

ADVENTURES IN THE PLANT KINGDOM (LEVEL 3)







Description	Learners will explore the plant kingdom and learn about the importance of plants in our lives through different experiments and activities that will illustrate how plants behave and some of their characteristics.
Leading Question	Can you design your own plant?
Total Time Required	7 hours over 5 days
Subjects	Science
Supplies Required	Pen/pencil, paper, color pencils/crayons, scissors, 6 plastic bottles or 3 plastic bottles and 3 paper cups/small lightweight bowls, plant with roots, soil, leaves, water, string/thread, jar, seed, paper towels, and food coloring (optional)
Learning Outcomes	<ol style="list-style-type: none"> 1. Understanding the different parts of a plant and listing some of their functions compared to human body parts. 2. Understanding the general life cycle of a plant. 3. Understanding some of the uses of plants in daily life. 4. Understanding of the role of osmosis in transport in plants. 5. Understanding of the role of plants in desertification.
Previous Learning	None

DAY 1

Today you will begin by understanding the characteristics of living things and how plants adapt to their environment.

Suggested Duration	Activity and Description
10 minutes	<ul style="list-style-type: none"> - Explore your surroundings and look for examples of living and nonliving things from your home or neighborhood. - Write or draw a list of 5 living and 5 non-living things. Living: dog; non-living: book.

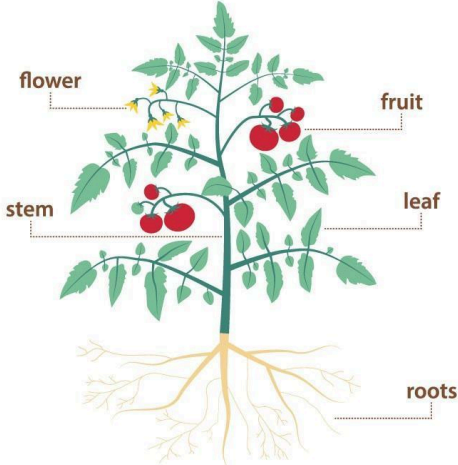
	<ul style="list-style-type: none"> - Learners can be given prompts to encourage them to understand that plants are living things. For example, point to a houseplant, tree, bush etc. and ask the learner whether that is a living or non-living thing. 												
<p>20 minutes</p>	<ul style="list-style-type: none"> - List a few differences between living and nonliving things - Explain that everything in life can be classified as living and nonliving, and that that living things fall into either the animal kingdom (Kingdom Animalia) or the plant kingdom (Kingdom Plantae) and have certain characteristics: <ul style="list-style-type: none"> - They move - They breathe - They are sensitive, which means they respond to changes around them - They grow - They reproduce - They eat - They get rid of waste 												
<p>20 minutes</p>	<ul style="list-style-type: none"> - Create the following table in your notebooks and give examples of how living things demonstrate all these characteristics from both plantae and animalia. <table border="1" data-bbox="467 995 1401 1299"> <thead> <tr> <th>Characteristic</th> <th>Kingdom Plantae example</th> <th>Kingdom Animalia example</th> </tr> </thead> <tbody> <tr> <td>Moving</td> <td>e.g. sunflowers moving with the sun</td> <td>human walking</td> </tr> <tr> <td>Breathing</td> <td>e.g. tree leaves breathing</td> <td>dog breathing</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table> <ul style="list-style-type: none"> - Reflect on how different plants adapted to their environments and list or draw some examples of these. - What do you think helps plants survive in different climates and environments? - For example, plants that grow in harsh climates with little rainfall need less water to survive because they store the little rainfall they do get for later use. - You can compare it to how different animals adapt to their environments. For example, camels store water to cope with the harsh desert climate with little rainfall, just like a cactus does! - There are many examples of adaptation in nature. For example, some plants attract bees for pollination (which helps them reproduce) 	Characteristic	Kingdom Plantae example	Kingdom Animalia example	Moving	e.g. sunflowers moving with the sun	human walking	Breathing	e.g. tree leaves breathing	dog breathing			
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	through their scent. Others like the Venus Flytrap eat insects because there aren't enough nutrients in the soil in the places it grows!									
20 minutes	<ul style="list-style-type: none"> Draw some plants you are familiar with from your own surroundings, as well as examples of other plants that grow in at least 3 other different environments. See appendix 1 for examples of some adaptations and then identify and draw the plants that have these adaptations. <table border="1"> <thead> <tr> <th>Plant</th> <th>Environment</th> <th>Adaptation</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>Can store water</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Plant	Environment	Adaptation			Can store water			
Plant	Environment	Adaptation								
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15 minutes	<ul style="list-style-type: none"> Numeracy activities: <ul style="list-style-type: none"> A furniture factory cuts down 3 trees per month and plants 5 in the same forest. If the forest had 100 trees at the beginning of January, how many trees will it have by the end of that month? If you have \$40 and flowers cost \$2.5 each, how many flowers can you buy for your mother? Advanced option: Mariam wants to make a wooden pot for her plants that is 30 cm³. If she makes the height 5 cm and the length 2 cm, how wide should she make her pot? (hint: volume of a rectangular prism is length x width x height. Here, the volume is 30 cubic centimeters and you are given the height and length. Find the width using the formula volume = l x w x h) 									

