Swiss Water & Sanitation Consortium

BLUE SCHOOLS

Linking WASH in schools with environmental education and practice

CATALOGUE OF PRACTICAL EXERCISES

1st Edition

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SUPPORTED BY

Swiss Agency for Development and Cooperation (SDC)
Swiss Water & Sanitation Consortium
Terre des hommes
Caritas Switzerland
HELVETAS Swiss Intercooperation
Swiss Federal Institute of Aquatic Science and Technology (Eawag)
International Rainwater Harvesting Alliance (IRHA)

Introduction

A Blue School offers a healthy learning environment and exposes students to environmentally-friendly technologies and practices that can be replicated in their communities. It inspires students to be change agents in their communities and builds the next generation of WASH and environment sector champions.

The Catalogue of Practical Exercises aims to inspire teachers with hand-on and low cost exercises to complement the lessons from the national curriculum. The examples provided facilitate students' learning by doing and can be replicated in the students' home and in their communities.

It provides examples of practical exercises for each topic of the Blue Schools Kit:
1. My Surrounding Environment
2. The Water Cycle
3. The Watershed around My School
4. My Drinking Water
5. Sanitation and Hygiene
6. Growth and Change
7. From Soil to Food
8. From Waste to Resources.

For each topic, technical background sections are provided to facilitate understanding of basic key concepts. Each topic includes a selection of teaching, participatory or creative activities, discussions, demonstrations, games, and experiments, all requiring simple material at little to no cost. The practical exercises aim to help reaching the key learning objectives defined in each topic's first page. The level of difficulty for each exercise is indicated; depending on the class and age group, teachers can select the most appropriate activities and students can deepen their knowledge on these topics from year to year.

This catalogue is a compilation of references from the WASH in School (WINS) community of practice as well as other sectors related to the Blue Schools' topics. It can evolve: Future editions of this Catalogue will benefit from inputs and feedback from users and experts from around the world. Feedback form available on the Swiss Water and Sanitation Consortium website: http://waterconsortium.ch/blueschool/

Users of this document are also encouraged to refer to the other materials of the Blue Schools Kit i.e. the Concept Brief, the Facilitator's Guide and the Catalogue of Technologies. These can be downloaded on the Swiss Water and Sanitation website.
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With support from Schweizerische Eidgenossenschaft, Confédération suisse, Confederazione Svizzera, Confederaziun svizra
Federal Department of Foreign Affairs FDFA
Swiss Agency for Development and Cooperation SDC

Table of Contents

Practical Exercises (by Topic)

Table of Contents

Topic 1_My Surrounding Environment

The environment is everything that isn't me.
Albert Einstein

This topic introduces the concept of environment to the students. It encourages them to look beyond the surrounding of their school and analyse the landscape around them. This includes the topography, the soil characteristics and the vegetation, as well as the climate conditions such as temperature and rainfall and the impact of the climate on the landscape. This aims to help students:

- To understand the opportunities and resources that our surrounding environment offers.
- To become aware of the fragility of our surrounding environment and learn how to protect/support it.

Image source:: http://www.wordandspiritbristol.org.uk

Topic 1_Technical Background

HUMANS RELATIONS WITH THEIR ENVIRONMENT

Broadly, the “Environment**”** is everything that is around us. It includes physical, chemical and other natural elements and forces. Living things constantly interact with—and adapt themselves to—conditions in their environment. Specifically, the **natural environment** encompasses all living and non-living things occurring naturally. It includes the interaction of all living species, climate, weather, and natural resources that affect human survival and economic activity.

The natural environment has resources: means that are available and supportive to our existence; as well as constraints: conditions that could make us vulnerable. There are landmarks with stories to tell, and it is important to support the youth to understand the environment in which they live and to accompany them to perceive challenges and solutions.

There are many ways to learn about the natural environment, to *examine*, analyse and better understand the landscape. At first it is important to describe the feeling that one has about the location: if one feels safe or insecure, comfortable or tense, if the area is open or closed, appealing or uninviting, noisy or quiet, mineral or vegetal, etc. These initial impressions make it possible to characterize how people *experience* their environment. Next it is interesting to become aware of what is visible around us and to describe our environment by breaking it down into distinct, physical elements: trees, soil, roads, buildings, inhabitants, natural resources and their use for services. These services include producing food and water, protecting against extreme climate related phenomena and landscape degradation, and providing leisure and cultural benefits. Finally, it is essential to observe the relations between the visible elements and how they interact with each other.

These three sequential levels of understanding make it possible to characterize our surroundings, to better perceive the underlying constraints as well as the potentials to live more in harmony with the natural environment. This includes learning to ask essential questions about our environment and taking measures for its preservation and protection.

Main reference

Definition adapted from Johnson, D. L.; et al., (1997). "Meanings of Environmental Terms". *Journal of Environmental Quality*. Cited in Wikipedia.

Other resources

https://www.aquaportail.com/definition-9038-environnement.html
http://www.vivacites-idf.org/

1.1_Transect walk

OUTDOOR ACTIVITY
LEVEL: SIMPLE

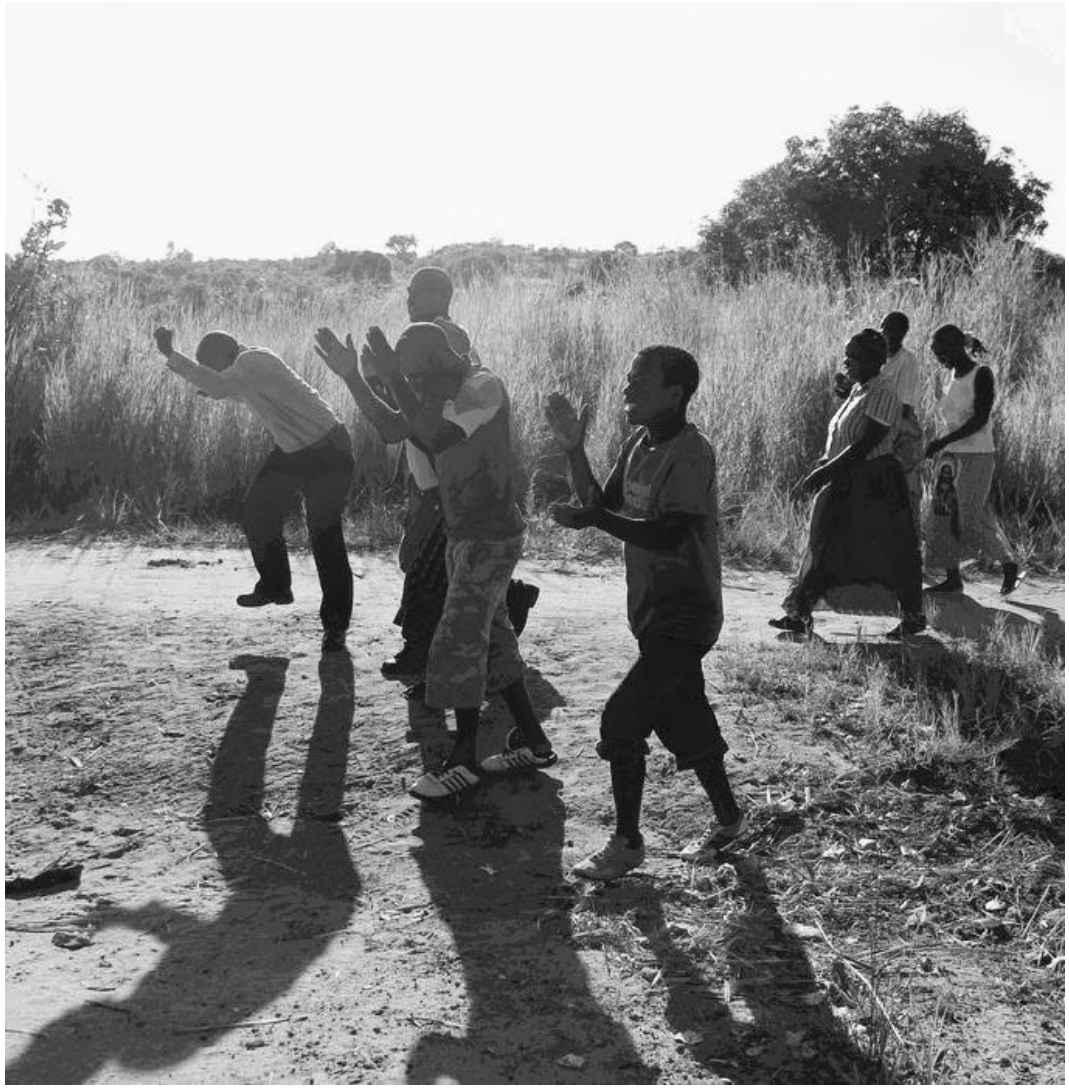
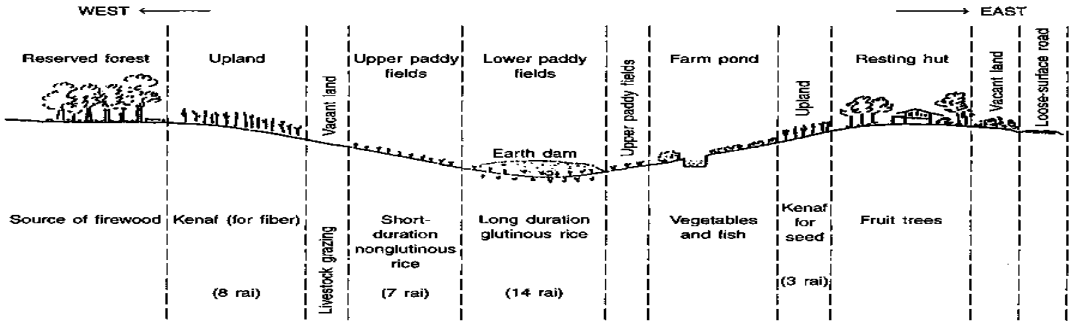


Image source: Flickr



Teaching Objective
The objective of a transect walk is to familiarize students with their local environment and to show them how to be keen observers. The students should make notes about their environment's characteristics, resources, and vulnerabilities, and observe whether these vulnerabilities have been caused by climate change and unsustainable human behaviour.

Exercise
A transect is a straight, direct line through a natural feature, through the community or through a project area. A transect walk is a systematic, purposeful walk along a defined path or transect. The purpose of this walk is to observe existing conditions and gain a more detailed insight into ones' surroundings and the challenges or vulnerabilities in the environment. The walk can be general in focus or specifically linked to a topic such as the watershed, hygiene and sanitation, or waste. Students observe the conditions through asking questions, through listening and looking closely, gathering information that can be incorporated into a transect diagram. Observations can be noted and shared in group discussion and as part of a mapping exercise (1.2).

Required Materials
notebooks or paper | pencils | camera (if available)

Additional Resources (hyperlinks)
- CLTS (focusing on sanitation) SSWM Geoparticipation World Bank Group

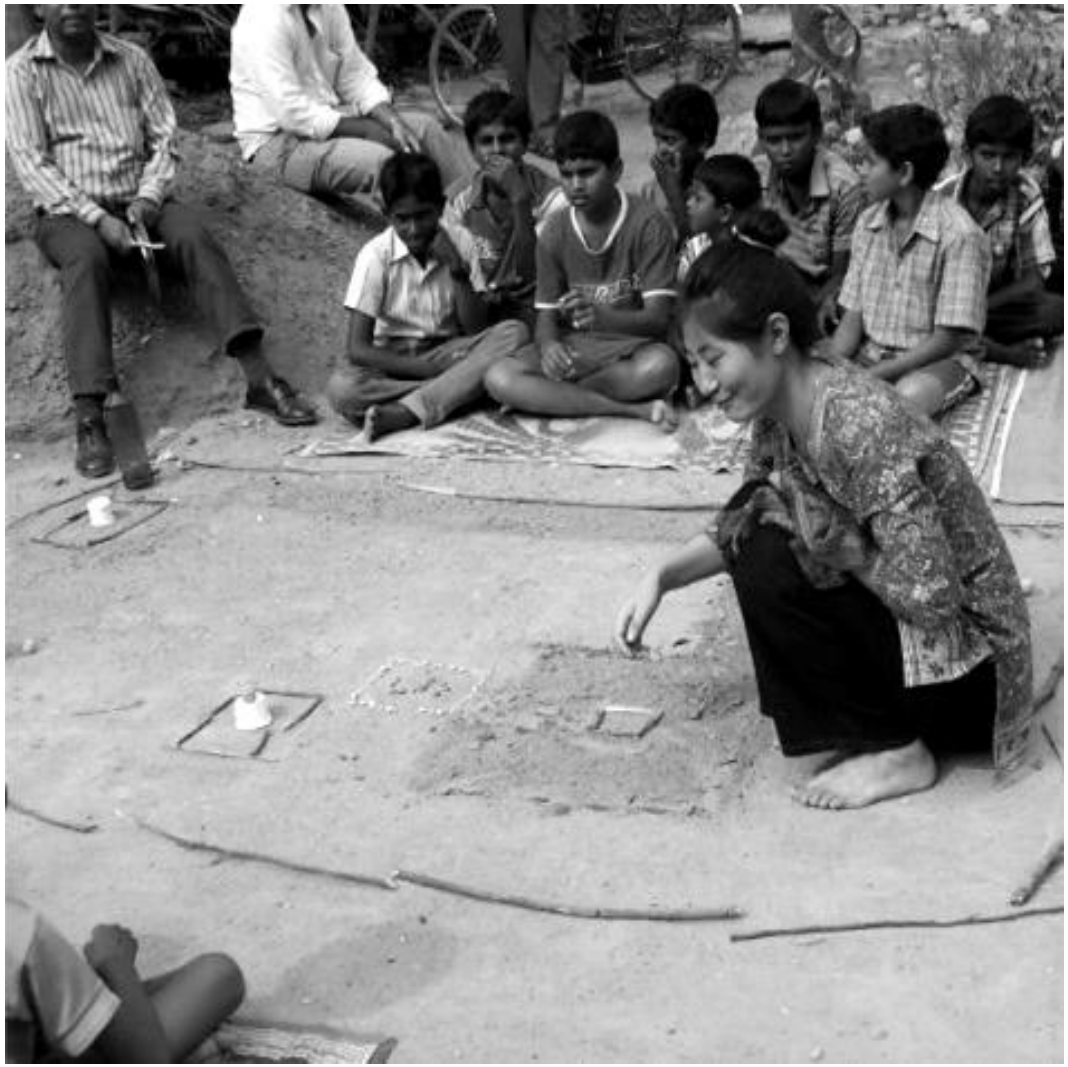


Image source: Social Work Christ University

1.2_Participatory mapping

PARTICIPATORY ACTIVITY
LEVEL: MEDIUM

Teaching Objective
The objective of this exercise is to make a large map of the environment, community or watershed in which the students live. The purpose of the map is to promote the sharing of knowledge about this region, and to support good decision making about the management of it's natural resources. The teacher or community leader assumes the role of facilitator.

Exercise
This mapmaking technique can provide a community with an important overview of the vulnerabilities and hotspots in their environment, in regard to the access of clean water, sustainable sanitation, food sources and land management. First, determine the size of the map and the materials that you will use to make it. The map can be made be with paper and writing or with locally available materials such as wet sand and earth with sticks and stones or seeds. Second, invite the group to draw the outline of the local area to be mapped in the exercise. Include, as appropriate, roads, towns, rivers and other water sources, forests and property boundaries. Aspects of the landscape can be represented by adding objects onto the map. Third, when the base map is complete, invite each individual to add detail that they consider important from their perspective. The detail should encompass problems that the community is facing, such as those related to water, sanitation and the health of the environment. Record where the problems are located, where are the hotspots of these problems, which are worst, who is responsible for causing these problems. Ask whether these problems are connected to each other, and how these problems influence one another. Keep modifying the map until everyone participating is happy with the result.

Required Materials
paper | pen or pencil | or any locally available materials as described above.

Additional Resources (hyperlinks)
SSWM

Image source: Participatory GIS:

1.3_Participatory modelling

PARTICIPATORY ACTIVITY
LEVEL: ADVANCED

Teaching Objective
The objective is similar to Exercise 1.2 but this method leads to the construction of a large scale 3-dimentional model. It is more complex to achieve but it is by far the most effective tool for a community to use to collect and capture local knowledge about ecosystems and human habitation, and to empower themselves to make good decisions about the future of their environment.

Exercise
This is a complex logistical exercise that requires planning and the collecting together a lot of materials. A base map needs to be prepared using digital contour data (GIS). It may be possible to get assistance from the Department of Land and Surveys, or its equivalent. Appropriate horizontal and vertical scales (the thickness of contours) need to be determined for the model. The scale is affected by resources and space available for construction. This is a model that should be preserved and used over a long period of time and so it is important that there is a safe place in the community where it can be kept. Contour data needs to be transferred from source maps to card and then cut out. Contour sheets then need to be glued together. Once the form of the landscape is complete, the model is covered with paper to smooth the surface, and painted to reflect the different elements in the environment, water bodies, land, forest, pasture and so on. Once the base model is complete, labeled pins can be positioned on the map to refer to natural and man-made elements in the environment, identifying areas affected by climate change and anything else the students and community deem to be relevant.

Required Materials
plywood sheets (model base) | foam core or card (contours) | GIS information | large sheets of carbon paper to transfer contour data onto foam core | paper | glue | paint | pins

Additional Resources (hyperlinks)
IAPAD PACC

Topic 2_The Water Cycle

We forget that the water cycle and the life cycle are one.
Jacques-Yves Cousteau

This topic is about encouraging students to learn about the water cycle, what it is, what its key properties or stages are, how students can see the water cycle at work in their own environment, and how the water cycle is affected by climate change and global warming. The exercises in this topic are selected to help students:

- To realize that water is a limited resource coming from nature and that it is important that we protect and use it well.
- To experience the different states of water and the four primary components of the water cycle.

Image source: WallpaperUp

Topic 2_Technical Background

THE WATER CYCLE

What water is and where you find it

When you look at Earth from space, perhaps its most noticeable feature is its water, covering 70% of the planet's surface. Deep blue oceans hold about 97% of Earth's water, and glistening white ice sheets and glaciers near the poles account for another 2%. Wisps of clouds swirl across the globe, holding water droplets and ice crystals, and even clear skies contain water in the form of vapour. Smaller amounts of water exist in rivers, lakes, and swamps and also hide beneath Earth's surface, buried between rock and soil. Whether stored as solid ice, liquid, or vapour, water exists almost everywhere on Earth's surface.

The steps of the water cycle

The never-ending movement of water between different states is called the water cycle. The sun's energy drives the evaporation of liquid water stored in oceans, seas, lakes, and rivers, providing almost 90% of the water vapour in the atmosphere. Much of the rest comes from transpiration, the release of water vapour from plants. Surprisingly, even a single large oak tree can give off as much as 40,000 gallons of water per year. Once evaporated or transpired, water molecules remain in the atmosphere for about ten days before falling back to the surface as precipitation. Most falls as rain, but some falls as snow or ice. This solid water collects on mountaintops and in glaciers and ice caps, providing a vast storage facility of freshwater. In fact, snowpack in Western states holds as much as 75% of the area's water supplies. Rain and melting snow and ice flow into rivers and oceans and infiltrate the ground, replenishing aquifers and seeping slowing back into bodies of open water. From there, the cycle continues, perpetually moving one of life's most important molecules around the planet.

HOW CLIMATE AFFECTS THE WATER CYCLE

Temperature, evaporation and transpiration

Changes in climate, or the long-standing patterns of weather seen in a given region, alter the water cycle. Temperature plays a particularly important role, as increased heat speeds up the cycle. Warmer temperatures lead to increased rates of evaporation, transpiration, and the amount of water vapour in the air. Over the past century, scientists have observed that temperatures have increased globally, and with this, atmospheric water vapour has also increased. Since what goes up must come down, at least with respect to the water cycle, increased water vapour leads to increased precipitation. The consequences of this on the ground, however, are difficult to predict. Precipitation does not always occur at the same place that evaporation happens, and factors such as geography and atmospheric circulation patterns play a large role in determining where the water eventually falls.

Consequences of increased Evaporation:

A faster water cycle can lead to two seemingly contradictory results: increased drought and increased precipitation and flooding. In some environments, especially those with limited open water, increased evaporation and transpiration dries out the ground, leaving less water to move to the atmosphere, fewer clouds, and less precipitation. Over the past century, the Sahel in Africa, the Mediterranean, southern Asia, and the southwest United States have all become drier. In other environments, particularly those with access to oceans or lakes that provide a more plentiful source of water, more evaporated water can lead to more precipitation. Eastern North and South America, northern Europe, and northern and central Asia have all become significantly wetter over the past century, a change that correlates with increased regional temperatures. And when precipitation occurs, it is more likely to be intense and heavy because the atmosphere contains more water. Rain and snowstorms may then lead to regional flooding. (Laura Holder for Clue Into Climate KQED)

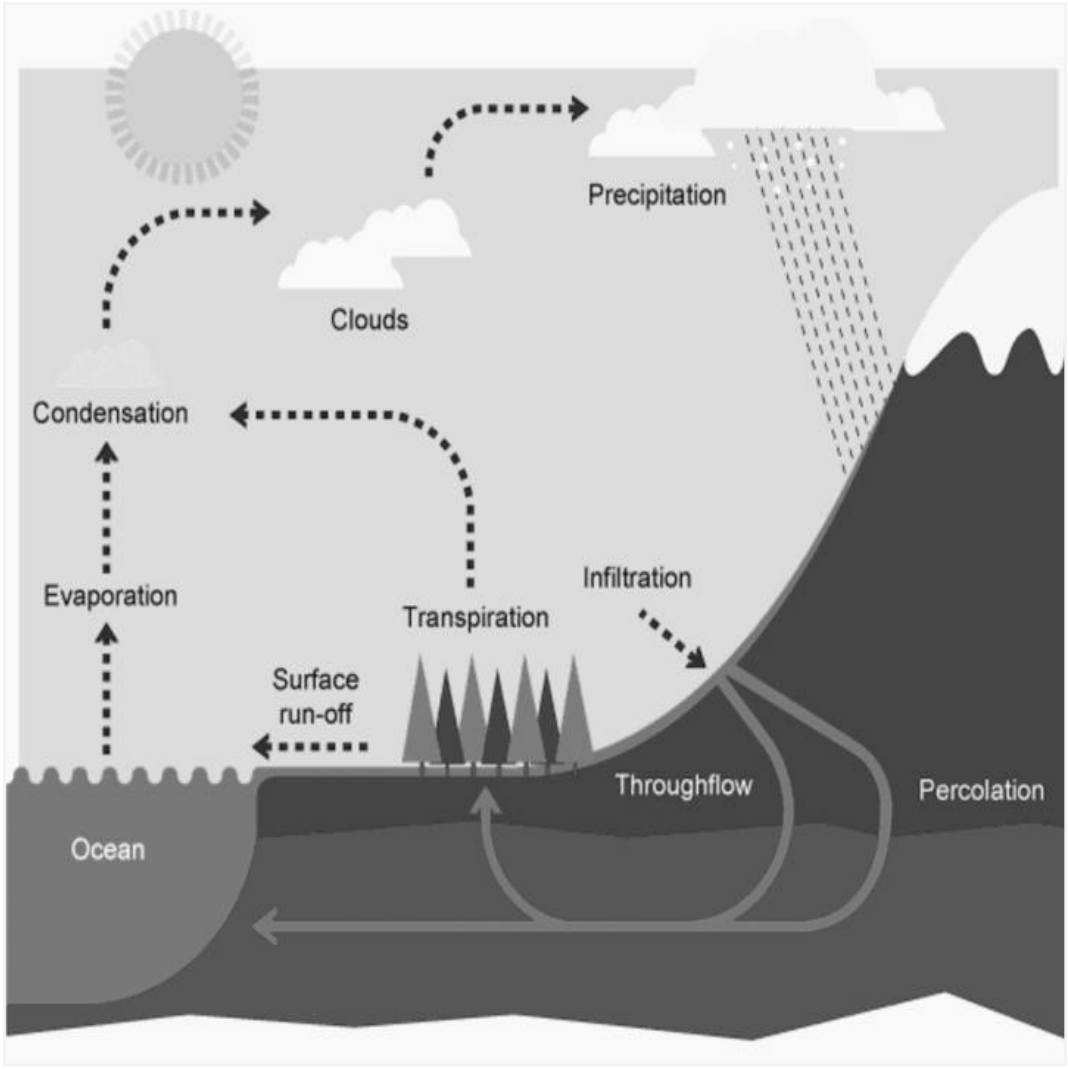


Image source: bbc.co.uk

2.1_What is the water cycle?

DISCUSSION
LEVEL: ADVANCED

Teaching Objective
The objective is to introduce students to the key properties of water cycle and to explain how these properties explain how the water on the earth is in a continuously changing state.

Exercise
ENERGY from the Sun heats the surface of the Earth. WATER evaporates from oceans, rivers, lakes, etc. Warm, MOIST air rises because it is less dense. CONDENSATION occurs when this water vapour comes into contact with a surface (in this case dust particles in the air) and is turned back into water droplets as it cools down and clouds are formed. PRECIPITATION occurs as these water droplets get bigger and heavier and they begin to fall as rain, snow and sleet, etc. When the precipitation reaches the earth's surface, some falls directly into the sea but other water falls on land: Some of the water falling on the land is INTERCEPTED by vegetation. Some water will reach bare ground. Some will EVAPORATE from the surface of leaves or be taken up by the plant roots, and some of this water will eventually return to the air as vapour through the process of TRANSPIRATION. This slows down or prevents some water flowing back to the river. Some water flows across the surface of the ground - surface RUN-OFF. This happens when the surface doesn't allow water to penetrate. Surface run-off is more likely to occur if the ground is SATURATED with water or when the rock is hard and IMPERMEABLE. This water moves quickly to the river. Some water INFILTRATES into the soil. This THROUGH FLOW moves more slowly back to the river than surface run-off. Some water PERCOLATES deeper into the ground and is slowly transferred back to the river or sea. STORES AND TRANSFERS: The movement of water between the major water stores; the ocean, ice caps, land and the atmosphere are called transfers. (bbc.co.uk)

Required Materials
none

Additional Resources (hyperlinks)
SSWM USGS_Downloadable Poster

2.1.2_Water cycle terms

DISCUSSION
LEVEL: ADVANCED

Condensation	The process where water vapor changes from a gas to liquid water.
Water Cycle	The movement of water between the atmosphere and Earth. It includes: Evaporation, Condensation, Precipitation, Surface Runoff, Transpiration and Perspiration.
Transpiration	When plants release water through pores in their leaves back into the atmosphere.
Groundwater	All the water that soaks into the ground, found under the Earth's surface.
Cloud	Millions of tiny water droplets or crystals. They form when water vapor in the air condenses to form liquid water or ice crystals. They can only form when dust particles and cool air are present**
Evaporation	The process where liquid water changes to a gas as water vapor.
Cool Air	Cool air is necessary for condensation to occur in the atmosphere and clouds to form.
Surface Runoff	Water that cannot be absorbed into the surface (the ground is too dense) but runs along it.
Water Vapour	When water is in the gas state.
Precipitation	Any form of water that falls from clouds and reaches Earth's surface. Rain, snow, sleet or hail.
Humidity	The amount of water vapor in the air warm air can hold more water vapor than cool air.
Relative Humidity	The percentage of water vapor in the air compared to the maximum amount of water that the air can hold at a particular temperature.
Dew Point	The temperature at which condensation begins.
Perspiration	When animals release water through pores in their skin back into the atmosphere. It is commonly known as sweat!

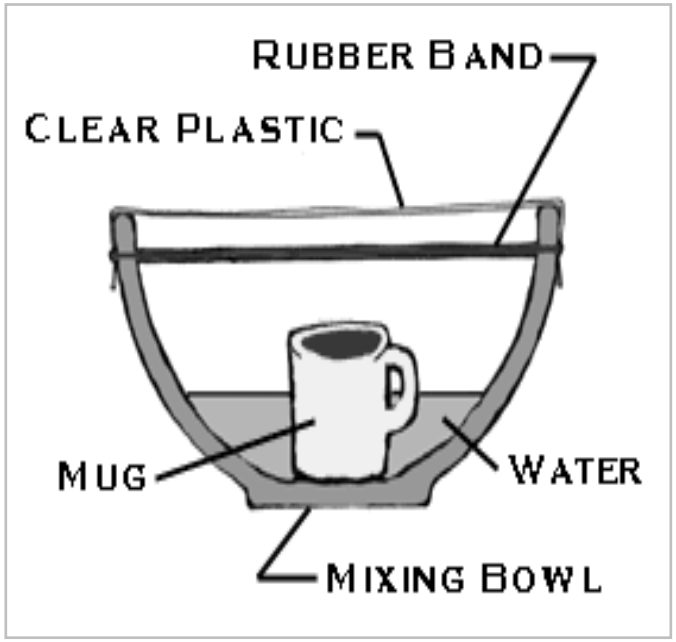


Image source: thewaterproject.org

2.2_Make a water cycle

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
The objective is to enable students to visualize the key processes taking place in the water cycle. Students should understand that water is always changing its state, from liquid to vapour and back again.

Exercise
This small, simple experiment demonstrates what happens at a much larger scale when the sun's heat causes water to evaporate from streams, lakes, rivers, and oceans. Water vapour rises, and eventually reaches cooler air and condenses into clouds. When the clouds are full of water, or saturated, they release some of the water as rain.

Put the bowl in a sunny place outside. Using the pitcher or bucket, pour water into the bowl until it is about ¼ full. Place the mug in the centre of the bowl. Be careful not to splash any water into it. Cover the top of the bowl tightly with the plastic wrap. Tie the string around the bowl to hold the plastic wrap in place. Watch the bowl to see what happens. The "mist" that forms on the plastic wrap will change into larger drops of water that will begin to drip. When this happens, continue watching for a few minutes, then carefully peel back the plastic. Is the mug still empty? Water from the "ocean" of water in the bowl evaporated. It condensed to form misty "clouds" on the plastic wrap. When the clouds became saturated it "rained" into the mug. (The Water Project)

Required Materials
a large metal or plastic bowl | a pitcher or bucket | a sheet of clear plastic wrap | a dry ceramic mug,| a long piece of string or large rubber band | water

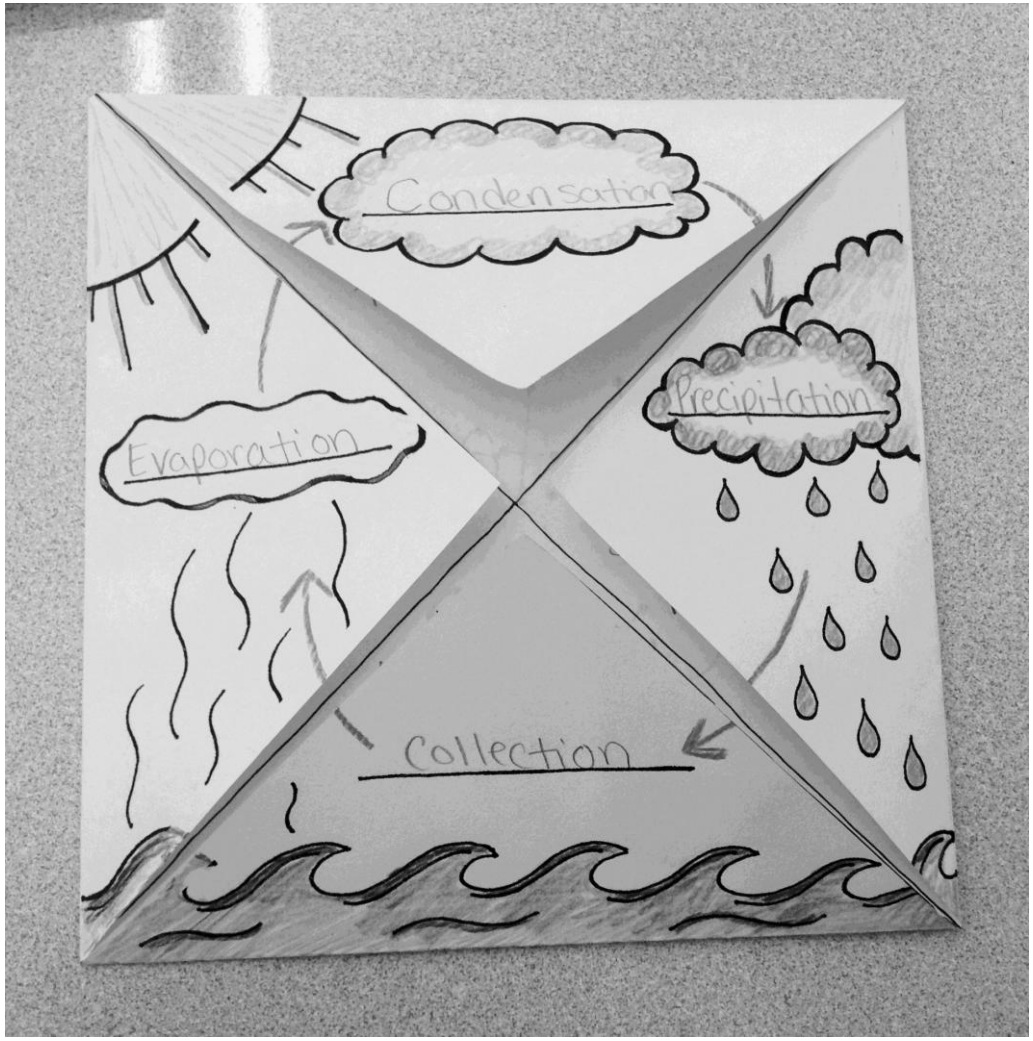


Image source: pinterest

2.3_Water cycle model

CREATIVE ACTIVITY

LEVEL: SIMPLE

Teaching Objective

The objective of this activity is to have the students each demonstrate their understanding of the four key stages of the water cycle: Condensation, Precipitation, Collection, and Evaporation. This project is something they can take home with them and share with their family and siblings.

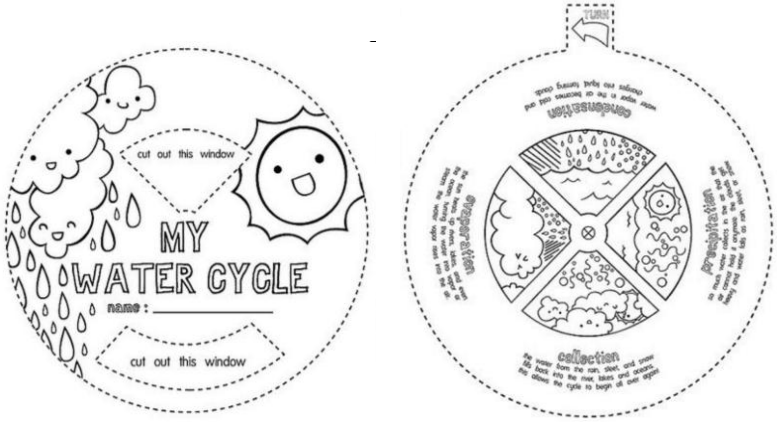
Exercise

Invite students, either individually or in teams, to make a simple paper model illustrating the water cycle. First, begin with a square piece of paper. Second, fold each corner to the centre to form a smaller square. Third, draw a picture of one of the fundamental properties of the water cycle onto each flap. Fourth, underneath each flap they can write the definition for that property.

Required Materials (hyperlinks)

square sheet of paper | pencils or crayons

Image source: pinterest



2.4_ Water cycle wheel

CREATIVE ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The objective of this activity is to have students demonstrate their understanding of the key processes of condensation, precipitation, collection, and evaporation and how and where these processes take place in their own environment.

Exercise
Invite students, either individually or in teams, to make a simple circular paper model illustrating the water cycle in their environment. Are there mountains or hills? Is there a river of lake? Do they see clouds? The model is made up of two circles fixed together in the centre with a pin, that allows the circles to be rotated. The bottom circle illustrates water droplets or moisture moving through the cycle. The top circle illustrates the environment or watershed. Holes cut into the top circle reveal the water moving through the environment.

Required Materials
2 sheets of paper | a pin | pencils or crayons

Additional Resources (hyperlinks)
Template

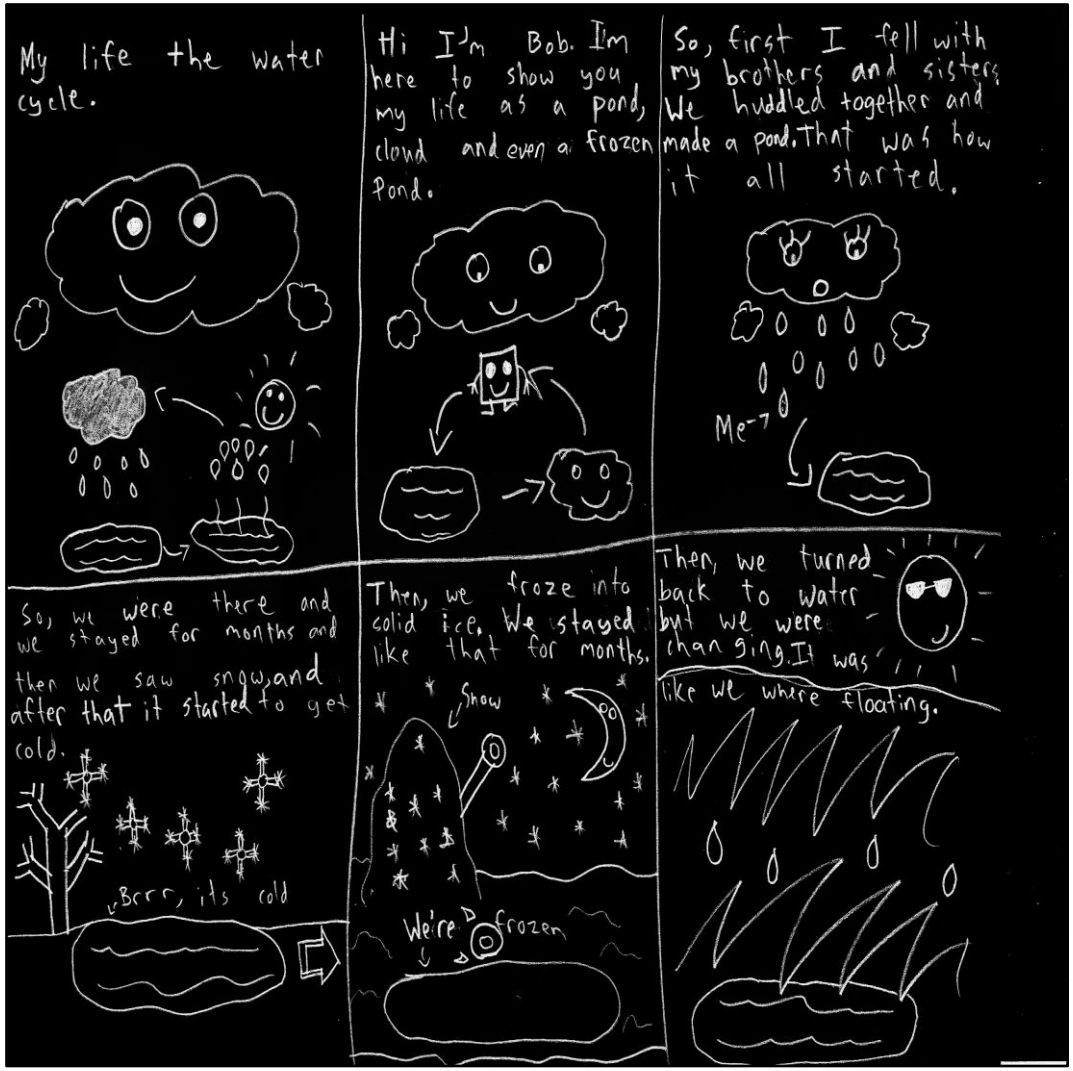


Image source: Wsd Blue and Gold

2.5_Comic strip

CREATIVE ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The objective is to have the students make water cycle processes vivid through a 'fun' or 'witty' comics. This activity gives students the opportunity to demonstrate their understanding of the water cycle through creative story telling.

Exercise
This activity can be in a number of ways; orally, as a story telling, by drawing the comic on a classroom blackboard, or by having the students each draw the comic or story on a piece of paper. Invite students to invent a comic or a story about the adventures of a raindrop. This activity can be done individually, in pairs, or in groups.

Required Materials
none or paper | pencils

Image source: University Corporation for Atmospheric Research

2.6_Poem

CREATIVE ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The objective is to have students demonstrate a deeper, less scientific understanding of the water cycle through the reading and writing of poetry. Poetry can convey subtleties, emotions, feelings and problems in ways that are not expressed through more practical or scientific language.

Exercise
Select a Poem about the water cycle and invite the students to learn it by heart. More advanced students can be invited to make up their own poem about the water cycle.

Required Materials
paper | pencils (no materials needed for the poetry reading)

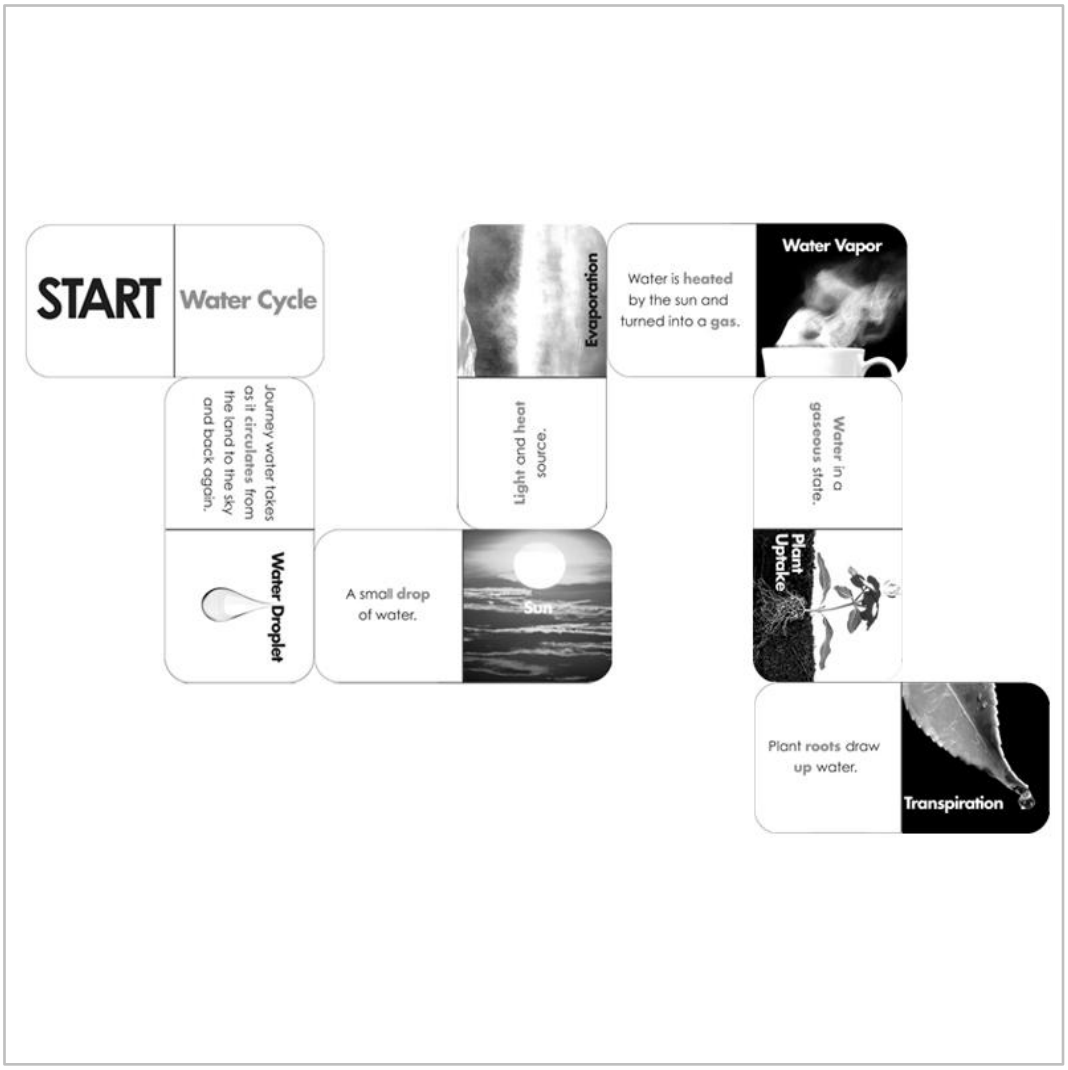


Image source: E is for Explore

2.7_Water cycle dominoes

GAME

LEVEL: ADVANCED

Teaching Objective

The objective of this activity is to enable the students to demonstrate their full understanding of how the water cycle behaves in their environment through the creation and playing of a game of dominoes. The faster and more energetically the game is played, typically the better the understanding of the students.

Exercise

This is a game can either be made in advance by a teacher or as part of the activity by the students themselves. 28 images and 28 statements paired with those images should be selected. The images can illustrate aspects or details of the students natural environment and the written descriptions paired with them should describe water cycle processes that would be taking place in the image. When playing the game, students need to match each image to its correct statement or description.

Required Materials

paper or cardstock | glue | pencils, crayons or pens

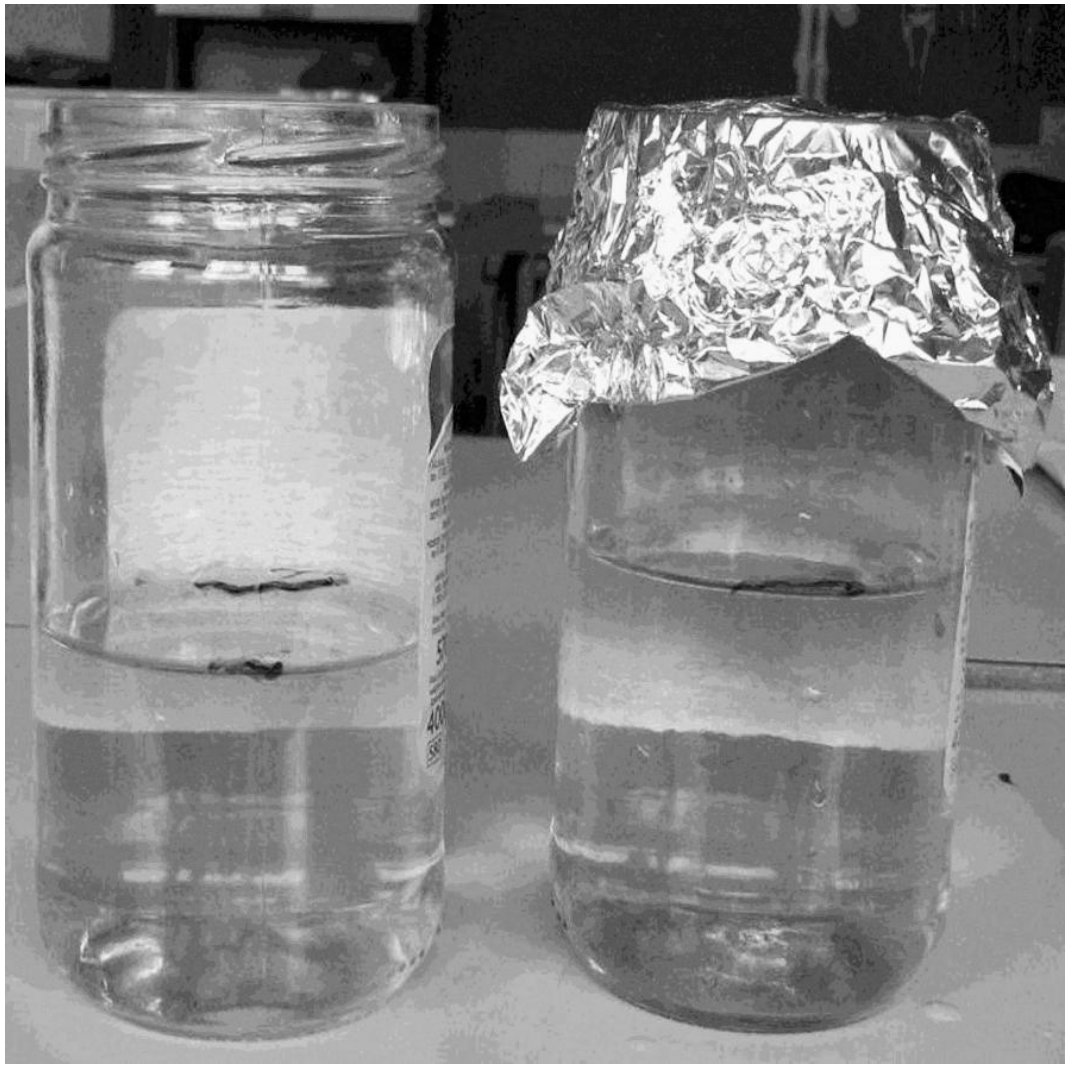


Image source: Elements of Science

2.8_Evaporation in a jar

EXPERIMENT

LEVEL: SIMPLE

Teaching Objective

The objective of this exercise is to see the principle of evaporative loss at work. This experiment demonstrates that when water is left uncovered and exposed to the sun, it evaporates far more quickly that water that is covered. This is a way of illustrating the value of covered water tanks in hot climates.

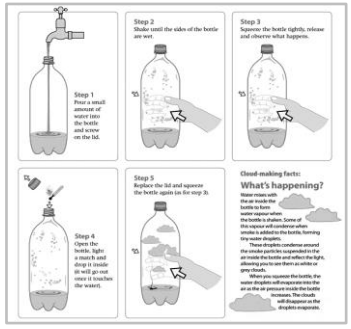
Exercise

Fill two identical glass jars with water. Leaving one of the jars uncovered, cover the other one with an improvised aluminium foil lid. Make the lid as secure as possible. Then, take the jars outside and place them both in an equally sunny spot. Draw a picture of the jars, noting the current water levels. Return to the experiment every day for the next week to observe and draw the current state of the water jars. You will observe that the water in the uncovered jar “disappears” more every day, while the water in the covered jar evaporates at a much slower rate because the evaporation process is blocked by the aluminium foil.

Required Materials

2 glass jars of the same size | water | aluminium foil | a marker pen

Image source: Herald Sun



2.9_Cloud in a jar

EXPERIMENT

LEVEL: SIMPLE

Teaching Objective

The objective is to make vivid the process of condensation, that forms clouds and makes it possible for rain to fall, irrigating the land.

Exercise

Clouds are formed when rising moist air cools. The water molecules condense around particles of dust or smoke forming water droplets. In this experiment, you will create a mini cloud in a glass jar using hot water, a lit match, and ice.

A few minutes before beginning the demonstration, warm the jar by partially filling it with hot water. Leave the water in the jar until right before you are ready to use it. Put a handful of ice cubes into the plastic bag or a pouch made from plastic wrap. Keep the bag of ice handy so you have it ready during step 5 of the activity. At the beginning of the demo, swirl the warm water around the sides of the jar to clear any condensation. Then pour out that water and pour several cups of very hot or boiling water back into the jar. Light the match and drop it into the jar. The water will extinguish the flame and a small amount of smoke will rise from the surface of the water. Quickly place the bag or plastic pouch with the ice cubes over the top of the jar so that it hangs down into the jar slightly. Pull the sides of the plastic bag down over the mouth of the jar and secure with a rubber band or the jar lid.

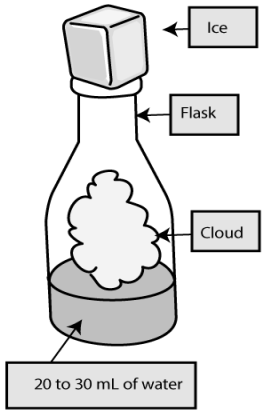
Required Materials

glass Jar (preferably a gallon) | garbage bag or plastic wrap | large rubber bank | match | ice cubes | very hot water.

Additional Resources (hyperlinks)

Science Illustrated The Water Project

Image source: Rusticremnants



2.10_Rain in a jar

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
The objective is to demonstrate the principle of precipitation. Water vapour requires contact with a surface in order to condense and become liquid. In the jar that surface is the glass and in the air it is the dust.

Exercise
Boil Water until Steaming. Fill 1/3 of glass jar with steaming water. Cover mouth of jar with plate. Wait 2 minutes. Put some ice cubes on the plate and watch carefully to see what happens in the jar. You should be able to see little streams of water running down the sides of the jar just like the way rain runs down a windows when it is raining outside.

Required Materials (hyperlinks)
glass jar | plate | boiled water | ice cubes

Image source: Teach Beside Me

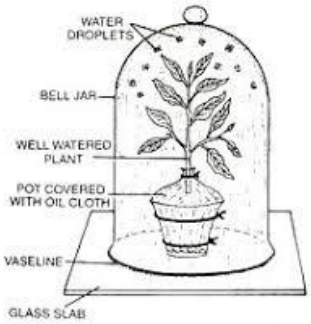


Fig. 11.31. Demonstration of transpiration by bell jar experiment.

2.11_Transpiration in a bag

EXPERIMENT

LEVEL: SIMPLE

Teaching Objective

The objective is to show students transpiration at work and to convey that without plants emitting water vapour into the air the air becomes dry, rainfall decreases and the ground dries, making it hard to sustain plants.

Exercise

This shows at a small scale what happens when areas are deforested and why deforestation triggers the drying out of the air and land, a process also known as desertification.

Identify a plant and cover the while plant or part of it with a plastic bag or glass jar. Condensation will form on the surface of the bag or jar, revealing the transpiration process in the plant.

Required Materials

plant | a plastic bag and string or a bell jar

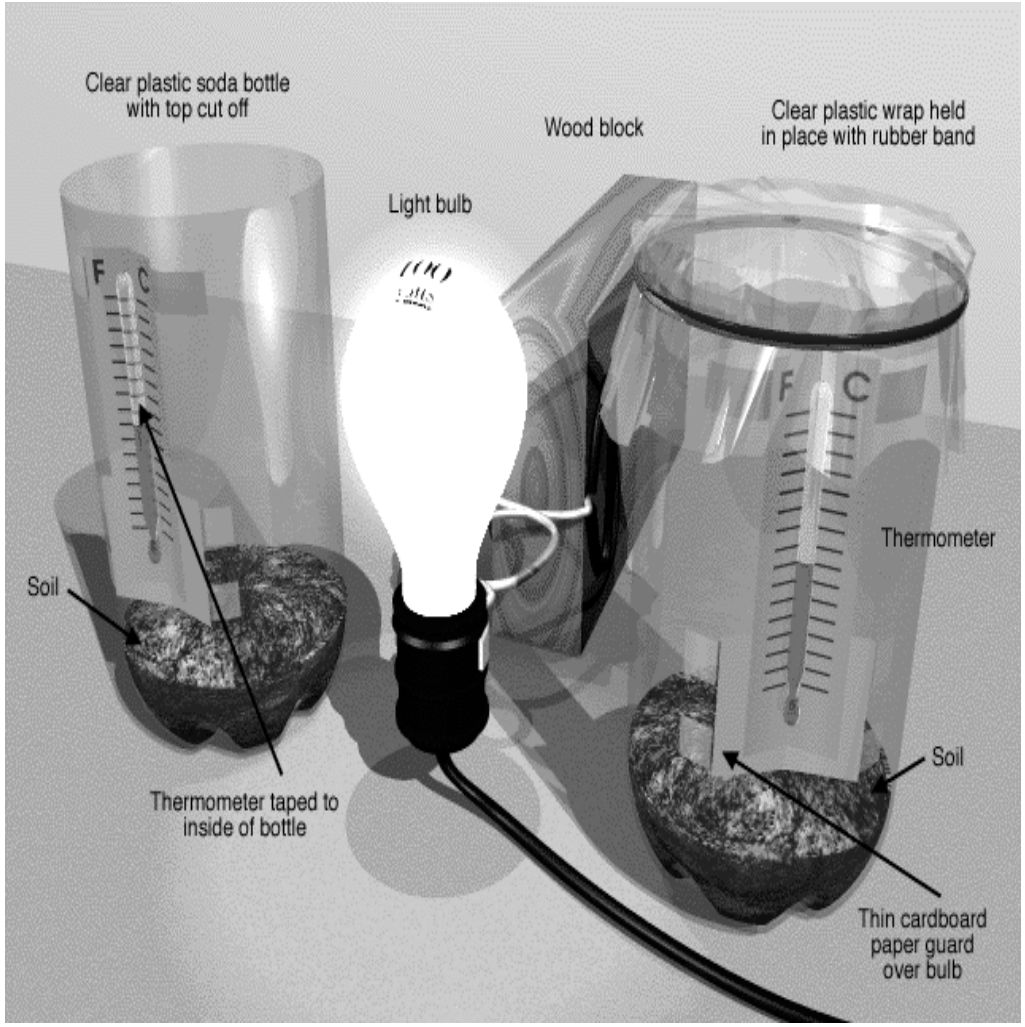


Image source: Bigelow Laboratory for Ocean Sciences

2.12_Global warming in a jar

EXPERIMENT

LEVEL:ADVANCED

Teaching Objective

The students will observe global warming using 2-liter plastic bottles, soil, and water to create a greenhouse effect. They will measure temperature changes as well as the effects of soil dampness. Key concepts include: how a greenhouse works, how the “greenhouse effect” keeps the earth warm for human habitation, and how Global warming is increasing the Earth's average temperature.

