Dar Si Hmad
ⴷⴰⵔ ⵙⵉ ⵃⵎⴰⴷ
دار سي حماد

WATER SCHOOL

by Dar Si Hmad

STEAM Curriculum for ages 6 -14

Acknowledgements and Copyright

This curriculum was designed for Dar Si Hmad, an independent nonprofit organization founded in 2010 promoting local culture and sustainable initiatives through education and the integration of scientific ingenuity in Southwest Morocco. We operate North Africa's largest fog harvesting project, providing villages with access to potable water. Our Water School and Girls' E-Learning programs build capacity and empower youth in the Anti-Atlas Mountains on the edge of the Sahara Desert. Through our Ethnographic Field School, researchers and students engage in cross-cultural exchange with local communities.

Dar Si Hmad's Water School Curriculum is the result of collaboration between many individuals and organizations that have contributed to the project since its founding in 2014. First, we would like to thank the Mortensen Center in Engineering for Developing Communities at the University of Colorado, Boulder and Tifawin Institute, both of which have been important to the Water School's success. We are likewise grateful for the continued support of the provincial delegation of the Moroccan Ministry of Education in Sidi Ifni and the collaborative teachers at the Agni N'Zekri, Smahra, and Jabal Al-Akhbar Schools. The WasserStiftung (WaterFoundation) in Germany and The Science League in Jordan have provided invaluable inspiration for Water School concepts and activities. The generous support of the US Embassy Public Affairs Office in Rabat facilitated the translation and publication of this curriculum.

We are also indebted to the Water School teams of 2014, 2015, and 2016, including Fatima Matousse, Abderrahmane Ennasiri, Nadia Bat, Brahim Mezgar, Jamila Bargach, Leslie Dodson, Jeanette Neethling, Marouane Smaili, Rebecca Daniel, Fatiha Tachakourt, Souad Kadi, and Jade Lansing, who have been instrumental in the continued dynamism of the Water School. This program has been a deeply participatory process, and we are likewise indebted to the students of our partner schools and their families. Their engagement and thoughtful feedback are the true engine of the Water School and this curriculum.

Dar Si Hmad is pleased to provide this curriculum as an open-source resource for schools, teachers, and organizations around the world. We hope the model we have built and the ideas we have compiled will be of use for others working in environmental education and STEAM learning. We would very much welcome additional ideas or suggestions. We would also appreciate any support offered to the Water School.

Contact and donation information, as well as additional resources and materials, are available online at **darsihmad.org** and **youtube.com/c/darsihmad.**

BP 20686 Agadir Principale
Agadir 80000 Morocco

Table of Contents

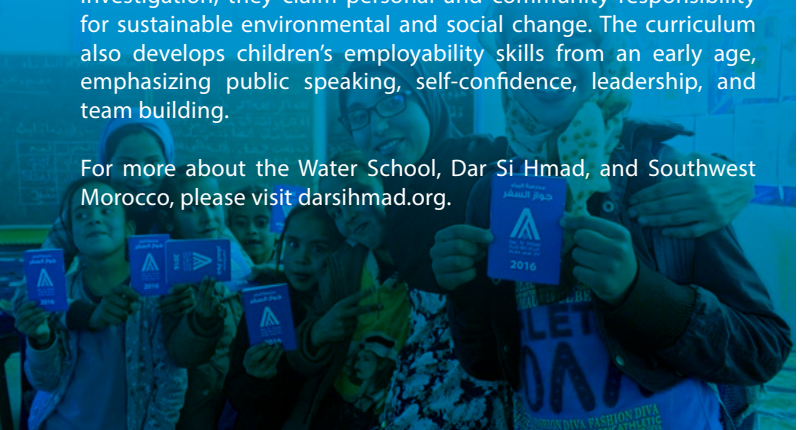
About the Water School

Living sustainably and equitably is a global challenge that requires creative solutions and the active participation of people of all ages around the world. Dar Si Hmad's flagship project provides potable water to rural homes in southwest Morocco through fog harvesting, combatting poverty in eco-friendly ways.

In combination with the fog harvesting project, Dar Si Hmad runs an annual Water School. The Water School uses environmental concerns to engage rural communities in experiential, life-changing learning. Children aged 6-14 in southwest Morocco's Aït Baamrane region learn about the societal and natural realities of their world, expanding their capacities for and understandings of global change.

Dar Si Hmad's Water School combines art, engineering, science, and mathematics learning through the exploration of water, sustainability, conservation, and environmental challenges. Through the Water School, children learn how to employ scientific lenses to investigate the natural world. Through hands-on investigation, they claim personal and community responsibility for sustainable environmental and social change. The curriculum also develops children's employability skills from an early age, emphasizing public speaking, self-confidence, leadership, and team building.

For more about the Water School, Dar Si Hmad, and Southwest Morocco, please visit darsihmad.org.



About this Curriculum

The key to the success of Dar Si Hmad's Water School is its relevance to local communities. The organization's pioneering fog-harvesting project, the relationships it has developed with partner villages during that work, and the inauguration of freshwater taps in homes for the first time have created a powerful context for environmental education revolving around water in Southwest Morocco.

The Water School follows three main themes, organized in this curriculum packet as units: basic ecology, the uses and sources of water, and environmental stewardship. While all lessons focus on water, the Water School purposefully uses the resource as a hook to engage students with broader questions of ecosystems and sustainability. Water connects human society with the world around us and human communities around the globe with each other. Understanding and valuing these connections is fundamental to teaching and learning in the Water School.

The activities and lesson plans presented here are arranged in a series of 10 half-day sessions. While they are given in a particular order, and learning is meant to build on itself, the curriculum intentionally presents each activity separately. Teachers and teams should select and adapt activities to suit their local contexts. For examples of what this looks like, see the sections at the end of each lesson about teaching "In the Bled". These summaries illustrate how Dar Si Hmad employs place-specific learning in Morocco's Aït Baamrane region.

The Water Heroes Program

The Water Heroes are a team of student superheroes devoted to protecting their community and the environment. The Water School not only teaches children to explore the natural world through scientific lenses, but also instills in them a sense of responsibility towards the environment. In each lesson, students learn the importance of water, sustainability, and conservation. As a Water Hero, they are empowered to use what they have learned to protect their community's natural resources and the ecology around them.

Water Heroes receive passports at the beginning of the Water School. Each lesson has a corresponding passport page. At the successful completion of each activity, heroes receive a sticker signifying that they have mastered that superskill. At the end of each session, heroes get their passports stamped with that day's theme to recognize their involvement in the heroes' brigade and their commitment to learning.

The passport, stickers, and stamps serve as incentives for attendance and active participation. Students who demonstrate good listening skills, complete all activities, and work well with their classmates are eligible to win the "Hero of the Month" award.

At the end of the Water School, all students receive a certificate of completion. Those who collect the most stickers and stamps are rewarded a certificate for being an "Outstanding Water Hero." All students should be sent into the world with their superhero mission clear: to be protectors and guardians of the natural environment.

Unit A

ECOLOGY BASICS

1: The Water Cycle

Lesson Objectives:

- To examine how water changes throughout the water cycle
- To understand how human activity impacts the water cycle
- To identify how to save and conserve water

Lesson 1 - The Water Cycle

The Three States of Matter: Molecule Movements

Time Required:
25 minutes

Materials Required:
Plenty of room

STEAM Subjects:
Physics, chemistry

Activity Objectives:

1. To learn about water molecules
2. To identify the characteristics of each state

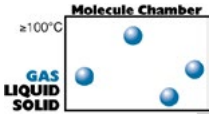
If possible, play the game outside!
For an added challenge, instead of yelling the phase by name, tell students whether heat has increased or decreased.

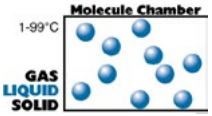
Explain:

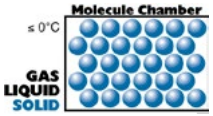
- There are 3 states of matter: solid, liquid, gas
- Molecules are the building blocks of the universe. Everything is made up of molecules
- Solid molecules are packed tightly together and hold their shape. Ice is solid water
- Liquid molecules flow and can fill the shape of any container they are in. Liquid water is what we use for washing and drinking
- Gas molecules are invisible and bounce around quickly, filling the container they are in. Water vapor is a gas that turns into clouds
- Changes in heat influence the states of matter. These changes drive the water cycle

Directions:

- Explain to students they are now water molecules grouped together
- When you yell "solid," students should squeeze together in a tight circle
- When you yell "liquid," they spread apart holding hands
- When you yell "gas," students break apart and jump around the room
- Call out phases in random order several times







Lesson 1 - The Water Cycle

Rain in the Coffee Pot!

Time Required:
15 minutes

Materials Required:
Water - Ice and cooler- Drip coffee pot- Aluminum foil Plastic measuring cup - Clear plastic cup - Paper towels - Pot holder

STEAM Subjects:
Physics, math

Activity Objectives:

1. To visualize the three states of water
2. To understand how water changes state

Let students do the pouring. They can practice measurements!

Directions:

- Ask students to review the three phases of matter. How does water change state?
- Pour 1-2 cups of water in the reservoir of the coffee pot and turn it on
- When hot water flows into the pot, point out the steam is called water vapor
- Explain that the rising temperature of the coffee pot changed water into the gaseous form of water called water vapor
- Hold the plastic cup above the pot to show water vapor collecting on the cup
- The water vapor is like clouds in the sky
- After the reservoir stops dripping, wipe the moisture off the inside of the pot. This moisture is like rain
- Place aluminum foil over the opening of the pot and pinch it around the edges
- Fill the cover with ice cubes
- Explain that ice is the solid form of water
- Watch as vapor condenses under the cover and drips into the pot

Discuss:

- What were different forms of water you saw?
- How did water change state?
- Where can you see this process at home?
- When were molecules moving most slowly?
- When were molecules closest together?

Lesson 1 - The Water Cycle

The Water Cycle

Time Required:
30 minutes

Materials Required:
Computer - Pictures or videos of each step in water cycle
Glass cup - Hot water heate

STEAM Subjects:
Geography

Activity Objectives:

1. To visualize the steps of the water cycle
2. To understand how water changes state

For an example of water collection, show Dar Si Hmad's fog-harvesting videos. Check out the YouTube channel in "Additional Resources."

Directions:

- Think about the water you drink, the water you see in rivers, and the water that falls as rain. Where does this water come from?
- The water cycle describes the movement of water and its changes of state on Earth and in the sky. There are four main steps:
- Evaporation: water (liquid) turning into water vapor (gas)
- When the sun warms rivers or lakes, water evaporates into the sky. When someone boils a pot of water, water evaporates into steam
- To demonstrate, use a hot water heater to boil water for students to see steam
- Condensation: water vapor (gas) turning into water (liquid)
- To demonstrate, pour ice cold water into a glass to see water droplets forming
- When water vapor in the air touches cold glass, it condenses back into liquid water
- Precipitation: water (liquid) condensing so much that it falls to Earth
- Rain, sleet, fog, and snow are different types of precipitation
- To demonstrate, show videos of precipitation (or if it's raining or snowing, go outside!)
- Collection: when water falls as precipitation, it collects in bodies of water and on land where it can become "groundwater"
- Humans also collect water to drink, live, and work. Show videos of different ways people collect water

Lesson 1 - The Water Cycle

The Human Water Cycle

Time Required:
35 minutes

Materials Required:
Large, six-sided dice - Six labels - Paper, crayons, markers

STEAM Subjects:
Geography, art

Activity Objectives:

1. To build on the basic steps of the water cycle
2. To understand how humans affect water flow

Discuss:

- Can you explain the four steps of the water cycle in your own words?
- How does temperature influence the changes of state in each step?
- How do humans use water?
- How does this use affect water distribution in the water cycle?
- Why might water stay in one step of the cycle longer than other steps?
- Is the water cycle always cyclical?

Directions:

- Make labels for "drinking, irrigation, pollution, urbanization, deforestation, and climate change" and paste them on faces of a large, six-sided dice
- Explain that the water cycle isn't always cyclical and that human factors influence how much and for how long water is distributed throughout each step of the cycle
- Ask a student to roll the dice. Explain the factor the dice lands on and how it influences water distribution in the cycle. For example, humans burning fossil fuels can influence climate change, which can cause an increase in temperature and lead to flooding or droughts. This would drastically influence how water is collected
- After discussing each factor, have students draw their own representations of the water cycle according to the environment and community they live in

Lesson 1 - The Water Cycle

Snack Time: 'Drawing' the Water Cycle

Time Required:
30-60 minutes

Materials Required:
A variety of fruits and cheeses - Crackers, pretzels, and/or bread - Plates, forks, and knives for each student - Cameras

STEAM Subjects:
Geography, art

Activity Objectives:

1. To enjoy a fun snack together
2. To review the visuals of the water cycle

Directions:

- Give each student a plate, knife, or fork
- Direct them to the variety of food 'materials' available to them
- Tell them their job is to create a visual representation of the water cycle using the food. This is the one time they are allowed to play with their food in class! For example, students might:
  - Use blueberries as rain drops
  - Cut a cloud out of a slice of cheese
  - Make some pineapple into a sun
  - Slice an apple into the shape of a mountain
  - Use broccoli to depict a forest
- While the students are making their creations, remind them to consider human elements of the water cycle in addition to the basic evaporation, condensation, precipitation, and collection elements that occur naturally
- Before eating, have each student present their cycle and review the science behind their depiction. Make sure they use proper terms
- Encourage students to be as creative as possible. For an extra element of fun and friendly competition, have a judging panel evaluate students' cycles and presentations!
- After the presentations, give students a chance to enjoy their snack – and the remaining 'art materials' as a group
- Make sure to practice safe hygiene before and after handling food!

Lesson 1 - The Water Cycle

Water Cycle Stories

Time Required:
45 minutes

Materials Required:
Cotton balls - Blue paper - Candy - Tape, glue - Large paper
Markers, crayons

STEAM Subjects:
Biology, art

Activity Objectives:

1. To reinforce states of matter cycle
2. To complicate and localize the water cycle

Discuss:

- What is the weather like in your community?
- Can you identify the steps of the water cycle around you or in your homes?
- How does temperature, weather, and precipitation influence how you and your family use water?