DAY 2

Today you will identify the main parts of a plant and understand their functions..

Suggested Duration	Activity and Description
20 minutes	<ul style="list-style-type: none"> Look for a plant outside or inside your home and pull it or raise it gently so that they can return it to the soil after the activity. They will identify the roots, stem, leaves, flower, and fruit.

	<ul style="list-style-type: none"> ● Explain that roots anchor the plant, which is why we cannot just pick plants easily. This protects plants from flying away by strong winds. They also collect water and nutrients from the soil. The stem is responsible for transporting nutrients collected by the roots upward to the rest of the plant. The leaves are responsible for respiration or breathing. Many plants bear flowers and fruits. ● If no plant is available, they can draw a flower, small plant or tree and label each part.  <p>The diagram shows a tomato plant with a central green stem. At the top, there are green leaves and a cluster of yellow flowers. Below the flowers, there are several red tomatoes. The plant has a network of roots extending into the soil. Labels with dashed lines point to the following parts: 'flower' (top left), 'fruit' (top right), 'stem' (middle left), 'leaf' (middle right), and 'roots' (bottom right).</p> <p>Source: https://www.greenandvibrant.com/parts-of-a-plant</p>
<p>15 minutes</p>	<ul style="list-style-type: none"> ● Explore the functions of each part. Reflect on how plants, like all living things, eat and breathe. ● How do you think plants eat? Breathe? What parts do you think help them do these things? ● Plants need sunlight and water to live and eat. They use the sun's energy to make their own food, but they also eat through their roots and stem! Do the following experiment to see how plant roots absorb water: <ul style="list-style-type: none"> - Place 3 clear plastic or glass cups next to each other in a line - Add water to the first and last cup, leaving the middle cup empty - Bring two long pieces of paper towels and twist them to create a long thick piece - Place one end of the first paper towel in the first cup and the other end in the center cup. Do the same for the other paper towel so that the center cup has two ends of both pieces of paper towels. Your setup should look like the following:

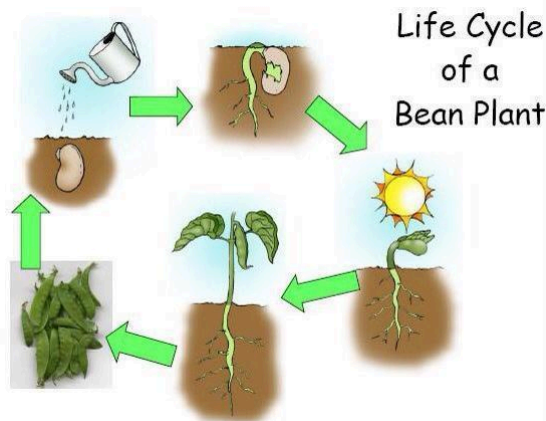
	 <ul style="list-style-type: none"> - If you have different food coloring or colored liquids, you can pour them in the first and last cup to see a cool color change effect in the end result. You can also color or paint the two paper towels blue and yellow to see how the colors mix. - Wait for 3 hours then come back to it. What do you think will happen? - You will observe that the center cup has filled up with water from the other cups! This is how plant roots collect nutrients from the soil and deliver it to the plant for the stem to then take it upward.
<p>10 minutes</p>	<ul style="list-style-type: none"> - Think of the stability function of a root and how it allows the plant to stay firm in the ground. Draw a tree and cut it out. Then try to make it stand - Notice that the tree falls because there is nothing attaching it to the ground. - If you tape a toothpick or small stick behind it and then stick it in a cardboard or piece of paper, it will stand. - This is what roots allow plants to do. This protects plants from flying away in the wind!
<p>10 minutes</p>	<p>Do an experiment to observe how the stem transports water and nutrients upward:</p> <ul style="list-style-type: none"> - Place a lettuce leaf in a cup filled with colored liquid like orange juice (or add food coloring or powders like beetroot, paprika etc. to water). - Observe how the leaf turns into the color of the liquid after 2-3 hours. - Learners can try to provide their own explanation for why we observe this change – how does the stem transport nutrients to the rest of the plant? - If possible, explain that this is possible because of the xylem and phloem cells within the stem of a flowering plant, which are like tubes

	that transport moisture and nutrients from the root upward to the rest of the plant.															
15 minutes	<ul style="list-style-type: none"> Plants breathe through their leaves. Do an experiment to observe plant respiration or breathing and waste removal: <ul style="list-style-type: none"> Place 2-3 fresh leaves of any plant in a glass bowl, preferably shallow Add lukewarm or hot water to the bowl and submerge the leaves just below the surface. Make sure they stay in this position Wait for 2-3 hours then come back to it. What happened? You should see small bubbles forming on top of the leaves. They might be too small, so get closer to the leaves. The bubbles indicate that plants produced oxygen from breathing. Learners can try to write a few sentences explaining their own understanding for what they observe – how do plants breathe? If possible, explain that there are small pores like your facial pores on the surface of leaves called the stomata. These are responsible for regulating gas exchange in plants. They take in carbon dioxide and release oxygen (seen in the experiment as bubbles) as a “waste” byproduct of photosynthesis The experiment also demonstrates the process by which plants make their food – or photosynthesis – where they take in carbon dioxide, water, and light, and create glucose and oxygen. The bubbles formed represent the oxygen created. 															
10 minutes	<ul style="list-style-type: none"> Optional: Draw a diagram of photosynthesis in nature showing the natural sources of light, water, and carbon dioxide and writing an equation that shows that carbon dioxide (CO₂) and water (H₂O) give glucose (C₆H₁₂O₆) and oxygen (O₂). 															
10 minutes	<ul style="list-style-type: none"> Write down some of the functions of different plant parts and compare them to human body parts responsible for those functions. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Function</th> <th style="width: 33%;">Plant parts</th> <th style="width: 33%;">Human body part</th> </tr> </thead> <tbody> <tr> <td>e.g Breathing</td> <td>Leaves, stomata</td> <td>Lungs, nose</td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Function	Plant parts	Human body part	e.g Breathing	Leaves, stomata	Lungs, nose									
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15 minutes	<ul style="list-style-type: none"> Write a paragraph on the following prompt in the first person: “Imagine you are a plant that grows in a forest or jungle/rainforest. Describe what you might look like and what each one of your parts might be doing to protect you on a particularly rainy day.” 															

DAY 3

Today you will be introduced to plant life cycles and understand some of the uses of plants for humans.

Suggested Duration	Activity and Description
20 minutes	<ul style="list-style-type: none"> ● Imagine what the life cycle of a plant looks like. Prompts: <ul style="list-style-type: none"> - Where do plants come from? How do we grow plants, for example, a flower? - After a plant grows out of the soil, what happens to it? How long does it stay in that form? - How does a plant change with time? - Explain that plants start out as seeds, then grow to plants gradually over time, and then they wilt or die. We call the process of plants growing from seeds germination or sprouting. The life cycle of a flower is as follows: seed -> root comes out of seed -> seedling grows out of the ground -> stem and leaves grow -> flowers grow -> flowers make fruits/vegetables and seeds
20 minutes	<ul style="list-style-type: none"> ● Create a labeled plant life cycle from seed to plant: <ul style="list-style-type: none"> - Draw the stages of plant life for a flower – 1. seed, 2. rooting seed, 3. small plant with leaves, 4. adult plant with flowers and fruit/vegetables - Color and cut out these drawings using a pair of scissors - Draw four big boxes and label them 1-4. These should be big enough to put the drawings inside - Decide which drawing should go on each box. The box labeled 1 should have the seed drawing inside because that is the first stage in a flower’s life cycle. Continue placing the other drawings in the other boxes. You can glue, tape, or staple them in the boxes - Next to each box, write a sentence about this stage of a plant’s life



Source: https://www.tes.com/lessons/RabEFf_WxRBnw/life-cycle-of-a-bean

20 minutes


Present your labeled plant life cycle to family members/class for feedback. Feedback will include:

- What they loved about about it
- What could be improved
- Any other suggestions for improvement

Use the feedback to revise your labeled plant life cycle.

