STEAM Tales

Lesson plans

Ángela Piskernik

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Ángela Piskernik's biography

Portrait of Ángela Piskernik, Unknown author (1925)

Source: Dolenc, S. Kvarkadabra. https://kvarkadabra.net/2019/07/angela-piskernik

Ángela Piskernik was born in 1886 in a small village called Lobnik, which is today part of Austria. She grew up on a farm in a big family (she was the 9th child), and she loved nature very much. She studied biology in Vienna and wrote her PhD thesis in 1914. She was deported to a concentration camp in Ravensbrück in 1943. Her main research was done in the field of botany, and her best-known work is The Key to Identifying Flowers and Ferns. She was the Head of the Natural History Museum in Ljubljana and advocated the creation of the Triglav National Park.

She died in Ljubljana in 1967, when she was 81. To honour her life, a park in Ljubljana was named after her.

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Lesson plan 1

How flowers absorb water Keywords: plants, botanical science	
Duration: 45 min, 1 day for observation	 **Age:** from 6 to 9 years old
 **Place:** Classroom and meadow	 **Related STEAM areas:** **S** (science): Children will be able to see and learn how flowers absorb water and the pathways of flower veins. **A** (arts): Different colours.
Description	During this experiment, children will be able to see coloured flowers and this will help them understand how they absorb water. They will pick flowers and add them to the coloured water. The full results of this experiment will be seen the next day.
Learning objectives	At the end of this experiment, children will: • Understand how flowers absorb water • Understand why water is important to plants • Exercise their observational skills

Connection to the female role model	Ángela loved and was interested in everything related to nature since she was a little girl. This led her to study biology and become a botanist – a scientist who studies plants. During this experiment, children will become little botanists themselves.
Individual or group	Optional: individual or in groups.
Safety	This experiment is safe to perform.
Materials	☐ Flowers (snowdrops, white roses, daisies; best results can be seen with white or bright-coloured flowers) ☐ Glasses (1 or more if you want to show different colours) ☐ Water (1dcl for 1 glass) ☐ A spoon ☐ Food colouring that dissolves in water (1 or more if you want to show different colours) ☐ Mobile phone (for taking photos, optional)
Lesson plan	
Introduction (10 min)	Do you like picking flowers? What is the first thing you have to do when you bring home flowers you have picked? Yes, you must put them into water. What would happen otherwise? That is right, they would

	wither. But what do flowers do with the water from the vase you put them in? They drink the water! Or as we say for plants, they absorb it. Just like you and me they too need water to stay alive. **If you read the story before the experiment:** Do you remember from Ángela's story what she studied and where she worked? She loved plants so much that she studied biology and became a botanist, a scientist who studies plants for a living. Today we will all become little botanists.
Research question/hypothesis (5 min)	And what do all serious scientists do? They ask themselves a lot of questions and they search for answers. So here is a research question for all of you: Do you think that we will be able to see if our plants will drink the water? (Children should be encouraged to give their answers, even the wrong ones. All opinions should be included and not discarded right away, even though the teacher knows they are not right. The experiment will serve to answer the research question, mimicking the scientific method.)

Step-by-step instructions (15 min)	**Before the experiment**: each child should pick flowers from the garden, meadow, forest, … **Step 1**: Put water in the glass so that it is half full. **Step 2**: Add a few drops of food colouring to the water. Stir well. **Step 3**: Put flowers in the glass. Repeat this process depending on how many flowers and how many different colours you have. Time: approx. 10 minutes, depending on how many flowers and colours you have. **Step 4**: Wait and observe what happens after a few minutes, 1 hour, at the end of the day and the next day. You can take pictures of different stages so that you can compare them at the end. **Time**: 15 minutes for the experimental part, and 1 day for the observation part.
Source	"How flowers absorb water" by InnoBox
Conclusion (5 min)	Check the research question/hypothesis. Results of the experiment show us that we are actually able to see the coloured water inside the flowers; therefore, the answer to our research question is: yes,