Directions:

- Divide students into groups of 4
- Each group must write a story about a water droplet in the water cycle
- Students can write, draw, or act out the story
- Students can choose how to start and end
  - Beginning prompts: *"I was just gas floating in a cloud…," "I was a droplet in a lake…,"* or *"I was a tiny snow flake…"*
  - Ending prompts: *"…and now I'm a drop of water in the ocean," "…and that's how I ended up in a water bottle,"* or *"…and now I'm part of a glacier."*
- The droplet must go through evaporation, condensation, precipitation, and collection throughout the story
- After giving students time to think, write, and draw, give each group a chance to present
- Have students give feedback on all the stories

Additional Resources

- **For more ideas on water stories, see** www.kineticcity.com
- **For Dar Si Hmad's Fog-Harvesting project, check out** youtube.com/darsihmad

In the Bled

The villages of Aït Baamrane where Dar Si Hmad's Fog Harvesting Project and the Water School take place are nestled in the Anti-Atlas Mountains of Southwest Morocco, a region particularly prone to climate change, increasing drought cycles, and water scarcity. Our fog-harvesting project utilizes innovative fog collection technologies as a sustainable, alternative source of potable water for more than 500 people in these villages. Since water is a precious and newly accessible commodity in these communities, the first lesson of the Water School on "The Water Cycle" is devoted to teaching the children of our 'fog villages' to identify the three states of matter and explore how water changes state as it moves throughout the water cycle.

Our teacher Fatiha Tachakourt begins this lesson by asking the students to identify different types of precipitation. The first response is often tagut, fog. Aït Baamrane is in a semi-arid region that experiences very little rain but has abundant fog for six months each year when the stratocumulus clouds floating above the Atlantic coast reach the Anti-Atlas Mountains. Fatiha shows students a video of fog wafting through our nets to condense into the water that is piped into their homes.

To introduce students to Morocco's diverse climates, Fatiha shows pictures of the snow-capped mountains of the High Atlas. "Thilj!" the children shriek. Fatiha nods approvingly and sprinkles white powder in their outstretched hands. This play snow was donated by a visiting researcher from England who fell in love with our Water School. Without fail, the children's eyes widen as Fatiha pours water over the powder and it expands into cool, fluffy 'snow'. Living in a place that never receives snowfall, this simulated version is a brand new experience for students.

Since the ages of our students range from 6 to 14 in a single classroom, Fatiha asks some of the older students to explain the Water Cycle to the younger children. As a class, they create a story and perform a dance about the journey of a water droplet. The students begin as gaseous water vapor molecules jumping in the sky. Their vapor condenses into rain as they link hands and form a tight circle. Wiggling their hands and bending their knees, they become precipitation falling to the ground. When Fatiha announces that the sun is coming out, the students shimmy and raise their hands and bodies upward, water evaporating back to the sky.

2: Plant Biology

Lesson Objectives:

- To identify and name plants and trees in the community
- To identify the structure and function of plant parts
- To understand photosynthesis and pollination

Lesson 2 - Plant Biology

Looking Local: Plant Identification

Time Required:
15 minutes

Materials Required:
Local plants, flowers, leaves, and tree samples
Pencils and paper

STEAM Subjects:
Botany

Activity Objectives:

1. To identify local plants, flowers, and trees

Directions:

- Display local plants, flowers, and leaves. Ask:
- What are the names of these plants?
- Where do they grow?
- Can you list any special characteristics?
- What can the plant be used for?
- Allow students to examine plants closely and sketch their observations

Lesson 2 - Plant Biology

Magnifying Glasses: Plant Scavenger Hunt

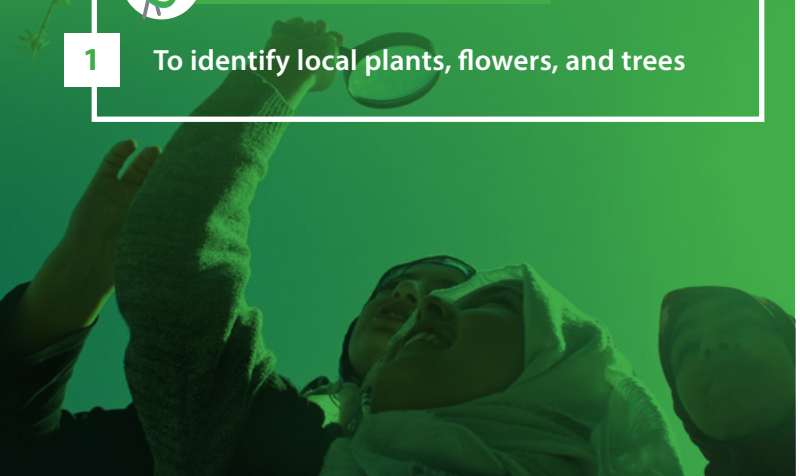
Time Required:
30 minutes

Materials Required:
Outdoor space - Variety of plants, flowers, and trees to find
Magnifying glasses - Pencils and paper

STEAM Subjects:
Botany

Activity Objectives:

1. To identify local plants, flowers, and trees



Directions:

- Place samples from the above activity outside
- Demonstrate how to use a magnifying glass and give each group of 3-4 pupils a glass
- Send students out to find and examine each of the plants. Task them with drawing what they see, writing down at least 3 observations, and identifying a unique feature in each plant
- After the hunt, gather to discuss observations

Lesson 2 - Plant Biology

Plant Parts

Time Required:
30 minutes

Materials Required:
Outline of a plant - Markers, pens - Variety of plants

STEAM Subjects:
Botany

Activity Objectives:

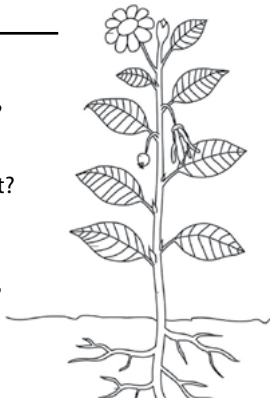
1. To identify different plant parts
2. To understand their structure and function

Directions:

- Pass out outline of plants
- Hold up different plants and explain the structure and function of each part of plant
- As parts are pointed out, students label and color corresponding part on their outline
- Roots: hold plant in place underground; absorb nutrients from soil for plant
- Stems: attached to roots; slender and long to support plant
- Leaves: attached to stems; absorb sunlight with chloroplasts for photosynthesis
- Flowers: different shapes, colors, sizes; contain pollen, which helps plants multiply
- Split students into groups of 2-3
- Pass out different plants to each group
- Each group draws its assigned plant, labeling each part and noting special features
- After 10-15 minutes, students can present their group's plants

Discuss:

- What part helps plants get food?
- What characteristics can you easily identify?
- How are these plants similar? Different?
- Why are each of these plant parts important?
- Do you eat any of these plants?
- What part of the plant do you eat?
- Besides food, what else are plants good for?



Lesson 2 - Plant Biology

Zooming In: Plant Cells

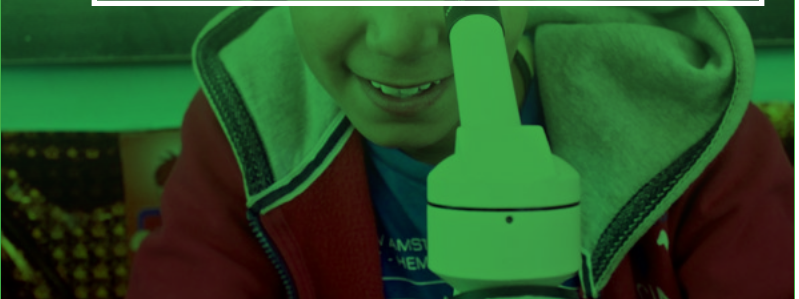
Time Required:
45 minutes

Materials Required:
Microscope - Slides and cover slips - Samples of an onion, a celery plant, a leaf, and a flower

STEAM Subjects:
Botany

Activity Objectives:

1. To learn about plant cells and chloroplasts
2. To learn how to use magnifying technology



Explain:

- Cells are important structures that are so tiny we can only see them with a microscope
- Cells are the basic unit of life—everything is made up of cells!
- Plants are made up of different types of cells
- Leaves have cells that contain a special structure called chloroplasts
- Chloroplasts in leaves absorb sunlight and use it to produce food for the plant
- Chloroplasts are what make a leaf look green

Directions:

- Tell students microscopes are like the magnifying glasses they used earlier, but much stronger
- Give students a tour of the microscope, explaining how its pieces work
- Prepare slides for onion, celery, leaf, and flower samples. If time permits, allow pupils to prepare the slides themselves
- Allow all students to observe and sketch the different slides
- Point out cell walls and other major elements

Discuss:

- What did you observe about these samples?
- What were similarities and differences between cells of the different samples

Lesson 2 - Plant Biology

Plant Theater: Photosynthesis

Time Required:
45 minutes

Materials Required:
Nametags labeled sunlight, plants, leaves, carbon dioxide, oxygen, water, and sugar - Construction paper - Crayons, markers - Tape - Stool or other 'set

STEAM Subjects:
Botany, art

Activity Objectives:

1. To identify what plants need to grow
2. To learn about photosynthesis

Explain:

- Plants need water, carbon dioxide, and sunlight to grow and make food
- Plants produce sugar and oxygen – what animals, including humans, need to live!
- Using energy from sunlight, plants convert water and carbon dioxide into sugar and oxygen in a process called photosynthesis
- Photosynthesis occurs in the leaves of plants:
  1 - Sunlight is absorbed by chloroplasts
  2 - Plants absorb water and CO2 from air
  3 - Carbon dioxide, water, and light are converted to make oxygen and sugar

Directions:

- Make groups of 7 and give each student a role via the differently labeled nametags
- Pass out paper and markers for students to decorate according to their role – making masks or full costumes if resources allow
- Help students devise lines and actions to perform an educational photosynthesis play (example lines are in the grey box on the left)
- Give groups a chance to practice their act
- Action! Have groups perform their plays for the class. Give all groups feedback and invite students to share what they liked most

Lesson 2 - Plant Biology

Pollination and Pollinators

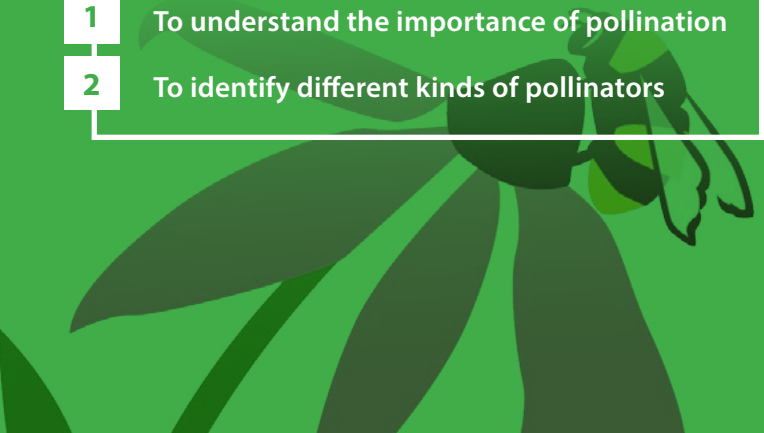
Time Required:
25 minutes

Materials Required:
Outline of a flower - Crayons, markers - Chalk - Cotton balls
Bee stuffed anima

STEAM Subjects:
Botany, art

Activity Objectives:

1. To understand the importance of pollination
2. To identify different kinds of pollinators



Explain:

- During pollination, pollen is spread from flower to flower, helping new flowers grow
- When bees visit flowers, they drink nectar and pollen rubs off on their bodies. Birds, wind, and even humans can also be pollinators

Directions:

- Pass out outlines of a flower to color, using chalk on the flower tips to represent pollen
- Make one student the 'bee' by giving them the bee and a cotton ball. The class bee should stop by each flower and rub the cotton ball in the picture's chalk pollen
- Show students how the pollen (chalk) was transferred from the flower onto the bee and how the pollen moved from flower to flower

Lesson 2 - Plant Biology

Snack Time: Pollination Pictures

Time Required:
30 minutes

Materials Required:
Foods representing the various pollination actors

STEAM Subjects:
Science, art

Activity Objectives:

1. To reinforce the process of pollination
2. To enjoy a healthy snack together

Replace these suggestions with local foods. For example, the sun might be bread or fruit instead of cheese.

Directions:

- Pass out 'flowers' (apple slices), 'bees' (raisins), 'stems' (pretzel sticks), 'the sun' (cheese), and 'water', 'oxygen', etc. (various colors of M&Ms)
- Invite students to use these ingredients to make a scene depicting pollination. For an extra challenge, incorporate photosynthesis too
- Be sure to enforce hand washing and cleaning!

Lesson 2 - Plant Biology

Plant Habitats

Time Required:
15 minutes

Materials Required:
Desert, river, and forest posters or objects - Plant flashcards

STEAM Subjects:
Ecology

Activity Objectives:

1. To explore the diversity of plant habitats

Preparations:

- Create 4 posters or objects, representing a desert, forest, and river habitat
- Create a number of flashcards of various plants and trees (cactus, trees, flowers, vegetables – make some of them tricky!)

Directions:

- Split students into teams and give them each a large stack of flashcards
- Explain they need to decide whether the plants belong in the desert, forest, or river
- Play music for around 5 minutes, giving students the chance to place their flashcards
- Discuss each plant as a group to check its placement and clear up any mistakes

Discuss:

- Did any of the plants surprise you?
- Are any of the plants found in multiple habitats? Do any of the plants move between habitats?
- Why is life different in deserts, rivers, and forests?
- How do these plants survive in their habitat? Which special features help them do that?
- What makes these habitats different? How are they the same? (Discuss temperature, precipitation, other species, etc.)
- Which habitat do students live in?
- Which do students prefer or want to visit?

Lesson 2 - Plant Biology

Musical Plants

Time Required:
15 minutes

Materials Required:
Chairs for each student - Music

STEAM Subjects:
Ecology

Activity Objectives:

1. To introduce the concept of habitat loss

Directions:

- This game is played like "Musical Chairs" with each chair representing a plant or tree. Tell students they are an animal depending on a plant habitat for food and shelter
- Play music and have students walk around the chairs. When the music stops, students must scramble to find a chair
- After each round, remove one chair signifying the loss of a habitat. Play for several rounds

Discuss:

- What can hurt or destroy plants? What kinds of things take away our 'chairs' in real life?
- What happens to animals, insects, and humans when plants are hurt or destroyed?
- What can we do to protect plants?