Observe the life cycle of a plant firsthand! Try to grow your own plants by sprouting pea or bean seeds in a jar and observe growth over 2 weeks.

- Bring a glass jar, some paper towels/cotton, water and a seed of a plant like mung, beans or peas
- Fill the jar with wet paper towels or tissue paper but make sure that the jar itself is not filled with too much water
- Push the seeds down between the tissues and bring it to the side of the jar so you can have a clear view of how it grows
- What do you think will happen? Observe how after two weeks, roots start to come out and how the seeds grow into a plant!
- Create a table and enter your daily observations on how you see the seed changing.
- Learners can experiment with 3 different set ups to see what plants need to grow. They will create the same set up in a different jar and in another jar, they will place dry paper towels so that they have 3 separate jars. They will then place one of the jars with wet paper towels and the jar with dry paper towels in the sun or next to a source of light, and leave one of the jars with wet paper towels in a dark place. Learners will check back in 1-2 weeks to see the progress of the seeds. They will find that the jar with water which was placed in the sun/light was the only one that grew a sprout, which means that water and light are necessary for plant growth.

	<p>- Write a paragraph about what plants need to grow</p>  <p>Source: https://littlebinsforlittlehands.com/seed-jar-science-experiment-kids/</p>
<p>20 minutes</p>	<ul style="list-style-type: none"> • Think of some of the uses of plants in our lives. Write a paragraph of poem about how plants are used in daily lives – from when we wake up to when we go to bed. Walk around the house for inspiration and use the help of an adult in understanding the different ways we use plants. Some of the many uses of plants are: <ul style="list-style-type: none"> - Breathing – plants make the air we breathe! - Eating – we eat fruits and vegetables, which are plants - Clothing – cotton in our clothes comes from plants

DAY 4

Today you will learn about desertification and the role of plants in protecting the soil.

Suggested Duration	Activity and Description
<p>10 minutes</p>	<p>Did you know that green areas of land can turn into deserts? Why do you think that happens?</p> <ul style="list-style-type: none"> • Desertification is the loss of green areas of land and expansion of desert area. Many factors contribute to desertification including overgrazing (when animals eat all the plants), droughts, and deforestation (when plants are cut in forests without replacing them). When these things happen, a natural process called soil erosion is accelerated. Soil erosion is the removal of the top layer of the soil.
<p>10 minutes</p>	<p>What do you think are some causes of soil erosion?</p>

	<p>Think of the different ways soil erodes naturally and write a list of 3-5 points. For example, soil drifting with rain, human cutting trees (deforestation), etc.</p>
<p>30 minutes</p>	<ul style="list-style-type: none"> ● Do an experiment to demonstrate deforestation and soil erosion: <ul style="list-style-type: none"> ● What do you think will happen if you cut the side of three large plastic bottles vertically leaving the neck intact so that the bottles can serve as a horizontal container ● Cut three smaller water bottles horizontally and set aside their bottom half or use three small lightweight plastic bowls or paper/plastic cups. Tape, staple or tie a string so that these pieces can be held like small buckets ● Place the large bottles that were cut open horizontally on a table with the cut side facing up and fill the first and second one with soil. Add a thick layer of dead or fresh leaves to one of these bottles and leave the other one with just soil. ● Place a plant with its soil in the last bottle. You can use a home potted plant or take a plant from outside your house making sure that you do not pull it by the root and make sure to take part of its soil with it ● Now you should have three large bottles cut open from one side with only soil in one bottle, soil and leaves in another bottle, and a plant with its roots and some soil in the last. ● Hang the small bowls or buckets by their string from the neck of each bottle as shown below ● Then we pour water in each of these bottles? What do you think will come out? Write your guesses down. ● Pour water from a container into each bottle and watch what comes out into the little buckets. Write your observations in your notebook and compare them to your guesses. ● You will notice that the water from the first bottle is filled with soil, while that from the one with leaves has very little soil, and the one with plants is clear! ● Why do you think this happened? This is because plant roots hold and protect the soil from erosion. Do you see how the roots are entangled in the soil when you lift the plant up? When desertification happens, soil erosion happens at a very fast rate because plants are not there to protect it!