	we were able to see if our plants drank (absorbed) the water.
Explain the experiment (5 min)	We can see that the flowers have absorbed the water because they have coloured themselves with the colour from the vase. This would not be possible with clear water, which is why we added food colouring to the water. This step allowed us to see the water inside the plants.
The science behind	All humans, plants and animals need water to live. Plants need water to perform crucial functions to survive: **1. Photosynthesis**, the process by which green plants transform light energy into chemical energy (sugar), an energy that helps plants grow. For this process to happen, plants need sunlight, carbon dioxide and – water. **2. Transpiration**: This process of water moving from roots to the stem and up to the leaf helps keep plant cells firm (that is why plants stay upright) and helps transport nutrients and minerals from the soil to every part of the plant. Plants draw water from the soil through their roots. The water then travels up the stem to the last leaf of

	the plant. Even when a plant no longer has roots, it can pump water through the stem to its leaves and flowers. This keeps the bouquets in the vase fresh for longer than if they are left out in the air. Plants have developed a special system to extract water from the ground and send it upwards to their above-ground parts. The plant overcomes gravity through capillary action, diffusion and osmosis. This draws water upwards, towards the top of the plant. We can usually see that flowers absorb (drink) water because if we put them in a vase with water, the water level drops over time. But with this experiment, we were actually able to see the insides of the plants. As the water flows through the plant just below the surface, we can observe the coloured water flowing through the plant from the outside, colouring the plant. Sometimes, we are even able to see pathways of flower veins.

Lesson plan 2

Cleaning an oil spill Keywords: conservation of nature, ocean pollution, oil spill	
Duration: 60 min	**Age:** from 8 to 9 years old
Place: Classroom	**Related STEAM areas:** **S** (Science), **E** (Engineering): Children will learn which methods work best for removing oil from water. They will combine science (they will learn about different substances) with engineering (physical oil removal).
Description	Children will become environmental engineers whose job will be to find the best and quickest way to remove oil from the "sea".
Learning objectives	At the end of this experiment, children will: • Learn which material is the most effective for cleaning an oil spill • Gain knowledge about basic oil characteristics • Gain knowledge of the impact of humans (industry) on the environment

	• Practice working in a group: they will practice communication and collaboration skills
Connection to the female role model	Ángela was very active and passionate about protecting nature. She founded Mountain Guard and helped establish Triglav National Park, to this day the only national park in Slovenia – both were important environmental initiatives to preserve nature. During this hands-on activity, children will become environmentalists who will try to remove oil from water and in doing so, protect living organisms from negative consequences of an oil spillage.
Individual or group	Individual. Each child should do one task; either in the preparation part or by trying the materials/methods. Use so many glasses/plastic cups that each child can try at least one step, even if that means that more children try the same material.
Safety	This experiment is safe to perform.
Materials	☐ Vegetable oil, 150 ml ☐ Oil-based food colouring (e.g. for chocolate) ☐ A spoon ☐ A small spoon ☐ 7 glasses or plastic cups (they must be transparent)

	☐ 2 Syringes ☐ Dishwashing soap, 1 spoon ☐ Glass bowl ☐ Flour, 1 spoon ☐ Cotton ball, 1 spoon ☐ Wooden chips, 1 spoon ☐ Foam Deurex Pure chemical absorbent, 1 spoon ☐ Optional: feathers, 1 spoon ☐ Marker ☐ Water, 500 ml ☐ 4 plates
Lesson plan	
Introduction (10 min)	Do you like swimming in the sea or lakes, or playing on the river banks? You can do all this only if the water you are swimming in or playing with is clean. Unfortunately, human behaviour sometimes harms water. Do you know who are the biggest water polluters? Factories, industries, and even individuals can harm the water quality if they are not careful. One of the biggest water polluters is large oil spills in the ocean. Do you know what oil is? (Wait for the answers.) Do you know why humans need oil? People need oil or

	their by-products (like diesel fuel or fuel oil) for many reasons (for transportation, heating, the industry). Do you know where oil is found? To get oil, people have to dig deep into the surface of the Earth. Most oil is extracted by drilling into the seabed. If pipelines break, oil tankers sink, or something goes wrong with the drilling operation, oil starts to leak. In all of those scenarios, oil leaks into the ocean, causing harm to animals, plants, and habitats. All wildlife is in danger, and it takes a lot of time and a lot of effort before the damaged area can recover. Smaller oil spills, unfortunately, happen quite often, and we do not even hear about them. However, whenever large oil spills occur, you can read and hear about them in the news. Do you remember hearing about or seeing the consequences of a large oil spill on TV or in a newspaper? Whenever this unfortunate event occurs, marine engineers try to combat the pollution. Let's see how you would do as a marine engineer! **If you read the story before the experiment?** Do you remember how the story about Ángela was titled? It was titled Ángela, the guardian angel of nature!

	Angela was a biologist, and she truly loved nature. She was very passionate about keeping nature unspoiled so that children who came after her – like you! – could enjoy it. I am sure she would love to see this experiment.
Research question/hypothesis (5 min)	Before we start the activity, I would like to ask you a question: Which material or method do you think will work best for removing the oil from the water? (Method: spoon, materials: dishwashing soap, flour, cotton balls, wooden chips, or foam). Why do you think so? (A teacher should write down all the answers.) (Children should be encouraged to give their answers, even the wrong ones. All opinions should be included and not discarded right away, even though the teacher knows they are not right. The experiment will serve to answer the research question, mimicking the scientific method.)
Step-by-step instructions (35 min)	**First part: Can we mix water and oil** **Step 1**: Fill a plastic cup/glass with vegetable oil (approx. 150 ml) **Step 2**: Fill another plastic cup/glass with water (approx. 150 ml)

	Step 3: Take another cup/glass and put 50 ml of oil with a syringe from the first cup. **Step 4:** Add colour for chocolate to it (because this type of food colour dissolves in oil), and stir well. **Step 5**: Take another plastic cup/glass. Add 60 ml of water from the second step to it with a syringe. **Step 6**: Add 10 ml of coloured oil to it. **Step 7**: Try to mix water and oil by mixing them with a spoon. Oil stays on the surface. **Step 8**: Try to remove the oil from the plastic cup with a spoon. Put the removed oil in another plastic cup/glass. (Results: most of the oil is removed, but it is time-consuming and not 100% effective.). **Step 9**: Put the removed oil back into the plastic cup/glass with water. **Step 10**: Add a small spoon of dishwasher detergent into the plastic cup/glass with water and oil. Stir well. (Result: dishwasher dissolves oil, which allows water to mix with oil, but it does not remove oil from water.) Time needed for this part: approx. 10 minutes. **Second part: With which material do you get the best results for removing oil from water?**

	Step 1: Place 4 plastic cups/glasses and 4 plates on the table. **Step 2**: Put flour, cotton balls, wooden chips, and foam on each of the plates. **Step 3**: Mark the plastic cups/glasses with numbers 1, 2, 3, and 4. **Step 4:** Add equal amounts of water (60 ml) and equal amounts of food colouring mixed with oil (3 spoons) to each plastic cup/glass. **Step 5**: Add 1 spoon of flour from the first plate to the plastic cup/glass number 1. Carefully push the material into the cup/glass. **Step 6**: Add 1 spoon of cotton balls from the second plate to the plastic cup/glass number 2. Carefully push the material into the cup/glass. **Step 7**: Add 1 spoon of wooden chips from the third plate to the plastic cup/glass number 3. Carefully push the material into the cup/glass. **Step 8**: Add 1 spoon of foam from the fourth plate to the plastic cup/glass number 4. Carefully push the material into the cup/glass. **Step 9**: Wait a minute. **Step 10**: Try to take out the oil from each plastic cup/glass by removing the materials with a spoon. Place the material on the plate.

	Step 11: Observe the results. (Flour made a mess, cotton cleaned some oil, wooden chips made a mess; only foam managed to clean the oil.) **Step 12** (optional, if teacher has enough time): Add 60 ml of water and 3 spoons of food colouring mixed with oil in a cup/glass. Add 1 spoon of feathers to the plastic cup/glass and push the material into it. Take the feathers out of the glass/cup to the plate and observe what happened to the feathers. (Oil stick to feathers) Time needed for this part: approx. 25 minutes.
Source	"Cleaning an oil spill" by STEMbot
Conclusion (5 min)	Check the research question/hypothesis. Results of the experiment show us that the best way to remove oil from water with the materials that we had is to use foam; some oil (but not all) was removed with a cotton ball. The mechanical oil removal with a spoon was also successful but time-consuming.
Explain the experiment (5-10 min)	Oil and water do not mix because oil has a lower density than water. That is why oil sits on the surface of the water. In the experiment, you have tested