Lesson 2 - Plant Biology

Plant Poetry

Time Required:
30 minutes

Materials Required:
Paper - Crayons, markers

STEAM Subjects:
Science, art

Activity Objectives:

1. To reflect on ecosystem connections

Directions:

- Pass out paper, crayons, and markers
- Invite students to write a poem or story or draw a picture about the importance of plants for animals, insects, and their communities
- Challenge students to include ways to protect and appreciate plants
- Give students the chance to share their work

In the Bled

Aït Baamrane is situated at the intersection of three diverse biomes: the Sahara Desert, the Atlantic Ocean, and the Anti-Atlas Mountains. This unique geographical location provides the perfect climate for growing cactus and argan, which are widely grown in the region and harvested for commercial use. The villages around Sidi Ifni are considered Morocco's cactus and argan capitals. The plants grow abundantly around our Water School classrooms. Fatiha uses these to introduce the basic parts of a plant. Students go outside with magnifying glasses, pens, and paper to identify plant parts. Our older students help the younger students peer through the magnifying glasses to see the spindly cactus needles and the argan fruit up close. Together, they sketch the plants and label each part.

After the plant scavenger hunt, Fatiha asks students to share their observations and present their drawings. Students have eaten the cactus as a fruit and used it in animal feed, but the use of cactus seeds in health and cosmetic products sold around the world is new to them. Many of our students' families work in the argan industry. They share their knowledge of how argan is harvested and made into a cooking and dipping oil or amlou, a delicious spread with almonds and honey.

Fatiha introduces the students to a few more of the 7,000 plant species that inhabit Morocco. The Mediterranean and Atlantic coastlines, the Sahara Desert to the east, the dense forests of the Rif Mountains to the north, and the far-ranging Atlas Mountains create incredible biodiversity. Hanging posters of these four ecosystems in the classroom's corners, Fatiha holds up various plant pictures. As olive, palm, argan, banana, orange, lemon, carrot, cucumber, tomato, and cactus are named, students race to the plant's habitat. Through this activity, students learn more about plants not only in their own communities but also in parts of Morocco they have never seen.

3: Animal Biology

Lesson Objectives:

- To identify local animals in the community
- To understand species endangerment and extinction
- To identify solutions for biodiversity protection

Lesson 3 - Animal Biology

Animal Identifications

Time Required:
25 minutes

Materials Required:
Posters of desert, ocean, mountain, and forest - Pictures of different animals that belong to each habitat - Computer, project, screen, and animal videos

STEAM Subjects:
Biology

Activity Objectives:

1. To identify and learn about different animals
2. To explore habitat diversity

Directions:

- Hang up posters of different types of habitats around the classroom
- Hold up pictures of a variety of animals native to the region and the country
- Instruct students to guess which habitat each animal belongs to by running to the poster
- When students are at the correct poster, discuss unique characteristics of the animal:
- What sound does it make?
- What does it eat?
- How does it move?
- Students can answer through gestures and sounds representing the animal
- After the game and discussion, show a variety of movie clips of animals in their native habitats. Focus on animals students may not see in their everyday places and talk about how varied ecosystems are around the planet

Discuss:

- What is your favorite animal?
- Can you name animals you see around the community? Around your country?
- What is the habitat like for those animals?

Lesson 3 - Animal Biology

Game: Souad Says

Time Required:
15 minutes

Materials Required:
Indoor or outdoor space

STEAM Subjects:
Biology

Activity Objectives:

1. To review animal diversity and characteristics

Change the name of Souad to a name common in your area to make it more relevant. Give students turns playing "Souad"

Directions:

- Review animals previously discussed and have students decide a gesture/sound for each
- A student "Souad" instructs students for review ("Souad says slither like a snake," "Souad says act like a monkey"). Students should only respond when the phrase begins with "Souad says"!

Lesson 3 - Animal Biology

Adaptation for Survival

Time Required:
20 minutes

Materials Required:
Pictures, models, feathers, teeth from different animals

STEAM Subjects:
Biology

Activity Objectives:

1. To learn and identify animal adaptations

Directions:

- Hold up pictures, models, feathers, teeth, etc. of different animal characteristics and have students guess the animal
- Explain that adaptations are body parts or characteristics that allow an animal to live in a certain type of habitat and environment:
  - Gills allow fish to breathe in water
  - Humps let camels store water in desert
  - Long limbs let monkeys swing in trees
  - Good eyes help birds see prey from air
  - Varied teeth let humans be omnivores
- Pass pictures and items around so students can observe them more closely
- Have students think about what other adaptations they saw in the habitat videos

Lesson 3 - Animal Biology

Adaptations: Eagle Eyes

Time Required:
30 minutes

Materials Required:
Feathers and models of an eagle or another bird of prey
Candy for each student - Large space - Tape measure
Whiteboard + markers - Candy for each student - Large space
Tape measure - Whiteboard + markers

STEAM Subjects:
Biology

Activity Objectives:

1. To identify eagles' physical adaptations

If possible, ask a bird rescue organization or a "bird expert" to speak and bring in rescued birds to show the class.

Explain:

- The world has thousands of types of birds
- Eagles, hawks, and falcons are "birds of prey" – they hunt and eat other animals
- Eagles live by bodies of water, in cliffs, canyons, and the mountains
- The pigment that makes eagles' wings black also makes their feathers stronger for flying
- Eagles have a special skull shape that shades their eyes from the sun, bristles to protect their eyes from dust, and a third eyelid to moisturize their eyes – all helping with flight
- Eagles eat fish, rodents, and small birds

Directions:

- Point out and explain the previously described adaptations for an eagle
- Explain to students they are now eagles
- Give a piece of candy 'prey' to each student
- Instruct students to place their candy in a line on the ground and back away
- When the first student can't see the candy anymore, they have reached the limits of their eyesight and should stop
- Gather where first student stopped. Measure the distance between them and the candy
- Multiply this distance by 10 on the board. That's how far an eagle can see its prey!
- Review with students why eagles need to see so far. Are there other animals with special eyesight or visual adaptations?

Lesson 3 - Animal Biology

Adaptations: Eagle Ears

Time Required:
20 minutes

Materials Required:
Blindfold - Elastic cuffs with bells

STEAM Subjects:
Biology

Activity Objectives:

1. To understand keen hearing as an adaptation

Directions:

- Explain that in addition to keen eyesight, eagles have sharp hearing to help them hunt
- Give one student 'eagle' a blindfold and three student 'prey' bells to wear
- Gather students into a circle holding hands with the 'eagle' in the middle
- Have prey 'hide' themselves amongst the other students while the eagle relies on their hearing to catch them
- When the eagle catches a student, that prey should move out of the circle. Continue play until all of the prey is caught. Give students turns being the eagle and prey
- Discuss how hearing helps animals feed. Why do nocturnal owls have really good hearing?

Lesson 3 - Animal Biology

Snack Time: Hunting for Prey

Time Required:
15 minutes

Materials Required:
Feathers, models, and pictures of an eagle - Candy and other snacks

STEAM Subjects:
Biology

Activity Objectives:

1. To reinforce eagle adaptations

Directions:

- Place feathers, models, and pictures of an eagle, its adaptations, and habitat around room with snacks by each item
- Using clues ("I spy with my eagle eyes… my favorite kind of prey"), instruct the students to race to find objects in order to win their snack for the day, just as an eagle must
- Be sure to practice good hygiene as well as eagle eyesight and hunting techniques

Lesson 3 - Animal Biology

Endangered Species

Time Required:
15 minutes

Materials Required:
Cards or labels - Whiteboard and markers

STEAM Subjects:
Ecology

Activity Objectives:

1. To understand endangerment and extinction

Preparation:

- Make and cut out labels of different causes and effects relating to species endangerment

Directions:

- Explain an endangered species is an animal/plant species in danger of dying out completely (extinction)
- On the board, make two columns and label them Cause and Effect
- Shuffle the labels, place them in a box, and have each student draw a label from the box
- Ask each student in turn to read their card aloud. The class must determine whether it should go in the "cause" or "effect" column
- If the label is a cause, students must come up with an effect, and vise versa. For example:
  - Cause: "Humans build buildings and cut down trees to make space." → Effect: "Birds lose their homes in trees.
  - Effect: "Fish and other marine animals are poisoned by trash and toxins and die." → Cause: "Trash and waste are dumped into waterways."

Discuss:

- What are endangered species in your community or region? Around the world?
- What causes species to become endangered?
- How do humans influence endangerment?
- Why is it important to protect biodiversity?
- What are things you can do to help protect endangered species?

Lesson 3 - Animal Biology

Endangered Species: Postcard PSAs

Time Required:
20 minutes

Materials Required:
Postcards or postcard-sized paper - Crayons, markers

STEAM Subjects:
Ecology, art

Activity Objectives:

1. To identify ways to protect endangered species

Directions:

- Pass out postcards, crayons, and markers
- Ask students to write a letter, draft a poem, and/or draw a picture on their postcard about the importance of protecting that endangered species, including a 'call to action' about how humans can help protect biodiversity
- Send postcards to an environmental organization, the local government, or students' homes

Lesson 3 - Animal Biology

Tales of Tails

Time Required:
45 minutes

Materials Required:
Two ecological pictures or paintings by local artists - Animal masks - Costume materials - Paper, markers, crayons

STEAM Subjects:
Ecology, art

Activity Objectives:

1. To tell a story emphasizing biodiversity

Take this opportunity to help students think about literary concepts of setting, rising action/conflict, climax, and resolution.

Directions:

- Divide students into two groups and give each group a picture that includes animals and/or an environmental setting
- Invite each group to use their picture as an inspiration to tell a story. Their story may be drawn, written, or acted
- Challenge students to use concepts covered throughout the lesson, including adaptation, habitats, biodiversity, and endangerment
- Have each group present or perform their story. If possible, record the presentations so students can see their work. You might also invite artists and other community members in to contribute to, observe, and/or judge students' work

Lesson 3 - Animal Biology

Recyclable Animal Masks

Time Required:
30 minutes

Materials Required:
Crayons, markers - Paper plates - Scissors - Popsicle sticks

STEAM Subjects:
Biology, art

Activity Objectives:

1. To reinforce animal adaptation concepts

Use as much recyclable material as possible!

Directions:

- Review animal adaptation characteristics
- Give each student a paper plate. Encourage all students to choose a different animal to make
- Make markers, feathers, and other art material available
- Task students with creating a mask – complete with eye holes and at least one adaptive feature – representing their creature
- Explain that the masks they make will be used to help storytelling come alive

Lesson 3 - Animal Biology

Storytelling Circle

Time Required:
15 minutes

Materials Required:
Storybook about animals - Short video story about animals

STEAM Subjects:
Ecology, art

Activity Objectives:

1. To practice listening skills and storytelling
2. To reinforce animal behavior and adaptation

Preparation:

- Choose a story, video, or folk tale to tell or show – or invite in a local storyteller!

Directions:

- Gather students in a circle
- Review the animals that will feature in the story, giving students the chance to practice how they will use their mask to contribute
- Tell the story, giving students as many chances to interact with material as possible
- Discuss the plot as a group, focusing on how adaptation and habitats influenced the story

In the Bled

Many of the Water School students have never left their villages in Aït Baamrane. As with our Plant Biology lesson, then, the Animal Biology session offers the opportunity to introduce students to four prominent biomes they may not have seen. The cliffs and dunes of Morocco's coastline stretch along the Atlantic Ocean and the Mediterranean Sea, housing rich avian life and a multitude of aquatic species. Bottle-nosed dolphins and porpoises frolic off the coast of Tangier, and sightings of one of the world's rarest seabirds, white-eyed gulls, are common. Despite the extreme heat of the Sahara, a wide variety of species including camels, golden jackals, and lizards have adapted to the arid climate. Among the animals that call the Sahara home are the Fennec fox and the Dorcas gazelle, the smallest of their kinds in the world. Famed Barbary macaques can be found hanging from cedar and oak trees in the Middle Atlas mountains, and the elusive Barbary leopard can be spotted slinking silently through the dense forests of the Rif mountains in the north.

Regions like Aït Baamrane are particularly prone to desertification and climate change. This lesson examines how animals in Morocco adapt to different and changing environments, explores factors that endanger them, and develops positive attitudes towards protecting species. To review the behaviors and special characteristics of these animals, the students play "Souad Says."

Using the example of the Atlas lion, Fatiha explains to students how species become threatened. The Atlas (or Barbary) lion once roamed a swath of land stretching across the Maghreb to the Mediterranean until the 18th century. Extensive hunting in the 19th century, however, drastically reduced the population, confining the species to Morocco. The last reported sighting of an Atlas lion in the wild was in 1922, when the last one was allegedly shot. Only 90 Atlas lions remain in the world, 35 of which are kept the Rabat Zoo. Despite its status as "extinct in the wild," the lion remains a source of pride for Morocco and is considered its national animal. The country's coat of arms showcases two Atlas lions supporting a shield of the green star juxtaposed against the Atlas Mountains and a rising sun.

During the 2016 iteration of our Water School, this lesson coincided with March 4's World Wildlife Day. These international celebrations can be used to connect class learning with wider conversations, making the local global and vice versa. Fatiha used the 2016 theme, "the future of wildlife is in our hands," to engage students. As a concluding activity, students decorated their own animal masks and made posters explaining the importance of protecting biodiversity. A visiting student from the US promised the class he would share their masks and pictures with the world. His blog highlighting the students' message has been seen by readers on 5 continents.

4: Aquatic Ecosystems

Lesson Objectives:

- To explore life below and around bodies of water
- To examine the differences between fresh and saltwater
- To appreciate the importance of lakes, oceans, and rivers

Lesson 4 - Aquatic Ecosystems

The Blue Planet – Apple Demonstration

Time Required:
10 minutes

Materials Required:
At least 1 apple (or 1 per group of 2-3 students) - 1 knife (or 1 per group)

STEAM Subjects:
Geography, math

Activity Objectives:

1. To visualize how much of the planet is water
2. To understand the vastness of our oceans

Let pairs cut their own apples as you demonstrate. It's good practice with fractions!

Directions:

- Explain that the apple represents the planet
- Slice it into quarters
- Tell students that 3 of the quarters represent all of the water covering the planet
- Cut the quarter of 'land' in half. One half represents uninhabited deserts, swamps, and the Arctic and Antarctic areas
- Take the other half and cut into quarters. 3 of those quarters are too rocky, wet, dry, or nutrient poor to grow food on
- The last piece is 1/32 of the apple. Its peel represents 3.125% of the Earth's surface, the bit of the planet that is able to produce food
- Cut 1 of the 'water' pieces into tenths
- Pulling one of those tenths aside, the remainder of the apple is our planet's oceans
- Cut the tiny piece of apple left in half
- 1 of those halves is ice and snow. The other is rivers, lakes, swamps, and groundwater

Discuss:

- Did this demonstration surprise you?
- How big are oceans compared to rivers?

