to ask during the lesson

Question	Expected answer
A mother in a village in Luangwa says she uses water for washing, cooking and drinking. (a) Say why water is called the universal solvent. (b) Say what a solute is. (c) Say what a solvent is.	(a) Because it dissolves many substances. (b) A substance that dissolves in a liquid. (c) A liquid that dissolves another substance to form a solution.
A learner watches a small insect walk across a pond without sinking. (a) Say what cohesion is. (b) Say what surface tension is and what causes it. (c) Say what adhesion is.	(a) The attraction between water molecules. (b) The skin on the surface of water, caused by cohesion. (c) The attraction between water molecules and other surfaces.
A boy puts ice in a glass of water and sees that it floats. (a) Say what happens to the density of water when it turns into a solid. (b) Explain why the ice floats. (c) Say what density is.	(a) Water becomes less dense as a solid. (b) Ice is lighter than the same volume of liquid water. (c) The mass of a substance in each unit of volume.
A teacher says pure water is neither acidic nor alkaline and stays liquid at the normal temperature in a classroom. (a) State the pH of pure water in words. (b) Say what room temperature means. (c) Say why it matters for living things.	(a) Neutral. (b) The normal indoor temperature. (c) It is comfortable for living things, and water is a liquid at that temperature.

Worked examples for the board

Example 1: three cups

A learner puts sugar, salt and sand into three cups of water and stirs. Which dissolve, and what does this show? Sugar dissolves in the water. Salt dissolves in the water. Sand does not dissolve. This shows that water dissolves many substances, which is why it is called the universal solvent.

Example 2: clear and muddy ponds

A fish farmer has a clear pond with plenty of green plants and a muddy pond with few. Water is transparent, so clear water lets light pass through and underwater plants can photosynthesise. Muddy water lets less light through, so there are few plants. The farmer can keep the clear pond healthy by keeping the water clear.

Example 3: the insect and the person

A small insect rests on a pond while a person who steps in sinks. Water molecules attract each other, which is cohesion. Cohesion makes the top of the water behave like a thin skin, which is surface tension. This skin supports the insect, but it does not support a person.

Board plan

Write the title and the key words. Left: the dissolving results with solute and solvent. Centre: the table of properties and uses. Right: the diagram of the insect on the surface of water.

Property	Meaning	Use for life
Universal solvent	Dissolves many substances	Nutrients are carried in plants and animals
Cohesion and surface tension	Water molecules attract each other and form a thin skin	Some insects walk on water
Transparency	Lets light pass through	Underwater plants photosynthesise
Less dense as a solid	Ice is lighter than liquid water	Ice floats on water
High heat capacity	Absorbs a lot of heat before it warms	Keeps living things and habitats at a steadier temperature

Properties of water and how they support life

Mistakes to expect

Learners often think	Put it right
Water dissolves everything, including sand.	Water dissolves many substances, such as salt and sugar, but sand does not dissolve. That is why water is called the universal solvent.
Cohesion and adhesion mean the same thing.	Cohesion is the attraction between water molecules. Adhesion is the attraction between water molecules and other surfaces.
Ice sinks because solids are heavier than liquids.	Water becomes less dense when it turns into a solid, so ice is lighter than the same volume of liquid water and floats.
Muddy water and clear water let through the same amount of light.	Clear water lets more light through than muddy water, so underwater plants photosynthesise better in clear water.

Differentiation

Learners who struggle

Give learners a table with the property names filled in and ask them to complete the meaning and the use. Repeat the dissolving activity slowly and ask learners to say the result aloud before writing it.

Learners who finish early

Ask learners who finish early to explain in three sentences why a cooling system uses water, using heat capacity, and to give one more example of water as a solvent in daily life.

Hearing or visual impairment

For learners with hearing impairment, write the key words on the board and show each result of the dissolving activity. For learners with visual impairment, let them feel the cups and hear the results read aloud, and describe the insect diagram aloud.

No projector, no printing

Use any three containers of water from home or school. If no sugar or salt is available, use any two household substances that dissolve and sand or soil that does not. Draw the insect diagram on the board.

If time is short

Teach the universal solvent with the three-cup activity and cohesion with surface tension. Leave transparency, density and heat capacity for the next lesson.