Exercise

To make the Greenhouses, cut half of the bottles near the shoulder (these are the experiment bottles) and the other half, about 4” from the bottom of the bottle (these are the control bottles). Let the bottles sit in direct sunlight for 30-50 minutes. Find a place where the bottles can remain undisturbed and be in direct sunlight for the duration of the experiment. Position a thermometer in each bottle. Make sure all thermometers are facing the same direction relative to the light source. To test the effect with damp soil, add the same amount of soil to the bottom or the experiment bottle and the control bottle. For testing the effect on water temperature, add the same amount of water to each bottle and make sure the bulb of the thermometer is the same amount into the water. For testing the effect on iced water, begin with about 3” of water in each bottle, marking the level of water with a marker on each bottle. Add 6-12 ice cubes to each bottle. In this experiment change in the water level is more important than the temperature difference. Continue the experiment until all the ice is melted.

Required Materials

2 clear plastic 2-liter bottles per team of students | plastic wrap or clear plastic bags to cover the "greenhouses” | string or rubber bands to hold the plastic in place | 2 thermometers per team | 2 2”x 2" pieces of thin cardboard | soil | ice cubes | water | plastic rulers | masking tape | utility knife or saw for cutting the plastic bottles | sunshine

Additional Resources (hyperlinks)

Bigelow Laboratory for Ocean Sciences The Water Project Yale

Image source: Aguasan

2.13_Water & nutrient cycle puzzle

GAME

LEVEL: MEDIUM TO ADVANCED

Teaching Objective

The objective of this exercise introduce the concept of nutrient cycles in the environment and how water plays a very important part in keeping nutrients in the right place.

Exercise

This puzzle concerns the role and complexity in the water cycle and nutrient cycle can be made downloaded from the link provided.

Required Materials

paper or cardstock | pencils | crayons or pens

Additional Resources (hyperlinks)

Aguasan

Image source: WikiHow

2.14_Plant in a bottle

EXPERIMENT

LEVEL: EASY

Teaching Objective

The objective of this exercise exemplify the concept of nutrient and water cycles and how in a closed system it allows plants to grow.

Exercise

1. Select your bottle. The bottle should be large enough to allow room for plants to grow. Clean it and allow the bottle to dry thoroughly before using it. The larger the opening, the easier it'll be to maintain the garden.
2. Turn the bottle right-side up. This will form the base of the bottle garden.
3. Place pebbles and sand on the base of the bottle. You can use a small spoon through the mouth of the bottle to add the pebbles and sand and move them around. This will provide a good drainage base for the plants. Wet the sand before putting it in place. Do not underestimate the importance of good drainage, as the bottle does not have drainage holes and wet substrate can lead to fungus issues.
4. Cover the sand and pebbles with soil. The soil should be good quality and pre-dampened. If you accidentally get soil on the sides of the bottle, obscuring the view, you can tie gauze or cotton to the end of a pencil and reach in to wipe off the soil.
5. Plant the garden. Choose seeds of small indoor plants. Place the seeds in the soil. Put the seeds in different spots to make it an interesting arrangement. Bottle gardening lends itself well to plants which require a good deal of humidity (e.g. tropical plants) because the bottle will trap moisture.
6. Watch the plants grow. Tend to them as they mature. The plants will need air and moisture. Be sure to perforate the lid or cap of the bottle or jar, or don't put it on at all. Only water when no condensation is observed on the glass.

Required Materials

bottle with lid | pebbles and sand | soil | seeds of small indoor plants | water

Additional Resources (hyperlinks)

WikiHow

Topic 3_The Watershed around My School

Water is the driving force of all nature.
Leonardo da Vinci

The topic is about encouraging students to learn about the watershed in which they live. Through discussions and activities the students can understand what a watershed is, why it is important to them, how a watershed can change over time and be affected by climate change and how unsustainable human behaviour can damage the watershed.

The exercises in this topic are selected to help students :

- To understand what a watershed is, where water comes from and who are the different water users in my environment.
- To recognize the impact of overuse, pollution and practices such as deforestation on the quantity and the quality of my water.
- To find out what we can to do to protect our watershed.

Topic 3_Technical Background

What is a watershed? If you are standing on ground right now, just look down. You're standing, and everyone is standing, in a watershed. A watershed is the area of land where all of the water that falls in it and drains off of it goes to a common outlet. Watersheds can be as small as a footprint or large enough to encompass all the land that drains water into rivers that drain into a bay where it enters the ocean.

A WATERSHED IS A PRECIPITATION COLLECTOR
Most of the precipitation that falls within the drainage area of a stream, collects in the stream and eventually flows downstream. Imagine that the whole basin is covered with a big (and strong) plastic sheet. Then if it rained one inch, all of that rain would fall on the plastic, run downslope into gullies and small creeks and then drain into main stream. Ignoring evaporation and any other losses, then all of the water that fell as rainfall would eventually flow by to the outflow point of the watershed.

NOT ALL PRECIPITATION THAT FALLS IN A WATERSHED FLOWS OUT
To picture a watershed as a plastic-covered area of land that collects precipitation is overly simplistic and not at all like a real-world watershed. There are many factors that determine how much water flows in a stream (these factors are universal in nature and not particular to a single stream):

Precipitation: The greatest factor controlling stream flow, by far, is the amount of precipitation that falls in the watershed as rain or snow. However, not all precipitation that falls in a watershed flows out, and a stream will often continue to flow where there is no direct runoff from recent precipitation.

Infiltration: When rain falls on dry ground, some of the water soaks in, or infiltrates the soil. Some water that infiltrates will remain in the shallow soil layer, where it will gradually move downhill, through the soil, and eventually enters the stream by seepage into the stream bank. Some of the water may infiltrate much deeper, recharging groundwater aquifers. Water may travel long distances or remain in storage for long periods before returning to the surface. The amount of water that will soak in over time depends on several characteristics of the watershed:

Soil characteristics: Clayey and rocky soils absorb less water at a slower rate than sandy soils. Soils absorbing less water results in more runoff overland into streams.

Soil saturation: Like a wet sponge, soil already saturated from previous rainfall can't absorb much more, thus more rainfall will become surface runoff.

Land cover: Some land covers have a great impact on infiltration and rainfall runoff. Impervious surfaces, such as parking lots, roads, and developments, act as a "fast lane" for rainfall - right into storm drains that drain directly into streams. Flooding becomes more prevalent as the area of impervious surfaces increase.

Slope of the land: Water falling on steeply-sloped land runs off more quickly than water falling on flat land.

Evaporation: Water from rainfall returns to the atmosphere largely through evaporation. The amount of evaporation depends on temperature, solar radiation, wind, atmospheric pressure, and other factors.

Transpiration: The root systems of plants absorb water from the surrounding soil in various amounts. Most of this water moves through the plant and escapes into the atmosphere through the leaves. Transpiration is controlled by the same factors as evaporation, and by the characteristics and density of the vegetation. Vegetation slows runoff and allows water to seep into the ground.

INTEGRATED WATER RESOURCES MANAGEMENT
Promoted across the world, this concept aims to promote changes in practices which are considered fundamental to improved water resource management. There are three interrelated principles:

1. Ensuring equal access for all users (particularly marginalised and poorer user groups) to an adequate quantity and quality of water necessary to sustain human well being (principle of social equity);
2. Bringing the greatest benefit to the greatest number of water users possible with the available financial and water resources (principle of economic efficiency);
3. Requiring that adequate allocation is made to sustain aquatic ecosystems and their natural functioning (principle of ecological sustainability).

Reference: (USGS)
https://en.wikipedia.org/wiki/Integrated_water_resources_management

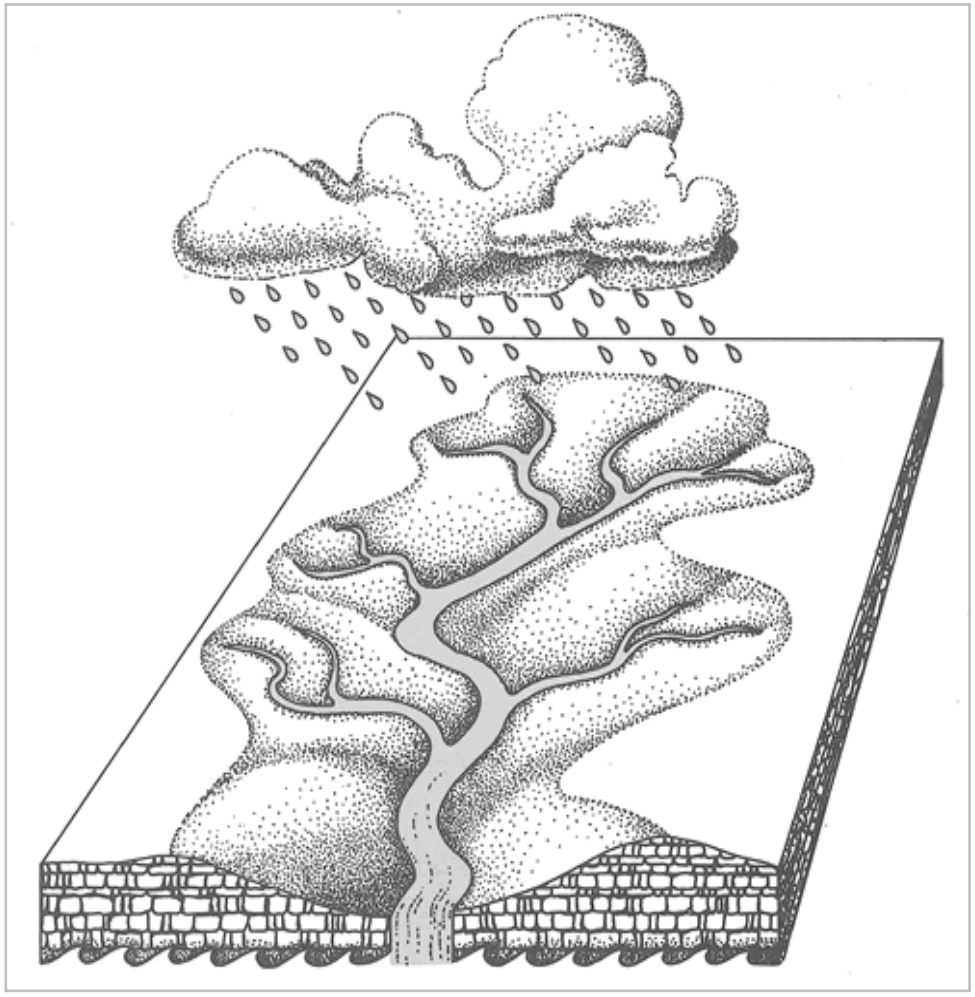


Image source: Soundbook Online

3.1_What is a watershed?

DISCUSSION

LEVEL: SIMPLE TO ADVANCED

Teaching Objective

The purpose of this exercise is to teach students that a watershed is defined as the land area drained by a particular river or stream, how to find the limits of the watershed in which they live and how certain practices like deforestation negatively affect the watershed.

Exercise

Conduct a discussion around the following concepts: Imagine a watershed as an enormous bowl. As water falls onto the bowl's rim, it either flows down the inside of the bowl or down the outside of the bowl. The rim of the bowl or the watershed boundary is sometimes referred to as the ridgeline or watershed divide. This ridge line separates one watershed from another. (Watershed Delineation). All human beings live in a watershed. A watershed is an area of land that drains into a body of water. When rain falls it lands on trees, grass, homes, roads, farms, gardens, schools and more. Natural surfaces absorb that water, but paved surfaces, buildings, and landscaped plots send most of the water flowing over land, downhill to nearby streams. We call that water runoff, and it carries with it anything that's on the land – soil, fertilizer, feces trash and more. Forests transport large quantities of water into the atmosphere via plant transpiration. This replenishes the clouds and instigates rain that maintains the forests. When deforestation occurs, precious rain is lost from the area, flowing away as river water and causing permanent drying. Without trees, eventually the land will become a desert. (USGS)

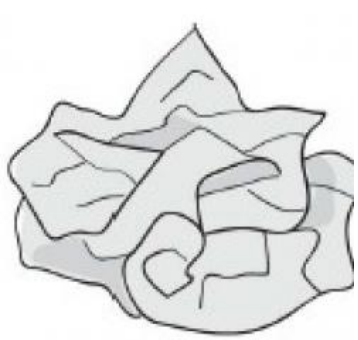
Required Materials

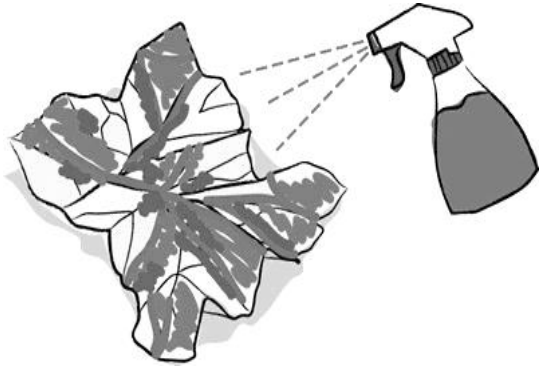
none

Additional Resources (hyperlinks)

USGS

Image source: https://ttfwatershed.org





3.2_Crushed paper watershed

EXPERIMENT

LEVEL: SIMPLE

Teaching Objective

The purpose of this exercise is to allow students to understand the principle attributes that define a watershed.

Exercise

First introduce the students to the following definitions and concepts: What is a watershed? A watershed is an area of land that drains into a body of water. When rain falls it lands on trees, grass, homes, roads, farms, gardens, schools and more. Natural surfaces absorb that water, but paved surfaces, buildings, and landscaped plots send most of the water flowing over land, downhill to nearby streams. We call that water runoff, and it carries with it anything that's on the land – soil, fertilizer, faeces trash and more. Then, invite the students to make a simple model of a watershed by crumpling two pieces of paper, flattening them out slightly and then marking onto the top sheet, the high points of the model's topography with water soluble markers. The high points on the model define the watershed boundary. The low points define the rivers and water basins. Once the high points) and low points are marked, spray the model with water and watch water run down the slopes and soak in to the paper.

Required Materials

2 pieces of plain A4 scrap paper | pray bottle | water | water-based markers (blue, brown, and black)

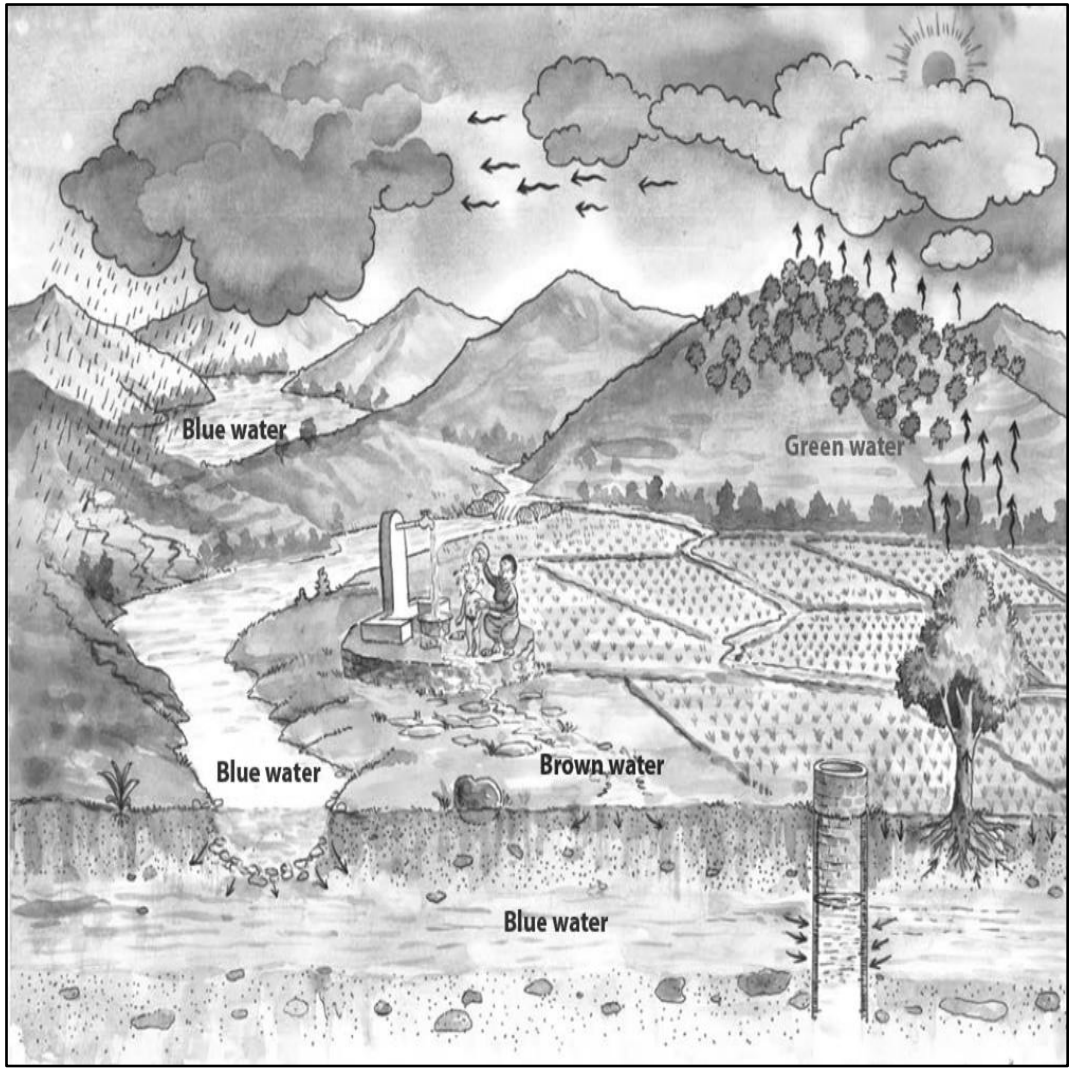


Image source: Helvetas Nepal

3.3_Picturing my watershed

CREATIVE ACTIVITY
LEVEL: SIMPLE TO ADVANCED

Teaching Objective
The purpose of this exercise is to use creative processes of drawing or painting to describe the watershed they are living in, in order that the student becomes even more familiar with it. The pictures can emphasize the features of the watershed, human interventions in it, and the things they love and find difficult about living in it.

Exercise
Students can work individually or in groups to draw or paint their watershed. This activity can be directed to focus on specific or more general aspects, on the natural and the man-made elements affecting it.

Required Materials
paper | pencils | coloured pencils or paints

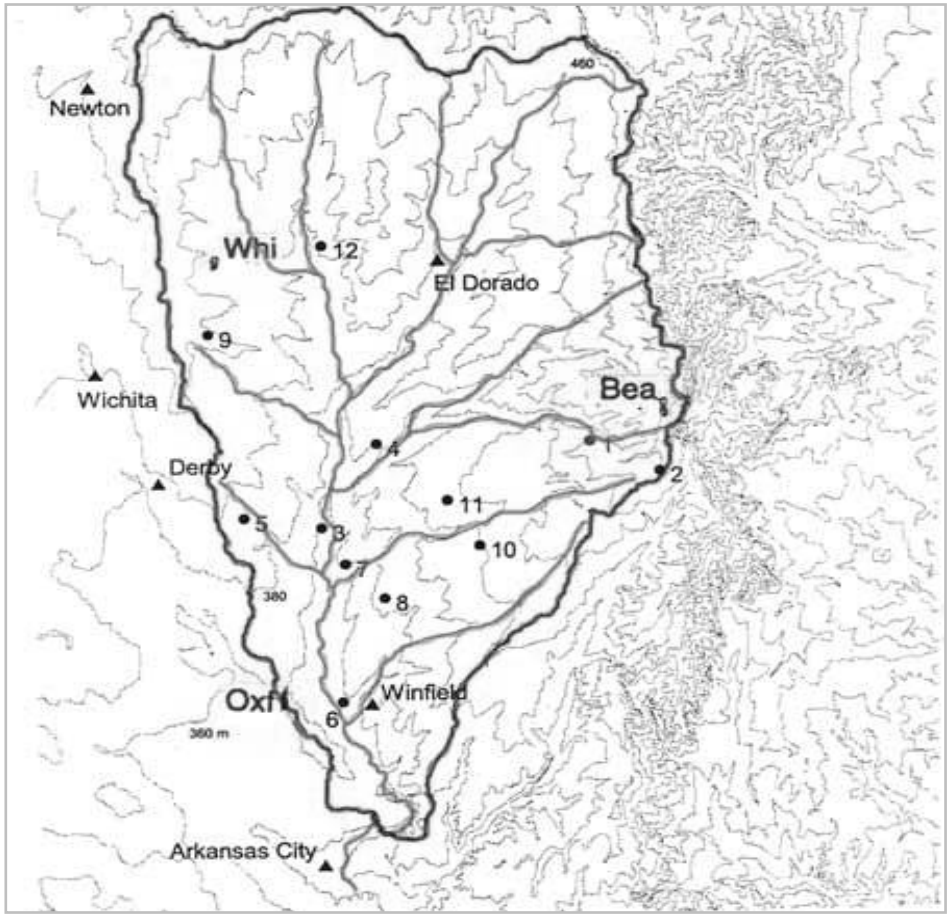
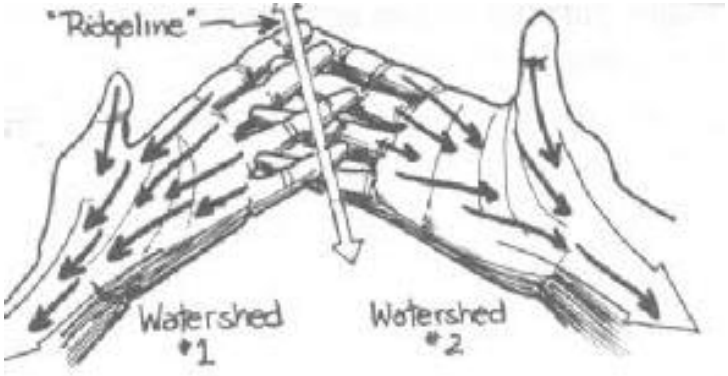


Image source: Globe.gov



3.4_Drawing my watershed

EXPERIMENT

LEVEL: MEDIUM TO ADVANCED

Teaching Objective

The purpose of this exercise is to teach students how to find their own watershed from studying a topographic map.

Exercise

Use a topographic map to locate the river, lake, stream, wetland, or other water bodies of interest. Trace the watercourse from its source to its mouth, including the tributaries. This step determines the general beginning and ending boundaries. Examine contour lines on the topographic map that are near the watercourse. Contour lines spaced far apart indicate that the landscape is more level and gently sloping. Contour lines spaced very close together indicate stepper areas. Check the slope of the landscape by locating two adjacent contour lines and determine their respective elevations. A depressed area (valley, ravine, swale) is represented by a series of contour lines “pointing” towards the highest elevation. A higher area (ridge, hill) is represented by a series of contour lines “pointing” towards the lowest elevation. Determine the direction of drainage in the area of the water body by drawing arrows perpendicular to a series of contour lines that decrease in elevation. Storm water runoff seeks the path of least resistance as it travels downslope. Mark the break points surrounding the water body. The “break points” are the highest elevations where half of the runoff would drain towards one body of water, and the other half would drain towards another body of water. Imagine a drop of rain falling on the surface of the map. Imagine the water flowing down the slopes as it crosses contour lines at right angles. Follow its path to the nearest stream that flows to the water body you are studying.

Required Materials

Paper | pencils | topographic map

Additional Resources (hyperlinks)

Watershed Delineation

Topic 4_My Drinking Water

When the well is dry we will know the worth of water.
Benjamin Franklin

This topic is about encouraging students to understand the importance of clean drinking water. The exercises in this topic are selected to help students:

- To understand that clear water is not always safe to drink.
- To experience and practice how to make water safe for drinking, by safe storage and water treatment at school and at home.

Image source: Water for Africa

Topic 4_Technical Background

SAFE WATER

Water is essential to life. More than 90% of deaths from diarrheal diseases in the developing countries occur in children under five years old (WHO/Unicef). Malnutrition also reduces children's resistance to infectious diseases. Access to safe drinking water is then a top priority to reduce child mortality today.

This section aims to make students realise the importance to drink safe water for their health and give them practical tools on how to make sure the water they drink is safe.

It focuses on:

- Introducing the concept of water quality, and that clear water is not necessarily clean water;
- The difference in water quality depending on the source of water;
- The importance of transport and storage;
- How to treat water at the school and at home.

WATER PURIFICATION

There are five steps to basic water purification: aeration, coagulation, sedimentation, filtration, and disinfection. Aeration adds air to the water. It allows gases trapped in the water to escape and adds oxygen to the water. Coagulation is the process which allows dirt and other suspended solid particles to chemically 'stick together' into flocks (clumps of alum and sediment). During this step, the water is also clarified, or made clear and colourless. Sedimentation is the process that occurs when gravity pulls the particles of flocks to the bottom of the container. So as the water sits undisturbed, most of the flocks settles, preparing the water for the next step. Filtration is the process where remaining solid particles and flocks are separated and removed from the water. Disinfection is the final step, in which water is treated with solar energy or chemicals (chlorine) to remove bacteria and other micro-organisms. These unseen bacteria can cause severe sickness and even death in humans. Toxic chemicals and heavy metals may require further steps to make the water safe to drink. (Home Science Tools)

Image source: Pinsdaddy.com

4.1_Clear water isn't clean water

EXPERIMENT

LEVEL: SIMPLE

Teaching Objective

The purpose of this exercise is to demonstrate to students that clear water is not always safe to drink. Clear water may contain many things invisible to the eye that can make us ill; such as effluent from human and animal excreta, and fertilizers and chemicals used to grow food.

Exercise

Bring four water bottles full of safe drinking water where one bottle has dissolved salt, one has dissolved sugar, one has cinnamon or other spice (to visibly discolour the water) and one bottle without any additive. Have participants choose which water they would like to drink. Have them take a large sip in a cup. Make sure they are facing the group so that the group may view their reaction to the taste. Participants can take turns, but make sure to rearrange the water bottles between each taste test in order to preserve the surprise. Shake water bottles as necessary. Next, ask group members what they have learned from this activity. Which water bottles look clean? Is a clean-looking one always actually pure? How does this translate to our lives? This activity should get people thinking about the water they drink in their own households. (Peace Corps)

Required Materials

4 plastic water bottles | water | salt | sugar | cinnamon (or other visible spice)

Image source: CHAST

4.2_Safe storage and transportation

DISCUSSION
LEVEL: SIMPLE

Teaching Objective
The objective of this activity is for student to understand the importance of transportation and safe storage to keep water safe to drink.

Exercise

Show students different ways to transport and store water, an discuss which one are safe and which are not. Explain the risks of unsafe practices, and how to improve the process, for example by keeping the storage containers clean and closed by a lid.

There are a few important points:

- Treated water should be stored in plastic, ceramic, or metal containers especially when using treatment options that do not leave residual protection. The following characteristics of containers serve as physical barriers to recontamination (CDC & U.S. AID 2009);
- A medium sized, easy to clean opening with a lid or cover that discourages users from placing potentially contaminated items such as hands, cups, or ladles into the stored water;
- A spigot or small opening to allow easy and safe access to the water without requiring the insertion of hands or objects into the container;
- A size appropriate for the household water treatment method, with permanently attached instructions for using the treatment method and for cleaning the container.

Required Materials
Pictures or drawings of different types of storage vessel

Main reference (hyperlinks)
SSWM
Additional resource (hyperlinks)
CHAST, Caritas Switzerland

4.3_Water filter in a bottle

EXPERIMENT
LEVEL: SIMPLE

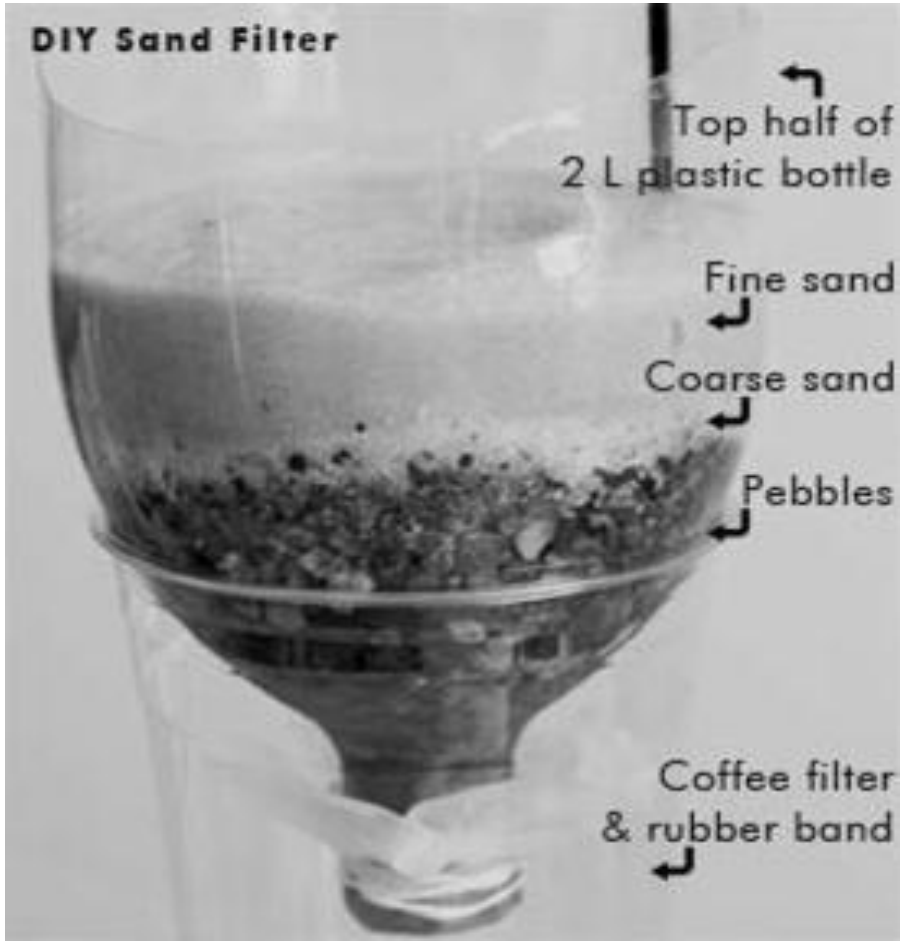
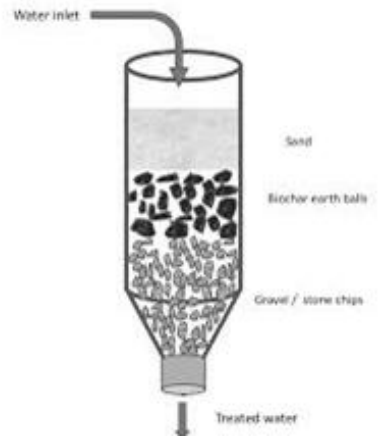


Image source: Home Science Tools



Teaching Objective
The purpose of this demonstration is to show the basic principles of water filtration at work.

Exercise
Remove the bottom of a plastic soda bottle. Cover the cap end of a plastic bottle with a coffee filter and secure with a rubber band. Add the gravel (or small pebbles). Add the course sand and than add the fine sand. Set the bottle up side down on the bottom of the bottle that was cut off or in a glass jar. Pour in the dirty water and watch what happens. Activated charcoal can be added to the filter between the gravel layer and the course sand layer if available.

Required Materials
soda bottle with lid | 2 cups of fine sand | 1 cup of coarse sand | 1 cup of small pebbles | filter paper or coffee filter | rubber band | spoon | half a litre of dirty water

Additional Resources (hyperlinks)
How to make a water filter Wikihow

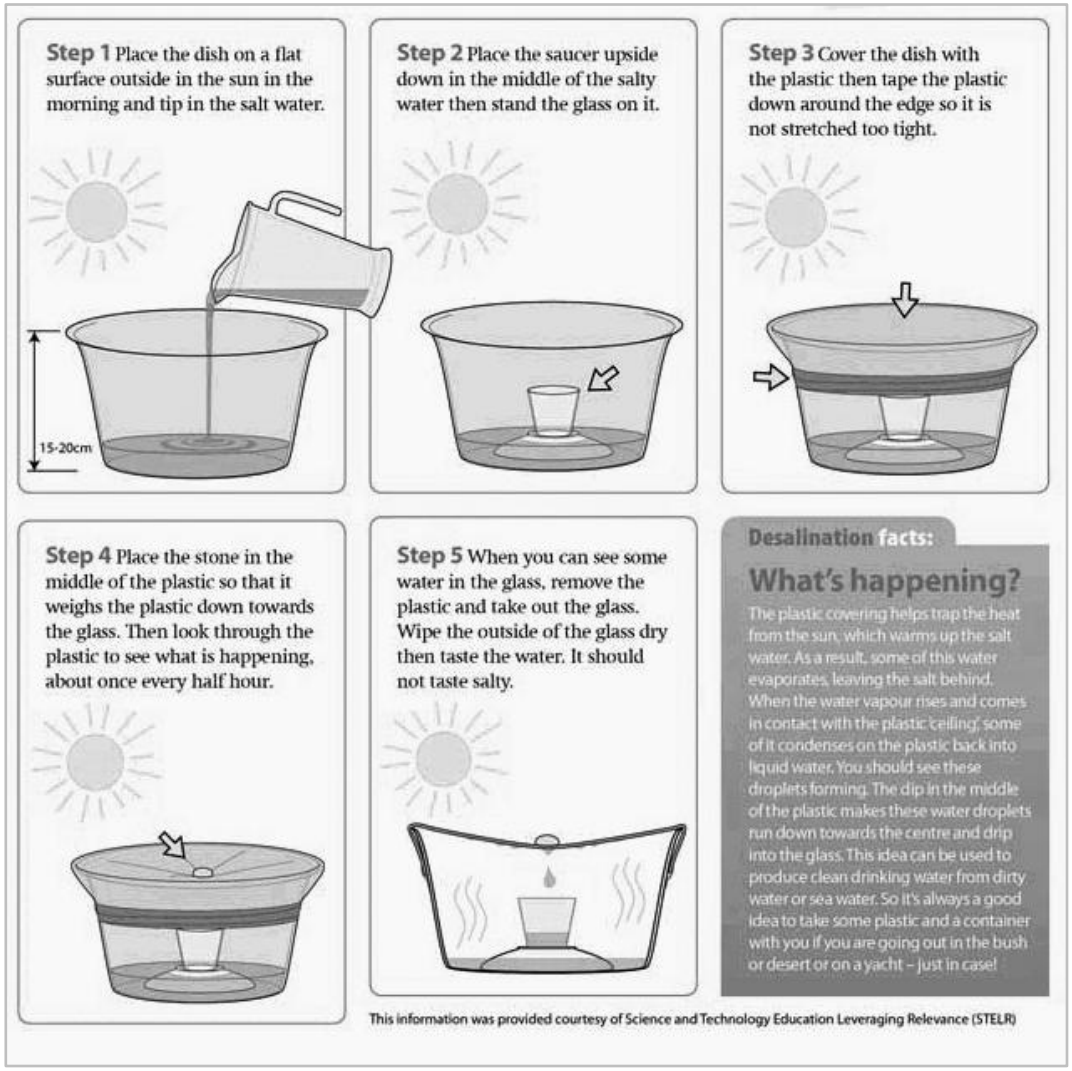


Image source: [Science illustrated]

4.4_Mini desalination plant

EXPERIMENT

LEVEL: MEDIUM

Teaching Objective

The purpose of this experiment is to allow students to understand the principle of desalination and water purification

Exercise

Place the dish on a flat surface, outside in the morning sun and add the salt water. Place the saucer upside down in the middle of the bowl and stand the glass on it. Cover the dish with plastic and tape it down so that the surface is tight. Place a stone in the middle of the plastic and observe what is happening every 30 minutes. When you can see water collecting in the glass, remove the plastic and glass and taste the water.

Remark

Many natural waters are low in many minerals or soft (low in divalent ions). That water may contain desirable substances has received less attention in guidelines and regulations, but an increased awareness of the biological value of water has occurred in the past several decades. Demineralised water is defined as water almost or completely free of dissolved minerals as a result of distillation. It has been adequately demonstrated that consuming water of low mineral content has a negative effect on homeostasis mechanisms, compromising the mineral and water metabolism in the body.

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Required Materials

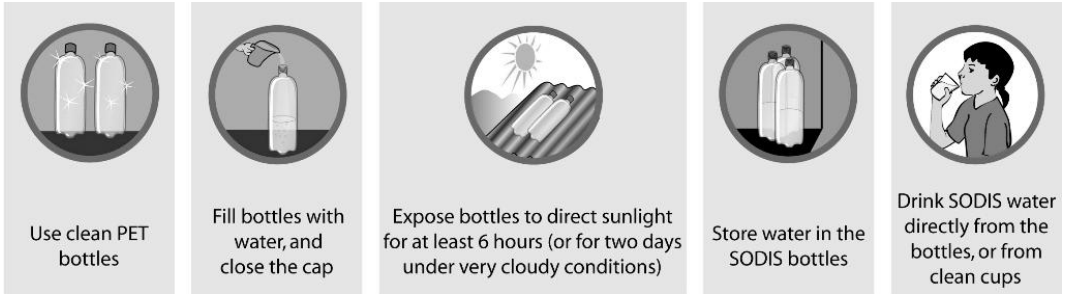
flat bottomed glass dish | drinking glass | saucer | 2 cups of sea water or water with salt dissolved in it | plastic film | masking tape or rubber band | stone

4.5_Solar water disinfection

EXPERIMENT

LEVEL: SIMPLE

Image source: SODIS Eawag Fundacion SODIS



Teaching Objective

The purpose of this experiment is to demonstrate how to disinfect water using solar energy

SODIS is a water treatment method which uses solar energy to improve the microbiological water quality. It is used at household level to treat small quantities of drinking water. The treatment process is a simple technology using solar radiation to inactivate and destroy pathogenic microorganisms present in the water. The treatment basically consists in filling transparent containers with water and exposing them to full sunlight for about six hours.

Exercise

Using clean PET bottles, fill with water and close the cap. Expose the bottles to direct sunlight for at least 6 hours (or for two days under cloudy conditions). Store the water and drink from clean cups. This method does not work under conditions of continuous rainfall. During the rainy season harvested rain is the best option.

Required Materials

PET water bottles | water

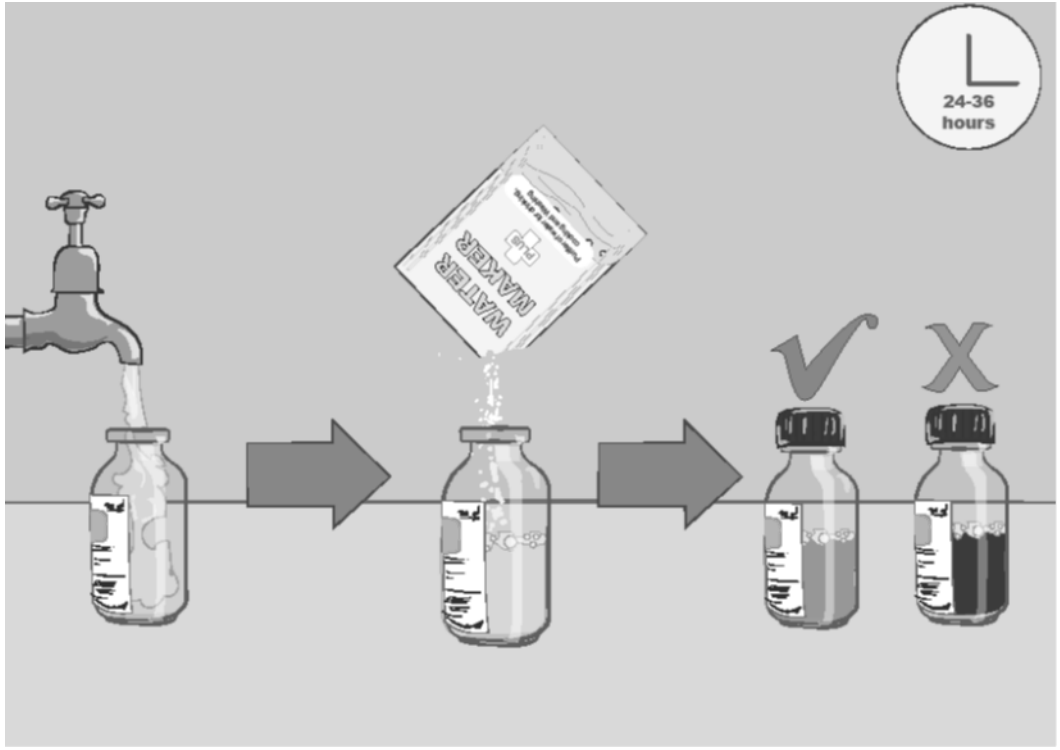


Image source: School Health Club Poster, Caritas Switzerland, 2017

4.6_Water quality testing

EXPERIMENT

LEVEL: SIMPLE

Teaching Objective

The objective of this activity is for student to learn how water can be tested and realize that transparent water does not mean safe for drinking.

Exercise

To know if water is safe, it should be tested. A simple test that can be done is the H2S method. The H2S method comes with little glass bottles containing a reddish powder. To test the water, fill the water sample in the bottle, gently shake it and keep the bottle at ambient temperature for 24-48 hours. If the water stays reddish, it is safe to drink. If it turns black, it is contaminated with fecal bacteria and unsafe to drink. To make the exercise more fun, take two samples at a time to compare, for example a sample of treated drinking water and a sample of untreated water from the river.

Required Materials

The H2S test kits can be purchased from a chemist.

Additional Resource (hyperlinks)

SSWM

India Water Portal

Image source: http://holland-water.nl/moringa-seeds-engels/?lang=en/

4.7_Treating water with Moringa seeds

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
This exercise shows students how to use Moringa seeds to reduce the turbidity of water. (See also exercise 7.8 Planting Moringa). Moringa seeds can be used to increase water's quality, mainly by reducing the turbidity. There are indications that they could also act as an anti-microbial agent (but this is still being researched).

Exercise
- Collect mature *Moringa oleifera* seed pods and remove seeds from pods.
- Remove seed coat to obtain clean seed kernels; discard discoloured seeds.
- Determine quantity of kernels needed based on amount and turbidity of water; in general 1 seed kernel will treat 1 litre of water.
- Crush appropriate number of seed kernels (using grinder, mortar & pestle, etc.) to obtain a fine powder and sift the powder through a screen or small mesh.
- Mix seed powder with a small amount of clean water to form a paste.
- Mix the paste and 250 ml (1 cup) of clean water into a bottle and shake for 1 minute to activate the coagulant properties and form a solution.
- Filter this solution through a muslin cloth or fine mesh screen (to remove insoluble materials) and into the water to be treated.
- Stir treated water rapidly for at least 1 minute then slowly (15–20 rotations per minute) for 5–10 minutes.
- Let the treated water sit without disturbing for at least 1–2 hours.
- When the particles and contaminates have settled to the bottom, the clean water can be carefully poured off.
- This clean can then be filtered or sterilized to make it completely safe for drinking.
    - Sand Water filters
    - Solar Sterilization
    - Chlorination: 1–2 drops per litre
    - Boiling: minimum of 5 minutes

Main source (hyperlinks): Ecocommunity.org

Other resource (hyperlinks): CAWST

Required Materials
Moringa seeds | grinder or mortar | 1 bowl and a bottle | small mesh

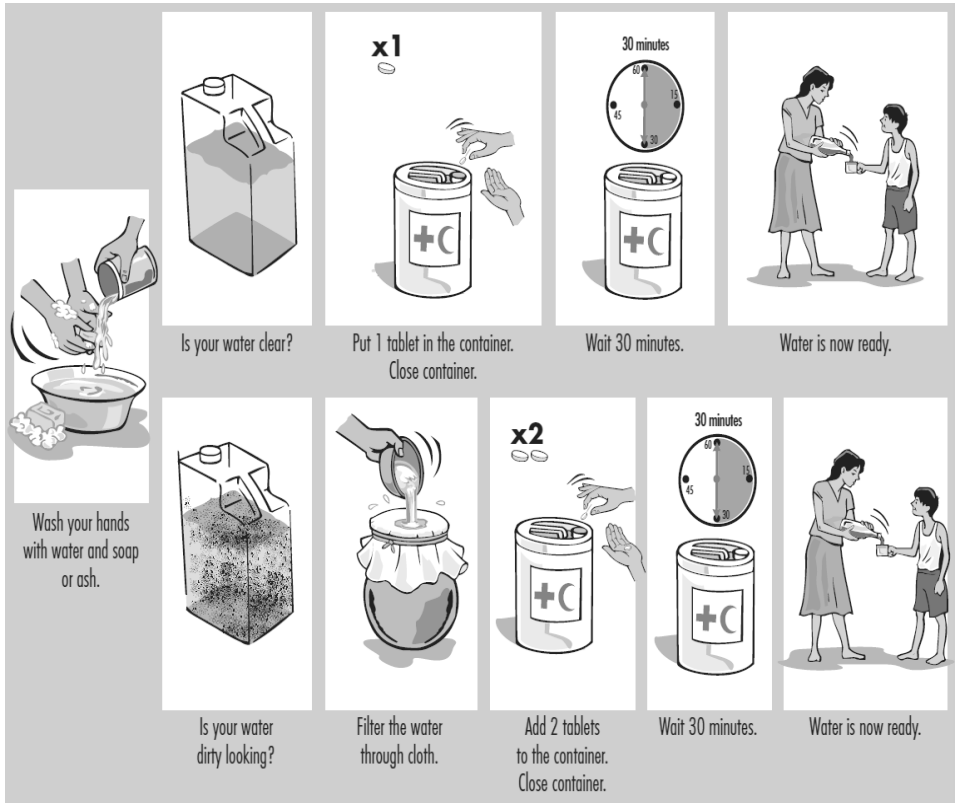


Image source: : http://www.ifrc.org

4.8_Treating water with chlorine

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
This exercise shows students how to apply chlorination tablets or solution. Chlorination is one of many methods that can be used to disinfect water. This method was first used over a century ago, and is still used today. It is a chemical disinfection method that uses various types of chlorine or chlorine-containing substances for the oxidation and disinfection of what will be the potable water source.

The main purpose of chlorination is to disinfect water, but it also has many other benefits. Unlike some of the other disinfection methods like ozonation and ultraviolet radiation, chlorination is able to provide a residual to reduce the chance of pathogen regrowth in water storage tanks or within the water distribution system. In addition to destroying harmful microorganisms, chlorination also reduces the amount of iron, manganese and hydrogen sulphide in water. Chemical disinfection using chlorine has the benefits of being relatively quick, simple, and cheap and to provide some protection against recontamination.

Exercise
The correct amount of chlorine solution must be used. If the concentration of chlorine is inadequate the solution may fail to destroy all the harmful micro-organisms and if in excess, health may be adversely affected. Only an appropriate amount of chlorine can destroy most of harmful micro-organisms and provide a safe amount of residual chlorine. Please follow the instructions given on the product used.

Use water purification and disinfection tablets. Water purification tablets are made of either chlorine dioxide or iodine, and kill bacteria and viruses in water. To use these tablets, fill a pitcher or jar with water and add enough tablets to treat the water. One tablet typically treats 1 litre of water. These tablets generally need anywhere from 30 minutes to four hours to work.

Main source (hyperlinks)
www.sswm.info

Required Materials
Chlorination tables or drops

Topic 5_Sanitation and Hygiene

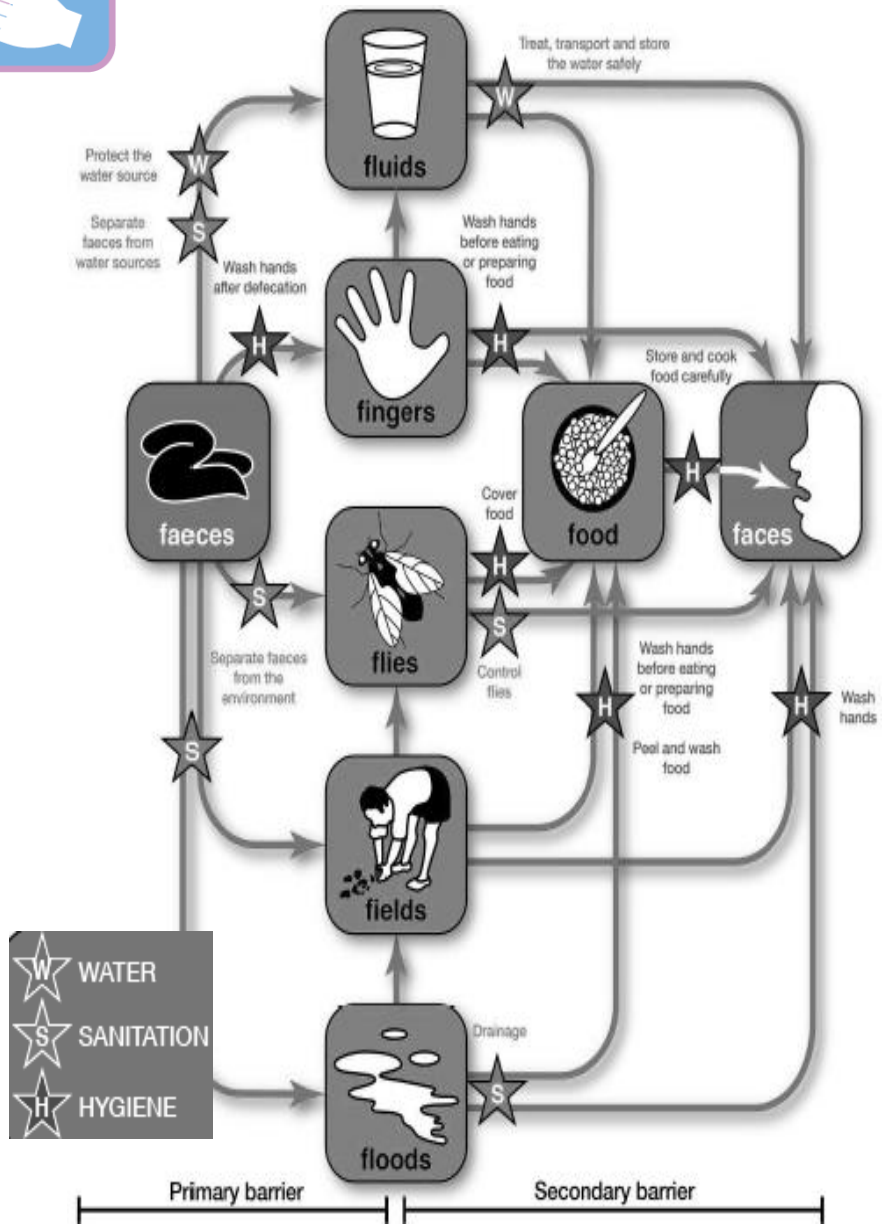
Hygiene is two thirds of health.
Lebanese Proverb

This topic encourages students to establish a connection between their health and well-being and good hygiene and adequate sanitation. The exercises in this topic are selected to help students:

- To understand how diseases are transmitted and what good and bad hygiene practices are.
- To apply good hygiene practices that can help blocking the transmission route of diseases at school and at home.

Image source: https://aglobalhf.squarespace.com

Topic 5_Technical Background



The 'F' Diagram
Image source: Scott, WEDC

HYGIENE AND SANITATION

Definitions and differences between hygiene and sanitation
Hygiene generally refers to the cleanliness of the human body and respective practices, such as washing hands, nail trimming and showering. Beyond that, hygiene also refers to practices that guarantee hygienic conditions of a surrounding environment, such as cleaning and waste management. **Sanitation** is synonymous with the infrastructures that allow human beings to satisfy personal and public hygiene. Properly constructed and maintained "improved" toilets hygienically separate human excreta from human contact in the environment. This prevents human contact with waste and bacteria in the environment that can cause (lethal) diseases. Importantly, "safely-managed sanitation" includes the onsite treatment and disposal or reuse of human excreta, or conveyance to an offsite facility for treatment and disposal/reuse.

Why are water, hygiene and sanitation so important?
As seen in the 'F' diagram, water, sanitation and hygiene interventions act as barriers to stop the transmission of disease; these can be primary (preventing the initial contact with the faeces) or secondary (preventing it being ingested by a new person), This section of the Blue Schools Kit focuses on the promotion of knowledge about how diseases spread and how to limit this through sound hygiene practices and sanitation infrastructure.

This topic introduces, through a variety of exercises—including practical demonstrations—the effects of good hygiene practices for personal health and how to integrate them into daily routines. It aims to cover most aspects of hygiene and sanitation, including:

- The correct use and maintenance of toilet facilities at school and at home, including how to safely confine faeces and to avoid faecal-oral contamination from flies, food, fluids, floods, fingers and domestic animals;
- How to correctly wash hands with soap or ash at critical moments, and important elements and adequate performance of personal hygiene (tooth brushing, face washing, wearing shoes, nail trimming etc.);
- Covering food to protect it from contamination from flies or other sources;
- The importance to keep the surrounding environment clean, collecting (and separating waste) - further covered in topic 8.

Image source: Philip Cohen

5.1_Glitter hands

GAME
LEVEL: SIMPLE

Teaching Objective
Through this game you can teach children that clean hands require effort, the use of soap and vigorous rubbing. Simply getting their hands wet and wiping them on their clothes will not remove the glitter (or germs).

Exercise
Some students only rinse their hands quickly under water, if they wash at all. Hands, in fact, should be scrubbed with soap for at least 15 to 20 seconds. Sprinkle glitter on the children's hands and challenge them to wash off the glitter with soap and water. Because glitter is naturally sticky, it may take up to 30 seconds to scrub the glitter away. Then indicate that they should scrub off germs like the glitter each time that that hand washing occurs.

Required Materials
glitter | water | soap

Image source: Love to know

5.2_Germ transfer

GAME
LEVEL: SIMPLE

Teaching Objective
This exercise is a playful way to communicate to the students how easily germs are spread. Just because they cannot see the germs on their hands it doesn't mean they are not there. The paint stands in for germs and makes them visible.

Exercise
Teach students about the spread of germs by showing how germs can live on hands and the things they touch. Pretend to sneeze, and when you do, cover your hands in a washable paint. Then go about your business, touching things around the room. The students will see the transfer of germs. After the exercise, invite the students to find and tally all the surfaces where germs now live from your transferring them around the room, and then invite them to clean the marks off the surfaces.

Required Materials
Colour washable paints

Image source: [Board Maker Online]

5.3_Hygiene matching game

GAME
LEVEL: SIMPLE

Teaching Objective
This exercise shows children the cleaning activity that corresponds to each body part.

Exercise
Develop a matching game that teaches students the various tools for personal hygiene appropriate for use in your community and which body part to use them on. On one set of cards, draw pictures of soap, a toothbrush, fingernail clippers or mouthwash. Then create another set of cards that shows hands, teeth, nails and mouth or the name of the instrument. Flip all of the cards over and have the students try to match the tool to the body part.

Required Materials
paper or cardstock | crayons | scissors

5.4_Good habit - bad habit

GAME
LEVEL: SIMPLE

Teaching Objective
This exercise encourages students to show their understanding of good and bad hygiene habits.

Exercise
On pieces of paper, write 10 good hygiene habits; such as: brushing teeth each night, washing for 20 seconds or covering the mouth when coughing. On 10 more pieces of paper, write down the bad habits. Fold all of the pieces of paper and place them in a hat. The children can draw out one at a time and decide whether it's a good hygiene habit or a bad hygiene habit

Required Materials
paper | pencil | hat or container

5.5_Hygiene charades

GAME
LEVEL: SIMPLE

Teaching Objective
The objective of this game is to have students familiar with all actions and gestures required for good hygiene.

Exercise
Help students get the motions of hygienic behaviour right by playing hygiene charades. One child picks an action for hygiene, such as brushing teeth, coughing into a sleeve or taking a shower. Each student acts out the hygiene habit without using any words. The other students guess what action is being portrayed and then you talk about the proper way to do each hygiene habit.

Required Materials
none

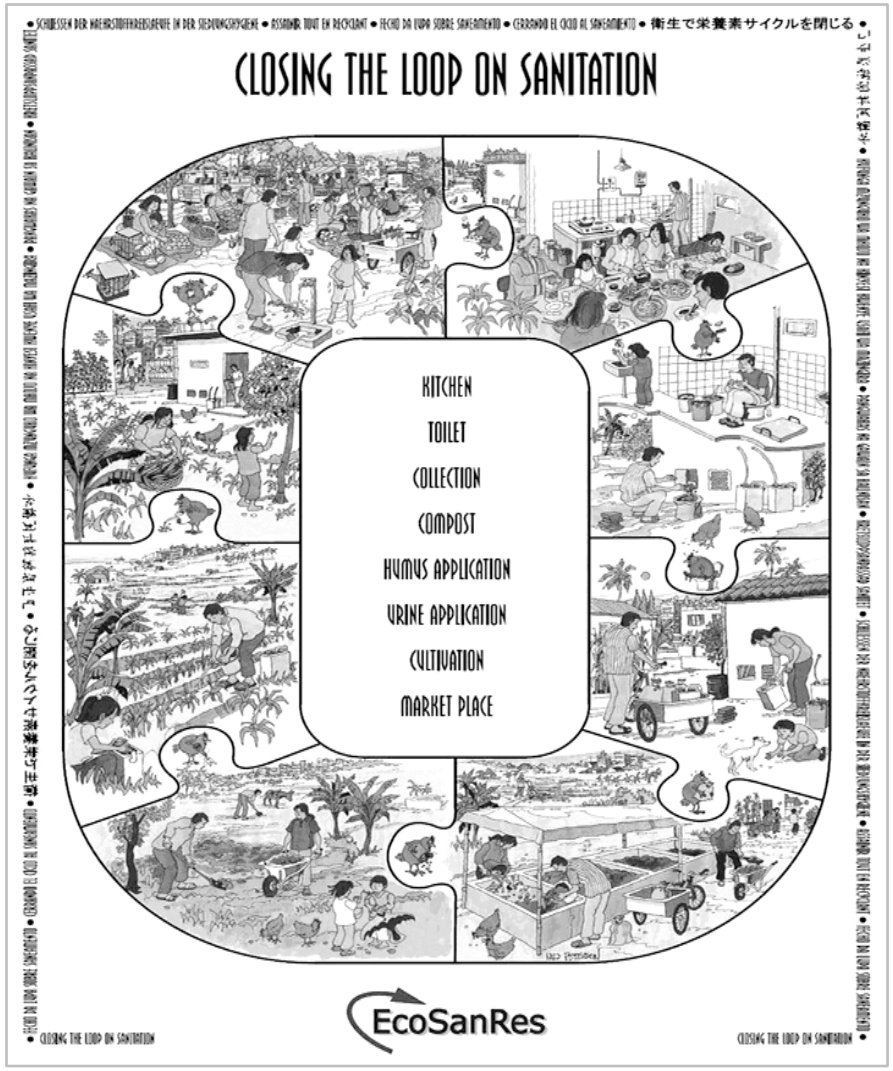


Image source: EcoSanRes

5.6_Eco sanitation puzzle

GAME
LEVEL: ADVANCED

Teaching Objective
This exercise introduces students to the steps of safely managed sanitation.

Exercise
Ask students about what happens to excreta after using the toilet.

During the discussion, describe sanitation as a multi-step process in which human excreta and wastewater are managed from the point of generation to the point of use or disposal. 'resources'.
Explain that onsite sanitation systems, where excreta is collected in pits or septic tanks, requires the safe emptying of solids (sludge) and conveyance to treatment sites or safe burial depending on the system design. Sewerage systems use flush water to move excreta to treatment stations.

Talk about the different steps in the safely managed sanitation chain: type of toilet, collection/storage, evacuation, transport, treatment and disposal / reuse. Although considered *wastes*, some sanitation systems, such as EcoSan and small scale treatment plants, recover products as *resources*; for examples as fertilizers, cooking gas, and compost.

Download the poster/puzzle from the Ecosan Database or make a puzzle with a drawing for each step in a safely managed sanitation system based on the predominant system in your community.

Required Materials
card stock | pencils or crayons.

Additional Resources (hyperlinks)
EcoSanRes
Eawag Compendium of Sanitation Systems and Technologies

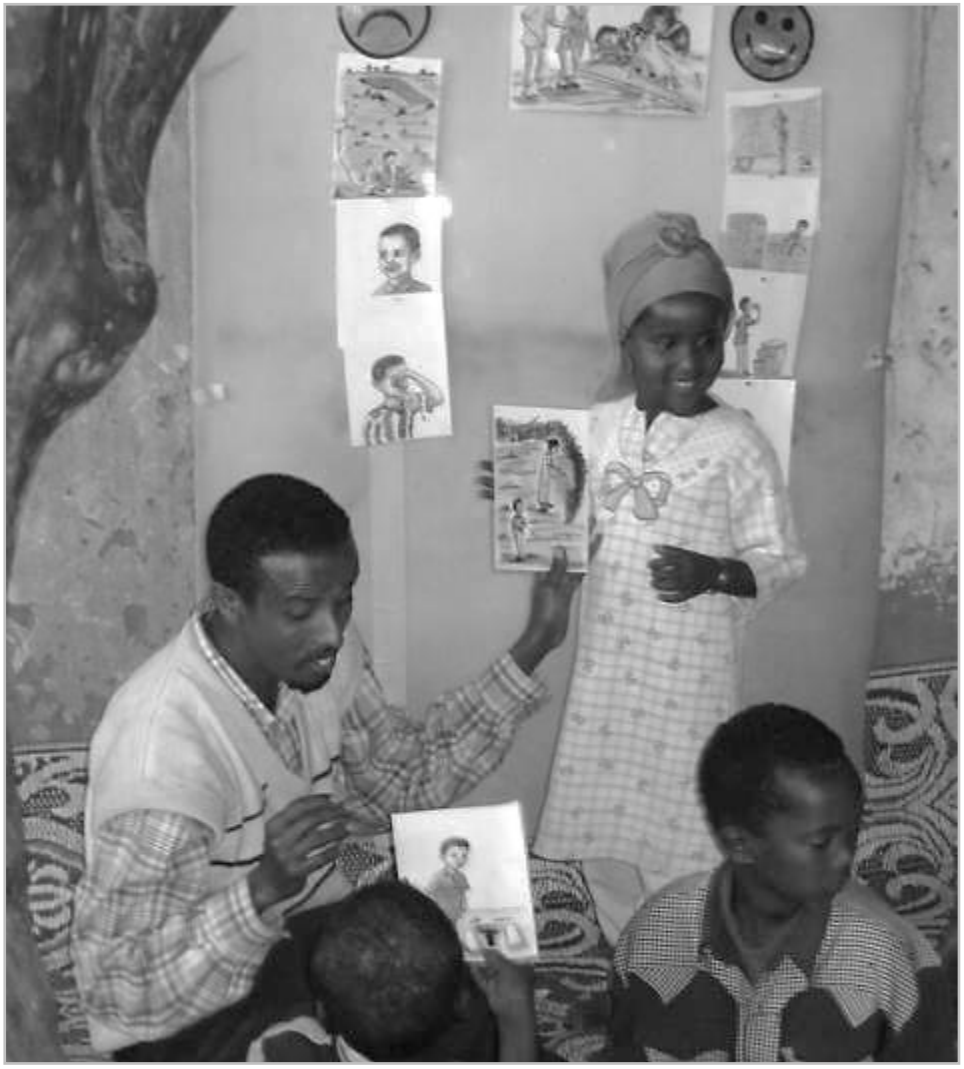


Image source: CHAST

5.7_Pile sorting of hygiene practices

GAME

LEVEL: SIMPLE

Teaching Objective

The objective of this exercise is for student to analyse different practices of daily life, discuss whether it is a good or bad practices and understand why, using pre-drawn cards or drawings.

Exercise

Use cards demonstrating daily good and bad practices or even ask students to draw some. Draw a happy smiley and a sad smiley. Ask students to discuss between themselves if the practice is good or bad and ask them why.

Additional Resources

CHAST, Caritas Switzerland

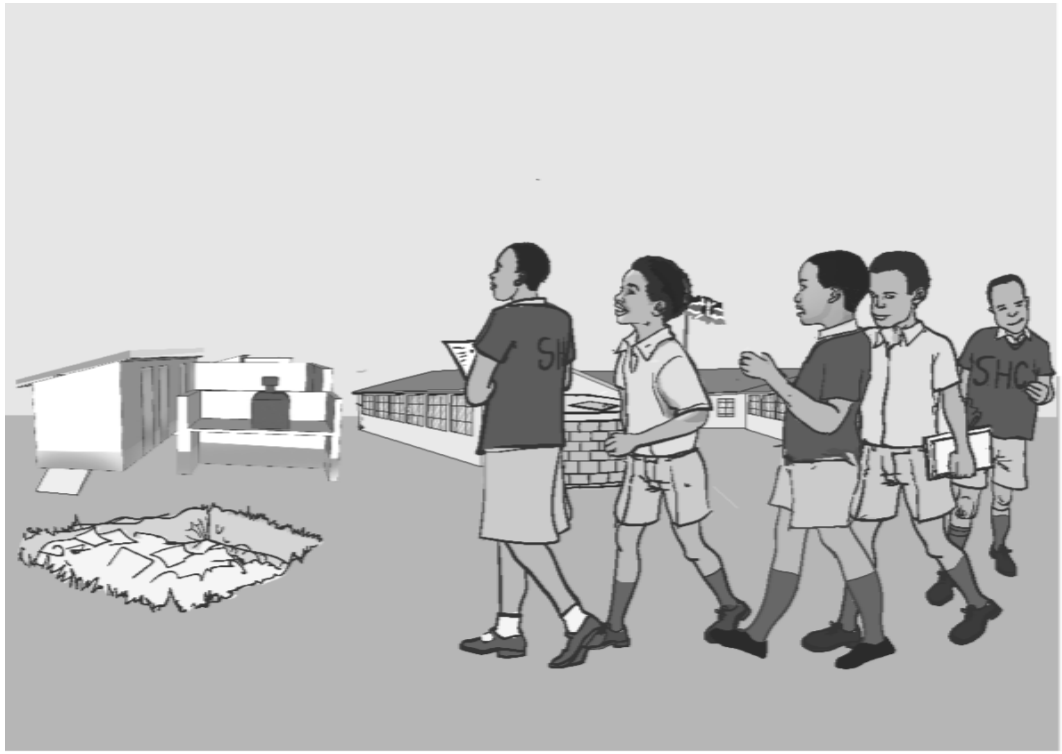


Image source: School Health Club Poster, Caritas Switzerland, 2017

5.8_Supervision of WASH facilities

OUTDOOR ACTIVITY

LEVEL: SIMPLE

Teaching Objective

The objective of this activity is to make students responsible and play a more active role in the maintenance of WASH facilities.

Exercise

Some selected students, volunteers or members of the school health club or equivalent if existent, can monitor the status and cleanliness of the WASH facilities in the school with the help of a checklist. Together with a teacher, they can then discuss how to further improve the WASH conditions in their school. This should be done on a regular basis, and should be institutionalized in a cleaning roster.

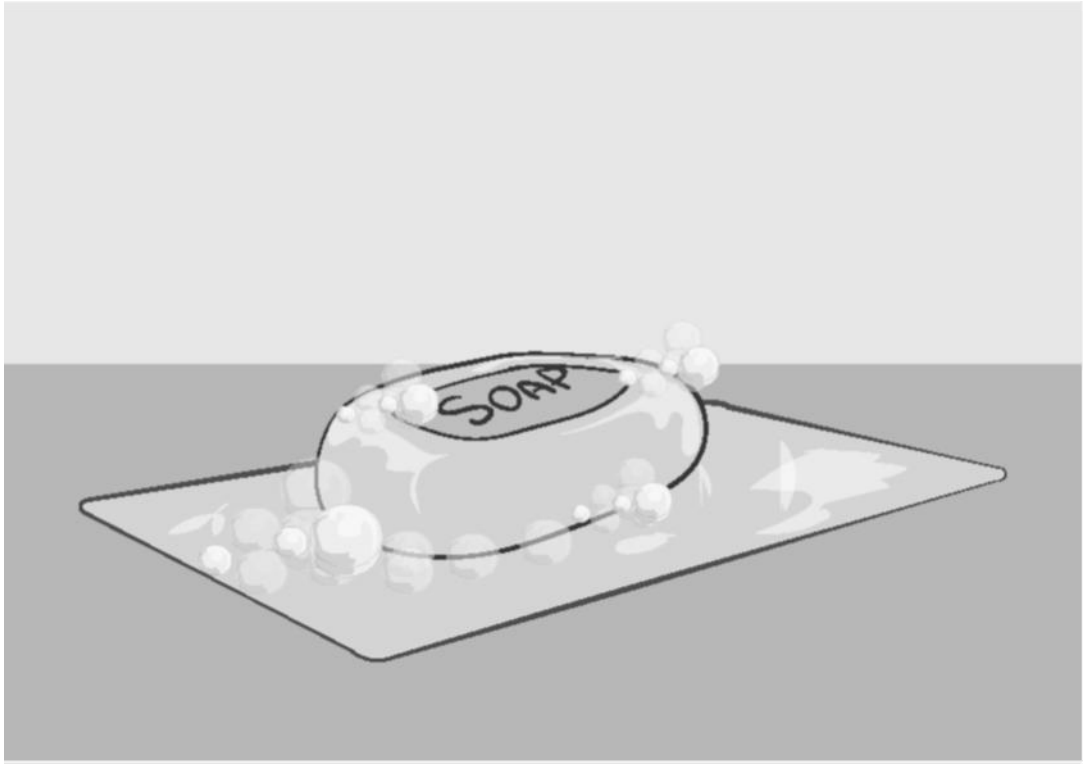


Image source: School Health Club Poster, Caritas Switzerland, 2017

5.9_Soap making

EXPERIMENT
LEVEL: ADVANCED

Teaching Objective

The objective of this activity is for student to learn how to make soap using local materials.

Exercise

A teacher can look for someone in the community who knows how to make soap from local materials to come and teach its members on how to prepare soap. The soap can be used for hand washing in the school. It can be used as a bar or liquid soap filled in a small plastic bottle with a hole in the top. Extra soap can be sold to generate funds for other WASH items such as tissues or sanitary pads. In case making soap is too complicated or if the required materials are not accessible locally, teachers can consider using ashes instead of soap.

Materials needed:

There are 3 key ingredients in soap: oil or fat, lye and water.

1. Oil or fat — beeswax, aloe butter, coconut oil, coffee bean oil, moringa oil, animal fat, palm oil, and shea butter
2. Lye — sodium hydroxide (NaOH) or potassium hydroxide (KOH)
3. Water — bottled, filtered or distilled water

Additional Resources

CAWST
Wikihow – handmade soap

Image source: CLTS handbook

5.10_Glass of water

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective

The purpose of this experiment is to realize that open defecation leads to everyone eating each other faeces. By triggering a sense of disgust and shame, students will be urged to change behaviour.

Exercise

Ask for a glass or a bottle of drinking water. When it is brought, offer it to students and ask if they want to drink it. Most likely, they will say yes.
In the meantime, bring some faeces in the middle so that all student can see it. Pull a hair from your head or take a small stick or a blade of grass and then touch the faeces with it so that all can see, and dip the hair in the glass of water. Ask if they can see any thing in the glass of water.
Next, offer the glass of water to a student and ask if he wants to drink it. Immediately he/she will refuse. Pass the glass on to others and ask if they could drink. No one will want to drink that water. Ask why they refuse it. They will answer that it contains ‘shit’.
Now ask how many legs a fly has. Inform them it has six legs and they are all serrated. Ask them what happens when flies sit on their food and plate: what are they bringing with them from places where open defecation is practiced? Finally ask them what they are eating with their food. When a student says that they are eating one another’s shit, bring them to the front to tell everyone. Do not say it before they do. It has to be what they have said as a result of their analysis, not what you have come to tell them.

Materials needed:

• A glass or a bottle of water
• Fresh faeces collected from the surrounding environment

Resource (hyperlinks)

CLTS handbook

Image source: School Health Club Poster, Caritas Switzerland, 2017

5.11_Organizing events

PARTICIPATORY ACTIVITY

LEVEL: SIMPLE

Teaching Objective

The objective of these events is to reach out to parents and the broader community and demonstrate good hygiene and sanitation practices.

Exercise

Some selected students, volunteers or members of the school health club or equivalent if existent, can develop songs, dramas, poems or a quiz on H&S and present them to the other students, before, during or after classes to sensitize them on good hygiene practices.

The songs, dramas and poems can also be performed during:

- Celebrations of global WASH days*;
- Parents' days;
- Interclass or interschool competitions;
- Visits to the adjacent villages.

Important global WASH days:
22/03: World Water Day
28/05: Menstrual Hygiene Day
15/10: Global Hand Washing day
19/11: World Toilet Day

Image source: School Health Club Poster, Caritas Switzerland, 2017

5.12_Visit to the community

PARTICIPATORY ACTIVITY

LEVEL: SIMPLE

Teaching Objective

The objective of this activity is to reach out to parents and the broader community and demonstrate good hygiene and sanitation practices.

Exercise

Some selected students, volunteers or members of the school health club or equivalent if existent, can visit adjacent villages to pass hygiene messages to the community, as well as to children who do not come to school. They can use dramas, songs, poems and practical demonstrations such as proper hand washing, collection of waste or to demonstrate the construction of a tippy-tap and how it is used.

Image source: School Health Club Poster, Caritas Switzerland, 2017

5.13_Handwashing routine

DISCUSSION
LEVEL: SIMPLE

Teaching Objective

The purpose of this discussion is to institutionalize the practices of hand washing at key moments during the school day.

Exercise

Teachers, with their class, can introduce systematic handwashing, before eating and/or after the break, with all students. Another way to institutionalize handwashing is by starting every day by a word related to good hand washing practices and carrying out, with the students, systematic monitoring of the WASH facilities.

Image source: CHAST

5.14_Demonstration of good practices

DISCUSSION

LEVEL: SIMPLE

Teaching Objective

Good hygiene practices is more than only hand washing. The objective of this activity is to demonstrate other good hygiene practices such as latrine use, tooth brushing, and face washing exercise for students to practice at school but also at home.

Required material

Tooth brush or wood stick, soap, water, piece of clothes for dying**.**

Additional Resources (hyperlinks)

CHAST, Caritas Switzerland

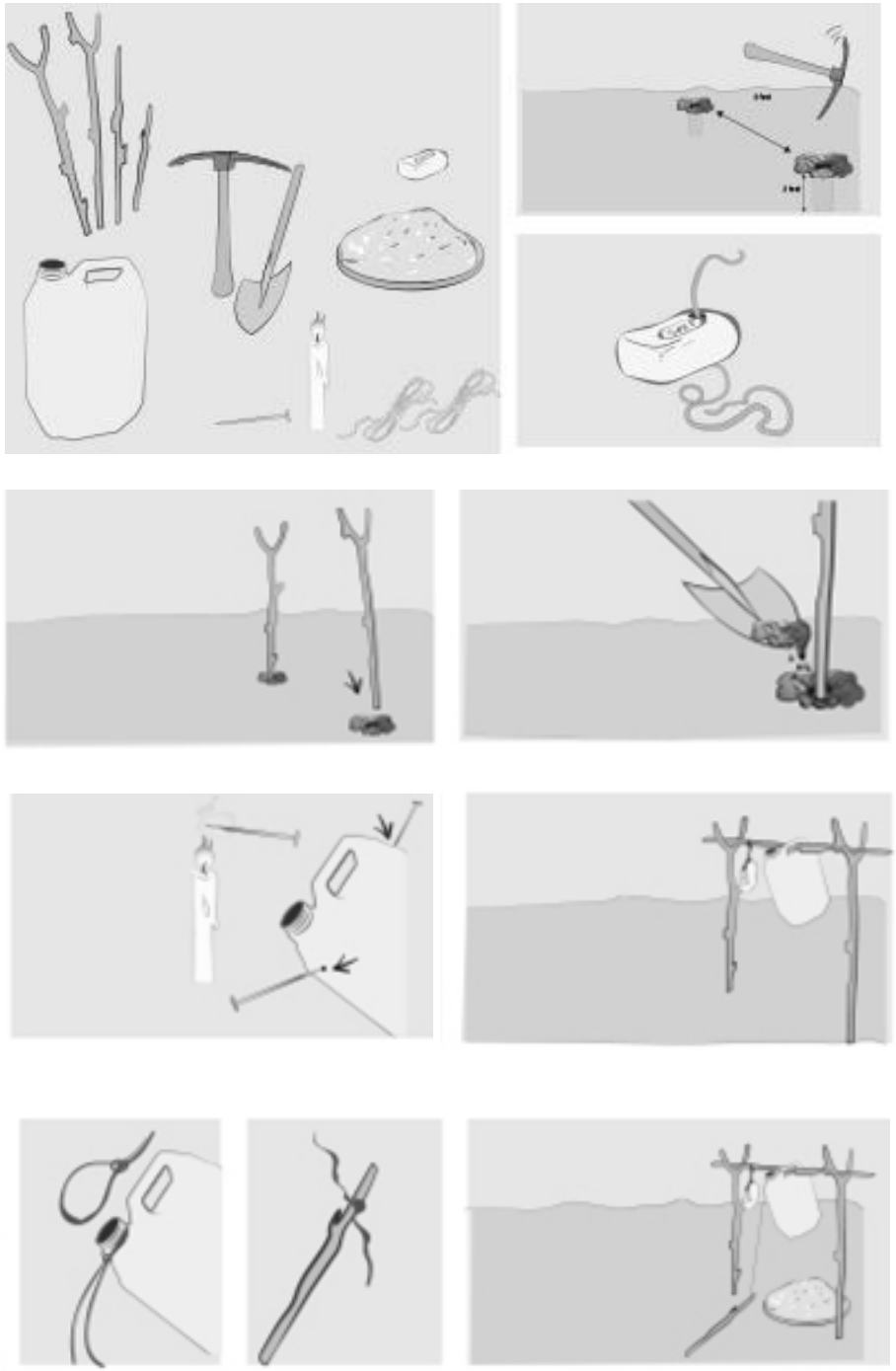


Image source: School Health Club Poster, Caritas Switzerland, 2017

5.15_Construction of tippy tap

OUTDOOR ACTIVITY

LEVEL: SIMPLE

Teaching Objective

The objective of this activity is for students to learn how to construct a simple handwashing facility using local materials, and to replicate it at home.

Exercise

Students can learn how to construct it in school and afterwards teach their families.

Materials needed to build a tippy-tap:

- Two pieces of 2 meters forked sticks;
- Two pieces of 1m straight sticks ;
- One water container;
- One nail;
- One candle/matches;
- Two strings.

Additional Resources (hyperlinks)

Tippytap.org

WASHplus

Topic 6_Growth and Change

To call women the weaker sex is libel
Mahatma Gandhi

This topic is about encouraging students to be respectful about gender differences, particularly during puberty and adolescence, to respect gender equality between the sexes, the importance of avoiding gender stereotyping and learning that all children have an equal right to education. The exercises in this topic are selected to help students:

- To understand the changes for both boys and girls in puberty: it is part of growing up and is a normal process.
- For girls: to learn how to manage menstruation: body hygiene, types of pads available and their disposal.

Image source: https://menengage.org

Topic 6_Technical Background

MENSTRUAL HYGIENE MANAGEMENT

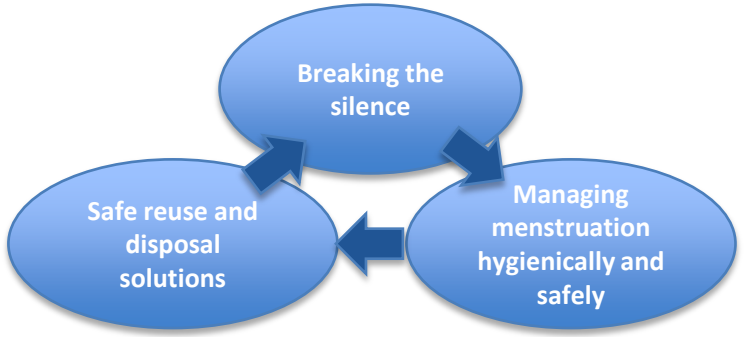
Respecting gender based specificities and needs
As children grow, changes in their bodies occur, accompanied by an evolution of their minds, feelings and understanding of psycho-social differences between males and females. Their needs also will evolve in many ways. This section of the Blue Schools Kit addresses in priority the young women's needs when they reach puberty, namely menstrual hygiene management (MHM). These needs may appear mostly physical, but they also have strong emotional repercussions. Respect for those needs are very important to ensure young women can fully and harmoniously take their place in their families and communities.

Menstruation
Menstruation is a natural process. However, in most parts of the world, it remains a taboo and is rarely discussed, even with family members. Many cultures have beliefs, myths and taboos relating to menstruation. Almost always, there are social norms or unwritten rules and practices about managing menstruation and interacting with menstruating women. Some of these are helpful but others have potentially harmful implications (SWSS).

MHM in schools
Many schools do not support adolescent girls or female teachers in managing menstrual hygiene with dignity. Inadequate water and sanitation facilities make managing menstruation very difficult, and poor sanitary protection materials can result in blood-stained clothes causing stress and embarrassment. Teachers (and male members of staff in particular) can be unaware of girls' needs, in some cases refusing to let them visit the latrine. As a result, girls have been reported to miss school during their menstrual periods or even drop out completely.

Nonetheless, schools make a good entry point to talk about menstrual hygiene, to be included or to strengthen the existing curriculum. Students trust their teachers and listen to their advice. Teachers also have more factual and scientific knowledge to break taboos and bring about the fact that menstruation is a normal process in life.

A sound approach of MHM
The Water Supply and Sanitation Collaborative Council (WSSCC) developed a framework for Menstrual Hygiene Management that includes three interlinked dimensions of managing menstruation hygienically:



1. **Breaking the silence** – fostering the understanding that menstruation is a fact of life, and a distinct biological female attribute that women should be proud of, not ashamed by.

2. **Managing menstruation hygienically and safely –** ensuring adequate water, cleansing and washing materials and private spaces for managing menstrual flows hygienically and privately, and with dignity, in the home and in public spaces.

3. **Safe reuse and disposal solutions** – ensuring mechanisms for safe reuse, collection and disposal of menstrual waste in an environmentally safe manner. Disposal can actually involve a number of steps in the waste disposal chain, particularly when a girl is in a school where sanitary materials are collected for disposal.

In schools (and other public places), the waste chain includes:
- A discrete, washable container with lid, where sanitary materials can be temporarily stored in.
- Collection, transfer and empting of the containers.
- Final destruction of the sanitary materials through burying, incineration or other method.

MAIN SOURCE: *Esther Lowe-de Vreede, Caritas Switzerland*

Image source: Dreams time

6.1_Handprint circle

CREATIVE ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The purpose of this activity is to encourage students to demonstrate principles of equality and awareness of how to get along with students different from themselves.

Exercise
Children can trace and cut out a handprint in a colour of their choosing that can be used to create a classroom display, such as a handprint wreath that combines all their classmates' hands in one wreath of equality. Children can also make stick or paper bag puppets to tell stories of how they can get along with and show respect for someone who is different.

Required Materials
construction paper | scissors | crayons or paint

6.2_Equality quiz

GAME

LEVEL: SIMPLE

Teaching Objective

The purpose of this game is to encourage students to demonstrate their understanding of the difference between fact and opinion around issues of gender.

Exercise

A game structured like a fact and opinion quiz gives children practice at recognizing truth and falsehood in the conscious and unconscious assumptions they make about others. Make cards that display statements such as, “Girls are smarter than boys,” “Girls and Boys should both be educated”, “Girls should fetch Water,” or “All boys are good at sports.” Divide the students into teams and take turns drawing cards and reading them aloud. The other team has 15 seconds to decide if the statement is fact or opinion and tell why for a point. Play as time allows. The team with the highest score at the end wins.

Required Materials

cardstock or paper | pencils or pens

Image source: Clover foundation

6.3_Music equality game

GAME
LEVEL: SIMPLE

Teaching Objective
The purpose of this game is to encourage students to demonstrate good behaviours around issues of equality.

Exercise
Students can quickly focus in on the differences between themselves and others, resulting in a sense of shame or overzealous pride, depending on how they view their own traits. A game of musical diversity can get them thinking more about their similarities. Play some music and allow the students to wander or dance around freely. When the music stops, they have 30 to 60 seconds to grab a partner and find one thing that they have in common.

Required Materials
musical Instrument (or singing) | chairs (or sitting on ground)

Image source: bbc

6.4_Role reversal game

GAME
LEVEL: SIMPLE

Teaching Objective
The purpose of this game is to get the children to take on roles typically associated with the opposite gender. Invite boys to act out carrying water, cooking or looking after children. Invite girls to demonstrate their abilities to do activities that the boys do.

Exercise
Choose 6 students, 3 girls and 3 boys and pair them. Assign an activity that they are each familiar with doing in their daily lives. Have them act out this activity in class. Then ask them to switch activities with their partner and show their ability or willingness to do it. A race could be set up between the girl and boy pair both carrying water to see who spills the least.

Finally, have students share their experiences of the exercise during a class discussion.

Required Materials
none

6.5_Knock down the myth

GAME

LEVEL: SIMPLE TO ADVANCED

Image source: Unicef

Teaching Objective

The purpose of this game is literally to ‘knock down’ myths surrounding girls and gender discrimination.

Exercise

In this game, taboos against girls are written on pieces of paper. The paper is placed into a plastic bottle and the bottles are placed in the middle of a circle of students. The aim is to use a ball to knock the bottle down and ‘knock down the myth’

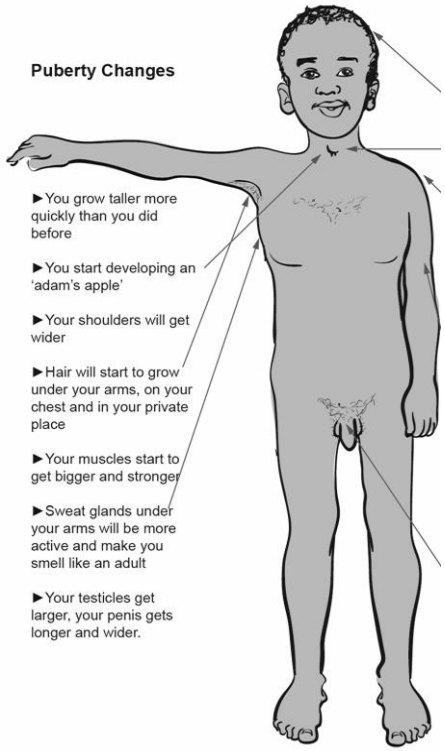
After the game, ask students to share what they have learned.

Required Materials

paper | pencils | plastic bottles | ball

Additional Resources (hyperlinks)

Unicef



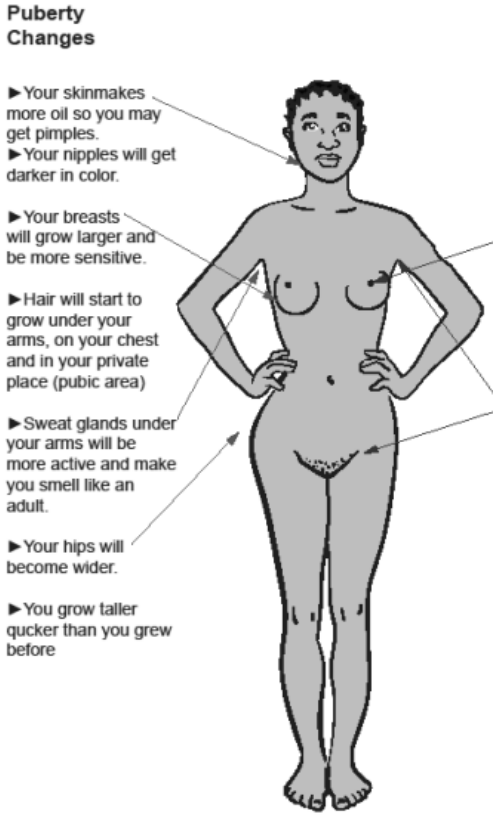


Image source: CHAST

6.6_As we grow up

DISCUSSION
LEVEL: ADVANCED

Teaching Objective
The purpose of this session is to discuss the changes that occur during adolescence to boys & girls and to describe the functional difference of the reproductive organs of boys and girls

Exercise
Define adolescence and when it starts.
Discuss both the physical and emotional changes that occur in boys & girls.
Discuss the changes that are similar and those that are different, comparing boys & girls. Highlight that the first wet dream for boys is called semenarche and the first period for girls is called menarche.
Draw the reproductive organs and discuss their functions.

Required Materials
Chalk | blackboard

Additional Resources (hyperlinks)
WSSCC
CHAST, Caritas Switzerland

6.7_My menstrual cycle

DISCUSSION
LEVEL: ADVANCED

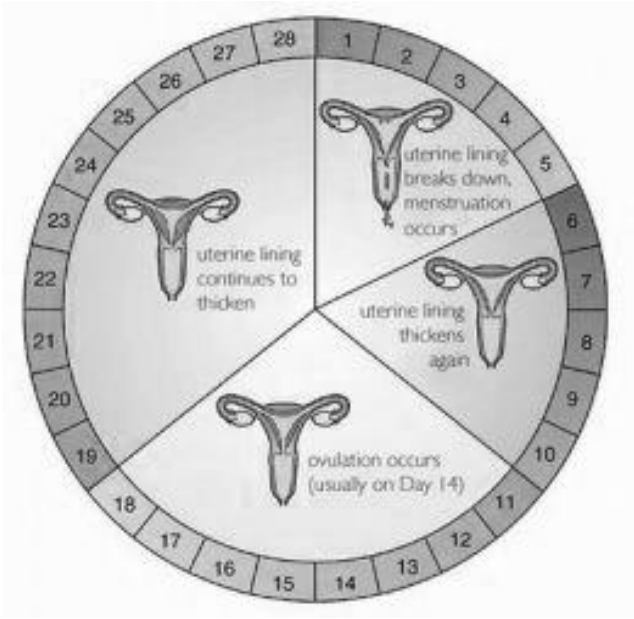


Image source: CHAST

Teaching Objective
The purpose of this discussion is to enable the girls to understand the different stages of the menstrual cycle.

Exercise
The teacher introduces the fact that every girl's cycle is different.

The teacher can draw the uterus and guide the students to discuss what happens at each stage of the menstrual cycle:

- The fact that the uterus is connected to the ovaries by fallopian tubes. Girls receive their first period (menarche) when an egg in one of the ovaries matures. This can happen between the ages of 8 and 19 years.
- Typically, one egg matures every cycle. Once mature, the egg is released from the ovary and passes through the fallopian tube. As the egg passes through the tube, the lining of the uterus thickens.

Required Materials
Chalk | Blackboard | Menstrual wheel (download)

Additional Resources (hyperlinks)
WSSCC

6.8_Keeping my menstrual cycle calendar

DISCUSSION

LEVEL: ADVANCED

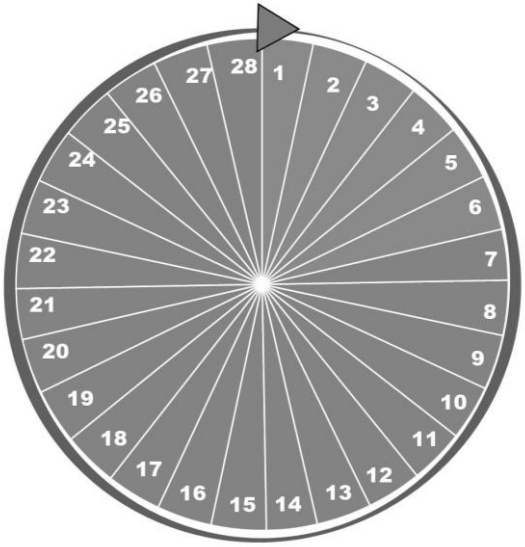


Image source: CHAST

Teaching Objective

The purpose of this discussion is to enable the girls to understand that each girl's cycle is unique. Every girl needs to know the length of their cycle including how many days in each cycle she gets her period. This is not for family planning purposes (e.g. counting safe days) rather so that she is able to have menstrual material ready for use in good time. This is also important so that they monitor how their cycle changes and are able to note when they need to see a doctor e.g. if they do not get periods for multiple cycles or if their cycle changes dramatically e.g. very heavy bleeding, very painful cramps etc.

Exercise

Ask the girls to keep a calendar. They need to record for at least 6 months, taking note of the first & last days of each cycle. The teacher can use the example of a 28 day cycle to explain, but after 6 months, each girl will know how long her cycle is on average.

Required Materials

Calendars and pens

Additional Resources (hyperlinks)

CHAST, Caritas Switzerland

Image source: Perals from Africa

6.9_Reusable pad making workshop

PARTICIPATORY ACTIVITY

LEVEL: MEDIUM

Teaching Objective

The purpose of this activity is to engage both male and female students in the importance of menstrual hygiene management and provide all students with the skill of being able to make reusable pads.

Exercise

Organize a student workshop for making reusable pads. Guidelines and detailed instructions can be found in the links provided below.

Required Materials

fabric | scissors | threads | sewing machines (ideal but not mandatory)

Additional Resources (hyperlinks)

SSWM Unicef Wikihow.com

Image source: Menstrupedia

6.10_Disposal

DISCUSSION
LEVEL: MEDIUM

Teaching Objective
The purpose of this discussion is to discuss how to safely & hygienically dispose menstrual waste i.e. soiled menstrual material

Exercise
1. The teacher can ask the girls to draw a map of the school & draw where they have seen or think soiled menstrual material being disposed off.
2. The teacher leads a discussion on the importance of disposing safely & hygienically e.g. to keep the environment clean.
3. The teacher and the girls go to the toilets and the teacher demonstrates how to use the disposal facilities available e.g. bins.

Additional Resources (hyperlinks)
Menstrupedia

Topic 7_ From Soil to Food

A society grows great when old men plant trees whose shade they know they shall never sit in.
Greek Proverb

This topic is about encouraging students to understand the processes associated with growing food, the importance of retaining and replanting trees, and the need for healthy soil, what causes it to become degraded, and what are the methods for returning nutrients to it. The exercises in this topic are selected to help students:

- To apprehend he crucial role of biodiversity and sustainable agriculture technique sin our food growing systems.
- To recognize the importance of trees in supporting the watershed and food production.
- To observe soil composition and its connection with plants and water.

Image source: unsplash

Topic 7_Technical Background

As the human population has expanded, more and more land has been cleared for agriculture and other pursuits that degrade the soil and make erosion more likely to occur. This in turn has a detrimental effect on biodiversity—the ability of plants, animals, insects and humans to work together for healthy soil.

AGRICULTURE
When agriculture fields replace natural vegetation, topsoil is exposed and can dry out. The diversity and quantity of microorganisms that help to keep the soil fertile can decrease, and nutrients may wash out. Soil can be blown away by the winds or washed away by rains.

DEFORESTATION
Without plant cover, erosion can occur and sweep the land into rivers. The agricultural plants that often replace the trees cannot hold onto the soil and many of these plants, such as coffee, cotton, palm oil, soybean and wheat, can actually worsen soil erosion. And as land loses its fertile soil, agricultural producers move on, clear more forest and continue the cycle of soil loss.

OVERGRAZING
The conversion of natural ecosystems to pasture land doesn't damage the land initially as much as crop production, but this change in usage can lead to high rates of erosion and loss of topsoil and nutrients. Overgrazing can reduce ground cover, enabling erosion and compaction of the land by wind and rain.. This reduces the ability for plants to grow and water to penetrate, which harms soil microbes and results in serious erosion of the land.

USE OF AGROCHEMICALS
Pesticides and other chemicals used on crop plants have helped farmers to increase yields. Scientists have found that overuse of some of these chemicals changes soil composition and disrupts the balance of microorganisms in the soil. This stimulates the growth of harmful bacteria at the expense of beneficial kinds.

The loss of fertile soil makes land less productive for agriculture, creates new deserts, pollutes waterways and can alter how water flows through the landscape, potentially making flooding more common.

DESERTIFICATION
Desertification can be characterized by the droughts and arid conditions the landscape endures as a result of human exploitation of fragile ecosystems. Effects include land degradation, soil erosion and sterility, and a loss of biodiversity, with huge economic costs for nations where deserts are growing.

LOSS OF ARABLE LAND
Arable land is any land that can be used to grow crops. Many of the practices used in growing those crops can lead to the loss of topsoil and destruction of soil characteristics that make agriculture possible.

CLOGGED AND POLLUTED WATERWAYS
Soil eroded from the land, along with pesticides and fertilizers applied to fields, washes into streams and waterways. This sedimentation and pollution can damage freshwater and marine habitats and the local communities that depend on them.

INCREASED FLOODING
Land is often transformed from a forest or other natural landscape, such as floodplains and wetlands, into a crop field or pasture. The converted land is less able to soak up water, making flooding more common. There are methods to improve soil water holding capacity as well as restoration and maintenance of wetlands. (worldwildlife.org).

Topic 7_Technical Background

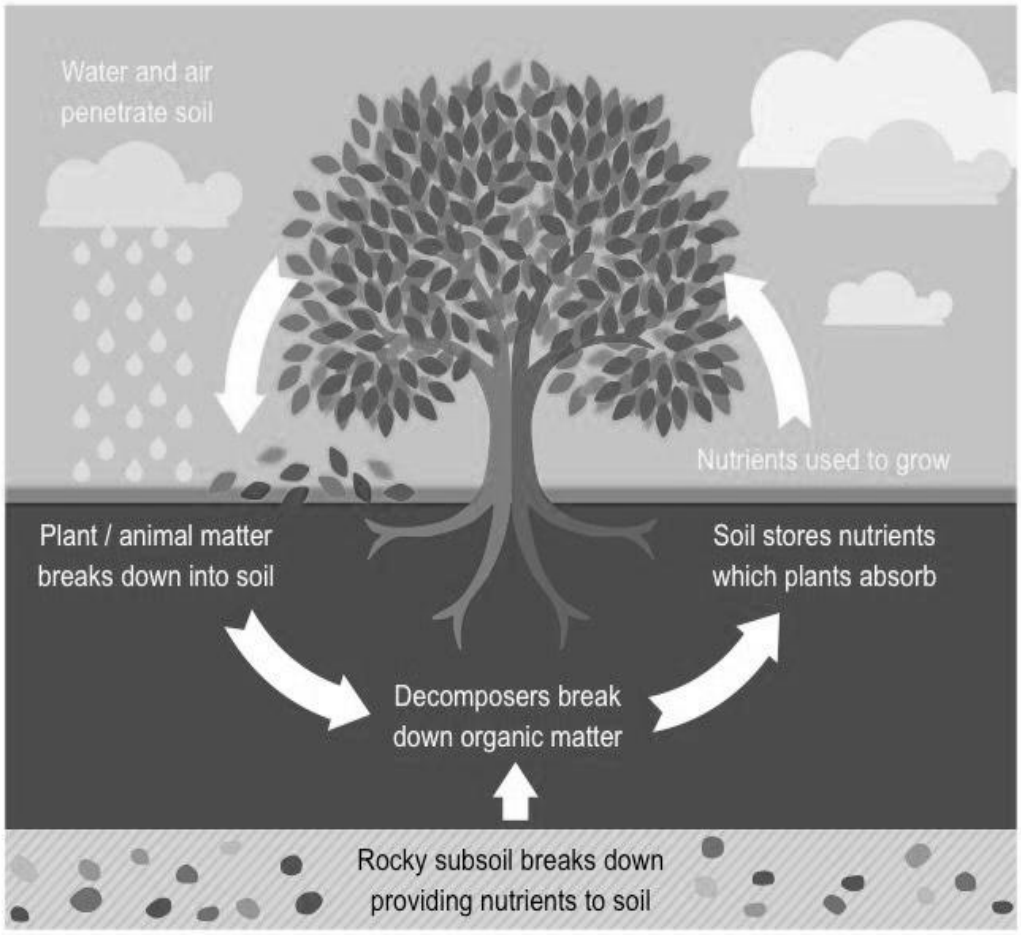


Image source: http://ib.bioninja.com.au

THE NUTRIENT CYCLE

Alongside the water cycle, another cycle is fundamental to life. It is called the Nutrient Cycle. Nutrient cycling is one of the most important processes that occur in an ecosystem. The Nutrient Cycle describes the use, movement, and recycling of nutrients in the environment.

Global and local cycles

The biosphere is a network of continually recycling materials. There are two main types of cycles: global cycles and local cycles. Elements such as carbon, nitrogen, oxygen, and hydrogen are recycled through abiotic environments including the atmosphere, water, and soil. Since the atmosphere is the main abiotic environment from which these elements are harvested, their cycles are of a global nature. These elements may travel over large distances before they are taken up by biological organisms. The soil is the main abiotic environment for the recycling of elements such as phosphorus, calcium, and potassium. As such, their movement is typically over a local region.

Why are nutrients so important?

Just like we need to eat to have energy for our daily activities, aside from water, plants depend on the availability of nutrients in order to grow. Valuable elements such as carbon, oxygen, hydrogen, phosphorus, and nitrogen are essential to life and must be recycled in order for organisms to exist.

Composting within agricultural systems capitalises upon the natural services of nutrient recycling in ecosystems. Bacteria, fungi, insects, earthworms, bugs and other creatures dig and digest the compost into fertile soil. The minerals and nutrients in the soil is recycled back into the production of crops.

Image source: www.greendots.ch, Burkina Faso

Topic 7_Technical Background

"You never feed the plants. You feed the soil creatures."
Geoff Lawton
Permaculture Research Institute Australia

SOIL

Soil is the earth's fragile skin that anchors all life on Earth. It is comprised of countless species that create a dynamic and complex ecosystem and is among the most precious resources to humans. Increased demand for agriculture commodities generates incentives to convert forests and grasslands to farm fields and pastures. The transition to agriculture from natural vegetation often cannot hold onto the soil and many of these plants, such as coffee, cotton, palm oil, soybean and wheat, can actually increase soil erosion beyond the soil's ability to maintain itself.

Half of the topsoil on the planet has been lost in the last 150 years. In addition to erosion, soil quality is affected by other aspects of agriculture. These impacts include compaction, loss of soil structure, nutrient degradation, and soil salinity. These are very real and at times severe issues.

The effects of soil erosion go beyond the loss of fertile land. It has led to increased pollution and sedimentation in streams and rivers, clogging these waterways and causing declines in fish and other species. And degraded lands are also often less able to hold onto water, which can worsen flooding. Sustainable land use can help to reduce the impacts of agriculture and livestock, preventing soil degradation and erosion and the loss of valuable land to desertification.

The health of soil is a primary concern to farmers and the global community whose livelihoods depend on well managed agriculture that starts with the dirt beneath our feet. While there are many challenges to maintaining healthy soil, there are also solutions and a dedicated group of people, including WWF, who work to innovate and maintain the fragile skin from which biodiversity springs. (worldwildlife.org)

It's the microbes and the bacteria that do all the main work in fostering soil fertility. The only effort required is to apply some regular soil mulch and good compost and then allow time to have nature break it all down.

Topic 7_Technical Background

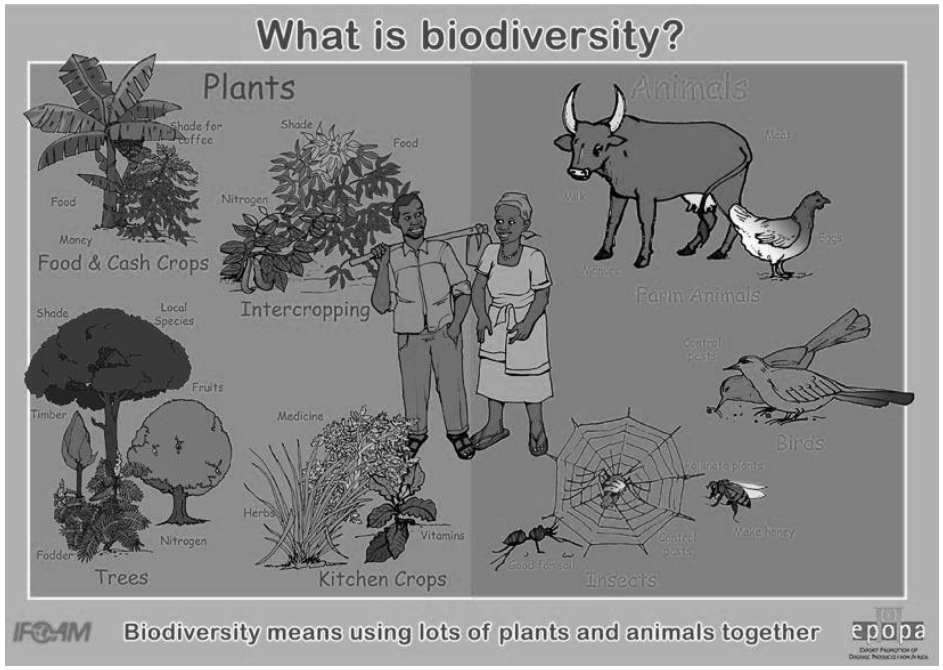
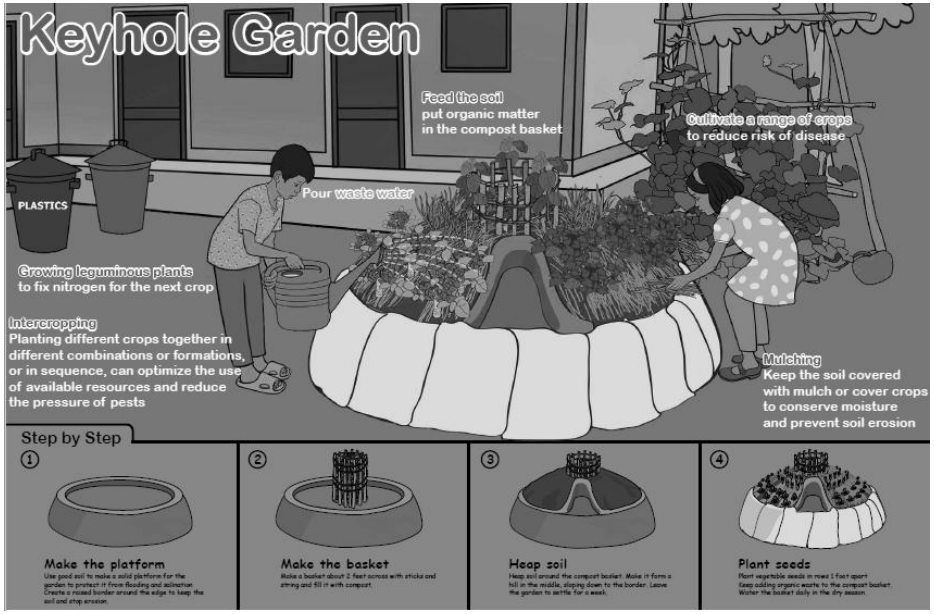


Image source: www.fourthway.co.uk



LOW EXTERNAL INPUT SUSTAINABLE AGRICULTURE (LEISA) and ORGANIC AGRICULTURE

The problems stated in the previous slides are important. But there are solutions to progressively restore degraded landscapes. Despite the remaining challenges, adopting sustainable practices for food production is possible and has proven effective and productive in many different countries and settings all over the world.

LEISA and organic agriculture are both examples of those new paradigms for agriculture, food production and farming systems. They represent not only a viable alternative to industrial agriculture, but maybe also a real hope, if not the only hope, for a positive and abundant future for humanity on this planet. Today, one important approach for implementing organic agriculture principles is permaculture design.

LEISA and permaculture, although not entirely the same, share common key strategies:

- The maximum use or sharing of local resources available on the homestead and the community (tangible assets, vegetation, animals, manual labour, knowledge, etc.);
- The aim to reduce as much as possible dependence toward external resources (such as energy, water, seeds and agro-chemicals) for health, ecological and economical reasons;
- The will to reduce waste;
- The importance of observing, assessing the needs, planning ahead and designing the food production systems to maximize their efficiency and minimize their environmental impacts;
- The importance of interacting with and accepting feed-back from the system, as a guidance to operate necessary changes;
- The utmost respect for the surrounding natural ecosystems (forests, watersheds, etc.) which support all life on Earth, including ours as humans.

FURTHER RESOURCES

Farming Matters, magazine on agro-ecology and LEISA:
REIJNTIES, c.., et al, Farming for the future: an introduction to LEISA, 1992
HOLMGREN, D., Permaculture: principles and pathways beyond sustainability", 2002
MOLLISON, B., Permaculture: a designer's manual, 1988

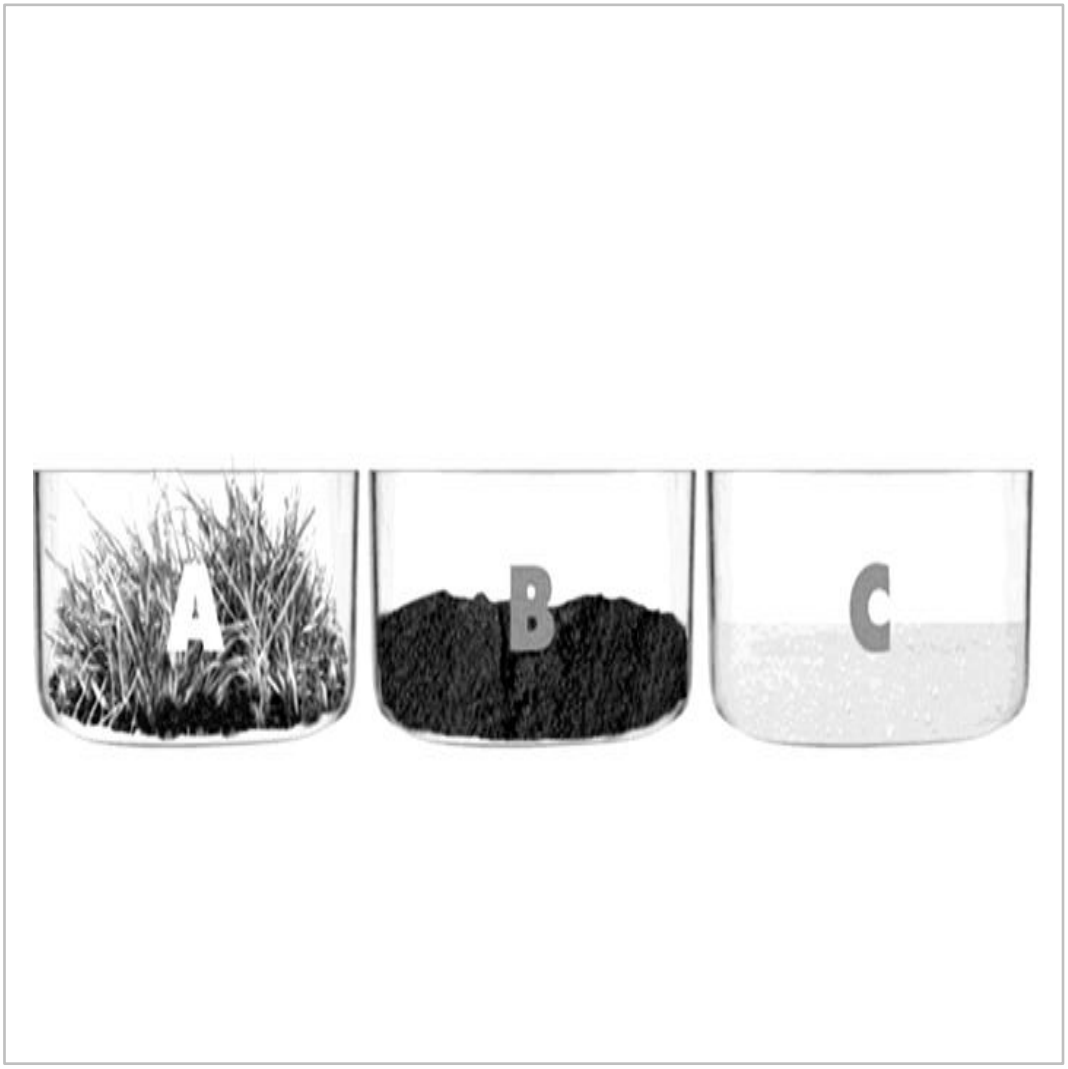


Image source: Farmcreditknowledgecenter

7.1_Evaporative loss

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
The purpose of this experiment is to encourage students to understand the principle of evaporative loss and how plants in the soil help to retain water in the soil.

Exercise
Select 3 open topped glass containers. Fill the first container with soil with grass, weeds, or plants (fill with water to top of soil without drowning plants). Fill the second container with soil and add the same amount of water as added to the first container. Fill the third container with an equal amount of water. Weigh each container and then place the containers in a sunny spot. Weigh each container once a day and examine any changes. Use a ruler and measure the water line along the side of each container. Use tape or a marker to show where the water line is and to compare day to day changes. Watch for at least one week. Additionally, students can also try to fill a fourth container (B') with a mix of 50% top soil 50% compost and compare the difference with the B container to show the water holding capacity of an organically rich soil.

Required Materials
3 glass containers | water | soil | grass | a scale

Image source: Farmcreditknowledgecenter

7.2_Soil erosion

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
The purpose of this experiment is to make the process of soil erosion visible to students and demonstrate that the less ground cover there is and the more exposed the soil, the worse the soil erosion and nutrient loss is.

Exercise
Start by cutting the top off of the milk jug or other container (be sure to leave the spout part of the bottle attached). Do this for all three containers. Fasten all three containers to your board. Fill all three with soil to just below the level of the spout. Plant grass seed or put your established plants in one of the containers. Cover a second one with the ground cover. Leave the third bare…they should look similar to this when you are done. To demonstrate soil erosion, make sure they are on a slightly elevated surface. You can either place clear containers under each of the spouts, or you can have a student hold the container as you go through the exercise. Measure out 2 cups of water (this may need to be adjusted depending on the size of the containers holding the soil). Put the water in the watering can, and then “water” the container with the bare soil. Measure out another 2 cups of water and repeat the process by “watering” the container with ground cover. Measure out a final 2 cups and “water” the container with the plants. Then discuss with students the difference in the “run off” from each of the three containers, emphasizing the loss of nutrients increases with the loss of ground cover and plants.
After this experiment, take a walk in the area surrounding your school and spot signs of erosion. Discuss the extent, the causes and the possible solutions of soil erosion occurring around you.