	different materials and methods to explore which works best to remove oil from water. **The spoon**: Environmental engineers sometimes use barriers to limit the oil spread and then use large pumps to extract oil from the sea. You tried to separate the oil from the water with a spoon. It was not 100% efficient as some oil was left in the water. Similarly happens with large pumps; most of the oil is removed but not all. **Dishwasher soap**: in the past, engineers tried to remove oil from the ocean with the addition of emulsifiers, substances that break down the oil into small droplets. You used dishwasher soap to do this. When added, oil disperses into water and further pollutes water. Engineers do not use emulsifiers anymore. **Cotton wool**: absorbed some of the oil but also some of the water and left the remaining oil on the surface of the water. **Wooden chips**: because of their weight, wooden chips sank to the bottom, making the water even dirtier. **Flour**: both water and oil stick to it, making it an inefficient method. **The foam** used is a special chemical absorbent, designed for the purpose of removing oil from water.

	The professional absorbent foam absorbs all the oil, does not sink, and is easily removed from the water. Engineers have discovered that it is the best option to remove oil from water when oil spills occur. Therefore, absorbent foam is nowadays a commonly used option. If you used **feathers**: Oil sticks to feathers, which affects a bird's ability to fly and stay warm. When ingested during preening, it can also poison the bird.
The science behind	**What is oil?** Crude oil is a carbon-based liquid that forms out of the remains of the living organisms that decompose underneath the seabed. Over millions of years, the remains sink further into the seabed, and with heat from the earth's core and pressure from numerous layers of silt and sand, it eventually becomes a liquid mass of hydrocarbons. In simpler words: oil is a thick, dark brown or greenish low-flammability liquid located in the upper layers of some parts of the Earth's crust. **Why do we need oil?** Oil is an important source of energy and raw materials. Using a distillation process, the oil can make plastic for all kinds of products, and gas for heating our homes. But for the most part, we use crude oil to make petrol and diesel, so we can

	drive our cars and transport goods around the world. Plastics for plastic bottles, soles on sneakers, polyester for clothing, waxes in tetra packs, fertilizers and many other things are made out of oil. **Environmental effects**: Oil is harmful to animals and plants. When oil spills happen, many animals and plants die, and the area where it happened is contaminated for a long time. Oil penetrates the structure of bird feathers, and birds usually also ingest the oil. Most birds affected by an oil spill often die without human intervention. Marine mammals are exposed to oil spills, which affect them in a similar way. Whales, dolphins and sea turtles that come to the surface to breathe or to feed are killed by poisoning or suffocation. Because the oil floats on top of the water, less sunlight penetrates the water, which limits the photosynthesis of marine plants and phytoplankton, which in turn affects the food chains in the ecosystem. Sulfate-reducing bacteria and acid-producing bacteria naturally interact with each other and remove oil from the ecosystem so their biomass replaces other populations in the food chain.

	How to remove oil from oceans: Nowadays, the most common method of cleaning up oil spills from oceans is using floating barriers (called booms) that are placed into the ocean to contain oil and prevent it from spreading. After that, skimmers are used to remove oil from water with different mechanical equipment. **The biggest oil spills in history**: The biggest oil spill caused by an accident happened in 2010 in the Gulf of Mexico and was called BP's Deepwater Horizon oil spill. It was caused by a surge of natural gas that blasted the cement well cap and caused an explosion on the platform that later sank. Before the well was capped several months later, an enormous amount of oil leaked into the ocean, causing one of the greatest environmental disasters in the United States. The world's largest known oil spill was caused on purpose for political reasons. Known as the *Persian Gulf War oil spill*, in 1991, Iraqi forces ignited hundreds of Kuwaiti oil wells and released millions of gallons of oil into the ocean. **Foam used in the experiment**: 1 kg of foam can absorb 6 Litres of oil. It is used precisely because of its

	properties – it does not sink and sucks all the oil from the water surface. The composition of this foam is a carefully guarded patented secret. When the foam is taken out of the water, it is discarded or burned. It can also be centrifuged to squeeze the oil out of the foam. The foam is then dried and reused.

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