



Lesson Plan 9

Mini Water Cycle

Brief description

Students observe the water cycle in action inside a mini solar still. The still consists of a plastic tub filled with a layer of moist soil or sand, and sealed with cling wrap. Water evaporates from the soil, condenses on the cling wrap and trickles to a point directly above a cup. In a few hours on a hot day, the still will collect enough water for several students to taste.

- Duration: 60 minutes total (two 30 minute sessions)
- Year level: Lower to upper primary
- Topics: The water cycle, evaporation, condensation, states of matter
- Preparation: 5 to 10 minutes (depending on availability of materials)
- Extensions: SOSE: Perform a water audit (see teacher notes)
Art/Science: Design and decorate a water cycle poster/diorama



Overview

Session 1: Make Mini Solar Stills (20 – 30 min)

- Whole class Introduce lesson (10 – 15 min)
Discuss procedure and elicit students' predictions
Prepare a mini solar still for the class *to test or:*
- Small groups Optional – prepare several solar stills (10 – 15 min)*
- Whole Class Position the solar still(s) (10 – 15 min)
If several stills have been made, place them in several locations, each with different levels of exposure to sunlight. Discuss students' predictions about which positions they expect will collect more water.

Session 2 (Afternoon or following day*): Check the Results (20 – 30 min)

- Whole class Observe the results (10 – 15 min)
Optional: measure the water collected in the cup(s)
Choose students to taste the water
Discuss the results
Write recount / draw diagrams in science journal

* The amount of water collected in the cup will depend on the temperature and to a lesser extent, the humidity, so longer exposure to sunlight will produce better results



Materials and equipment

Per Solar Still:

Note: use identical equipment and materials if making several solar stills

Total Qty	Description
1	Plastic tub ¹
1	Plastic cup
1	Small rock or marble
1	Watering can
1	Measuring cup (optional)
1	Roll of cling wrap plastic (or similar)
1	Roll of wide tape to seal the still
2 – 4	Litres of soil or sand ² (depending on size of still)
1 – 2	Cups of water ² (depending on size of still)

¹ Eg See picture in teachers notes or use large ice cream containers

² Use more if you are using very large tubs



Objectives

Students' prior knowledge

No prior knowledge is required or assumed for this lesson plan.

Science skills

- Students will:
- Measure the amounts of soil (or sand) and water to be added to each solar still
 - Predict what will happen when the solar still is placed in a warm sunny position
if more than one still is made, also predict what effect the level of exposure to sun (temperature) will have on the results
 - Observe the formation of water droplets on the inner surface of the cling wrap
 - Infer that the water collected in the cup is condensed water vapour which has evaporated from the soil
correct inferences will depend on and vary significantly with student age and previous knowledge

Science concepts

- water can be solid (ice), liquid (water) or gas (water vapour)
- evaporation: liquid water evaporates to become invisible water vapour
- condensation: when cooled, water vapour condenses to become liquid water
- water evaporates more quickly at higher temperatures

Positive attitudes

- Students will
- work cooperatively in small groups and ensure everyone has sufficient opportunities to see and understand the activity
 - handle equipment and water responsibly
 - handle and dispose of waste responsibly (eg pour excess water into garden beds, not down the sink)



Procedure

Session 1: Make Mini Solar Stills (20 – 30 min)

Introduction – Whole Class (10 – 15 min)

- Introduce the water cycle by asking leading questions such as:
 - “where does rain come from and how did all that water get up into the sky in the first place?”
 - “where do all the puddles go after rain?”
 - “what is that stuff that fogs up a window when you breath onto it?”(enjoy the answers!)
- Introduce the lesson by discussing the procedure and describe the mini solar still – if you are making one still, let the class see the preparation and discuss students’ predictions by posing questions such as:
 - “do you think water can get in or out of our plastic tub once we have sealed it up with the tape?”
 - “do you think the water will just stay in the soil or will some go into the cup? If so, how?”