Required Materials
3 different large plastic containers with lids | a board or other flat surface large enough to hold all three containers | soil | grass seed or already established plants | leaves, twigs and other ground cover | three clear containers that can hold water | a measuring cup | a small watering can ideally with a sprinkler head

Natural Factors Affecting Soil Erosion

- *Heavy rains on weak soil: rain drops loosen soil particles and water transports them down hill*
- *Vegetation depleted by drought: rain drops are free to hit the soil, causing erosion during rainfall; winds blow away the fine particles during droughts*
- *Steep slopes: gravity "pulls harder;" water flows faster; soil creeps, slips, or slumps downhill*
- *Sudden climate change*
- *Rainfall: erosion increases unexpectedly rapidly as rainstorms become more severe*
- *Drought: water dries up and the soil becomes a play ball of winds; soil biota die; a sudden rain causes enormous damage*
- *Changing winds: areas previously sheltered become exposed*

Human-induced Factors

- *Changing the land by cutting down trees and deforesting it. The land loses its cover, then its soil biota, porosity, and moisture. Healthy top soil runs away and plants won't grow well.*
- *Intensive farming: the plough, excessive fertilizer, and irrigation damage the land often permanently*
- *Unsustainable management of waste, leading to contamination of the ground.*
- *housing development: soil is bared; massive earthworks to landscape the subdivision; soil is on the loose*
- *road construction: roads are cut; massive earthworks, leaving scars behind; not enough attention paid to rainwater flow and maintenance of roadsides*

7.2.1 _Soil erosion supplement

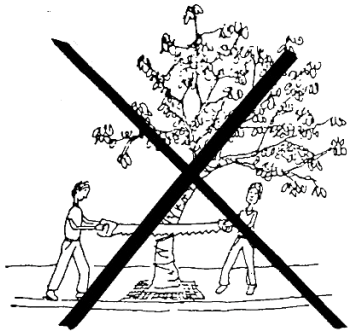
DISCUSSION
LEVEL: SIMPLE

Teaching objectives
The purpose of this discussion is to convey to the students what soil erosion is, so that they understand that while it is a natural process it is now happening at alarming rates, because of the way human beings are using their environment unsustainably.

Exercise
Explain to the students how ocean waves, rivers, wind, rainwater, and ice, shape and reshape the earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers. Soil is formed in the break own of organic and inorganic materials, sediments of sand, and smaller particles, sometimes containing the remains of organisms. Soil erosion is a natural process that occurs on all land. The agents of soil erosion are water and wind, each contributing a significant amount of soil loss each year. Soil erosion and degradation are now so severe worldwide that our ability to grow food is being threatened. Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing serious loss of topsoil. The loss of soil from farmland may be reflected in reduced crop production potential, lower surface water quality, and damaged drainage networks. The rate and magnitude of soil erosion by water is controlled by these factors: rainfall intensity and runoff, soil erodibility, slope gradient and length, and vegetation. (Benchmarks for Science Literacy)

Required Materials
none

Image source: http://www.astorialic.org/ | wisegeek.com



7.3_Deforestation

DISCUSSION
LEVEL: SIMPLE

Teaching Objective
The purpose of this discussion is to convey to the students the fact that deforestation, the unsustainable cutting down of trees, makes soil dry out, erode in the rain – and eventually causes decrease in rainfall.

Exercise
Conduct a discussion with the students based around the following facts: Deforestation is when forests are destroyed by cutting of trees and not replanted. Sometimes deforestation happens when people change the land into farms, pasture land and cities. A lot of deforestation is caused by the removal of all the trees from a forest for wood or fuel. An estimated 18 million acres (7.3 million hectares) of forest, which is roughly the size of the country of Panama, are lost each year, according to the United Nations' Food and Agriculture Organization. The loss of trees, which anchor the soil with their roots, causes widespread erosion throughout the tropics. Only a minority of areas have good soils, which after clearing are quickly washed away by the heavy rains. When forests are cleared or burnt, stored carbon is released into the atmosphere, mainly as carbon dioxide. Deforestation accounts for around 18% of all global greenhouse gas emissions due to human activities. It is a major contributor to global warming. Forests are vital for life, home to millions of species, they protect soil from erosion, produce oxygen, store carbon dioxide, and help control climate. ... Deforestation by humans is causing all of these necessary functions to be lessened, and hence damaging the atmosphere even further. (FAO)

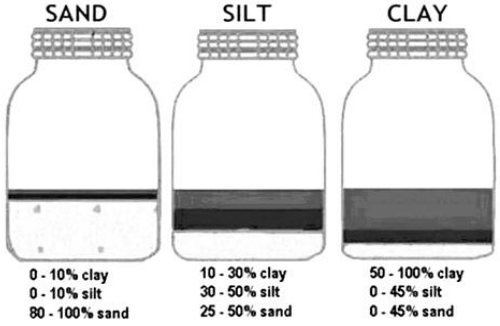
Encourage students to imagine solutions that limit tree cutting and deforestation, i.e. on appropriate tree species to plant, agro-forestry or simple traditional techniques such as tree trimming (both pollarding or coppicing).

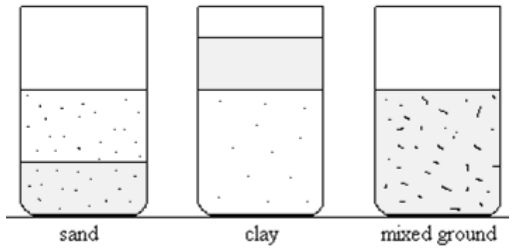
Required Materials
none

7.4_Soil shaking

EXPERIMENT
LEVEL: SIMPLE

Image source: pinterest





Teaching Objective
The purpose of this experiment is to familiarize students with the composition of soil in their area, and the types of soil that are best for growing plants.

Exercise
Collect a local soil sample. Fill a large clear glass jar halfway with the soil sample. Fill the remaining half of the jar with water, leaving 1” of air. Attach the lid and then shake the jar vigorously until the lumps of soil have broken up. Put the jar in a place where it can rest undisturbed overnight. After 24 hours, the jar’s contents will have settled into distinct layers, SILT, CLAY and SAND. By examining the relative proportions of these layers you can gain a sense of the type of soil in your environment. Repeat this experiment with soils from different areas of varying quality (including soil from a garden where healthy plants are growing).

Remark
Except in naturally occurring soils, such as in untouched forests, it is very rare, if not impossible, to find a “perfect combination” of silt, clay, sand and organic matters. But most of the time, you can improve the soil’s structure by adding compost (and mulch) where you want to grow a garden.

Required Materials
glass jar with lid | water | local soil sample

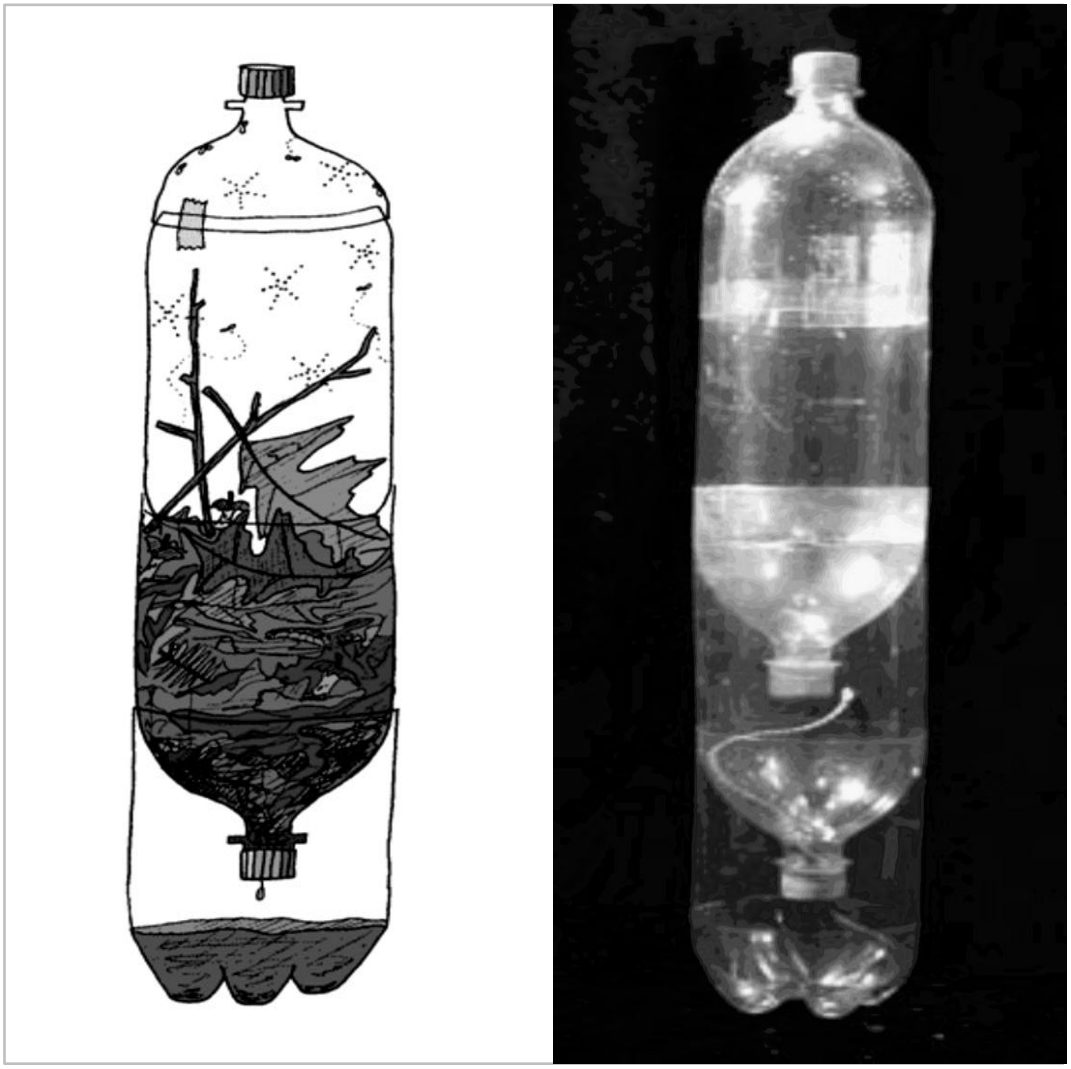


Image source: Bottle Biology

7.5_Decomposition column

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
The purpose of this experiment is to encourage students to understand the process of decomposition in the formation of compost, as well as the problem of non-biodegradable materials such as plastic in the environment

Exercise
Invite the students, either individually or as a group, to construct a decomposition bottle. The decomposition column can be thought of as a miniature compost pile or landfill, or as leaf litter on a forest floor. Through the sides of the bottle students can observe different substances decomposing and explore how moisture, air, temperature and light affect the process. Many landfills seal garbage in the earth, excluding air and moisture. How might this affect decomposition? Will a foam cup ever rot? What happens to a piece of fruit, or tea bag? Do banana peels decompose more quickly or slowly than leaves? Does adding layers of soil to the column affect the decomposition process? What happens to plastic? Invite the students to choose what they would like to see decomposing.

Main source (hyperlinks)
Bottle biology

Required Materials
2 PET bottles | scissors | organic materials from local environment

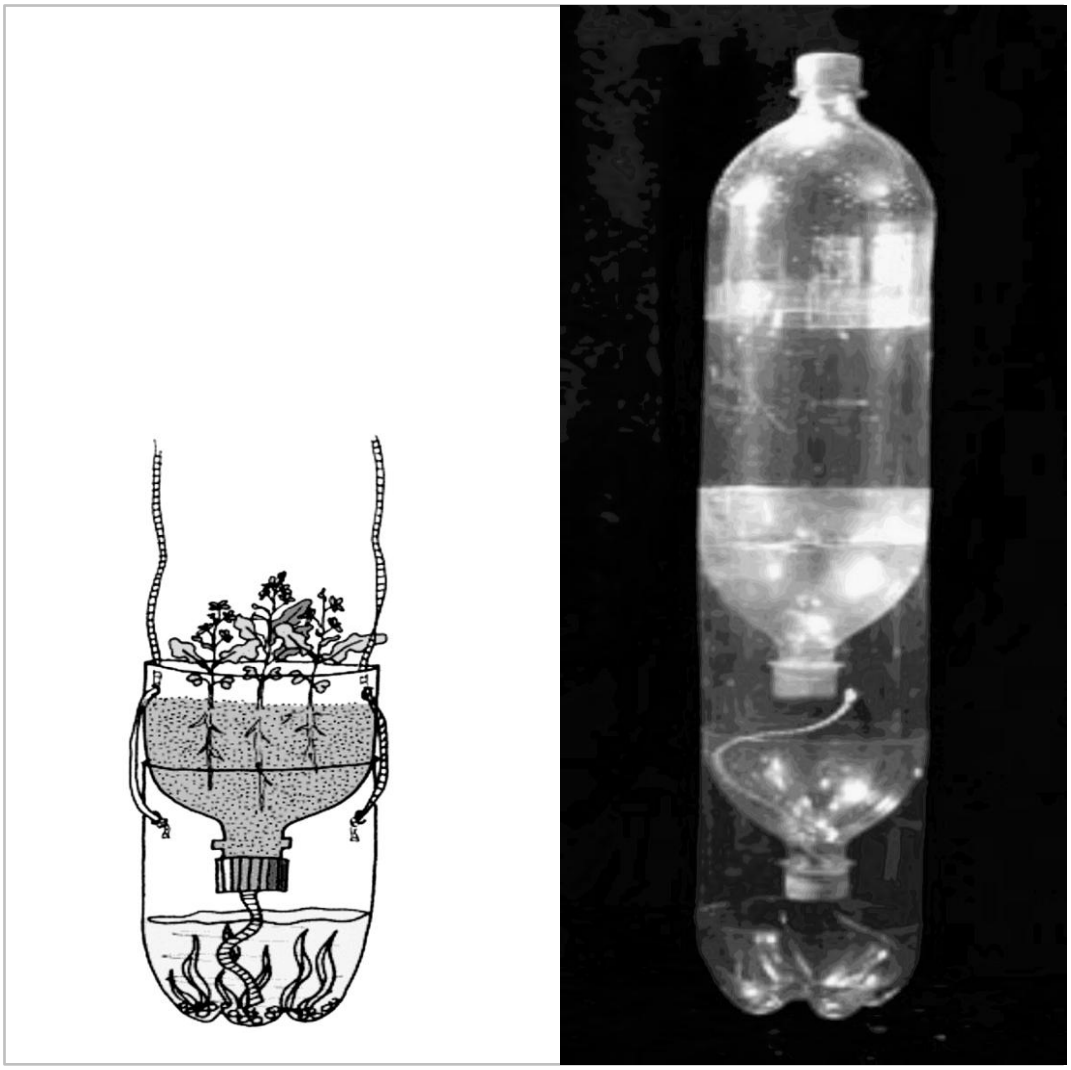


Image source: Bottle Biology

7.6_Terra-Aqua column

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
The purpose of this experiment is to familiarize students with the organic processes that take place between land and water—and how the balance affects their environment. The Terra-Aqua Column provides a student with a model to explore the link between land and water.

Exercise
Water is the common substance that falls from the atmosphere, flows through our bodies, runs through the soil beneath our feet, collects in puddles and lakes, then vaporizes back into the atmosphere in a never-ending cycle. Water, as it cycles between land, ocean and atmosphere, forms the major link between the terrestrial world (anything living on the earth) and the aquatic world (anything living on or in the water). Water drips off rooftops, flows over roads, percolates through the soils of fields and forests and eventually finds its way into rivers, lakes and oceans. During its journey, water will pick up leaf litter, soil, nutrients, agricultural chemicals, road salts and gasoline from cars, all of which have profound impacts on life in aquatic systems. Water can also be filtered or purified as it percolates through soil. The Terra-Aqua Column provides a student with a model to explore the link between land and water. The model has three basic components: soil, water and plants. By varying the treatment of just one of these components you can explore how one variable can affect the whole system. How does salt affect the growth of plants ? How does adding fertilizer to the soil affect algal growth in the water chamber ? What type of soil best purifies water ? Experimentation with the Terra-Aqua Column is practically unlimited. A student can be invited to define a question, and then design an experiment to explore it.

Main source (hyperlinks)
Bottle biology

Required Materials
PET bottle | string | soil and organic materials | water

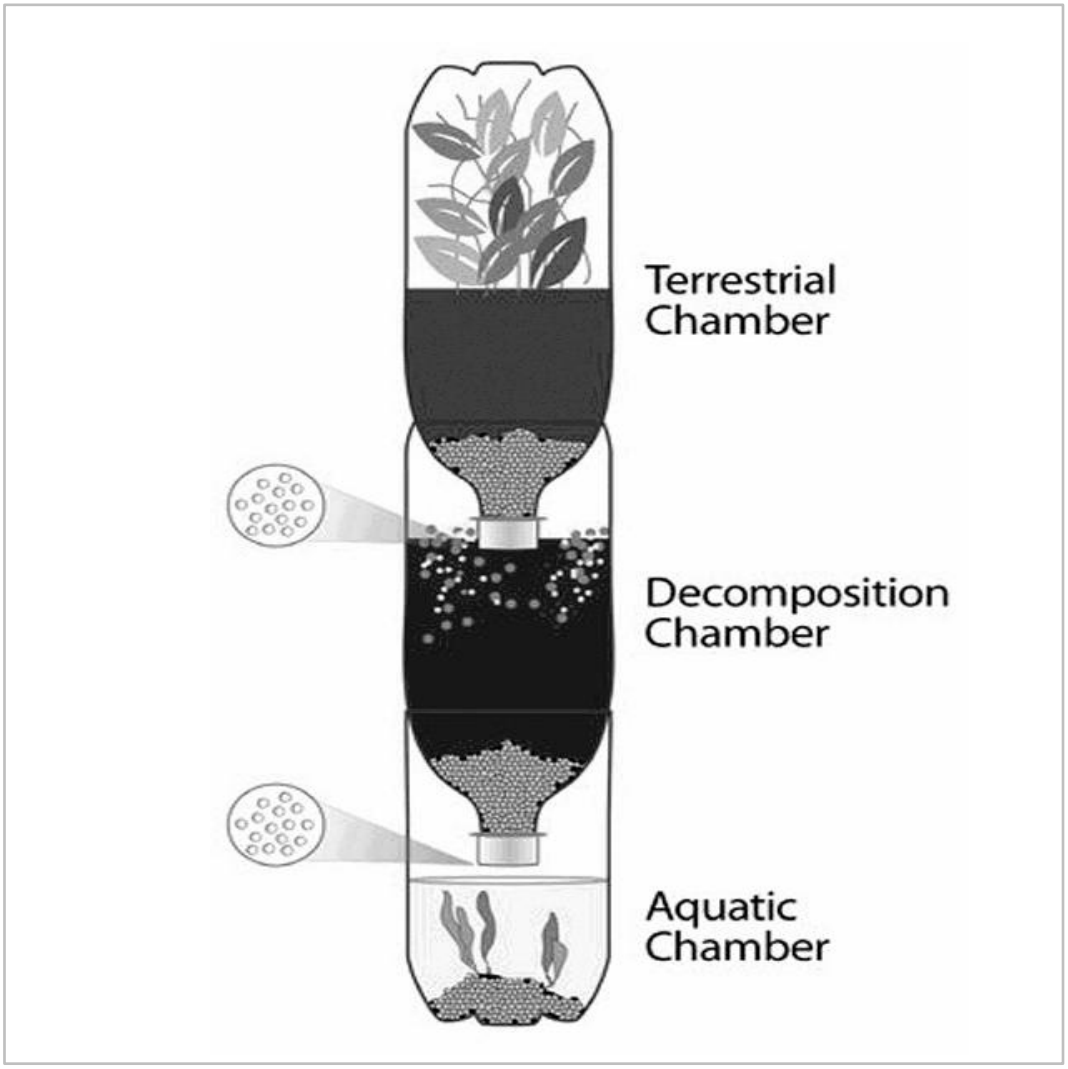


Image source: Bottle Biology

7.7_Terra-Decomposition-Aqua column

EXPERIMENT

LEVEL: SIMPLE

Teaching Objective

The purpose of this experiment is to encourage students to learn about the organic processes taking place in their environment: on the soil surface, within decomposing leaf litter, and in a freshwater habitat.

Exercise

An eco-column is a self-sustaining ecosystem on a small scale, made of plastic soda bottles. This eco-column has 3 chambers: the terrestrial chamber, the decomposition chamber, and the aquatic chamber. The terrestrial layer represents the land habitat including plants and insects (if desired). The bottle caps are perforated to allow fluid to move from one chamber to another. The decomposition chamber represents a leaf litter habitat, much like a compost pile. The aquatic chamber is a mini freshwater habitat for aquatic plants and even small fish. All three of these chambers make a “mini-ecosystem” within a classroom setting. A student can see the interactions between the chambers as the student waters the plants that grow in the terrestrial chamber and observe how the water travels through the decomposition layer all the way to the aquatic habitat below.

Main source (hyperlinks)

Bottle biology

Required Materials

3 PET bottles, scissors | soils and organic materials from local environment | water and aquatic materials for aquatic chamber

Image source: www.permaculture.co.uk

7.8_Plant a tree

OUTDOOR ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The purpose of this activity is to teach students about the importance of growing trees and regenerating the landscape; and how to plant and care for trees.

Exercise
Pick out a tree. Very young trees are usually sold bare-root. Bare-root means that they will look like sticks with a bit of root at one end. They can only be planted when they are dormant. The roots of very young trees must be soaked in a bucket of water for a few hours before planting. Larger trees are usually sold balled-and-burlapped. This means that the roots are enclosed in dirt and wrapped in burlap and twine or wire. These trees can be planted at any time. Pick a suitable spot in your yard to plant your tree. Be sure that the tree has the amount of sunlight that it needs to grow. Dig a hole and set aside the soil, sod clumps, and rocks. You want the hole large enough that the roots fit in without being crowded. For bare-root trees, the hole should be a few inches deeper than the length of the root and wider than the spread of the root. For the ball-and-burlapped tree, you will want to measure the height of the root ball and the depth of the hole before planting it. Remove the twine or wire before putting in the hole. Put the tree in the hole and fill it 2/3 of the way with the dirt. Fill the rest of the hole with water. Once it has settled, fill the rest of the hole with dirt. Make a saucer-like circle around the tree using the leftover rocks and dirt clumps. Water thoroughly and then mulch. Stake the tree so that it does not get knocked over by strong winds, lawn mowers, and other hazards. Water thoroughly once a week in dry weather. (Family education)

Remark
Conduct a thorough research on appropriate trees to grow. A native tree is the safest choice; however: in some areas alien species can be highly beneficial (for example, leguminous trees with nitrogen fixing capacities can play a long-term role in fostering soil fertility). Be aware, however, that some alien species (such as Eucalyptus trees) can reduce soil fertility—detrimental to other flora.

Required Materials
One tree (native to your region) | shovel | bucket of water | measuring tape

Image source: https://www.facebook.com/MoringaMission/

7.8.1_Plant *Moringa Oleifera*

OUTDOOR ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The purpose of this experiment is to inform students about beneficial multipurpose plants that can easily be grown and propagated, using the example of Moringa.

Exercise
Moringa oleifera grows in dry to moist tropical or subtropical clime. It grows in any soil type, but heavy clay and waterlogged. Commonly known in various names such as Horseradish tree, Moringa, Drumstick tree, *Moringa oleifera* is deciduous, fast growing, and resistant to drought. It reaches a height of up to 12 m and trunk diameter of up to 45 cm upon maturity, but is tolerant to heavy pruning (good for hedges). The leaves are the most nutritious plant part; they are sometimes used to combat malnutrition. It is often cooked and consumed as vegetable, or dried and crushed into a powder then added into soups and sauces. Leaves can also be given to livestock as a complement to their fodder (including small animals such as chicken). Moringa is also planted as windbreaks and to prevent soil erosion. The seeds can be used to improve water quality (by coagulation; see exercise 4.8). Besides, Moringa is also used for its medicinal properties.
Moringa can easily be propagated by seeds, that are collected from existing trees' mature pods. You can plant the seeds in small containers in a mix of 50% sand and 50% compost, or alternatively, in locally available top soil; maximum 2cm depth. Watering regularly will be important. The seeds should germinate after two weeks, and the seedlings can be transplanted in the ground when they have reached 30cm at least. If seeds are not easily available, Moringa can be grown from cuttings as well.

Remark
Moringa is often presented as a miracle tree, as indeed the benefits of it are multiple. However, in order to build resilient food production systems, it is important to grow diverse crops and trees and avoid extended monocultures.

Main source (hyperlinks)
PFAF (Plants For A Future)

Other resources (hyperlinks)
NCBI, FAO, CAWSR

Required Materials
Moringa seeds or seedlings | compost | appropriate space | water

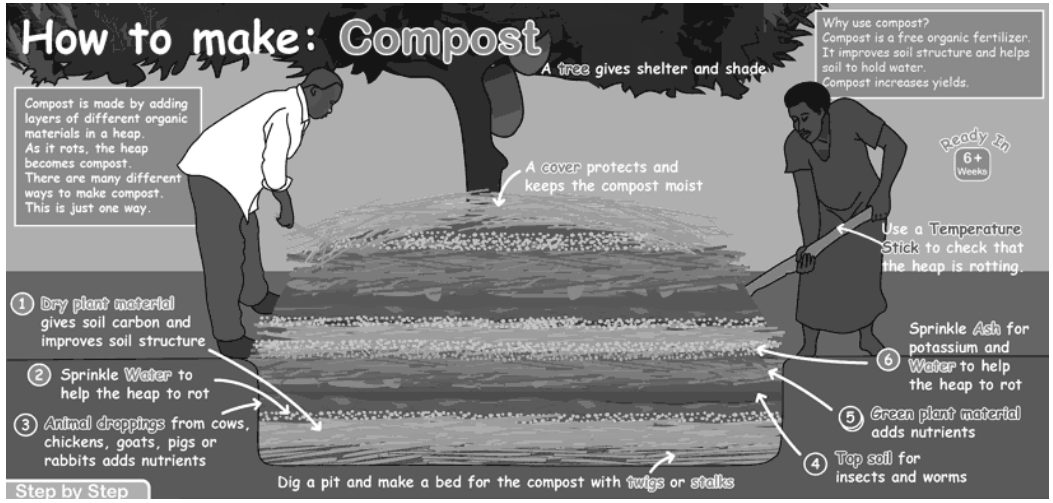


Image source: www.fourthway.co.uk

7.9_Compost pit

OUTDOOR ACTIVITY
LEVEL: SIMPLE

Teaching Objective

There are many ways to make compost. This exercise's objectives are to show students one easy way to make it and explain its importance for enhancing or keeping fertility in cultivated lands.

Exercise

To make compost, you will need to follow the following steps:

- Dig a pit, 20-30 cm deep and approximately 1mX1m in size.
- Build the compost layers alternating dry plant material, wood ash, animal dropping, top soil and green plant material. As a rule of thumb, the ratio 50% green and 50% brown material usually works well. Mostly, avoid putting more green than brown material.
- Water well as you go, to keep the dry layers moist and activate the composting process.
- If you can find compost worms, add them to the bottom layers of the heap, as they tend to work their way up. In that case do not add wood ash!.
- After three weeks, turn the compost around, and leave it for approximately another 3 weeks.
- When the compost is ready (dark brown crumble, smelling nice), apply to crops or sieve it and use for potting.

Remark

Make sure the compost heap is placed under a tree to protect it from direct sunlight and rain, as much as possible. Another tip is: if the compost smells bad, there is something wrong. The compost is probably saturated with nitrogen: in that case, add more dry vegetal material. You can use a temperature stick to make sure the heat goes up in the compost heap, which indicates that the composting process is happening. If it doesn't, add a little water and green material to the heap.

Main source (hyperlinks)

fourthway.co.uk
Other method (hyperlinks): The 18 days compost recipe

Required Materials

Appropriate tools to dig (spades, or other) | brown (dry) vegetal material | green (wet) vegetal material | animal droppings, manure, wood ash

Image source: Terre des hommes (Bangladesh)

7.10_ Keyhole Garden

OUTDOOR ACTIVITY
LEVEL: ADVANCED

Teaching Objective
The purpose of this activity is to how students a way to cultivate vegetables in an efficient and productive way, even when only a small space is available. Ideally, this garden should be built near the kitchen to facilitate its use and maintenance.

Exercise
To build a keyhole garden, you will need to follow the following steps:

- Measure and mark the circle for the central compost basket (roughly 50cm radius).
- Measure and mark the circle for the garden (150 cm), with the V shape access to the compost basket.
- Build the compost basket and start filling it up with dry material, green material, wood ash and manure. Sprinkle water on the dry layers.
- Build the garden's border with stones or bricks (or anything else available, like logs or banana stems).
- Mix and add the soils as you build the garden's walls (with top soil, well rotted compost and manure, and straw or dry vegetal matter). Heap the soil toward the compost basket, creating a little mound (this facilitate the plants' access to the nutrients in the basket, and increases the surface available for cultivation).
- Cover the compost basket to protect from sunlight or excess water during rainy season.
- Leave the garden to rest and settle for a week before planting seeds or seedlings.

Remark
It is important to build these garden following the main basic principles, such as the size of the garden (3m across is a maximum), make the central compost basket the right size, and using the material locally available.

Main source (hyperlinks)
Send a Cow UK - The Bangladeshi version can be seen here

Required Materials
A 3x3m space | bricks, or stones, or etc. | top soil, compost, well rotted manure, wood ash | straw | pegs (sturdy and bendy) | natural string |

Topic 8_From Waste to Resources

Let's be part of the Solution, not the Pollution.

Image source: [illegible]

This topic encourages students to become conscious about the impact related to poor waste management and about what can be done to avoid it.
It introduces activities that promotes waste as a resource by applying the 3R principles: Reducing the amount of waste generated by consuming less or differently, Reusing and Recycling waste.
The exercises in this topic are selected to help enable students:

- To understand the importance of waste management and how waste pollutes our environment when not properly handled.
- To learn and experience sustainable waste management practices.