Evaluation

Question or task	A correct answer shows
A learner at a school in Luangwa stirs a spoon of salt, a spoon of sugar and a spoon of sand into three cups of water. (a) Say which substances dissolve. (b) Name the solute and the solvent in the salt cup. (c) Explain why this property helps plants and animals.	(a) Salt and sugar dissolve; sand does not. (b) The solute is salt and the solvent is water. (c) Nutrients dissolve in water, so they can be carried around the bodies of plants and animals.
A fish farmer notices that a pond with clear water has plenty of green plants, but a nearby pond with muddy water has very few. (a) Name the property of water that explains the difference. (b) Explain how it helps the plants. (c) Say what the farmer could do to keep the clear pond healthy.	(a) Transparency. (b) Clear water lets light pass through, so underwater plants can photosynthesise; muddy water blocks the light. (c) Keep the water clear, for example by stopping soil and mud from washing into the pond.
A learner sees a small insect resting on the surface of a basin of water while her own hand pressed into the water sinks. (a) Name the attraction between water molecules that forms a skin. (b) Name the skin on the surface. (c) Say why the insect does not sink.	(a) Cohesion. (b) Surface tension. (c) The surface tension supports the small insect, while a person sinks.

Homework

A girl in Luangwa leaves a bottle of water in a freezer overnight and sees that the ice floats in a cup of water the next morning. (a) Say what happens to the density of water when it turns into a solid. (b) Explain why the ice floats. (c) Name the property that lets water absorb a lot of heat before its temperature rises and give one use.

Extra practice with answers

Question	Answer
1. A learner at a school in Luangwa mixes a spoon of salt into a cup of water and a spoon of sand into another cup, and stirs both. (a) Say which one dissolves. (b) Name the solute and the solvent in the dissolving cup. (c) Say what this shows about water.	(a) Salt. (b) The solute is salt and the solvent is water. (c) Water dissolves many substances, so it is the universal solvent.
2. A boy says that a pond with muddy water will have as many green plants as a pond with clear water, because water is water. (a) Say whether he is right. (b) Name the property that explains your answer. (c) Say why it matters to the plants.	(a) No. (b) Transparency. (c) Clear water lets more light through, so underwater plants can photosynthesise.
3. A girl watches a cup of water and a cup with ice cubes in it and notices that the ice floats. (a) Say what happens to water's density when it turns solid. (b) Explain why the ice floats. (c) Say what density means.	(a) It becomes less dense. (b) Ice is lighter than the same volume of liquid water. (c) The mass of a substance in each unit of volume.
4. A fisherman says that the water in his pond stays at a steadier temperature than the air around it, and the same property makes water useful in cooling systems. (a) Name the property. (b) Say what it means. (c) Say how it helps living things.	(a) High heat capacity. (b) Water can absorb a lot of heat before its temperature rises. (c) It helps keep living things and water habitats at a steadier temperature.
5. A teacher shows a diagram of an insect resting on the surface of a pond and asks the class about the forces involved. (a) Say what cohesion is. (b) Say what adhesion is. (c) Say what surface tension is.	(a) The attraction between water molecules. (b) The attraction between water molecules and other surfaces. (c) The skin on the surface of water, caused by cohesion.

Answers to the learners' check-yourself questions

1. Why is water called the universal solvent?
   Because it dissolves many substances.
2. What is cohesion?
   The attraction between water molecules.
3. What is surface tension, and what causes it?
   The skin on the surface of water, caused by cohesion.
4. Why does ice float on water?
   Water is less dense when it is a solid, so ice is lighter than the same volume of liquid water.
5. State the pH of pure water in words.
   Neutral: it is neither acidic nor alkaline.
6. You are a learner at a school in Luangwa. You mix a spoon of salt, a spoon of sugar and a spoon of sand in three cups of water and stir. (a) Which substances dissolve? (b) Name the solute and the solvent in the salt cup. (c) Explain how this property helps

plants and animals.
(a) Salt and sugar dissolve; sand does not. (b) The solute is salt and the solvent is water. (c) Nutrients dissolve in water, so they can be carried around the bodies of plants and animals.

7. A fish farmer notices that a pond with clear water has plenty of green plants, but a nearby pond with muddy water has very few. (a) Which property of water explains the difference? (b) Explain how it helps the plants. (c) Say what the farmer could do to keep the clear pond healthy.
(a) Transparency. (b) Clear water lets light pass through, so underwater plants can photosynthesise; muddy water blocks the light. (c) Keep the water clear, for example by stopping soil and mud from washing into the pond.

Teacher's reflection

What went well:

What I will change next time:

Learners who need follow-up: