The mystery of the disappearing water

Primary: (ages 7 – 11)	**Science**

This unit challenges students to solve the mystery of disappearing water. Students discover how everyday evaporation is taking place around us and water is changing into vapour at varying rates from all open water bodies (and living organisms) depending on the sun's heat. This evaporated water falls right back to earth in the form of rain, hail, or snow. Students develop understanding of the role evaporation plays in our daily life.

Time allocation	4 lesson periods
Subject content	Explore and understand transitions between solid, liquid, and gaseous states of matter Identify the part played by evaporation and condensation in the water cycle and associate rate of evaporation with temperature
Creativity and critical thinking	This unit has a **creativity** and **critical thinking** focus: • Generate and explore multiple ideas to solve a mystery • Consider several perspectives on a scientific problem • Reflect on and appraise their thinking and create an output to represent it
Other skills	Collaboration, Communication, Persistence/Perseverance
Key words	evaporation; condensation; water cycle; phase change; vapour; steam; ice

Products and processes to assess

The activity challenges students to think creatively and critically about happens to water once they can no longer see it. They engage in a process of discovery and at the highest levels of achievement, they show a sustained enthusiasm for introducing novel ideas and perspectives to the discussion with good rationale. They consider different perspectives, show awareness of the strengths and limitations of their own and others' thinking, and create outputs that are both original and show a good understanding of subject content.

Teaching and Learning plan

This plan suggests potential steps for implementing the activity. Teachers can introduce as many modifications as they see fit to adapt the activity to their teaching context.

Step	Duration	Teacher and student roles	Subject content	Creativity and critical thinking
	Prior to lesson period 1	The teacher sets up a driving question board with chart paper with the heading "how can we solve the mystery of disappearing water?" in a science corner, where they can also post notices to the students to look for the next task. After each task, students can be asked to add to the board with facts/words/ideas related to the topic for discussion.		
1	Lesson period 1	The teacher introduces the topic by asking the students to watch the video 'Robinson makes drinking water' (see resources). Students engage in a 10-15 minute discussion about the various steps taken by Robinson to quench his thirst. The teacher can support this process by asking the questions in annex 1, and asking students to add any thoughts, questions, or 'theories' they have come up with so far to the driving question board.	Introduction to condensation and evaporation	Questioning their own knowledge and assumptions about water Identifying gaps in their knowledge and exploring ideas that may seem radical or unlikely
2		The teacher demonstrates the activity 'watching water boil' (Annex 2). Students are tasked to observe, question, connect and correlate with what they saw in the video. The teacher can support this process by asking the questions and giving the explanations in annex 2 and asking students to reflect on what they have seen, explain the strengths and weaknesses of the ideas they have come up with so far, think about what questions they still have and add any ideas/questions/words to the driving question board.	Phase change, and the concept of distillation and condensation	Considering how the driving question can be approached from a scientific perspective Reflecting on strengths, limitations, uncertainty and the limits of their thinking so far
3	Lesson period 2	Students are divided into groups of 4 or 5. The teacher provides each group with the game 'scrabble' with instructions to only form words connected to the topic. Students can use a dictionary and words are to be noted on chart paper and pinned up after 20 minutes. The students now embark on a gallery walk and observe what words other groups have written. Students assess the number and complexity of words by sticking stars or smileys and evaluating groups on a simple rubric (Annex 3). At this point, the teacher may choose to connect some of the words that students have provided and the ideas on the driving question board to introduce the water cycle if this has not already come up. Students can again be asked to add to the driving question board and assess the strengths and weaknesses of their ideas about the mystery so far.	The water cycle	Coming up with interesting words related to the water cycle Comparing different perspectives on the problem Reflecting on the steps taken so far taken to solve a scientific problem
4		The teacher implements a friendly group competition by having each group come up with ideas for a quick process of melting an ice cube and letting it evaporate. The teacher points students in the right direction by asking them to place the ice cube in an open Ziploc bag in areas where heat gets generated and, if this can be managed safely, to use a burner under the teacher's supervision. The teacher then uses the questions in Annex 4 to lead a discussion of what the students have done and connect it to the driving	Role of temperature in phase change and relating this to everyday life.	Generating and playing with unusual ideas when approaching a scientific problem Considering different perspectives on and different aspects of a

		question. This activity can be further enhanced if the teacher gives the students bags that contain ice coated with saw dust. Ask students to do a comparison between the two bags and explain the difference in the time taken for melting, in order to explore the concept and role of insulation in the process		scientific problem
5	Lesson periods 3 and 4	The teacher asks students to think of some unusual ways they could explain how water can change state. Students can then be asked to bring some of these ideas to life in different groups. Two or three groups could be asked to come up with plays on the topic. For this, students could use some of the words they have generated and imagine those words are characters in a play in which they act out the water cycle. Another task can be given to the rest of the groups to splash water paints so that they run over a plastic sheet supplied by the teacher. Whilst waiting for this to dry, students can write a story, poem, or song explaining the mystery of the disappearing water. They can then write or paint extracts from this onto the design so that each group weaves a story, poem or song relating to evaporation into the spaces formed by the running water paint. The unit can be tied up with a reflective discussion or written work on how students solved the mystery of the disappearing water and what they learned along the way. Alternatively, as a culminating activity, the students can be asked to design a creative board game that reflects their understanding of the topic. The students can be divided into groups to play each game and prizes or stars etc can be given to the group who designed the most creative, informative etc. game.	Consolidating and communicating knowledge of phase change and the water cycle	Generating and playing with unusual and radical ways to articulate and represent their subject knowledge Producing an output that is personally novel Reflecting on the steps taken to pose and solve a scientific problem