At a Glance:

- **~75% of the planet's surface is water**
- **~3.125% is fertile land**
- **<1% of the world's water is fresh and available**

Lesson 4 - Aquatic Ecosystems

Where the River Meets the Sea

Time Required:
15 minutes

Materials Required:
1 cup per student in 3 different colors - Water - Salt Dye/colorin - Bucket

STEAM Subjects:
Physics

Activity Objectives:

1. To understand how freshwater becomes salty
2. To visualize how pollution spreads

Run the exercise several times with various concentrations of pollution (dye), river 'sizes' (number of cups, amount of water in cups), and paths. Rain can fall more in some rivers than others, some rivers may enter the ocean sooner, etc. How do these changes impact the system?

Preparations:

- Pour a bit of water into each cup
- Colors should be evenly split between pupils
- Color 1 should have freshwater, with 1 or 2 of those cups dyed
- Color 2 should have freshwater, with 1 or 2 of those cups dyed a different color
- Color 3 should have saltwater (no dye)

Directions:

- Give each student a glass
- Explain to students that Color 1 cups represent rain, with the dyed water signifying acid rain, formed by clouds and pollution. Color 2 cups are rivers, with clear water being clean and dyed water representing pollution. Color 3 cups are ocean water
- Quiz students on the water cycle: How will the waters flow? (Rain → Rivers → Oceans)
- Students with Color 1 need to 'rain' into rivers by pouring their cups in the freshwater
- Rivers then flow into the ocean: Color 2 should 'meet' the ocean students, pouring their water into the Color 3
- The oceans are all connected. Ocean students should pour their cups into the bucket

Discuss:

- What happened to what was clean water?
- Does any water remain unpolluted or fresh?
- What would happen in the continued cycle?

Vocabulary: Ask students why the color dye spreads. Explain diffusion.

Lesson 4 - Aquatic Ecosystems

Habitat Matching

Time Required:
15 minutes

Materials Required:
River, ocean, + beach posters or objects
Water animal and plant flashcards

STEAM Subjects:
Biology

Activity Objectives:

1. To explore the diversity of water habitats

If resources allow, use stuffed animals instead of flashcards and a kiddie pool + slide instead of posters

Preparations:

- Create 3 posters or objects, representing an ocean, a beach, and a river habitat
- Create a number of flashcards of various water-based organisms (fish, seagulls, algae, dolphins, coral – make some of them tricky!)

Directions:

- Split students into teams and give them each a large stack of flashcards
- Explain they need to decide whether the organisms belong in the river (freshwater), the beach, or the ocean (saltwater)
- Play music for around 5 minutes, giving students the chance to place their flashcards
- Go through each animal and plant as a group to determine if it was placed correctly

Discuss:

- Which of the organisms surprised you?
- Are any of the organisms found in multiple habitats? Do any of the organisms move between habitats?
- Why is life different in rivers and oceans?
- What makes rivers and oceans different from each other? How are they the same? (Talk about currents, lakes, fresh versus saltwater, beaches, size and depth…)
- Which do students prefer?
- Which is vital for human life? (Hint: Both! We need rivers to get freshwater, but we rely on the algae in oceans to produce oxygen for the planet. Many people rely on fish for food, and all life in and above water is connected.)

Lesson 4 - Aquatic Ecosystems

Microscopes: Fresh and Salty Water

Time Required:
25 minutes

Materials Required:
Microscope - Slides and cover slips - Samples of various kinds of water, some of them dehydrated onto the slides - Pens and paper

STEAM Subjects:
Chemistry, technology, math

Activity Objectives:

1. To learn how to use magnifying technology
2. To see differences in kinds of water

Preparations:

- Dry different kinds of water onto slides, creating a variety of patterns for observation

Directions:

- Explain how the microscope works
- Prepare slides and allow students to observe various kinds of water. If time permits, allow pupils to prepare the slides themselves
- Have students draw the patterns they see and write down 3 observations for discussion
- Share results with the class

Lesson 4 - Aquatic Ecosystems

Bugs!

Time Required:
35 minutes

Materials Required:
Bug biology presentation - Microscope - Bug samples and dishes - Pointers or tweezers

STEAM Subjects:
Biology, technology

Activity Objectives:

1. To continue practicing with microscopes
2. To learn about aquatic bug biology

Preparations:

- Preserve for display a variety of aquatic bugs
- Create a slideshow detailing the bugs' names, labeling their body parts, giving facts, etc.

Directions:

- Present the bug biology introduction to students. Discuss why some bugs look different and what their major features are
- Give each student the chance to see the bugs for themselves under the microscope. Using tweezers, let them move the bug around and point to various body parts for identification

Lesson 4 - Aquatic Ecosystems

Snack Time: Sea Jello

Time Required:
25 minutes

Materials Required:
Blue Jello - Shortbread cookies - Gummy fish, bugs
Clear cups for each student

STEAM Subjects:
Biology, art

Activity Objectives:

1. To enjoy a tasty snack together
2. To model a aquatic ecosystem

Preparations:

- Prepare and chill the blue Jell-O
- Crumble the cookies into small crumbs

Directions:

- Give each student a cup with some blue Jell-O
- Provide a variety of gummy candy sea creatures and crumbled shortbread cookies
- Let students create an aquatic scene, using cookies for sand to make a beach and spreading fish and bugs around their 'ocean'

Lesson 4 - Aquatic Ecosystems

Sea Family Tree

Time Required:
15 minutes

Materials Required:
BPictures or stuffed animals of dolphin, penguin, shark

STEAM Subjects:
Biology

Activity Objectives:

1. To understand vertebrate classes

Discussion:

- Explain to students there are five big groups, or classes, of vertebrates (animals with a backbone): reptiles, amphibians, birds, mammals, and fish. Give an example of each
- Ask students what kind of animal a dolphin is. They will likely guess fish. Explain they are a mammal – and more closely related to us than a fish! They have hair, are warm-blooded, nurse with milk, and breath air
- How about the penguin? A bird! But it can't fly. Not all birds do – but they have beaks, feathers, lay eggs, and are warm-blooded
- And a shark is a fish! They have scales and gills and are cold-blooded

Lesson 4 - Aquatic Ecosystems

Breathing Underwater: Blowholes

Time Required:
15 minutes

Materials Required:
Computer and projector with screen - Internet access or downloaded videos

STEAM Subjects:
Biology

Activity Objectives:

1. To learn how dolphins and whales breathe

Directions:

- Ask students how dolphins breathe. They should remember that they are mammals – they breathe air like humans. They do not actually breathe underwater, unlike fish
- Tell students that dolphins and whales have learned how to hold their breath for dives
- Explain that blowholes are like nostrils at the top of their heads. When they come to the surface, dolphins and whales push the bad air out and breathe in air with oxygen
- Show students a YouTube clip of dolphins and whales surfacing. Explain they're pushing out air, not water – but the water around them moves because they blow so hard!
- Ask students how long they think they can hold their breath. The sperm whale can hold its breath for up to 90 minutes! The average bottlenose dolphin stays underwater for 7 minutes. Play music to show students how long that is…and see how long they can last!

Breathing Underwater: Snorkeling

Time Required:
15 minutes

Materials Required:
Filled kiddie pool - Snorkel and mask, with water + soap to clean

STEAM Subjects:
Technology

Activity Objectives:

1. To experience snorkeling underwater

Directions:

- Show students how the snorkel mask works
- Give everyone the chance to put their head in the kiddie pool and breathe with the snorkel

Lesson 4 - Aquatic Ecosystems

Humans Underwater: Submarines and Scuba

Time Required:
15 minutes

Materials Required:
Computer and projector with screen - Internet access or downloaded videos

STEAM Subjects:
Technology

Activity Objectives:

1. To explore how humans survive underwater

Directions:

- Ask students if they think humans can survive underwater. Explain that we cannot hold our breath as long as whales and do not have gills like fish, so we have had to be creative in order to explore oceans and lakes
- Ask students why we would want to go underwater (recreation, science, medical discoveries, natural resources)
- Show students videos from YouTube of scuba diving and submarine technologies
- If possible, ask a local diver to come in and show off their equipment or visit a local submarine or naval museum

Humans Underwater: Inventing

Time Required:
25 minutes

Materials Required:
Paper and markers

STEAM Subjects:
Engineering, art

Activity Objectives:

1. To invent ways to survive underwater

Directions:

- Give each student a piece of paper and markers or crayons. If desired, also make available construction materials (Legos, cardboard, pipe cleaners, scissors and glue, etc.) for modeling and construction
- Tell students they have been assigned by a research team to invent a new way to survive and work underwater. Their invention needs to keep people safe under the water and can be a boat, pod, suit, anything!
- Give each student the chance to present their invention and explain how it works

In the Bled

Morocco boasts one of the highest levels of fish diversity in the world. Its Atlantic and Mediterranean coastlines are host to an incredible array of animals and plants. Fatiha begins this lesson by displaying pictures of common marine animals in Morocco: seagulls, sardines, spadefoot toads, loggerhead sea turtles, bottlenose dolphins, great white sharks, and harbor porpoises. Using these familiar creatures, she teaches the students about vertebrate classes. "Souad Says" is used to review animals' habitats, unique behaviors, various sounds, and diets.

For a tasty and educational snack, students create their own 'oceans.' Dar Si Hmad's Director, Jamila Bargach, purchased Blue Jell-O while in the US for a conference. Fatiha practices counting in multiple languages (yan, sine, krad in Tachelhit; un, deux, trois in French; wahid, juj, tlata in Moroccan Arabic) with the students as they place gummy fish representing various species in their Jell-O. Students learn that Morocco's rich aquatic biodiversity is under threat from pollution, overfishing, and climate change. As Fatiha names problems, students eat one fish to represent the loss of a species.

When Fatiha shows shocking pictures of pollution in Morocco's water systems, harrowing scenes of dead sea animals ensnared in nets, and sorrowful images of birds choking on plastic debris, students are frequently disturbed. Making posters on the importance of preventing pollution is a positive way for them to respond and feel they are doing something to help. Students proudly display their posters around the classroom, a reminder to themselves and their parents to keep the planet clean. (See Lesson 8 for more ideas on teaching pollution.)

Unit B

USES OF WATER

5: Drinking & Eating

Lesson Objectives:

- To understand the importance of water for human life
- To consider how human water use connects to ecosystems
- To explore how people around the world access water

Lesson 5 - Eating & Drinking

Water for…

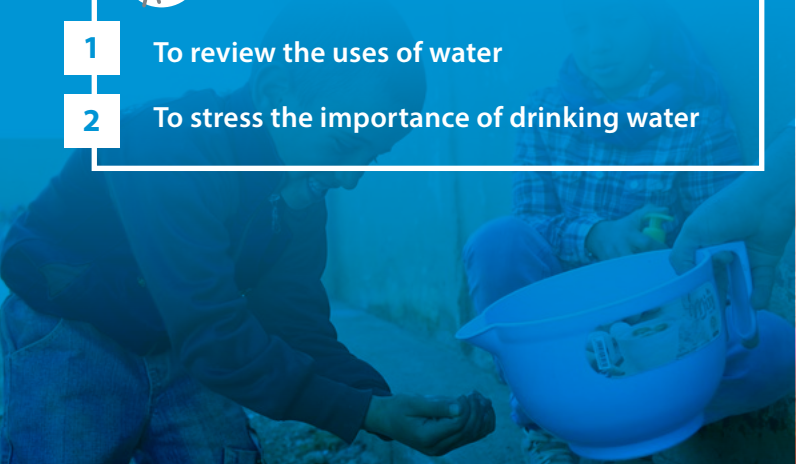
Time Required:
15 minutes

Materials Required:
Pens/markers - Flipchart paper

STEAM Subjects:
Biology, ecology

Activity Objectives:

1. To review the uses of water
2. To stress the importance of drinking water



Directions:

- Ask students why water is important – what do we use it for?
- Brainstorm with students and write their ideas on the flipchart
- Emphasize that water for drinking is one of the most important uses of water. Humans can survive about 3 weeks without food, but only 3 days without water
- People need to drink 7-8 glasses of water a day to be healthy. Do they drink enough? Just because you do not feel thirsty does not mean your body does not need water – you should drink regularly all day long
- But we do not only need water to survive – and it is not only humans who need water
- Plants and animals also need water. Because we depend on plants and animals for food, we need water to eat as well as to drink!
- All ecosystems depend on water in a variety of ways. In order to live sustainably on the planet, we need to ensure that we have enough water for eating and drinking (and playing!) while also making sure that other plants and animals have enough for them

Lesson 5 - Eating & Drinking

Water Footprints

Time Required:
30 minutes

Materials Required:
Pencils and paper - Virtual water data

STEAM Subjects:
Science, mathematics

Activity Objectives:

1. To understand the concept of virtual water
2. To explore students' water footprints

See the Resources page at the end of this section for sources of data on virtual water. Online resources include a product gallery. If resources allow, give students the chance to browse the website looking at various products they like to eat or use and researching their virtual water footprints.

Directions:

- Ask students to write down how much water they think they use in their daily lives
- Once everyone has a number, ask students what they included in that number
- Ask students if they think they are currently using water. Explain to them that, even if they are not actively drinking water right now, they are. Water is 'hidden' in everything we use – and eat
- Virtual water is a term used by scientists to explore the amount of water it takes to produce and transport something. Everything takes water to make. Clothes use water to grow cotton. The factory that made their toys relies on energy, and water is necessary to produce and maintain electricity. Water is also used to transport goods
- Globally, the average human uses 4550 liters of water a day (Americans use 9100). Most of that is not drunk – it's eaten, worn, played with, or used as a tool
- Ask students to reconsider their water footprint – the amount of water they use. Explain that about half of it comes from what they eat. Making food takes a lot of water, both for plants and meats. Give each student a copy of Virtual Water statistics or write a few on the board. An apple uses 125 liters of water to grow. One pot of coffee takes 840 liters of water to produce; 100 grams of chocolate, 1700 liters
- Discuss with students how they can reduce their water footprint, and why they should

Lesson 5 - Eating & Drinking

Drinking from Straws: Vacuums & Pressure

Time Required:
15 minutes

Materials Required:
Reusable straws (1 for each student)
Glasses of water (1 for each student)

STEAM Subjects:
Physics

Activity Objectives:

1. To understand how a straw works
2. To learn about vacuums and pressure

Directions:

- Give all students a straw and explain to them that it works using a vacuum
- When you suck through a straw in water, you create a vacuum (an empty space)
- Have the students experiment with the straw by placing it firmly against their finger and sucking in. The pressure they feel on their fingers is the result of the vacuum
- The atmosphere (all of the air around us) puts pressure on us and everything. When we suck a straw, the vacuum we make inside the straw means there is less pressure inside the straw than the atmosphere is pushing on us. The atmosphere's pressure down on the water in our cup pushes that water upward into the straw. The atmospheric pressure is greater than the impact of gravity. You can't drink from a straw in space, because there is no atmospheric pressure or gravity!
- Give each student a glass full of water. Have students experiment with different rates of suction. Have them try to suck enough to get water into the straw but not their mouths. Explain they do this by controlling how much of a vacuum is made, and how much of a pressure change there is between the atmosphere and the inside of the straw
- Ask students to brainstorm other ways that suction, vacuums, and pressures are useful
- Tell students that while drinking from straws can be fun, plastic straws also create a lot of rubbish and pollution. If they want to use a straw, it is better to keep a sturdy, reusable one than to generate lots of waste!

Lesson 5 - Eating & Drinking

Game: Straw Race

Time Required:
15 minutes

Materials Required:
Reusable straws for each student - 2 cups for each student, 1 of them filled with water -Pitchers of extra water

STEAM Subjects:
Physics

Activity Objectives:

1. To boost group energy
2. To review suction and vacuum physics

As a variation, put students in groups to fill a bucket. You can set the bucket and cups far away from each other so students have to move while controlling their vacuum.

Directions:

- Give each student two glasses, one empty and one full of water, as well as a straw
- Review vacuums and atmospheric pressure
- Explain their job is to move water from the full cup to the empty one, using their straw
- This is a competition – whoever has the most water in their cup when time is up wins!
- Run a timer or a song and play a few rounds
- Award a prize to the winner(s) – and perhaps to whomever has made the least mess as well!

Lesson 5 - Eating & Drinking

Snack: Virtual Water Cost

Time Required:
30 minutes

Materials Required:
A variety of snacks - Labels and pens - Chips or tokens

STEAM Subjects:
Mathematics

Activity Objectives:

1. To share a treat together
2. To review virtual water and practice math

This will work best if you have a number of options so students can get a handful of small snacks, deciding how to allocate their 'water'.

Directions:

- Prepare a variety of individual snacks
- Calculate the virtual water 'cost' of each snack and label each with that cost
- Pass out a handful of tokens to each student
- Tokens represent virtual water units
- Explain to students they must decide how they want to use their water for food
- Let students 'spend' their water
- Make sure to practice snack time hygiene!

Lesson 5 - Eating & Drinking

Sources of Water

Time Required:
20 minutes

Materials Required:
Paper - Markers - Pencils

STEAM Subjects:
Geography

Activity Objectives:

1. To review the water cycle
2. To consider how we access water

If time and resources allow, show students several videos showing different creative ways to collect or access water. Dar Si Hmad's fog harvesting project is on YouTube. Clips of wells, dew collection, and rainwater harvesting systems may give students who see water come from a tap a chance to broaden their horizons!

Directions:

- In groups or as individuals, give students 10 minutes to draw or write down as many sources of water as they can think of
- Ask students to share their ideas with the class. Use the discussion to review the water cycle and the three main sources of water: surface water, groundwater, precipitation
- Discuss as a class various ways that humans around the world get water. Some people have taps with pipes from groundwater; others use wells or collect rainwater. Explain that the next few activities will consider how we access water and know it is safe for us

Lesson 5 - Eating & Drinking

What to Drink?

Time Required:
5 minutes

Materials Required:
2 glasses of water: 1 clear but dirty, the other cloudy but clean

STEAM Subjects:
Chemistry, technology

Activity Objectives:

1. To understand drinking water treatment
2. To learn that not all water is safe to drink

Directions:

- Place the 2 glasses of water in front of pupils
- Ask the students which water they would drink? Which is safe?
- Explain it is not the appearance of water that makes it safe to drink, but knowing that it has been treated
- Pick up the cloudy water and drink it
- Describe various kinds of drinking water treatment: boiling, chemicals, sunlight

Lesson 5 - Eating & Drinking

Acids and Bases

Time Required:
30 minutes

Materials Required:
Picture or model of water molecule - pH test strips - Pure (deionized) water - Water samples from a variety of sources Vinegar - Baking soda - Mixing bowl

STEAM Subjects:
Chemistry

Activity Objectives:

1. To learn about acids, bases, and pH

This activity is a great chance to review the sources of water students named. How is water from the sea different than the ground? How about rainwater versus what came from the local well?

Directions:

- Show students the water molecule model and explain the basic chemistry to them, focusing on how the hydrogen atoms bind to oxygen
- An acid is a compound that releases hydrogen ions in water. A base absorbs those ions. The interaction between acids and bases is a major part of understanding chemistry
- Explain to students that vinegar is very acidic; baking soda is basic. Pour the vinegar and baking soda together and let students watch it foam up. Explain it does this because the hydrogen atoms move around and mix with other elements to create new gases and solids
- pH is a measure of how acidic something is. Acids have pH values <7; bases, >7
- Demonstrate how to use a pH test strip and perform tests on the vinegar and baking soda
- Explain to students that pure water is neutral and its pH is 7 – it does not let go or take in hydrogen atoms (they are stuck to the oxygen). Perform a pH test to demonstrate
- Pass out pH test strips and have students test a variety of water sources (from the toilet, their homes, a nearby lake or sea, etc.)
- Which were more or less acidic?
- Tell students that safe drinking water has a pH of 6.5-8.5. We do not drink pure H2O, but rather a mix of minerals in water. This is why water sometimes tastes different to us. While we need certain kinds of minerals in our drinking water to be healthy, and drinking too much acid gives us a stomachache, various plants and animals have adapted to survive at a variety of pH levels. It's part of biodiversity

Lesson 5 - Eating & Drinking

Desalination

Time Required:
15 minutes

Materials Required:
Water - Cotton balls or other visible model of 'salt crystals' Membrane/strainer -Pictures of desalination and osmosis, if possible - Baking soda - Mixing bowl

STEAM Subjects:
Chemistry, technology

Activity Objectives:

1. To learn about desalination for freshwater
2. To understand the concept of osmosis

Osmosis: If saltwater and freshwater are separated by a semi-permeable membrane (a barrier that water can move through but salt can't), the water will flow from the saltwater to the freshwater, until both sides are equally concentrated. This works for other liquids too!

Directions:

- Remind students that most of the Earth's water is in the ocean as saltwater and not good for us to drink or use in most farming
- But scientists have found a way to make more freshwater from saltwater, increasing supply. This is called desalination
- Explain the process of osmosis
- Explain to students that reverse osmosis is the most common kind of desalination. It uses pressure to push water through a membrane with holes small enough for water to go through but too little for the salt to pass
- Demonstrate this by mixing water with cotton balls and pouring it through a strainer: the clean, fresh water comes through and the 'salt' is trapped on the other side!

Lesson 5 - Eating & Drinking

Irrigation Systems

Time Required:
25 minutes

Materials Required:
Paper - Pens and colored pencils -Pictures of irrigation systems/ tools - Baking soda - Mixing bowl

STEAM Subjects:
Engineering, art

Activity Objectives:

1. To learn about irrigation and design a system

Directions:

- Ask students how plants get water. In places without enough rain, humans have developed ways to water plants. Show pictures and discuss different irrigation technologies
- Give students paper and pencils and have them draw an irrigation system they think would work in their area. When time is up, have students share their ideas with the class

Additional Resources

On Virtual Water and Water Footprints:

- For images and posters of virtual water 'costs':
  virtualwater.eu
- For information about water footprints:
  waterfootprint.org/en
- For an interactive gallery of products and their water use:
  waterfootprint.org/en/resources/interactive-tools/product-gallery
- For an interactive calculator of personal and home water footprints that includes diet and lifestyles habits (US only, though others regions may find it helpful to see which products and processes the calculator includes):
  environment.nationalgeographic.com/environment/freshwater/change-the-course/water-footprint-calculator

On Fog Harvesting:

youtube.com/darsihmad

On Desalination:

youtube.com/watch?v=aysj7696b0A

In the Bled

In underserved rural areas, food security is often a concern alongside water supply and public services. Urban schools in developed countries frequently serve students coming from poor homes and surrounded by 'food deserts.' When resources allow, having food in classrooms can be a powerful tool for learning while alleviating some of the burden of poverty for students without drawing unnecessary attention to their limited resources.

Hadda Bouzgar is our Water School's much beloved cook. Beyond the traditional Moroccan staples of bread, vegetables, and tagine, Hadda introduces our students to a wide range of delicious foods, challenging their palates with new tastes and textures. Regularly providing various kinds of food introduces our students to different cultures, creates an opportunity to practice healthy hygiene habits, and allows us to explore the connection between food, water, and other natural resources.

One of the easiest ways to make this lesson place-specific and tie water to food is via the activity on irrigation. In Southwest Morocco, students will grow up seeing khattarat but may not know how they are built or why they work. The khattarat system of irrigation (frequently called qanat in other parts of the Arab world) is a series of connected shafts. Shafts and tunnels deliver underground water to the surface without pumping. The system works by setting the destination lower than the source, allowing water to be transported long distances in arid areas without losing very much to evaporation or requiring energy input. Though khattarat are expensive and timely to construct, they require little maintenance once built. In Southwest Morocco, khattarat are used frequently, drawing from aquifers, oases and rivers to irrigate croplands. Some of these systems have been in place since the 1300s.

Exploring khattarat allows our Water School students to learn more about a sustainable, local solution to agricultural water. It also provides us with a powerful way to introduce physics concepts like gravity and energy in applied ways.

6: Microbes, Sanitation & Hygiene

Lesson Objectives:

- To consider the importance of water in sanitation
- To learn and commit to proper hygiene habits

Lesson 6 - WASH

Glitter Germs

Time Required:
15 minutes

Materials Required:
4-5 colors of glitter - Lotion - Paper towels - Water and soap - Bowl + pitcher or sink - Baking sod - Mixing bowl

STEAM Subjects:
Biology, health

Activity Objectives:

1. To learn how easily germs can spread
2. To understand that water and soap is the most effective way to wash hands

Directions:

- Give each student a small amount of lotion and have them rub it in
- Give 4-5 students a generous amount of glitter (different color for each pupil)
- Tell the students they need to introduce themselves to the whole group with a handshake or high five. Play some music and give them time to properly spread the glitter.
- Stop the music and have students look at their hands. Who is dirty?
- Go outside to have pupils try to remove the glitter in three stages:
  1. Dry wipe with paper towels
  2. A bit of water on its own
  3. Soap and water

Discuss:

- What happened to the glitter?
- What method of cleaning was best?
- Explain to students that germs are like glitter, only we can't see them with our eyes. We are going to learn about germs – and how we can stay safe – today.

What's a Germ?

Time Required:
10 minutes

Materials Required:
N/A

STEAM Subjects:
Microbiology

Activity Objectives:

1. To learn about germs
2. To understand the importance of WASH

Explain:

- Germs are microorganisms that make us sick.
- The "micro" in microorganism refers to something very, very small – so small we cannot even see it!
- Microorganisms live everywhere – in water, dirt, in your bathroom or kitchen, on electronic devices and toys.
- Because they can be found anywhere, these creatures get on your hands and it is important to wash them off.
- "Water for sanitation and hygiene", WASH, reminds us how important water is in keeping us healthy and germ-free!

Lesson 6 - WASH

Handwashing

Time Required:
15 minutes

Materials Required:
Warm water- Soap - Clean towels - Bowl + pitcher or sink

STEAM Subjects:
Health science, math

Activity Objectives:

1. To learn effective hand-washing techniques

This is a great opportunity to review counting – or teach pupils to count to 15 in another language.

Directions:

- Now that we see how important it is to wash our hands, let's make sure we do it properly!
- Explain to students the 5 steps:
  1. Run hands under warm running water.
  2. Add some soap.
  3. Scrub well for 15 seconds.
  4. Rinse well under warm running water.
  5. Dry your hands with a clean towel.
- Give all students time to practice.

Lesson 6 - WASH

When to WASH

Time Required:
15 minutes

Materials Required:
A mobile hand-washing station (e.g., a teacher with a bowl of water) - A large area for running

STEAM Subjects:
Health science

Activity Objectives:

1. To learn when hand-washing is necessary

Directions:

- Tell students they will hear a series of situations. If they think they need to wash their hands in that situation, they should run to the hand-washing station. If they do not need to wash their hands, they should instead run to the reader
- In between scenarios, the hand-washing station should move, so that students run each time
- Read statements such as:
  - when your hands are dirty (Y)
  - before eating or touching food (Y)
  - before using the bathroom (N – after!)
  - after blowing your nose or coughing (Y)
  - after touching pets or other animals (Y)
  - before playing outside (N – after!)
  - before and after visiting a sick relative or friend (Y)
  - after touching shared objects (Y)
  - after helping your mom set the table (N – after!)
  - after being on public transit (Y)
  - after touching your eyes or face (Y)

Discuss:

- Ask students if any of the times they should wash their hands surprised them
- Ask pupils if they can think of other instances in which hand-washing is important

Contagion

Time Required:
30 minutes

Materials Required:
Diversely colored discs (3 tokens per pupil) - A hand-washing station, staffed by a teacher - A large classroom

STEAM Subjects:
Epidemiology, math

Activity Objectives:

1. To understand the spread of germs and how hand-washing can help promote public health

Directions:

- Give each student 3 discs or tokens. Each student should have only 1 color, but many colors should be around the room. Explain these represent bacteria and germs – but they do not know which color will make them sick
- Inform students their job is to introduce themselves to each other. Each time they meet another pupil, they need to shake hands or give high fives – and exchange discs with each other (so that disc colors spread)
- Students may, at any time, go to the hand-washing station. Each time they wash their hands, the teacher will take one of their discs.
- After a stated period of time (~10 minutes), call students together. Announce which color is dangerous and see who is now sick
- Have students keep their discs, and tell them they will play again – but this time, a different color will be sickness (and again, they will not know until the end)
- Play a few rounds, depending on how students' behavior is changing

Discuss:

- Debrief: Ask students if and how they changed their strategies during the game. Could they have entirely removed illness from their group? (Yes, if they all washed multiple times at the beginning!)
- How was this game similar to real life? (Germs spread by touch; we may not know we are sick; germs can grow and mutate; hand-washing helps keep us healthy)

WASH Identification

Time Required:
10 minutes

Materials Required:
A selection of everyday objects (clothes, phone, floor tile, sink, dishes, toy, etc.) – ideally the objects themselves, but pictures will work

STEAM Subjects:
Health science

Activity Objectives:

1. To identify where WASH is needed in homes

Directions:

- Place a variety of everyday objects in front of students
- Ask students which of them need to be cleaned regularly (answer: all!)
- Lead a discussion about how water is used in homes to keep these objects clean
- Share ideas for how to help improve WASH at home while conserving water and supplies

Lesson 6 - WASH

Snack: Washing Fruits and Veggies

Time Required:
25 minutes

Materials Required:
Selection of fresh fruits and vegetables - Cold water and soap
Basin/sink for washing - Knives and cutting boards
Plates and napkins

STEAM Subjects:
Health science

Activity Objectives:

1. To enjoy a tasty snack together
2. To learn proper food preparation techniques

Directions:

- Demonstrate food preparation techniques, including washing and knife safety
- Remind students that foods carry germs too, and we should always help at home by washing food for meals
- Assign duties to students: fruit and vegetable washing, cutting, setting the table
- Have all students wash their hands before beginning work
- Give students a chance to sit and talk with each other during snack time
- Assign washing up duties, again with proper WASH techniques for clean dishes & hands!

