The Plant Game (Level 3)

Description	Learners will make a board game that teaches the concepts of photosynthesis, nutrition and transportation in plants when played.
Leading question	Can I make a board game based on how nutrition and transportation work in plants?
Subjects covered	Science, Art and Design, English
Total time required	40-60 min a day for 5 days
Resources required	Paper, pencils, a plant, water, food colour or ink, a shaving blade (for demonstration), a piece of bread, a plastic bag, water, magnifying glass, a glass container, paper, paper cups, dice
Learning outcomes:	By the end of this project, learners will be able to: Knowledge-Based Outcomes: 1. Identify the raw materials required and products generated during photosynthesis. 2. Explain the importance and the process of photosynthesis. 3. Describe the nutrition in parasites, insectivorous plants and saprotrophs. 4. Describe a food chain based on modes of nutrition. 21st Century Skill Outcomes: 1. Think critically while testing hypotheses and identifying ways to address local challenges. 2. Be creative while designing the board game. 3. Work collaboratively while receiving and improving the board game design. 4. Communicate effectively while sharing thoughts and ideas, and the plan to address local challenges.
Previous Learning	Needs of plants (water, air, sunlight)
Supervision required	Medium

Day 1 -

Today, you will learn about nutrition in plants.

Time	Activity and Description

<table>
<tr>
<td>10 minutes</td>
<td>

Introduction to Nutrition in Plants

What is food for you?

- Where do you get it from?
- Where do animals get their food from?
- Have you ever thought about how plants make their food?

Note: *Ask learners to make the table shown below and fill this out for human beings, one animal, and a plant.*

<table>
<tr><th>Living Things</th><th>Food</th><th>Raw Material</th></tr>
<tr><td>Human beings</td><td>Bread</td><td>Wheat plant</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Plants make their own food and do not get it from other living things the way humans or animals do. This is why plants are considered **producers** of energy while other living things, including humans and animals, are considered **consumers** of energy.

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<td>10 minutes</td>
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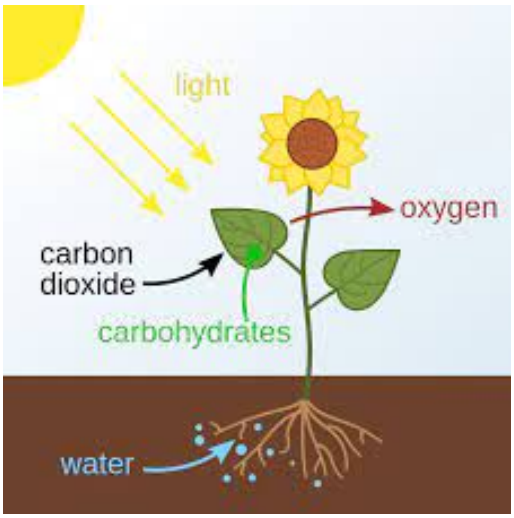
Ingredients for Photosynthesis

Note: *If possible, take learners outside to a garden/ park for this activity.*

Observe plants in your surroundings and share what you see around them that they can use to get food *(soil, air, sunlight, dead leaves etc)*.

Plants need sunlight, soil, water, and a specific gas in the air called carbon dioxide to make their food.

- They use the green colour or pigment called **chlorophyll** in their leaves to capture the energy of the sunlight.
- This energy is used to synthesize (or prepare) food from carbon dioxide and water.
- Because plants use photons (light) to synthesise their food, the process of preparation of food in plants is called **photosynthesis**.
- Plants consume water and carbon dioxide and release glucose (food) and oxygen during photosynthesis.



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<table>
<tr><td></td><td>Note: Ask learners to summarise their learnings about nutrition in plants in the table shown below.
<table>
<tr><th>Raw Material</th><th>How it is used</th></tr>
<tr><td>Water</td><td>Absorbed from the soil by the root and transported through the stem to the leaves through the branches</td></tr>
<tr><td>Carbon dioxide</td><td></td></tr>
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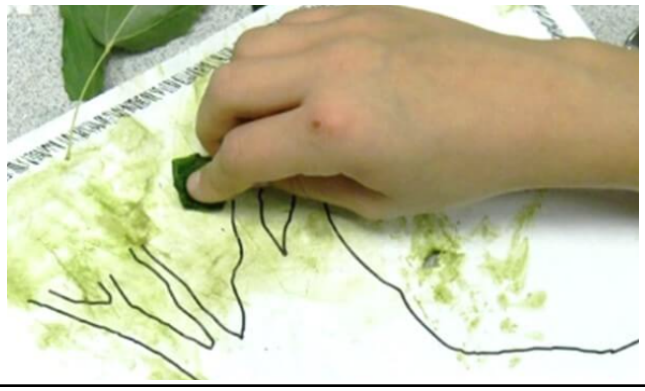
</td></tr>
<tr><td>10 minutes</td><td>Chlorophyll
Let us extract some chlorophyll from leaves in a fun way!

