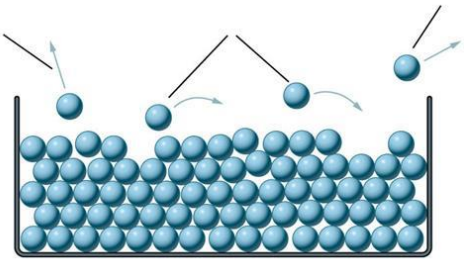
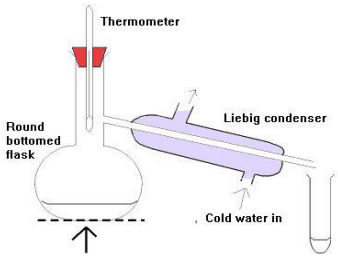


Station 5 - Sea to Fresh Water

Students use an Evaporative Still to convert seawater to freshwater. First they predict what they think will happen in the Still. They then measure the salinity of the seawater before and after it is boiled and relate this to the processes of the water cycle.

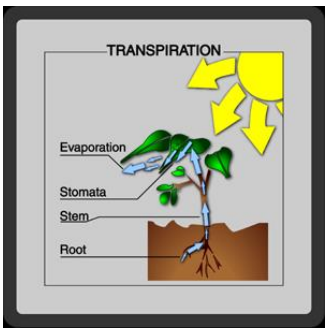
Key concepts

Evaporation occurs when molecules in a liquid gain enough energy that they overcome attractions from other molecules and break away to become a gas. Adding energy increases the rate of evaporation. Evaporation is a type of vapourisation of a liquid that occurs only on the surface of a liquid. The other type of vapourisation is boiling which occurs on the entire mass of the liquid.



To evaporate the thermal motion of water molecule must be sufficient to overcome the surface tension. Since only a small proportion of the molecules are located near the surface and are moving in the proper direction to escape at any given instant, the rate of evaporation is limited. Also as the faster-moving molecules escape, the remaining molecules have lower average kinetic energy and the temperature of the liquid decreases. This phenomenon is also called evaporative cooling and this is the reason that evaporating sweat cools the human body. www.sciencedaily.com

Evaporation is an essential part of the water cycle. Solar energy drives evaporation of water from oceans, lakes, moisture in the soil and other sources of water. Evaporation and transpiration (which involves evaporation within plant stomata) are collectively termed evapotranspiration. www.scienceclarified.com



Evaporation can be used to separate a dissolved solute from a solution e.g. using an evaporative still. The water in the flask evaporates and turns into steam. Anything dissolved in the water cannot evaporate and so remains in the flask. The steam condenses in the delivery tube and turns back into water which collects in the test tube.

Condensation is the process by which water vapour in the air is changed into liquid water. Condensation is crucial to the water cycle because it is responsible for the formation of clouds. Condensation is the opposite of evaporation. Even though clouds are absent in a crystal clear blue sky, water is still present in the form of water vapour and droplets which are too small to be seen. Depending on weather conditions, water molecules will combine with tiny particles of dust, salt and smoke in the air to form cloud droplets, which grow and develop into clouds, a form of water we can see. Cloud droplets can vary greatly in size, from 10 microns (millionths of a meter) to 1 millimetre and even as large as 5 mm. This process occurs higher in the sky where the air is cooler and more condensation occurs relative to evaporation. As water droplets combine with each other and grow in size, clouds not only develop, but precipitation may also occur. Condensation also occurs where warm moist air meets cold surfaces e.g. when we breathe out on a cold day or breathe on a mirror. http://water.usgs.gov

A Desalination Water Treatment Plant uses a filtration process called reverse osmosis technology to extract freshwater from seawater. Energy is used to push water through reverse osmosis membranes. These membranes block particles and salts so that only freshwater can pass through. Approximately 43% of the intake becomes drinking water and 57% is returned to the ocean as sea concentrate. http://sydneydesal.com.au

Images

www.aboutcivil.org (dark blue evaporation)

www.mikecurtis.org.uk (still)
http://physics.taskermilward.org.uk (blue balls)
http://www2.yk.psu.edu (plant)
http://www.whitesales.co.uk (window)
http://wallpapers-xs.blogspot.com.au (plane trail)

Water literacy list

Condensation: The process by which water vapour in the air is changed into liquid water.

Desalination: The removal of salt and other impurities from seawater to produce fresh drinking water.

Energy: In physical science, energy means the ability to do work. Work means a change in position, speed, state, or form of matter. Therefore, energy is the capacity to change matter. Energy can produce motion, heat or light. http://www.energyeducation.tx.gov

Evaporation: Occurs when molecules in a liquid gain enough energy that they overcome attractions from other molecules and break away to become a gas.