Optional: Make mini solar stills in small groups (10 – 15 min)

- *If you are making more than one solar still, prepare them in small groups (after discussing the procedure) ensuring each group uses exactly the same quantities of soil (or sand) and water*

Position the solar stills in sunny location – Whole Class (10 – 15 min)

- Find a location where the solar still will receive plenty of direct sunlight and where there is no risk of disturbance
- If using several solar stills, choose a variety of locations with different levels of exposure to direct sunlight – discuss the effect of these positions

Session 2: Check the results (20 – 30 min)

Collect the cups – Whole Class (10 – 15 min)

- Allow sufficient time for all the students to observe the stills before removing the cups
- Remove the cup and observe the amount of water collected – if several stills were tested, measure the amount of water collected in each

Conclusion – Whole Class (10 – 15 min)

- Prompt students to discuss their inferences by asking questions such as:
 - “where do you think the water in the cup came from?”
 - “where could the water have come from?”
- Discuss where the water that evaporates from soil goes when it is not trapped inside a still (ie into the atmosphere to form clouds)
- Discuss the use of solar stills in survival situations and ask questions such as:
 - “do you think the still would work in the middle of a desert?”
 - “what would you look for when deciding where to put your solar still?”
- Set journal recount and/or assessment task(s) for the activity



Teacher's notes

Instructions for Making a Mini Solar Still



1. Add one or two litres of soil or sand to the plastic tub – if making more than one still, add the same amount of soil or sand is used in each. You should also ensure the soil has a consistent and uniform moisture content.



2. Position the plastic cup in the centre of the tub, partially submerged in the soil for stability.



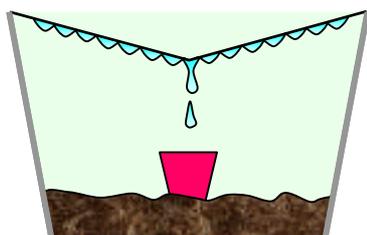
3. For a large tub such as this one, add 2 cups of water to the soil or sand. For smaller tubs (eg ice cream containers) add $\frac{1}{2}$ to 1 cup of water. Sprinkle the water evenly over the soil.



4. Seal the tub with cling wrap and tape. Add a pebble or large marble directly above the cup forming a depression for the water droplets to roll down.



5. Place the solar still in a still and sunny location (it may pay to check with groundsmen to find the best position – wind can cause the cling wrap to flap about so that the droplets miss the cup).



- * Ensure the cup is directly under the pebble or marble – on sunny days exceeding 25°C , the still should collect more than half a cup of water in approximately 3 to 4 hours.

Performing a school water audit

A water audit can yield surprising outcomes when the results are compared with tangible quantities of water such as buckets and swimming pools. A water audit can be as simple as reading the school or home water meter every day for a week or more detailed. Performing the water audit is very likely to result in a better appreciation of and improved attitudes to water conservation. Numerous local, state and federal government agencies have published online water audit lesson plans, some of which are listed below. A great place to start any water audit is by contacting your local council's water department who may also be able to provide further resources, guest speakers or field trips.

Online water audit lesson plans:

Sydney Water – Water Audit Unit Plan

http://www.sydneywater.com.au/Publications/_download.cfm?DownloadFile=Factsheets/RainwaterTanksInSchoolsStage4.pdf

River Murray Urban Users Committee – School Water Audit Resource

<http://www.murrayusers.sa.gov.au/waterauditkit04.htm>

Water facts and trivia

- Antarctica is the driest continent on earth.
- Australia is the driest inhabited continent on earth.
- Three quarters of the Earth's surface is covered with water.
- 97% of this water can't be used by people, plants or animals, because it is found in the oceans as salt water.
- The other 3% is fresh water. Of this 2% is frozen in ice caps, glaciers and on snowy mountain ranges.
- Only about 0.5% of the remaining water on earth is useable, fresh water.
- 80% of the water we use is surface water.
- 30 to 50 times more water is found underground. Groundwater is the water found between particles of soil and rocks beneath the ground.

Source: Sydney Water (www.sydneywater.com.au)

Percentage of household water usage, 2000–2001

Location	NSW	Vic	Qld	S.A.	W.A.	A.C.T.	Australia
Bathroom	26	26	19	15	17	16	20
Toilet	23	19	12	13	11	14	15
Laundry	16	15	10	13	14	10	13
Kitchen	10	5	9	10	8	5	8
Outdoors	25	35	50	50	50	55	44

Source: Australian Bureau of Statistics, [Water Account, Australia, May 2004, cat. no. 4610.0]