Draw the photosynthesis diagram in your notebooks then take a few leaves, crush them and use them to colour the leaves of the plant in your drawing.

  </td></tr>
<tr><td>10 minutes</td><td>Introduction to the Project
One way we can learn more about nutrition in plants is through playing a game! In this project, we will create our own board game to help us understand how plants get nutrition!

Think of some fun board games that we can play to do this! To do this:
- Think about some board games that you know of (such as Monopoly, ludo, chess etc).
- Choose one or two.
- Think about how you will make a similar board game that teaches you about nutrition in plants!</td></tr>
<tr><td>At-home activities</td><td>- Explore your neighbourhood and gather leaves of various colours to create a collection in your notebook. Discover the plant types these leaves belong to by engaging your family or neighbours in conversation. Consider whether these plants, with their diverse leaf colours, engage in photosynthesis. Be prepared to discuss your findings with the class, and remember to bring your collected leaves with you tomorrow!</td></tr>
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	- Additionally, sketch diagrams of each plant from which you collected leaves. Use the actual leaf colours to shade and depict each plant accurately. Record your observations and insights regarding the different plants.

Day 2

Today, you will learn more about the process of photosynthesis and create a board game!

<table>
<tr><th>Time</th><th>Activity and Description</th></tr>
<tr><td>5 minutes</td><td>Introduction
Did you collect leaves of various colours yesterday?
Do you think these plants also conduct photosynthesis?

All leaves possess chlorophyll and are capable of photosynthesis. However, leaves of different colours contain additional pigments alongside chlorophyll, which may affect the efficiency or rate of photosynthesis.

Let us learn about the process of photosynthesis.</td></tr>
<tr><td>10 minutes</td><td>Photosynthesis Experiment
Let us conduct an experiment to see photosynthesis in action!

Note: Take students out to collect leaves of different colours and draw the table shown below in their notebooks. Once done, get them to follow the instructions below.

<table>
<tr><td>Hypothesis:</td><td></td></tr>
<tr><td>Materials Needed:</td><td></td></tr>
<tr><td>Method:</td><td></td></tr>
<tr><td>Observations:</td><td></td></tr>
<tr><td>Inferences:</td><td></td></tr>
</table>
- Place the leaves inside a clear plastic container and fill it with water. Submerge the leaves in the water by placing the rock on top of them.
- Place some containers in the sun and others in the dark.
- We will come back to the setups at the end of the class.

Write the hypothesis (what you think will happen), materials needed, and method in the table. We will come back to our setups at the end of the class!</td></tr>
<tr><td>20 minutes</td><td>Plant Maze
Note: If only one learner is participating in the module, for this activity, ask the learner to get a friend or a family member to work with them.</td></tr>
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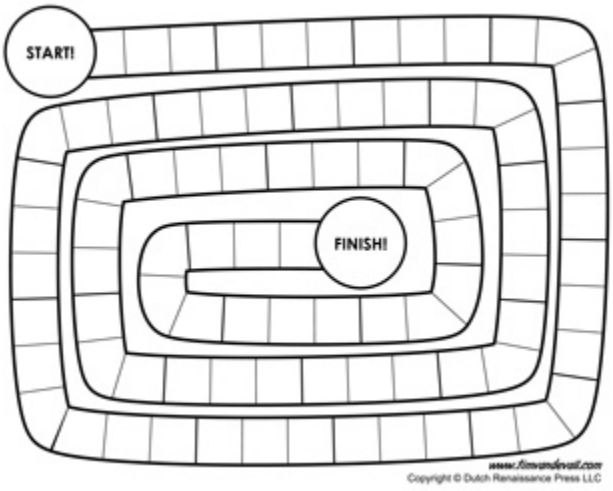
Yesterday we discussed a few game ideas to help people understand how plants feed themselves. Today, we will play a game called Plant Maze to help you come up with ideas for your game!