Evapotranspiration: The term used to describe the part of the water cycle which removes liquid water from an area with vegetation and into the atmosphere by the processes of both transpiration and evaporation. www.bom.gov.au

Mixture: Something that can be separated into two (or more) different substances e.g. air, sea water, earth, orange juice. http://www.mikecurtis.org.uk

Precipitation: Water in its liquid or solid form falling from the base of a cloud. http://water.usgs.gov

Pure: A material is pure if it contains only one chemical substance and so cannot be separated further

Insoluble: Cannot dissolve http://www.mikecurtis.org.uk

Residue: The solid left behind after an experiment (eg the solid left in the filter paper). http://www.mikecurtis.org.uk

Salt: Common salt is a chemical compound called sodium chloride with the formula NaCL (Na = sodium, CL = chlorine). Seawater contains other dissolved solids but salt represents about 77% of the total dissolved solids. http://www.saltworks.us

Soluble: Can dissolve http://www.mikecurtis.org.uk

Solute: A substance that has been dissolved in a solution. http://www.mikecurtis.org.uk

Solvent: The liquid that is used to make a solution http://www.mikecurtis.org.uk

Transpiration: Occurs when water in plant tissues is lost to the atmosphere, predominantly through the small opening in the leaves of plants and grasses called stomata. www.bom.gov.au

Water vapour: Water in a gaseous state that we cannot see.

Teacher reference

Interactive USA water cycle poster with definitions, photographs and global water distribution (% & cubic kilometres)
http://water.usgs.gov/edu/watercycle-kids-adv.html

Salinity
http://www.environment.gov.au/node/20505

CSIRO Salinity Fact Sheet. Link to Fact Sheet

Link to our local water supply and sustainable water use

Desalination Plants turn seawater into drinking water and are one of the ways of securing the water supply against the effects of climate change, a growing population and drought. The closest Desalination Plant to our North Coast Region is in the Gold Coast. The Sydney Desalination plant can supply up to 250 million litres a day which is up to 15% of their water needs. Many countries use desalination as a way of creating a water supply that doesn't depend on rain. Small desalination plants are used on ships and islands. Sea water is desalinated using reverse osmosis.
http://sydneydesal.com.au/

Kids section

Geography for kids: An online geography textbook written for kids to learn about the world around you, with easy steps, lots of information, songs and games try evaporation at **http://www.kidsgeo.com/geography-for-kids/0102-evaporation.php**

Tapstar from Shoalhaven water: facts and fun ways to learn how we get water.
http://shoalwater.nsw.gov.au/education/tapstar_home.htm

Science scenarios - Research and design an experiment that will show each statement to be correct:

- Water evaporates from the ocean and rises as vapour, leaving behind salt and other elements or impurities.
- Our bodies use evaporation to cool down.
- Evapotranspiration is water evaporating from leaves.

Experiments

What happens to water molecules when they are heated?

You will need: two glasses or clear plastic cups, water hot and cold, food colouring.
What to do: Pour cold water into one glass and hot into the other. Let the glasses sit for a couple of minutes so the water is still. Add one drop of food colouring to each glass of water.
PREDICT, OBSERVE & EXPLAIN
(The water molecules in liquid form are jiggling about and rolling over each other. With heat energy the water molecules move faster and faster and further apart).

How much water can plants transpire?

You will need: a clear plastic bag and an elastic band and one or two leafy trees or bushes outside, that you can easily reach.
What to do: Tie a clear, clean plastic bag firmly around some leaves on a bush, taking care not to harm it. Make sure the bag has no holes in it. Check the bag every hour and record what is happening.
PREDICT, OBSERVE & EXPLAIN
(Water is absorbed through the roots of plants and moves up through hollow tubes to the leaves. Plants lose water through tiny holes called stomata on the underside of their leaves. The amount of water plants transpire will depend on how much water is in the soil, how hot or humid it is and how windy it is).

Make a light bulb shine with salty water (Adult supervision recommended)
What You Need: Cup or beaker, masking tape, water, insulated copper wire, salt, 9-volt battery, aluminium foil, 3.7-volt light bulb in socket and tongue depressors or icy pole sticks.

What You Do:

1. Wrap two tongue depressors in aluminium foil. These will be your electrodes.
2. Cut three 6-inch pieces of insulated copper wire and strip a half-inch of insulation off each end.
3. Connect one end of a wire to the positive terminal of the battery - hold it in place with masking tape. (If you are using a battery cap, connect it to the red wire.) Connect the other end of the wire to the light bulb socket. (Just wrap the wire around the bottom of the bulb, if you don't have a socket. You may have to secure it with tape.)
4. Take the second piece of wire and connect the light bulb socket with one of the electrodes. Use masking tape to stick the bare end of the wire on the aluminium foil near the top the electrode.

5. Use the third piece of wire to connect the negative terminal of the battery with the other electrode.
6. Test out your circuit by touching the two electrodes together. This should complete the circuit and allow electricity to flow from one terminal of the battery to the other, lighting up the light bulb in the process. If the bulb doesn't light up, check your wire connections to make sure they are all secure and then try again.

Testing the circuit in water

1. Pour 1 cup water into a cup or beaker. (Distilled water will work best).
2. Put the two electrodes in the cup, but don't let them touch each other. What happens to the light bulb?
3. Remove the electrodes from the cup and then stir in a teaspoon of salt until it dissolves. Put the electrodes in the salt water without touching them together. Watch the light bulb.

Salt molecules are made of sodium ions and chlorine ions. (An *ion* is an atom that has an electrical charge because it has either gained or lost an electron.) When you put salt in water, the water molecules pull the sodium and chlorine ions apart so they are floating freely. These ions are what carry electricity through water. The light bulb lit up because the sodium and chorine ions conducted the electricity from one electrode to the other. This completed the circuit, causing the light bulb to shine. Try adding more salt and see if the light bulb shines brighter.