Resources and examples for inspiration

Web and print

- Video from website: http://www.creativeeducation.co.uk/video/3390 or Robinson Crusoe video from: https://www.youtube.com/watch?v=JeeoUrLkmcE

Other

- Projector, poster board, chart paper, thumb pins, sketch pens, ice cubes, Ziploc bags, scrabble game (at least 5), plastic sheets (at least 5 of 30 cm × 30 cm), water paints, star stickers or smileys.
- A small vessel or pan
- A hotplate or gas stove
- 2 cold metallic plates and a pair of tongs to hold
- A spoonful of salt

Opportunities to adapt, extend, and enrich

- This activity could be extended by using some of the activities here. https://pmm.nasa.gov/education/primary-topic/water-cycle

Creativity and critical thinking rubric for science

- Mapping of the different steps of the lesson plan against the OECD rubric to identify the creative and/or critical thinking skills the different parts of the lesson aim to develop

	CREATIVITY Coming up with new ideas and solutions	Steps	CRITICAL THINKING Questioning and evaluating ideas and solutions	Steps
INQUIRING	Make connections to other scientific concepts or conceptual ideas in other disciplines	1	Identify and question assumptions and generally accepted ideas of a scientific explanation or approach to a problem	1
IMAGINING	Generate and play with unusual and radical ideas when approaching or solving a scientific problem	1,3,4	Consider several perspectives on a scientific problem	3,4
DOING	Pose and propose how to solve a scientific problem in a personally novel way	4	Explain both strengths and limitations of a scientific solution based on logical and possibly other criteria (practical, ethical, etc.)	1-3
REFLECTING	Reflect on steps taken to pose and solve a scientific problem	1-5	Reflect on the chosen scientific approach or solution relative to possible alternatives	

Appendix

Annex 1- Questions

Q 1) What did you observe in the video? Narrate the story.
Q 2) After a swim you realise you have forgotten your towel. As you stand wondering what to do you realise you are slowly getting dry. Why does that happen?
Q 3) Can you give some examples of water drying up in everyday life?
Q 4) Coming back to the video what was the nature of water before the process and after the process?
Q 5) Where did the drops of clear water on the underside of the plastic sheet come from in the video?
Q 6) What were the processes involved in Robinson getting drinking water from sea water?
Student may not know answers to Q 5 and Q 6 .The teacher proceeds to show the activity in the second part of lesson 1.

Annex 2- Demonstration of experiment

Key concept: On boiling water it changes to water vapour in the air. The bubbles are steam bursting at the surface of the boiling water and disappearing into air. On holding a cold plate over this water, drops of water are formed on the underside as water vapour is changing back to water.
The teacher will need a small vessel or pan, a hotplate or gas stove, 2 cold metallic plates, a pair of tongs to hold and a spoonful of salt.

Procedure: Put some water in the small vessel. Mark the water level. Place it on the hotplate. The students are instructed to observe carefully and answer the questions asked by the teacher.
Q1) What happens to the water when it boils?
Q2) Describe the change in the size of the bubbles.
Q3) Boiled water is never put in a fish tank. Why?
Q4) As the bigger bubbles burst at the surface of the boiling water what could the whitish cloud above the boiling water be?

Concept: This is steam. Water vapour is the gaseous form of water and the process of water changing to gas is called evaporation.
Q5) Why is the level of water lower than the earlier marked level?
Q6) Where has the water disappeared? Has it actually disappeared?
The teacher now holds a cold metallic plate over the steam.
Q6) What do you notice forming on the underside of the plate?
Concept: On coming in contact with anything cold the water vapour changes back to water. This process is called condensation.
Q7) Why does a mirror or glass turn foggy when you breathe on it?
Teacher now adds a spoonful of salt to the boiling water and holds the other cold metallic plate over it.
Students are asked to taste the drops formed on the underside of the plate.
Q8) Is the water salty? If not, why?
The concept of distillation is explained by the teacher.
The teacher now initiates a discussion by the students on how Robinson obtained pure water from salt water to quench his thirst.
Q 9) However what was the heat source in Robinson's process?

Annex 3 – Simple rubric

Rubric for students to address and judge the activity in lesson 2 on number and complexity of words formed by each group pertaining to the topic.

CATEGORY	AVERAGE	GOOD	VERY GOOD
NUMBER OF WORDS FORMED	LESS THAN 10 WORDS	10 TO 15 WORDS	MORE THAN 15 WORDS
COMPLEXITY OF WORDS	LIMITED EFFORT	AVERAGE EFFORT	ENTHUSIASTIC EFFORT

Annex 4- Demonstration of Experiment

Q1) Can ice evaporate?

Q2) The rate of evaporation would be faster:

1) In shade or under the sun.
2) On a calm day or a windy day.
3) On a sunny day or rainy day.

Q3) In your group discuss and draw three examples of condensation from everyday life.