Lesson 6 - WASH

Close Up! Magnifying Scavenger Hunt

Time Required:
25 minutes

Materials Required:
Magnifying glasses for each 3-4 pupils - Pencils and paper
A variety of things to examine

STEAM Subjects:
Technology, math

Activity Objectives:

1. To learn how to use magnifying technology
2. To explore the world around us

Preparations:

- Place a variety of objects around the room (outdoors, if possible)

Directions:

- Demonstrate how to use a magnifying glass and give one to each group of 3-4 pupils
- Send students out to examine each of the objects. Task them with drawing what they see, writing down at least 3 observations, and identifying a unique pattern in each object
- After the hunt, gather to discuss observations

Microscopes: Clean and Dirty Water

Time Required:
35 minutes

Materials Required:
Microscope
Slides and cover slips - 2 samples of water – one apparently clear, the other obviously dirty

STEAM Subjects:
Chemistry, technology

Activity Objectives:

1. To learn how to use magnifying technology
2. To understand and see microbes in water

Directions:

- Tell students microscopes are like magnifying glasses, but much stronger. Explain how the microscope and its pieces work
- Prepare slides and allow students to observe both kinds of water. If time permits, allow pupils to prepare the slides themselves

Discuss:

- Which water had microorganisms?
- How can we know if water is clean? (Share with students filtration, boiling, and treatment technologies and techniques.)

Lesson 6 - WASH

Hamad Hygiene

Time Required:
25 minutes

Materials Required:
"Hamad", a doll, picture, human-shaped cutout…or teacher for a demo body

STEAM Subjects:
Health science

Activity Objectives:

1. To review personal hygiene techniques

Directions:

- Ask a student to point to or draw a body part they think needs to be kept clean
  1. Have other students determine:
  2. How that body part gets dirty
  3. How frequently that body part should be washed (daily, weekly, every time food is eaten, etc.)
  4. How that body part is cleaned
  5. How water is used in its cleaning
- Clear up any mistakes or misconceptions from the group discussion
- Send another student to point to or draw another body part
- Continue until all parts of the body have been covered

This activity may best be done in gendered groups, depending on students' age and context.

Review:

- Ensure all students understand the importance of personal hygiene in light of what they have learned about microbes

Additional Resources

For more ideas on WASH activities with young students, see:

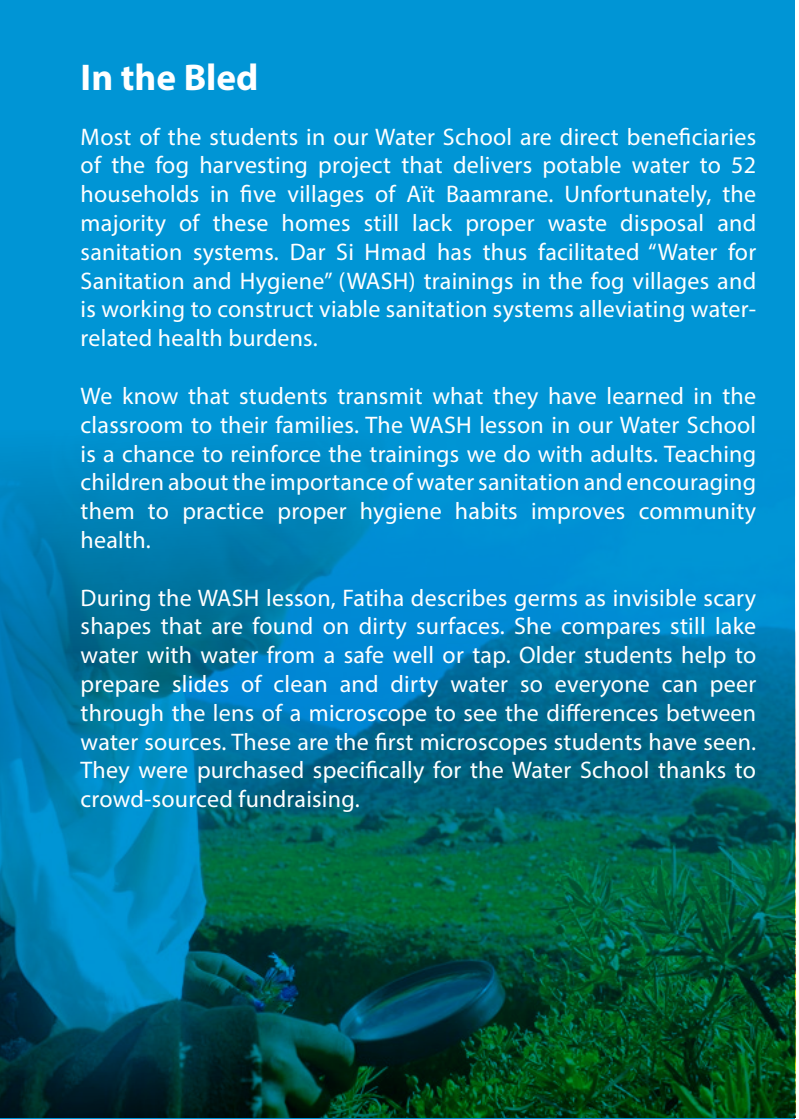
- www.glogerm.com/worksheets.html
- www.livelearn.org/sites/default/files/docs/Wash%20Activities.pdf
- www.childrenforhealth.org/wash-lesson-plans/

In the Bled

Most of the students in our Water School are direct beneficiaries of the fog harvesting project that delivers potable water to 52 households in five villages of Aït Baamrane. Unfortunately, the majority of these homes still lack proper waste disposal and sanitation systems. Dar Si Hmad has thus facilitated "Water for Sanitation and Hygiene" (WASH) trainings in the fog villages and is working to construct viable sanitation systems alleviating water-related health burdens.

We know that students transmit what they have learned in the classroom to their families. The WASH lesson in our Water School is a chance to reinforce the trainings we do with adults. Teaching children about the importance of water sanitation and encouraging them to practice proper hygiene habits improves community health.

During the WASH lesson, Fatiha describes germs as invisible scary shapes that are found on dirty surfaces. She compares still lake water with water from a safe well or tap. Older students help to prepare slides of clean and dirty water so everyone can peer through the lens of a microscope to see the differences between water sources. These are the first microscopes students have seen. They were purchased specifically for the Water School thanks to crowd-sourced fundraising.



To visualize how germs spread from person to person, students play the "Glitter Germ" game. Children apply glitter and lotion, then race to shake hands and high-five each other as fast as they can. Fatiha explains that the glitter represents germs and directs student attention to how quickly germs spread when they shake hands. She helps students realize how they get germs when they eat fruits or vegetables without washing them first or use the bathroom without washing their hands after. Students then practice proper handwashing techniques in order to wash off the glitter. Fatiha uses the opportunity to practice language, first counting in the local Tachelhit language (yan, sine, krad, koz, smouss, sdiss, sa, tam, tza, mraw, yan d' mraw, sine d' mraw, krad d' mraw, koz d' mraw, smouss d' mraw) and then Moroccan Arabic (Darija), French, English, and Modern Standard Arabic.

At the end of the session, students take a pledge to wash their hands regularly and make a sign-up sheet rotating responsibility for cleaning the toilets in their school.

7: Health & Sports

Lesson Objectives:

- To explore uses of water beyond basic needs
- To consider the fun to be had in interacting with nature
- To understand how water is used around the world

Lesson 7 - Health & Sports

Race: Water in the Bucket

Time Required:
10 minutes

Materials Required:
Large buckets filled with water (1 per group of 4 students)
Medium/large bowls (1 per group of 4 students)
Cups (1 per group of 4 students)
Music player
Large open space for running, ideally outside

STEAM Subjects:
Math

Activity Objectives:

1. To get students excited and having fun
2. To demonstrate how water is used for games
3. To consider how games can waste water and how to minimize this

Preparation:

- Fill large buckets with water
- Place buckets in a line about 5 meters apart from one another
- Place a cup next to each bucket
- Place bowls across from the buckets, about 30 meters away
- Prepare slides and allow students to observe both kinds of water. If time permits, allow pupils to prepare the slides themselves

Discuss:

- Split the group into teams of 4 and have each team stand in a line behind their buckets
- When the music starts, the first team member fills their cup with water from their bucket and runs to empty it in their bowl
- The student then runs back to their team and gives their cup to the next teammate
- Groups repeat this process, relay style, until the music ends (~3 minutes)
- When the music stops, the team with the most water in the bucket that they filled wins
- Have students consider the balance between speed and spilling, and water waste and fun. (Can the game's water be reused somehow?)

Lesson 7 - Health & Sports

Park Design

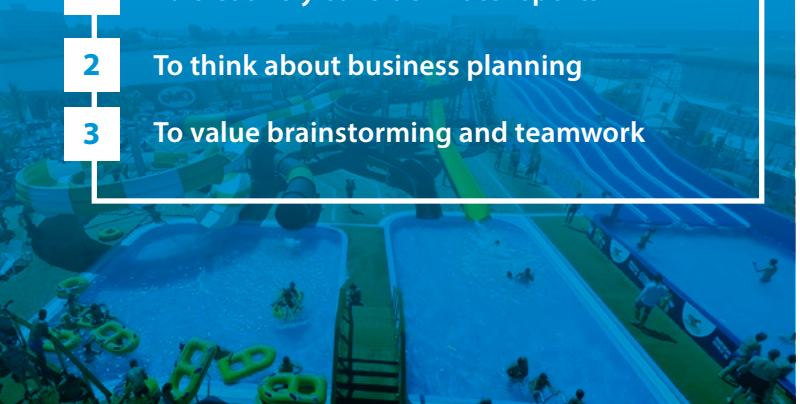
Time Required:
30 minutes

Materials Required:
Markers and pens - Paper - Flipchart paper

STEAM Subjects:
Engineering, art

Activity Objectives:

1. To creatively consider water sports
2. To think about business planning
3. To value brainstorming and teamwork



Directions:

- Pass out paper and markers to all students
- Tell them they have 15 minutes to design a water park. They can include anything they would like. They might consider issues like admission, safety, food, fun for all ages, waste
- Students then present their parks to the class
- After each presentation, the other pupils should choose an element from each individual park they like (a specific ride or game, an idea). Write these on the board
- Give the full group 10 minutes to create a joint park from these ideas
- Debrief with the class about how they created something together & everyone contributed. Both individual and group work is important!

Lesson 7 - Health & Sports

Fieldtrip

Time Required:
2 hours – full day

Materials Required:
Transport - Parental permission - Beach/park access

STEAM Subjects:
Potentially all

Activity Objectives:

1. To engage in outdoor fun together as a group

If you go to the beach, have students help clean-up trash on the coast to protect plant and animal life.

Directions:

- If logistics allow, take students to a nearby beach, water park, or other location
- Make the trip more educational with a discussion before or after about how water was used during the trip. Have students consider how water could be handled better. What would they change about the place?

Lesson 7 - Health & Sports

Keeping Active

Time Required:
60 minutes

Materials Required:
Various sporting equipment - Large open spaces

STEAM Subjects:
Technology, math

Activity Objectives:

1. To value exercise and hydration
2. To learn teamwork through games
3. To explore cultures around the world

Directions:

- Water for sports isn't only about using water to play games! We require water for all sports. Discuss with students the importance of both regular exercise and staying hydrated
- Split students into 4 groups
- Have students rotate through 4 stations for 15 minutes each, playing a new game at each (e.g., basketball, tennis, volleyball, soccer, American football, cricket, netball)
- At each station, have teachers explain the origins, history, and rules of the sport
- Ensure students have water bottles/cups and regularly drink adequate amounts of water

Lesson 7 - Health & Sports

Water Olympics Brainstorm

Time Required:
20 minutes

Materials Required:
Paper and crayons

STEAM Subjects:
Art

Activity Objectives:

1. To consider how water and sports intersect in a wide variety of ways

Directions:

- Which activities use water for recreation? Ask students which sports would be in the "Water Olympics" (don't forget frozen water!)
- Have students design a logo, a new sport, or an arena for the "Water Olympics"
- If desired, prepare and present a slideshow of sports from around the world that use water

Lesson 7 - Health & Sports

Snack Time: Apple Sailboats

Time Required:
30 minutes

Materials Required:
1 apple per 4 students - Pretzels or another straight snack stick
Cheese triangles - Peanut butter - Raisins

STEAM Subjects:
Art, engineering

Activity Objectives:

1. To enjoy a tasty snack together
2. To practice building skills and creativity

Get creative! Use local, in-season foods to make this flexible snack craft. Add Goldfish crackers and create a full ocean scene. Provide multiple base options (tomatoes, melons) to make things colorful.

Directions:

- Give each student a quarter apple for their boat's base
- Provide pretzels and cheese triangles for them to make a 'sail'
- Have pupils spread a bit of peanut butter and press raisins on the apple for 'crew members'
- Take pictures of the students' creations
- Bon appétit!

Remember to follow good WASH practice!