WASTE, ENVIRONMENTAL IMPACT AND REMEDYING STRATEGIES

Waste definition
Waste is a generic term that refers to something which is no longer used and is discarded. It is estimated that the world population now generates 1.9 billion tons of garbage each year, of which 30% remains uncollected and is mostly openly burned or dumped somewhere. For the collected fraction, 70% is disposed in landfills and dumpsites.

Environmental impact
Burning and dumping mixed waste are common practices that have a huge impact on human health and the environment.
Burning threat: Even if sometimes not visible, the smoke from burning waste can enter lungs through nose and mouth and the tiny particles can poison the blood, cause respiratory diseases and cancer. Burning waste is even more dangerous when it contains plastic waste as this releases harmful pollutants.
Dumping threat: Dumping waste leads to visible plastic accumulation in nature, environmental pollution of soil and water, and is also responsible for spreading of diseases as it encourages breeding of mosquitoes among other disease vectors.

The 3R principles
Waste is produced whenever we stop using a product and discard it. The best way to minimize the environmental threat of inadequate waste management is to minimize the waste amount that needs management by following the 3R principle of “reduce, reuse and recycle”.

Reduce means avoiding waste production by considering what you buy and consume products that create less waste.
Reuse involves a repeated use of a product before you then finally discard it.
Recycle means to make use of the discarded object and transform to a resource for re-processing to new products or to recover energy from it.

If we take the example of a plastic bag used to carry things, *Reduce* would mean to use only 1 plastic bag for all the things we buy instead of one plastic bag for each item. *Reuse* would mean to utilize the same plastic bag for next time we go shopping. *Recycle* would mean to use it for another purpose, for example to produce an eco-brick (see exercise 8.6).

Waste heterogeneity
Even if we commonly see waste as a single entity, waste is made of different materials such as: plastic, paper, glass and organic waste. Different waste management strategies can be applied for these different materials to enhance their reuse, recovery and recycling. Being aware of the waste composition is a key step to change our view that it is a potential resource instead of something we want to get rid of.

HOW TO IMPROVE WASTE MANAGEMENT IN SCHOOL

The severe threats to human health and environmental pollution from open burning and inappropriate management of waste highlights the necessity to safely manage waste at schools and increase knowledge and awareness of students regarding risks but also to show pathways for improvement.

Tasks for a good waste management at the school:

- Understand the issues of inappropriate waste management (8.1 – 8.4)
- Identify waste streams and quantities (8.5)
- Separate the waste materials at source into different waste bins : organic waste, plastic, paper, metal (8.5 – 8.6)
- Check the Practical Exercises and the Catalogue of Technologies for Topic 8 to see what you can do with each fraction (8.6 – 8.9)

Image source: EVAgua

8.1_Waste collection day

OUTDOOR ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The objective of this activity is to show to students the impacts of dumping and throwing waste away.

Exercise
Organize a Waste Collection Day at a water body (river, stream, lake), green area, or any place where students like to play in their free time.
At the end of the day, the amount of waste collected (number of plastic bags filled or the total weight) is reported in a notebook.

Questions are asked to the students on:
1. What are the most predominant waste types collected (plastic/ metal/ glass/ paper/ organic)?
2. Where do they think the waste comes from?
3. What could be done to avoid that waste is dumped into the environment?

Required Materials
plastic bag for waste collection| gloves | notebook | pencils | (scale)

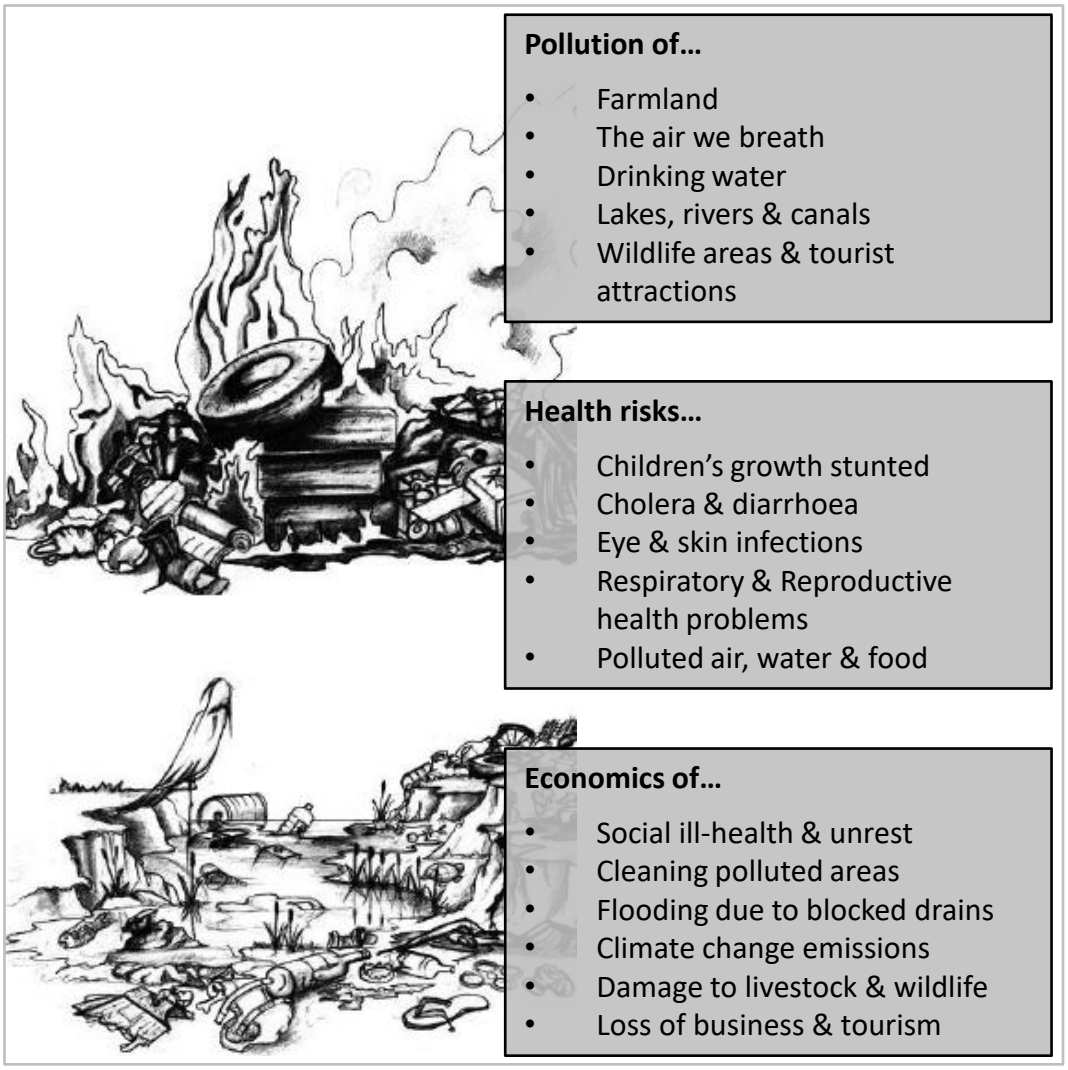


Image source: Wasteaid

8.2_Impacts of unmanaged waste

DISCUSSION
LEVEL: MEDIUM

Teaching Objective
The objective of this activity is to familiarize students with the issues of not managing waste properly when openly burning or dumping it.

Exercise
Based on the information provided in the boxes and in the Technical Background of this topic, discuss the issues of burning mixed waste with plastic and dumping waste with students.
The discussion can start by asking students if they have already burned or seen somebody burning mixed waste (with plastic) and if they think it is a good practice or not, and why. The same questions can be asked for the issue of dumping waste. Once they have shared their own experiences, provide them the information given on environmental and health threat. Discuss it with them and define what could be done to avoid these problems.

OPTION: Ask students to represent these threats in a drawing.

Required Materials
none | (pencils and paper)

Additional Resources (hyperlinks)
Wasteaid Toolkit

Image source: Eawag

8.3_Visit of landfill/dumpsite

OUTDOOR ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The objective of this activity is to show students what the end of life of waste is, its contamination risk and the importance of reducing waste generation.

Exercise
Organize a visit to the closest dumpsite or landfill. Before reaching the site, ask students where they think their waste ends and to describe what a landfill/dumpsite looks like. At the site, give students information provided in the Technical Background regarding annual amount of waste generated and dumped.
At the end of the day, collect impressions on what they think about the visit, what was the most impacting thing they saw, and what they would suggest to do to improve the situation.

Required Materials
appropriate shoes | local authorization to visit the sites | (transport)

Material	Degradation time
Paper	2-4 Weeks
Cardboard box	2 months
Cotton gloves	1–5 months
Painted wooden sticks	13 years
Plastic bag	10–20 years
Tin can	50 years
Disposable diapers	50–100 years
Soft plastic (bottle)	100 years
Hard plastic (bottle cap)	400 years
Aluminum cans	200 years
Glass bottles	Undetermined

Image source: Cmore

8.4_Waste degradation rate

DISCUSSION
LEVEL: ADVANCED

Teaching Objective
The objective of this activity is to familiarize students with the long term impact of throwing waste away.

Exercise
Biodegradation is a biochemical process in which materials are dissolved by bacteria and microorganisms. In nature, different materials degrade at different speeds, depending on their structure and composition. Main materials and corresponding degradation time are shown in the table.
Make cards for each material and for each degradation time separately and put them in two separate piles. Shuffle each pile and lay them out on a desk. Ask students to pair the material card with its correct corresponding degradation time card. Students should explain their choices. Once all material cards have been assigned to a degradation time, share the correct answers and ask them to make a drawing representing what they have just learned.

Required Materials
Pencils | paper | scissors

Image source: Waste Authority

8.5_Waste assessment

EXPERIMENT
LEVEL: ADVANCED

Teaching Objective
The objective of this activity is to enable students to evaluate their waste production.

Exercise
Collect the waste produced in one week from the waste bin of at least 5 classrooms. Note the number of students and teacher for each classroom. Weigh each bin and report it. Empty the waste onto a plastic sheet. Weigh the emptied bins to know the net amount of waste collected. Ask students to wear gloves and separate the waste in 5 piles of different materials: organic waste (food, fruit and vegetables leftovers), paper waste (used paper and cardboard), plastic waste (PET bottles, packaging,…), metal pieces and glass. Weigh each fraction by putting it into a basket and measuring it on a scale. Subtract the empty basket weight to calculate the net amount of waste generated for each fraction. Ask students to report the measurements in their notebook and calculate the percentage of each fraction over the total waste analysed. Rank the fraction according to their percentage. With the assessed number of students and teachers per classroom, calculate the waste generation per person. If there is a canteen, do the same exercise considering only the bins located in the kitchen and in the canteen. Evaluate how many meals are served per week to assess the waste generation rate per meal. At the end of the activity, questions are asked to students on:

1. What are the most predominant generated waste fractions (plastic/ metal/ paper/ organic)?
2. What could be done to reduce these amounts?

OPTION: Once the amount of waste generated per capita during 1 week is known, ask students to calculate how much time would be needed to fill up the classroom volume with waste, considering a waste density of approx. 600 kg/m^3.

Required Materials
Big plastic bags for waste collection | basket | gloves | plastic sheet (2X2m) | notebook | pencils | scale

Additional Resources (hyperlinks)
Wastewise Toolkit

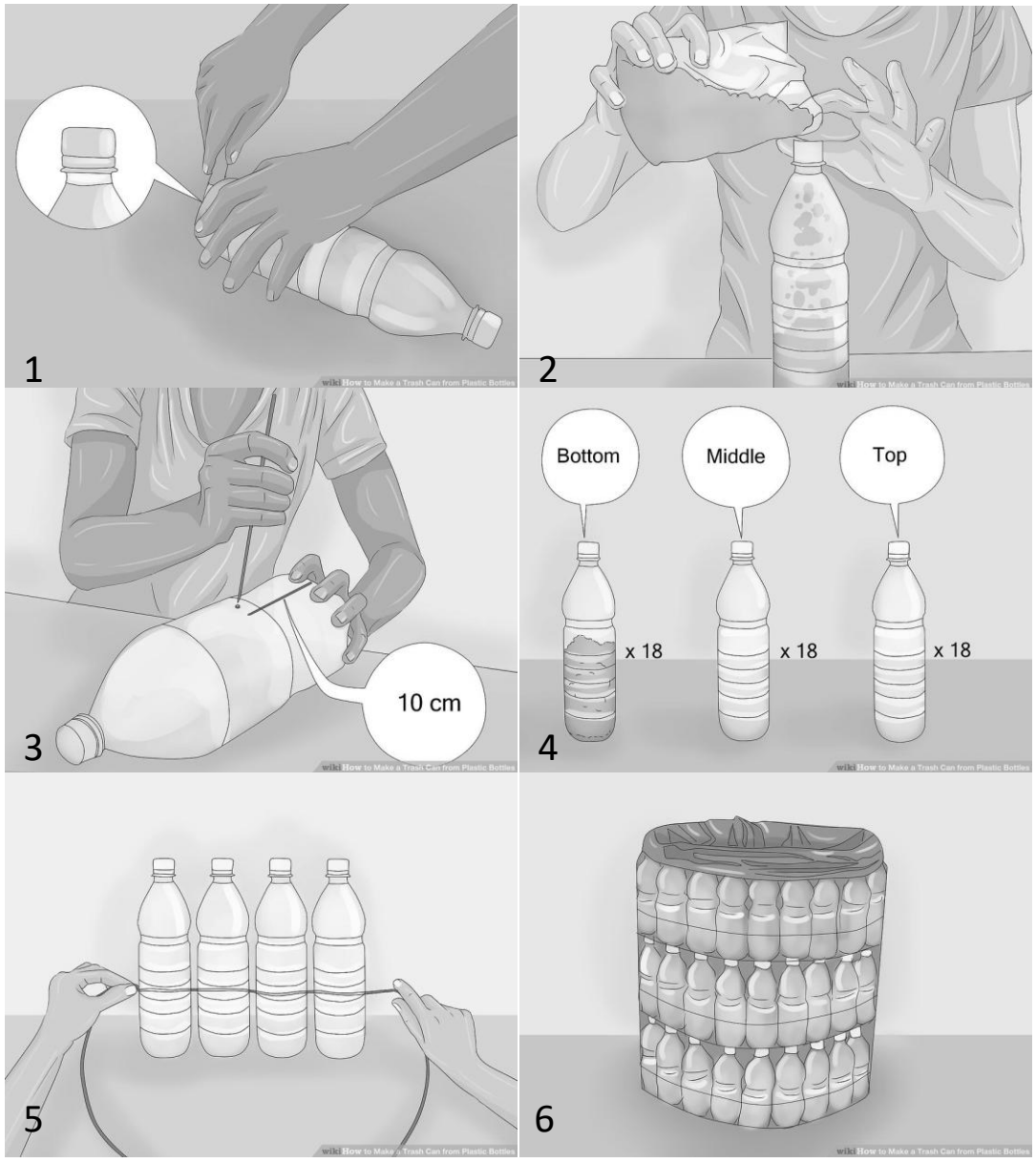


Image source: wikiHow

8.6_Waste bins from plastic bottles

OUTDOOR ACTIVITY

LEVEL: MEDIUM

Teaching Objective

The objective of this activity is to familiarize students with waste recycling and waste separation.

Exercise

Waste bins can be made out of plastic bottles in 6 steps:

1. Cut a hole at the bottom of 36 bottles of the size of the bottle cap, so that another bottle can snap right in and not fall out. This can be done with a sharp knife or by heating a knife in a candle for a few seconds.
2. Fill another 18 bottles halfway with trash, soil/sand. These bottles will be used for the bottom row of the bin to give the waste bin some weight.
3. Measure 10 cm from the bottom of each bottle and mark it on both sides of the bottle. Use a candle to heat a piece of wire and poke two holes through the markings of each bottle.
4. Make 3 rows of 18 bottles each. The row of bottles with trash or sand/soil is at the bottom. Snap an empty bottle (with a hole at its bottom) onto each bottle top of the row of bottles with trash or sand/soil and then make another row on top of that.
5. Line up all 3 rows. Start inserting a wire through the side holes of the bottom row. Repeat again for the middle row of bottles and then the top row. To make it easier, keep the bottles in a line as you insert the wire.
6. After inserting the wire through the whole row, bring the two ends of wires together and fix them together with wire cutters. Adjust the bottles so that they are standing as straight as possible. Put a big plastic or jute bag inside and make a sign of what type of waste should be thrown into this bin.

Required Materials

36 clean plastic bottles of same size | knife | candle | trash or sand/soil | wire | big plastic/jute bag | cardboard | pens

Additional Resources (hyperlinks)

Wikihow Guidelines

Image source: Wasteaid

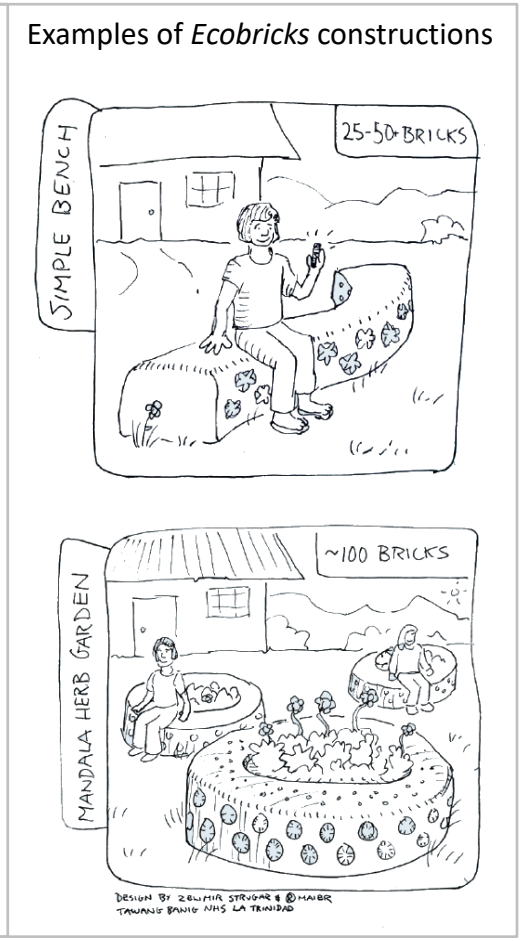


Image source: Ecobricks

Image source: Eawag

8.7_Ecobricks – Building with plastic

OUTDOOR ACTIVITY
LEVEL: ADVANCED

Teaching Objective
The objective of this activity is to demonstrate students how to recycle plastic waste by producing a building material.

Exercise
To create an *Ecobrick*, the following steps need to be undertaken:

1. Clean, dry and collect soft plastic waste
2. Compress the waste into a plastic bottle with a stick
3. Pack tightly many bags into the bottle until the bottle cannot be squeezed by hand at its sides
4. Squeeze with one hand to measure if it is full enough (for reference, a 1.5 litre PET bottle should weight around 400 g). Then close with a bottle top.

Once enough *Ecobricks* are produced, construction can begin. See the additional resources for more information. If you don't have enough *Ecobricks* or space for construction, you can also use them as an efficient way to store plastic waste.

Required Materials
PET bottles| soft plastic | stick

Additional Resources (hyperlinks)
Ecobrick Construction Guide, Wasteaid toolkit

Image source: Parenting Times (CC BY-NC-SA 2.5)

8.8_Recycling your own paper

CREATIVE ACTIVITY
LEVEL: SIMPLE

Teaching Objective
The objective of this activity is to teach students how to make their own recycled paper.

Exercise
To produce recycled paper, the following steps need to be carried out:
1. Tear your used paper into strips and soak it in water for several days
2. Use a fork to crush the soaked paper into tiny pieces
3. Pour the slurry of crushed paper into a fine sieve and drain the excess water from the crushed and soaked paper
4. Use a glass bottle to roll out the crushed paper into a flat sheet
5. Let the sheet dry in the sun and then you can start drawing on it

Required Materials
used paper | bowl | fork | sieve | glass bottle | water

Image source: CCAC Waste Initiative

8.9_Composting – Moisture test

EXPERIMENT
LEVEL: SIMPLE

Teaching Objective
The objective of this activity is to teach students how to check for the right moisture content of a composting heap.

Exercise
To ensure that the moisture content of a composting heap is around 50-60%, which is ideal for the composting process, the following steps can be carried out:

1. Put on a glove and take a handful of material from the centre of the composting heap
2. Squeeze the material in your hand and observe what happens:
   If you can squeeze water out of it: the compost is too wet
   If it does not release water or just a few drops: it is just right
   If it does not release water but crumbles apart when released: it is too dry

Based on your observation, if it is too wet you can either add dry material or turn the heap during a warm and sunny day to allow moisture evaporation. If it is too dry you can sprinkle the heap with some water.

Required Materials
gloves

Additional Resources
CCAC Handbook

List of references and additional resources

A lot of the exercises presented in the catalogue are accompanied by useful hyperlinks you can open by right clicking on it. Here is the list of these resources:

Title	Links
1.1_Transect Walk	http://www.communityledtotalsanitation.org/sites/communityledtotalsanitation.org/files/Guidelines_for_triggering_CLTS_0.pdf https://www.sswm.info/humanitarian-crises/urban-settings/planning-process-tools/exploring-tools/transect-walk https://siteresources.worldbank.org/EXTTOPPSISOU/Resources/1424002-1185304794278/4026035-1185375653056/4028835-1185375678936/1_Transect_walk.pdf
1.2_Participatory Mapping	https://www.sswm.info/planning-and-programming/decision-making/deciding-community/participatory-mapping-for-decision-making
1.3_Participatory Modeling	http://www.iapad.org/wp-content/uploads/2015/07/JCGaillard.pdf http://www.mspguide.org/sites/default/files/case/pacctechrep10lr.pdf
2.1_What is the Water Cycle?	https://d43fweuh3sg51.cloudfront.net/media/media_files/strand-3-background-article.pdf https://www.sswm.info/concept/water-cycle https://pubs.usgs.gov/gip/146/images/WaterCycle-Kids-USGS.jpg
2.4_ Water Cycle Wheel	https://i.pinimg.com/736x/8d/a8/fd/8da8fd9fe6aed62e807364ef8b6fa3e7--teaching-science-teaching-ideas.jpg
2.9_Cloud In A Jar	http://scienceillustrated.com.au/blog/wp-content/uploads/2010/11/ministorm.jpg https://thewaterproject.org/resources/lesson-plans/condensation-experiment
2.12_Global Warming in a jar	http://peabody.yale.edu/sites/default/files/documents/education/Global%20Warming%20In%20A%20Jar.pdf https://archive.bigelow.org/virtual/ https://thewaterproject.org/resources/download/water-cycle-water-crisis.pdf
2.13_Water & Nutrient Cycle Puzzle	http://www.aguasan.ch/ws2016/SDG-6-Water-&-Nutrient-Cycles.pdf
3.1_What is a Watershed?	https://water.usgs.gov/edu/watershed.html
3.4_Drawing my Watershed	http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/maine_appD_watershed-delineate.pdf
4.2_Water Filter in a Bottle	https://www.wikihow.com/Make-a-Water-Filter
4.6_Water quality testing	https://www.sswm.info/content/water-quality-testing http://www.indiawaterportal.org/
4.7_Safe storage and transportation	https://www.sswm.info/taxonomy/term/4026/safe-storage https://www.caritas.ch/fileadmin/user_upload/Caritas_Schweiz/data/site/was-wir-tun/engagement-weltweit/country-programme/kenia/wash/Caritas_CHAST_Manual.pdf https://www.sswm.info/water-nutrient-cycle/water-purification/hardwares/point-use-water-treatment/point-of-use-water-treatment-

List of references and additional resources

4.8_Treating water with Moringa seeds	http://c.ymcdn.com/sites/www.echocommunity.org/resource/collection/12164DCB-6FCC-42E5-899A-DBA41B1A9B19/TN_52_Moringa_Water_Treatment.pdf https://resources.cawst.org/appendix/436ffef5/appendix-b-household-water-treatment-technology-fact-sheets https://www.cawst.org/en/resources/biosand-filter http://www.sodis.ch/index_EN
5.6_Eco Sanitation Puzzle	http://www.ecosanres.org/publications.htm http://www.eawag.ch/en/department/sandec/publications/compendium/
5.7_Pile sorting of good and bad hygiene practices	https://www.caritas.ch/fileadmin/user_upload/Caritas_Schweiz/data/site/was-wir-tun/engagement-weltweit/country-programme/kenia/wash/Caritas_CHAST_Manual.pdf
5.9_Soap making	https://resources.cawst.org/fact-sheet/96362884/soap-making-fact-sheet https://www.wikihow.com/Make-Handmade-Soap
5.10_Glass of water	http://www.communityledtotalsanitation.org/sites/communityledtotalsanitation.org/files/cltshandbook.pdf
5.14_Demonstration of good hygiene practices	https://www.caritas.ch/fileadmin/user_upload/Caritas_Schweiz/data/site/was-wir-tun/engagement-weltweit/country-programme/kenia/wash/Caritas_CHAST_Manual.pdf
5.15_Construction of tippy tap	http://www.tippytap.org/wp-content/uploads/2011/03/How-to-build-a-tippy-tap-manual.pdf http://www.washplus.org/resources/tools/2014/05/01/how-make-other-types-tippy-taps.html
6.5_Knock Down the Myth	https://www.unicef.org/gender/
6.6_As we grow up	http://wsscc.org/wp-content/uploads/2015/10/As-We-Grow-Up-West-Africa-EN-web.pdf https://www.caritas.ch/fileadmin/user_upload/Caritas_Schweiz/data/site/was-wir-tun/engagement-weltweit/country-programme/kenia/wash/Caritas_CHAST_Manual.pdf
6.7_My Menstrual Cycle	http://wsscc.org/resources-feed/menstrual-wheel/
6.8_Keeping my menstrual calendar	https://www.caritas.ch/fileadmin/user_upload/Caritas_Schweiz/data/site/was-wir-tun/engagement-weltweit/country-programme/kenia/wash/Caritas_CHAST_Manual.pdf
6.9_Reusable Pad Making Workshop	https://www.sswm.info/humanitarian-crises/camps/hygiene-promotion-community-mobilisation/hygiene-promotion-community/menstrual-hygiene-management https://ww.unicef.org/wash/schools/files/Ethiopia_MHM_Conf.pdf https://www.wikihow.com/Make-Your-Own-Reusable-Menstrual-Pads
6.10_Disposal	https://www.menstrupedia.com/

List of references and additional resources

7.7_Terra-Decomposition-Aqua Column	http://www.bottlebiology.org/investigations/terraqua_main.html
7.8.a_Plant Moringa Oleifera	https://pfaf.org/user/Plant.aspx?LatinName=Moringa+oleifera https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4490473/ http://www.fao.org/traditional-crops/moringa/en/ https://resources.cawst.org/fact-sheets/5b700dbf/household-water-treatment-and-safe-storage-fact-sheets-detailed
7.9_COMPOST PIT	http://www.fourthway.co.uk/posters/pages/compost.html https://permaculturenews.org/2008/07/26/18-day-compost-the-appliance-of-science/ https://wasteaid.org.uk/toolkit/how-to-turn-organic-waste-into-compost-using-worms/
7.10_ Keyhole garden	https://www.youtube.com/watch?v=ykCXfjzfaco https://www.youtube.com/watch?v=ktg9Z1tGGcI
8.2_Impacts of unmanaged waste	https://wasteaid.org.uk/toolkit/making-waste-work/
8.5_Waste assessment	http://www.wasteauthority.wa.gov.au/media/files/wws/waste-audit-toolkitv4_web.pdf
8.6_Waste Bins from Plastic Bottles	https://www.wikihow.com/Make-a-Trash-Can-from-Plastic-Bottles
8.7_Ecobricks – Building with plastic	https://www.ecobricks.org/pdfs/EcoBrick%20Construction%20Guide%20-%20v0.7.pdf https://wasteaid.org.uk/toolkit/how-to-turn-mixed-plastic-waste-and-bottles-into-ecobricks/
8.9_Composting – Moisture test	h ttp://www.waste.ccacoalition.org/document/handbook-schools-organic-waste-management

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Citation (suggestion)

Leclert, L., Moser, D., Brogan, J. and Mertenat, A.,, Harrison, J., 2018. Blue Schools - Linking WASH in schools with environmental education and practice, Catalogue of Practical Exercises. 1st Edition. Swiss Water & Sanitation Consortium, Caritas Switzerland, Helvetas, Terre des hommes, Eawag. http://waterconsortium.ch/blueschool/ [Access date]

THE SWISS WATER & SANITATION CONSORTIUM

HELVETAS Swiss Intercooperation
CARITAS Schweiz Suisse Svizzera Svizra
Terre des hommes Aide à l'enfance. tdh.ch
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Schweizerische Eidgenossenschaft
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