Source: <https://www.youtube.com/watch?v=im4HVXMG168>

- Note: Simplify this activity by placing a potted plant or rooted plant with soil in a container temporarily and poking a hole in the container. Then pour water through the container to see how clear water comes out, which indicates that roots hold the soil together and do not allow water to wash it away. Compare this with a container that has only soil and notice how a lot of the soil comes out with the water, which is similar to how soil erosion through rainfall occurs.

Draw a before and after image of a forest where desertification has occurred. Also write a paragraph about what should be done to reverse the damage to this area. For example, planting more trees.

Share what you think should be done to reverse the damage due to desertification with family members/class for feedback and additional input.


<p>20 minutes</p>	<p>Draw a before and after image of a forest where desertification has occurred. Also write a paragraph about what should be done to reverse the damage to this area. For example, planting more trees.</p> <p>Share what you think should be done to reverse the damage due to desertification with family members/class for feedback and additional input.</p>
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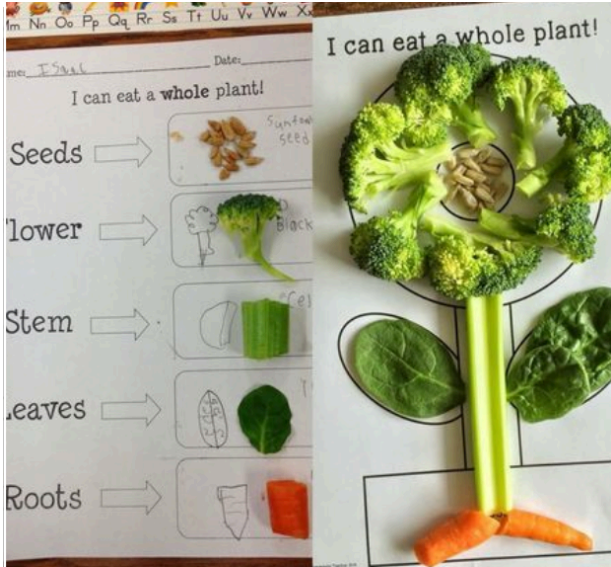
Day 5

Today you will learn about how plant cells absorb water through osmosis and explore the phenomenon of desertification through two cool experiments.

Suggested Duration	Activity and Description																									
40 minutes	<ul style="list-style-type: none"> ● Conduct the following experiment to learn about the mechanism that allows plant roots to absorb water from the soil – osmosis. ● Definition: Osmosis is the movement of water from a region of high concentration to a region of low concentration through a semipermeable membrane (surface or material that is somewhat porous, but not totally porous). ● Keep in mind that “High water concentration” refers to how much of the liquid is pure water. Saltwater has lower concentration of water compared to pure/distilled water because some part of it is salt and the other is water. ● The outer layer of potato pieces will serve as our semi permeable membrane. <ul style="list-style-type: none"> - Peel and cut a potato into 8 strips of identical size and weight almost the size of French fries (6 cm long). Measure them using a ruler to make sure they are all the same length and width. - Prepare 4 solutions: i) a bowl with water with no salt; ii) using one gram of salt (1/4th of a teaspoon) and 100 ml of water (1 tablespoon short of half a cup); iii) 3 grams of salt for 100 ml of water and iv) 5 grams of salt for 100 ml of water (if learners do not have the ability to measure, they can just prepare one cup of water with a tiny pinch of salt and the second will have two pinches of salt and the third will have three pinches of salt) - Place two potato strips into each solution and two in a container with just water - Let the potato strips sit for 20-30 minutes. What do you think will happen? Write down your hypothesis. - Create the following table to record your observations: <table border="1" data-bbox="467 1457 1344 1745"> <thead> <tr> <th>Salt concentration</th> <th>Initial length</th> <th>Final length</th> <th>Difference</th> <th>% change</th> </tr> </thead> <tbody> <tr> <td>0 grams</td> <td>6 cm</td> <td></td> <td></td> <td></td> </tr> <tr> <td>1 gram</td> <td>6 cm</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3 grams</td> <td>6 cm</td> <td></td> <td></td> <td></td> </tr> <tr> <td>5 grams</td> <td>6 cm</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Salt concentration	Initial length	Final length	Difference	% change	0 grams	6 cm				1 gram	6 cm				3 grams	6 cm				5 grams	6 cm			
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	<ul style="list-style-type: none"> ● Expected result: water moves from a place of high concentration to one with lower water concentration. Therefore, you can expect to find that in solutions with low salt concentration (and therefore higher water concentration), there is more water OUTSIDE of the potato, so water will move inside the potato by osmosis and increase the size of the strips, which will swell up. In solutions with high salt concentration and less water concentration, the opposite is true. There is more water INSIDE the potato than in the salt solution outside of it (because some of the saltwater molecules are occupied by salt – it is not pure water), so water will move out of the potato, resulting in the shrinking of the size of the strips. ● To calculate the percentage change: $\frac{(\text{final length} - \text{initial length})}{\text{initial length}} * 100$
<p>10 minutes</p>	<ul style="list-style-type: none"> ● Create a typical plant like a flower or design your own plant. Draw a few flowers you like, then think about how to design your own flower. For the plant, think of the following: <ul style="list-style-type: none"> - A creative name for their plant - How the plant eats - Whether the plant has a flower or just leaves - The colors of each part - The kind of environment or country the plant grows in
<p>20-30 minutes</p>	<ul style="list-style-type: none"> ● Draw and color the plant or create a 3D models such as the following, making sure that each part of the plant is labeled (flower, stem, leaves and root):