Lesson 7 - Health & Sports

Sports Movies

Time Required:
20 minutes

Materials Required:
Internet and/or downloaded videos - Laptop - Projector and screen - Recording equipment - Parental permissions

STEAM Subjects:
Technology

Activity Objectives:

1. To encounter technology via water and sports

Directions:

- Choose a few videos that highlight water used in sports. To connect to previous activities, include Olympics footage (ice skating, beach volleyball, swimming, surfing, etc.)
- If time and technology allow, record some of the students' game-playing and create your own water sports videos
- Upload your water sports videos to YouTube, showing students the process of video creation and internet-based technologies

In the Bled

The Agni N'Zekri, Smahra, and Jabal Al-Akhbar Schools are located a mere thirty kilometers from the Atlantic Ocean. In spite of this, very few of our Water School students have been to the beach. Public transport is extremely limited in the rural mountains, and few families can afford the expense of a vehicle. Far from an excuse for a day off school, a trip to the coast is a life-changing experience for our students. It is an opportunity for them to interact with an ecosystem they know so much yet so little about and a chance for them to viscerally connect with the wider world.

Organizing a trip to the coast is costly and logistically involved. Parental permissions, transport difficulties, and required resources mean that we are not able to make the fieldtrip happen for every iteration of the Water School. Given this reality, we do our best to incorporate games in every session and built in a variety of other activities related to sport. By rotating the coastal trip around schools, we hope that every student in the region is able to make the trip at least once during their education.

Football (soccer) is one of the most common games in Morocco. Kicking around a ball is an easy activity to engage diverse students across a wide variety of skillsets and range of ages. It is also a powerful way to transcend language barriers. Often, our visiting researchers who are not fluent in Tachelhit or Moroccan Arabic find sports an entry into relationships with the students.

Unit C

TAKING ACTION

8: Pollution & Conservation

Lesson Objectives:

- To identify what causes water, air, and land pollution
- To understand the importance of conservation
- To take action against pollution and promote conservation

Lesson 8 - Pollution and Conservation

What is Pollution?

Time Required:
30 minutes

Materials Required:
Clear pitcher of water - Clear plastic cups - Coffee straws
1 cup salt, 1 cup vinegar - Blue and red food dye
Small pieces of plastic/trash

STEAM Subjects:
Chemistry

Activity Objectives:

1. To introduce and identify water pollution

Directions:

- Fill a clear pitcher with water. Ask students if it is dirty (polluted). How do they know?
- Organize students into three groups and give each individual a clear plastic cup with water and a coffee straw. This water represents water from wells, lakes, rivers, and oceans
- Put two drops of food coloring and bits of trash in Group 1's cups
  - Does this water look polluted?
  - Discuss visible pollution problems
- Put a small amount of vinegar in Group 2's cups and stir
  - Does it look dirty?
  - Pollution may be invisible but smelly!
- Put salt in Group 3's cups
  - As they stir, ask if this water looks polluted. At first, the salt will cloud the water, but it will then dissolve
  - Just because we can't see or smell pollution doesn't mean it isn't present!

Discuss:

- What makes water polluted?
- Is clear water necessarily clean?
- Where do you see pollution around you?

Lesson 8 - Pollution and Conservation

Pollution: Causes and Effects

Time Required:
15 minutes

Materials Required:
Ecosystem coloring pages

STEAM Subjects:
Ecology, art

Activity Objectives:

1. To visualize pollution's causes and effects

Directions:

- Explain to students that pollution exists in air, water, and land. Brainstorm with them causes and effects of these three types, e.g.:
  - Air pollution from smoke makes it hard to breathe and creates acid rain
  - Animals get sick eating litter, land pollution, and trash blocks sunlight from reaching plants and habitats
  - Fish get caught in underwater plastics
- Give each student a coloring page and ask them to color half the picture with a clean environment and the other half polluted
- Ask for volunteers to share their work

Lesson 8 - Pollution and Conservation

Water Pollution: Oil Spills

Time Required:
10 minutes

Materials Required:
Clear, plastic container - Blue food coloring
Water, cooking oil - Rubber duck

STEAM Subjects:
Chemistry, ecology

Activity Objectives:

1. To understand how marine wildlife are affected by water pollution and oil spills

Directions:

- Have a student fill the container with water and add coloring to mimic the ocean's color as well as a rubber duck representing life
- Add cooking oil and stir the mixture making 'waves' to submerge the duck
- Review with students what happened when oil was poured, why oil and water don't mix, and how hard it is to clean the duck of oil

Lesson 8 - Pollution and Conservation

Water Pollution and Wildlife

Time Required:
45 minutes

Materials Required:
Feathers -Cooking oil - Plastic containers - Rulers
Eye droppers - Magnifying glasses - Paper and pens
Hardboiled eggs - Water
Liquid detergent (1 part soap: 1 part water)

STEAM Subjects:
Chemistry, math, technology

Activity Objectives:

1. To understand the effects of water pollution on wildlife

Directions:

- Split students into groups of 3 and give each group a plastic container, 2 boiled eggs & oil
- Pour oil into the container to cover the eggs
- Remove one egg after 5 minutes, trying to remove excess oil before peeling it. Do the same with the second egg after 15 minutes
- Ask students to reflect on their findings. What impact would oil have on eggs of birds nesting near oil spills and polluted waters?
- Give each group pen/paper, a feather, magnifying glass, water, oil, and detergent
- Have students examine the feather with their glasses and sketch observations
- Dip the feather in water for 1-2 minutes and sketch it again; then do the same for oil
- Have students try to clean the oil-coated feather with water and then detergent

Discuss:

- How did oil affect the feather differently than water?
- How easy was it to clean the feather? How easy would it be to clean a whole bird covered in oil?
- How do oil spills happen?
- How do oil spills affect wildlife?
- Do we have to choose between oil for energy and the health of birds and other wildlife?
- What are other pollutants that affect wildlife?
- What can be done to protect wildlife and prevent pollution? What can we do?

Lesson 8 - Pollution and Conservation

Pollution: Before and After

Time Required:
30 minutes

Materials Required:
Markers, crayons - Paper

STEAM Subjects:
Ecology, art

Activity Objectives:

1. To brainstorm ways to help address pollution

Directions:

- Give all students paper, markers, and crayons
- Have students draw three columns and label them “Before”, “Action”, and “After”
- In the “Before” column, students should write or draw polluted air, water, and land scenes
- With the class, brainstorm ways to take action against pollution
- Ask students to write or draw actions specific to their pollution scenes in the middle column
- In the final column, allow students to imagine what those scenes would look like after the intervention action

Lesson 8 - Pollution and Conservation

Pollution PSAs

Time Required:
30 minutes

Materials Required:
Poster paper - Crayons, markers

STEAM Subjects:
Ecology, technology

Activity Objectives:

1. To promote environmental conservation

Technology Twist: Make these PSAs into video ads!

Directions:

- Divide students into groups of 3-4
- Have each group brainstorm how they, their families, and/or their communities can help reduce pollution + protect the environment
- Students should then translate their ideas into a public service announcement including a catchy title, information about what pollution is and how it is caused, and solutions for reducing pollution. PSAs might take the form of a song, poem, poster, or skit
- At the end, each group shares its PSA

Lesson 8 - Pollution and Conservation

Let's Clean Up!

Time Required:
30 minutes

Materials Required:
Paper - Pipe cleaners, cardboard, Legos
Markers, crayons - Prize (optional)

STEAM Subjects:
Engineering, math

Activity Objectives:

1. To devise a process for trash removal

See "Additional Resources" for links to examples of trash pick-up inventions like Mr. Trash Wheel and Seabins.

Directions:

- Give students a variety of building materials and tell them they have 15 minutes to draw or construct a machine that will pick up trash
- Students must estimate how much trash their invention will pick up and if it will be used for land, air, or water pollution (or all three)
- Have each student present their innovation to the class, including information about how it works and why it is important
- Once everyone has presented, take a vote. The class' favorite invention can win a prize!

Lesson 8 - Pollution and Conservation

Snack Time: Avoiding Snack Trash

Time Required:
30 minutes

Materials Required:
Fruits and vegetables without any packing materials

STEAM Subjects:
Ecology

Activity Objectives:

1. To encourage healthy snacking

Directions:

- Ask students what their favorite snacks are. Discuss with the group how many of our top picks like candy, chips, and soda are not only less healthy for us, they're not good for the planet: packaging trash becomes pollution
- Provide a variety of fruits and vegetables or other options that don't come with packaging waste. Let students know these snack choices are good for our bodies and our home. Talk with students about how to reduce food packaging waste at home
- Give students the time to enjoy a good snack together, being sure to demonstrate and enforce good hygiene

Lesson 8 - Pollution and Conservation

Community Clean-Up

Time Required:
60 minutes

Materials Required:
Transport - Parental permission - Outdoor space
Gloves and eco-friendly trash bags or containers

STEAM Subjects:
Ecology

Activity Objectives:

1. To take action and clean up the community

Ocean Conservancy runs community clean-ups around beaches. Their website includes a data collection card. To give students practice with recording data and math, give each group a data card and have them track their trash!

Preparation:

- Find a local area like a beach, highway, or forest, where students can pick up trash
- Plan a fieldtrip, being sure to gain parental permission for students and make the necessary arrangements for transportation
- Invite families and community members to join the students for their day of action

Directions:

- In the classroom or on the bus, talk with students about how they can help make a difference by picking up litter. There is a lot of pollution, but every piece of plastic picked up and thrown away properly may save a bird's life and inspire more action!
- On site, split students into groups of 3-4 and give each group gloves and an eco-friendly bag to place trash. Be sure to cover safety rules and ask them to notify an adult if they find any dangerous waste
- After the cleanup, talk with students about the difference they made, the importance of picking up trash even if it is not theirs, and ways to prevent more pollution

Additional Resources

- **On oil spills:** nationalgeographic.org/activity/simulate-oil-spill-cleanup
- **Cool clean-up tech ideas:** baltimorewaterfront.com/healthy-harbor/water-wheel/ and youtube.com/watch?v=tFV2SkI3IIU
- **More for community clean-ups:** www.oceanconservancy.org

In the Bled

As in many rural areas, our fog villages have relatively few public services. With limited access to commercial markets and products, these communities produce less waste than urban areas. Proper waste disposal and management is, however, an issue. The "Pollution and Conservation" activities help students understand the dangers of dirty water for humans and animals and how litter impacts ecosystems.

Given the school calendar and logistical realities in the countryside, not every iteration of the Water School is able to have ten full lessons. Pollution and conservation are themes that can easily be integrated into other sessions. See, for example, Lesson 4, when Fatiha frequently draws attention to pollution concerns as they relate to marine animals. Pollution can also be integrated with WASH activities to run a joint lesson on healthy homes and habitats.

As an interactive and productive learning activity, we take Water School students outside to clean up the trash in their school yard. To make sure this action is more than a temporary intervention, the class brainstorms ways to prevent and reduce litter. Older students write these techniques into an anti-litter pledge. Younger students draw accompanying pictures to encourage the community to pick up the trash around their homes and villages.

9: Recycling

Lesson Objectives:

- To identify waste at home and and in the community
- To understand how to reduce, reuse, and recycle waste
- To emphasize that small changes can make a big difference

Lesson 9 - Recycling

Water at Home

Time Required:
15 minutes

Materials Required:
Pens/markers - Paper - Flipchart paper

STEAM Subjects:
Geography, math

Activity Objectives:

1. To understand the importance of water
2. To identify how much water students and their families use for daily activities

See the Resources page at the end of this section for information on home water use. If resources allow, give students the chance to calculate the amounts of water their homes use per week.

Directions:

- Give students paper, markers, and pens and task them to draw their homes, specifically drawing or labeling where water is used
- Draw a house on the board or flipchart paper
- After students have finished drawing their own homes, have them call out places in the home using water to create a class model with as many ideas as possible

Discuss:

- Why is water important? What is it used for?
- How much water do you think you and your families use every day? Where and when do you use water in your home?
- What activities did you include when you came up with this number?
- Did you know that the average family of four uses 1820 liters of water per day at home?
  - 27% of that is from flushing the toilet
  - An 8-minute shower uses 80 liters
- Discuss with students how they can reduce the amount of water they and their families use and why this is important

Lesson 9 - Recycling

Trash Timelines

Time Required:
45 minutes

Materials Required:
Various trash items: aluminum can, banana peel, glass bottle, plastic bag, cotton rag, rubber sole of shoe - Flipchart paper

STEAM Subjects:
Ecology, math

Activity Objectives:

1. To know where trash goes & how long it lasts
2. To understand the environmental consequences of creating trash

For more information on how long trash lasts, see "Additional Resources"

Directions:

- Hold up an assortment of trash (aluminum cans, banana peel, plastic bag, glass, etc.)
- Ask students which items they throw in the trash, how often they use them, and where they think the items go from the trash
- Explain that decomposition refers to the breakdown of organic material or waste. Ask students if their trash decomposes immediately when they throw it away
- Tell students that most trash ends up in landfills, where it stays for a very long time
- Passing out paper and pens, have students create a timeline for how long they think trash items will take to decompose
- Record the group's guesses on the flipchart
- Discuss with students why they put items where they did before revealing the answers:
  - Banana peels take 3-4 weeks to decompose; a paper bag, 1 month. For cotton rags, it's 5 months, and a whole year for socks. Rubber soles take 50-80 years…an aluminum can, 200-500 years. Plastic bags will take hundreds of years, and a glass bottle may never break down

Discuss:

- Were you surprised by the results? What does this data tell you about landfills and trash?
- How can we reduce, reuse, and recycle trash to minimize waste and protect our environment?

Lesson 9 - Recycling

Reduce, Reuse, and Recycle

Time Required:
15 minutes

Materials Required:
N/A

STEAM Subjects:
Ecology

Activity Objectives:

1. To learn the importance of reusing, reducing, and recycling

Directions:

- Explain the meaning of reducing, reusing, and recycling waste. Review the differences by sharing with students a variety of actions and have them shout whether it is reducing, reusing, or recycling. For example:
  - Writing on both sides of paper (reduce)
  - Separating plastics and cardboard from other trash so they can be recycled (recycle)
  - Using dishes instead of paper plates (reduce)
  - Using a broken glass to hold spare change (reuse)
  - Using old newspaper for an art project (reuse/recycle)
  - Donating old toys for others to use (reuse)

Lesson 9 - Recycling

Trash Obstacle Races

Time Required:
30 minutes

Materials Required:
3 plastic bins - Assorted "trash"

STEAM Subjects:
Ecology

Activity Objectives:

1. To practice recycling, reducing, and reusing

Directions:

- Set up bins for reducing, reusing, and recycling in an obstacle course
- Give each team of 5 students a bag of "trash"
- Each student must take an item and weave through the obstacle course to put it in the right bin for how they could save the item from going into landfill

Lesson 9 - Recycling

Snack Time: Reduce, Reuse, & Recycle

Time Required:
30 minutes

Materials Required:
Popcorn - Juice - Reusable containers

STEAM Subjects:
Ecology

Activity Objectives:

1. To identify ways to reuse, reduce, and recycle

Preparations:

- Make one big bag of popcorn and 6 individual-sized bags of popcorn; prepare one glass pitcher of juice and 6 small boxes of juice

Discussion:

- What are things you eat or drink everyday? Ask students how they can reduce packaging waste from snacking. Small changes matter!
- Hold up a big bag of popcorn and the five individual-sized bags of popcorn. Which uses more packaging and creates more waste?
- Explain that juice boxes require more plastic and create more waste than a glass jar
- Reusable containers are the best way to reduce packaging. Remind students to recycle any paper or plastic used
- Enjoy the popcorn and juice

Lesson 9 - Recycling

Let's Go Bowling

Time Required:
30 minutes

Materials Required:
1o 2-Liter soda bottles - Some sand (for weight) - Rubber ball

STEAM Subjects:
Math

Activity Objectives:

1. To use recyclable material to play a game

Directions:

- Weigh down the plastic pins with sand and show students how to set up a bowling pitch
- Explain the rules of bowling and break into small teams to play
- Play until each group has finished one game
- Brainstorm other games that can be played using recycled materials

Lesson 9 - Recycling

Recycling Posters and Campaign

Time Required:
60 minutes

Materials Required:
Poster paper - Crayons, markers - School or community support

STEAM Subjects:
Ecology, art

Activity Objectives:

1. To identify solutions for minimizing waste
1. To create a community recycling program

Directions:

- Pass out poster paper, crayons, and markers
- Divide students into groups of 3-4
- Have each group design a poster, cartoon series, or other flyer encouraging the 3Rs of reducing, reusing, and recycling
- Give each group time to share their poster
- Send students on a mission to display posters around the school where they will be seen by the greatest number of people
- If resources allow, organize a school or community recycling day

Additional Resources

- **To calculate a household's water use, check out:**
  www.swfwmd.state.fl.us/conservation/thepowerof10/
- **For statistics on water use in the home, visit:**
  www3.epa.gov/watersense/pubs/indoor.html
- **For more information about landfills and rates of trash decomposition:**
  www.landfill-site.com/waste-decomposition.html

In the Bled

One of the most unique things about our classrooms is their connection to our pioneering fog harvesting project. The water recycling lesson is an opportunity for students to learn more about this innovative technology. We work with them to think about ways they and their families can reduce water waste and reuse everyday items.

The session begins with a miniature model of the fog harvesting nets on display. Students take turns spraying the fog nets with a water bottle and watching the 'fog' condense to collect in the trough. They learn how this technology creates a solution to the water scarcity their communities have faced for generations by piping condensed fog directly into their homes.

Students are then introduced to the concept of greywater when Fatiha asks them to draw their homes and identify where water is used. As a class, they brainstorm water recycling and conservation techniques they could use in their daily lives. Students identify turning off the taps while washing their hands and brushing their teeth as one of the easiest ways to preserve potable water. They also suggest using the greywater from washing clothes and dishes to water plants and crops.

Fatiha challenges students to think about other items that could be reused or recycled – and the importance of using fewer disposables – by displaying common 'trash' items and asking students to guess how long it takes for each one to decompose. Our students are always surprised to learn that a single plastic bag takes hundreds of years to break down. Morocco is one of the leading consumers of plastic bags in the world. Our students have told us about seeing fields completely covered in them. Thinking about these issues, students commit to using cloth bags more often, reusing any plastic bags they find, and ensuring that old plastics are disposed of properly.

To end the session on a positive note, students paint old tires to use as decorative supports for the trees to be planted in their community garden.

10: A Community Garden

Lesson Objectives:

- To identify local plants and trees in the community
- To understand proper plant care techniques
- To learn how to plant and care for a garden

Lesson 10 - Community Garden

Plant Presentations

Time Required:
15 minutes

Materials Required:
Local fruits, vegetables, herbs, and other plants

STEAM Subjects:
Botany

Activity Objectives:

1. To identify local plants

Directions:

- Display common local fruits and vegetables. Allow students to examine plants closely. Ask:
- What are the names of these plants?
- Where do they grow?
- Can they be grown inside, outside, or both?
- What are these plants used for?

Lesson 10 - Community Garden

Snack Time! Fruit & Veggie Fun

Time Required:
20 minutes

Materials Required:
Variety of fruits and vegetables - Knives and cutting boards
Water and paper towels

STEAM Subjects:
Health science

Activity Objectives:

1. To enjoy a healthy snack and reinforce proper food preparation techniques

Practice counting the pieces of fruits and veggies in a different language!

Directions:

- Review food preparation techniques, including washing and knife safety
- Assign duties to students: fruit and vegetable washing, cutting, setting the table
- Have all students wash their hands before beginning work
- Enjoy a leisurely snack time as a group
- Assign washing up duties, again with proper WASH techniques for clean dishes & hands!

Lesson 10 - Community Garden

Garden Blueprints

Time Required:
45 minutes

Materials Required:
Flipchart paper - PowerPoint - Transport (if possible)
Markers and pens - Paper

STEAM Subjects:
Engineering, art, math

Activity Objectives:

1. To creatively design a garden
2. To understand how certain plants grow better in certain environments
3. To value brainstorming and teamwork

Directions:

- Prepare a PowerPoint with pictures of gardens feasible in the local community. Include gardens in different countries and environments as well to generate more ideas
- Ask students which plants grow best in the area and what their dream garden looks like
- If logistics allow, take students to a local garden or hear a gardening expert speak
- After some introductory ideas, pass out paper, crayons, and markers to each student
- Tell pupils they have 15 minutes to design a garden. They can include anything they would like. They might consider issues like who is benefitting from the garden, number and types of plants, and watering/care needs
- Ask all students to present their gardens to the class. After each presentation, have other pupils choose an element from each individual garden they like (a specific plant or an idea). Write these on the board
- Give the full class time to create a class garden from these ideas
- Debrief with the class about how they created something together & everyone contributed. Both individual and group work is important!

Lesson 10 - Community Garden

Soil Testing

Time Required:
20 minutes

Materials Required:
Variety of soil samples - Clear containers - Fine mesh strainer
Worms for soil samples

STEAM Subjects:
Biology

Activity Objectives:

1. To identify the components that make good soil and how plants get nutrients from soil

Directions:

- Set up 4 stations of different soil samples, with each station focusing on a facet of what makes up good soil in the community
- Allow students to touch, feel, and smell soil. Have them pay particular attention to:
  - Color: What does rich and poor soil look like?
  - Smell: What does healthy and unhealthy soil smell like?
  - Texture: What does good and bad soil feel like?
  - Structure: Use the strainer to show permeability of good and bad soil and how this influences water absorption
- Point out worms in soil and explain they are important soil engineers that help decompose (breakdown) nutrients for plants
- Have students write down observations from each soil and share them with a partner
- Discuss observations together as a class

Discuss:

- What is soil? Why do plants need it? What are the components of good soil?
- Soil contains nutrients like calcium, potassium, magnesium, and phosphate
- Plants use their roots to soak up these nutrients to help them grow. These are nutrients humans need too!
- Which animals or insects live in the soil? Why are they important for soil and plants?

Lesson 10 - Community Garden

Watering Techniques

Time Required:
30 minutes

Materials Required:
1 watering can with rosette - 1 watering can without rosette
3 containers of soil - 1 plant with leaves
Tall, clear vase filled with soil

STEAM Subjects:
Botany

Activity Objectives:

1. To learn how proper watering techniques can promote water conservation
2. To understand how & why to keep soil moist

Explain:

- Watering plants does not require a lot of water if done correctly
- Watering with a rosette mimics "rain," which preserves air spaces in the soil and allows it to absorb more water
- Watering without a rosette floods soil, causing it to sink and become dense, which does not maximize water absorption
- Watering the soil directly, rather than watering leaves, keeps it moist and promotes nutrient uptake
- Using more water less frequently is best because it penetrates the soil more deeply and leads to deeper roots, which prevents drought stress and conserves water

Directions:

- Fill 3 containers with soil and split students into 3 groups for different demonstrations:
- Group 1 shows watering with and without a rosette to view soil structure and absorption
- Group 2 waters the soil and then waters the leaves of the plant, noting how soil holds the moisture for a longer period of time
- Group 3 should fill the clear vase with soil and water it with a small amount of water, then water it again with another small amount of water. Make sure students see how only a little water penetrates soil, even though it's already wet. After 5 minutes, apply a larger amount of water and watch it slowly reach the bottom of vase

Lesson 10 - Community Garden

Nature Scavenger Hunt

Time Required:
30 minutes

Materials Required:
Outdoor space with plants - List of a variety of flowers and trees - Magnifying glasses - Cameras (one per group)

STEAM Subjects:
Botany, technology

Activity Objectives:

1. To identify local plants and trees

If logistics allow, take students to a local forest or nature preserve for the hunt

Directions:

- Divide students into groups of 3-4
- Give each group a magnifying glass, a camera, and a list of plants to find outside
- Challenge students to locate and document each of the specimens
- The first group to find everything listed wins!
- For an extra challenge or bit of fun, include tasks students must complete on camera – demonstrating proper watering technique, weeding a kept garden, etc.
- Discuss each type of plant, including its ecosystem requirements and particular uses for humans or other animals

Lesson 10 - Community Garden

Garden Mural

Time Required:
20 minutes

Materials Required:
Large sheet of green paper - Index cards
Markers - Tape

STEAM Subjects:
Botany, math

Activity Objectives:

1. To plan a community garden

Directions:

- Hang up a large sheet of green paper
- Pass out index cards and markers to each student and instruct them to write the names of plants, fruits, and vegetables they want to plant in a garden on the index cards
- Have students "plant" their ideas on the green paper and decide as a group how many of which plant should go where in the garden
- Discuss the importance of working together to care for a community garden. What regular work will need to happen? Who will be responsible for watering and weeding?

Lesson 10 - Community Garden

Let's Make a Garden!

Time Required:
60 minutes

Materials Required:
Outdoor space - Soil - Shovels, spades, gloves
Samples of plants, seeds, and flowers - Watering cans

STEAM Subjects:
Botany, engineering

Activity Objectives:

1. To learn proper planting techniques
2. To understand how to care for a garden

Maintaining a class garden takes a lot of time and preparation. Having local garden enthusiasts and parents to assist students with their responsibilities in garden care will be important!

Preparation:

- Find and prepare a plot of land for the garden
- Gather suitable soil, local plants and seeds

Directions:

- Building from the previous activities, have students design and map their garden, addressing dimensions, walking paths, water and soil requirements, etc.
- Take class to the predetermined plot of land
- Pass out gardening tools and watering cans and demonstrate for students how to plant seeds, flowers, fruits, and vegetables
- Review soil composition concepts and watering and planting techniques
- In groups of 3-4, give students a specific crop and allow them to work together to plant it
- Create a weekly schedule and assign students roles for watering, weeding, and monitoring the garden
- As a class, write a list of garden rules. Post the rules in the garden and the classroom

Discuss:

- Why is a garden important?
- What can we learn from planting a garden?
- How will we take care of the garden?
- What will the garden look like in one year?
- Who can benefit from our garden? How do we make sure it helps the entire community?

In the Bled

Too frequently, students in urban schools suffer from a lack of green space and outdoor time. Rural classrooms often do not have a safe community space. Our community garden is intended to create a green space for schools in our fog villages. By including students in its design and construction, young people learn how to care for plants and use sustainable methods for irrigation and agriculture. This also creates a community model for what could become small-scale income-generating agricultural production.

The community garden lesson also serves as a useful review of animal and plant biology. Fatiha again displays pictures of common crops in Morocco: palm, olive, argan, banana, orange, lemon, carrots, cucumbers, tomatoes, and cactus. She reviews which type of habitat each one grows in, which kinds of animals eat them, and the importance of agriculture for their villages and the country. Students draw a picture of their dream garden, giving them the chance to identify their favorite fruits, vegetables, and plants. After, the class begins planting in the school's garden.

A local gardener from Aït Baamrane visits to teach students about the conditions that are suitable to grow plants in hot weather with little rainfall. Given the arid climate, rocky soil, and limited precipitation, the most suitable plants to grow in our schools are argan, orange, and olive trees. Gardeners work with the students to teach them how deep to dig the holes, how often to water the trees, and how to care for the plants.

Inside our one-room schoolhouses, students plant flowers, scrubs, and herbs in recyclable plastic containers and place them on classroom windowsills. Fatiha takes the opportunity to review the water cycle, teaching students that evaporation happens more slowly in lower temperatures. Keeping delicate flowers inside helps ensure their survival and requires less water to make them grow.

To ensure the viability of the garden, different age groups are assigned specific plants to watch over. Students make a chore schedule, assigning each person a watering day.

Motivations & Outcomes

Innovative approaches to learning can change lives.
The Water School is designed to do just that.

In Southwest Morocco, Dar Si Hmad's Water School is one of the only places where rural students are able to develop communication skills and learn about diverse topics. The globally-focused environmental curriculum builds educational bridges between the outside world and children's local communities. Dar Si Hmad believes that all young people around the world deserve the chance to thrive and become environmental stewards through accessible, hands-on learning.

During our Water School, we frequently hear students asking "can we continue doing this all the time" and parents wondering "why do not you organize a camp for us as well"? Our trip to the beach for a session on water sports and environmentalism is, for most of our students, their first time ever seeing the ocean they live only kilometers from. After one of these trips, a mother let us know "we would also love to go on a trip like they did, they really enjoyed it a lot."

> "Can we continue doing this all the time?"

Dar Si Hmad
ⴰⵔ ⵙⵉ ⴰⵃⵎⴰⴷ
دار سي حماد

Dar Si Hmad for Development, Education & Culture

BP 20686, Agadir Principale
Agadir 80000 Morocco
www.darsihmad.org
www.youtube.com/c/darsihmad

WATER SCHOOL
by Dar Si Hmad
STEAM Curriculum for ages 6-14