	 <p>Source: https://www.pinterest.com/pin/348395721166351529/</p>
<p>30 minutes</p>	<ul style="list-style-type: none"> • Optional: did you know that some of the fruits and vegetables we eat come from different parts of plant? Carrots are actually roots and grow under the ground! Create an edible flower model with the help of an adult to show we eat different parts of plants. Look in the kitchen for examples of vegetables and fruits that come from different parts of plants or they can purchase some of these next time they go grocery shopping. Suggestions: <ul style="list-style-type: none"> - Flower: broccoli, cauliflower, artichoke, strawberries - Stem: celery, asparagus, spring onions - Leaves: spinach, lettuce, kale, rocca/arugula - Root: sweet potatoes, carrots, ginger, beetroot • Draw an outline of a flower and ask an adult to cut the vegetables and fruits into small parts so they can be placed on the outline as shown below. Include seeds such as pumpkin seeds, pistachios, walnuts or cashew nuts if you wish:

	 <p>The image shows a student's project titled "I can eat a whole plant!". It features a drawing of a plant with various parts labeled and corresponding real-life examples of those parts. The labels and examples are:</p> <ul style="list-style-type: none"> Seeds: Sunflower seeds lower: Broccoli Stem: Celery leaves: Spinach Roots: Carrots <p>Source : https://www.pinterest.com/pin/27232772726599701/</p>
<p>10 minutes</p>	<p>Present your model(s) with your families and quiz them on plant facts!</p> <p>Family feedback will include:</p> <ul style="list-style-type: none"> - What they loved about about the plant model? - What could be improved? - Any other suggestions for improvement <p>Use the feedback to revise your plant model.</p>

**Additional
Enrichment
Activities**

- Learners can observe the cycle of reproduction of flowering plants by cutting open a selection of fruits and examining the seeds. They can also plant seeds and observe their germination and growth.
- Learners can calculate the average change in size from the potato strip osmosis experiment and present it in a graph. They can take the average of the two stirps per container.
- Learners can write a paragraph about what would happen if they drank a gallon of seawater or saltwater using their knowledge of osmosis.

Modifications for Simplification

Learners can limit the activities to a labeled figure of plant parts and write a few words to signify the different uses humans have for plants and finally designing their own plant.

ASSESSMENT CRITERIA

A majority of my learners were able to:

- Display perseverance, critical thinking and precision while conducting experiments.
- Accurately label parts of plants.
- Accurately label plant life cycle.
- Critically think and identify the uses of plants in daily life.
- Create and label a 3D or 2D plant model.
- Reflect on the differences between different types of plants.

APPENDIX



Source: <https://sites.google.com/site/plantadaptations2ndgrade/>

Plant ADAPtation MatChing

- A. Lives in hot Deserts & stores water in its stem.
- B. Lives in areas where there is a lot of rainfall. Leaves are large to collect sunlight and have a waxy layer (cuticle) to help water drip off leaves.
- C. Lives in windy areas. Stems are soft so they can bend and not break.
- D. Lives in areas with different seasons. Some trees lose their leaves in the fall/winter to protect from freezing weather.
- E. Lives in areas with cold winters. Most of the trees have needles instead of leaves to lose less water.
- F. Lives in water so the plants have little to no roots.



Source: <https://www.thinglink.com/scene/730790365904240642>