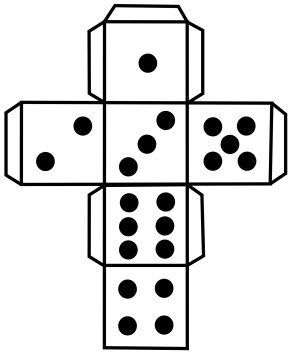
Write down a list of questions about nutrition in plants based on what we learned so far.

- Write each question on a small piece of paper cut out like a card.
- You should have at least 10-15 questions in total. Here are some examples to get you started:
  - What is chlorophyll?
  - _____ is the gas released by leaves during photosynthesis
  - True or false: plants are consumers of energy.
- On a large sheet of paper, draw the following outline. You can also draw it using rocks on the ground.



- Each player will choose a colour and counters to play with. Counters can be any small item such as rocks, pebbles or pieces of chalk.
- Rules of the game:
  - The first player will start by rolling a die.
  - The player will then draw a card and then answer the question on it. If the player answers correctly, they can move forward the number of steps that is shown on the die.
  - If the answer is wrong or if the player takes too long to answer, the card will be shuffled back into the deck and the player will not move.
  - The next players repeat these steps.
  - The first player to reach the finish point or the player that reaches the farthest point on the maze wins.

Tip: *Learners can create their own die if they do not have access to one by creating and cutting out the following template then taping or glueing it together to form a cube.*

	
5 minutes	**Process of Photosynthesis** Let us go back to our set-ups. What do you observe? *(green leaves produce more bubbles than leaves of other colours in water)*  ***Note:*** *Explain that the bubbles formed are that of oxygen, and the equation involved in the chemical reaction of photosynthesis.* Carbon dioxide + Water → (Sunlight, Chlorophyll) Carbohydrates + Oxygen

Day 3 –

Today, you will learn about nutrition in some other types of plants and work on your board game.

Time	Activity and Description
10 minutes	**Introduction to Parasitic, Insectivorous and Saprotrophic Plants**

	Today we will explore different types of plants that do not create their food through photosynthesis.
	
	Like humans and animals, some plants depend on the food produced by others. Do you know of any such plants?
	
	There are different ways these plants get their nutrition:
	- Parasites - they depend on other plants for nutrition and readymade food. For example, the Cuscuta plant.
	- Insectivorous or carnivorous plants - they depend on insects and small animals for nutrition. For example, the Pitcher plant and Venus Flytrap.
	- Saprotrophic plants - they take in nutrients from dead and decaying matter. For example, fungi like mushrooms. These are not really plants or animals, but a unique type of organism.
	  
	Pitcher plant Mushroom
	
	- Let's read this story to understand some of these plants better: https://storyweaver.org.in/stories/259590-little-green
	- Think and share:
	  - What did you learn about insectivorous and carnivorous plants?
	  - What types of things do they eat? Why do they eat them?
	  - What are three examples of insectivorous plants?
	  - Did you ever see any of these plants?

10 minutes	**Experiment - Nutrition in Saprotrophic Plants** Let us conduct an experiment to find out how saprotrophs feed! To do this: - Take a wet piece of bread and put it in a moist and warm place for a few days, like a plastic bag. - What do you think will happen? Draw an observation similar to the one you drew for the photosynthesis experiment and fill out the hypothesis, materials needed and method. **Hypothesis:** | **Materials Needed:** |

	Method:	
	Observations:	
	Inferences:	

We will revisit our setups on the last day and find out what happened!

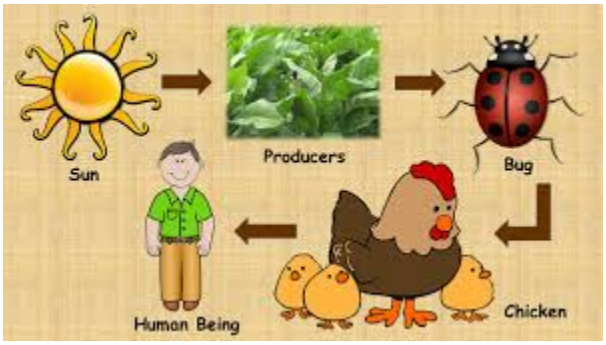
10 mis

Food Chains

We discussed that animals are considered consumers and plants are considered producers. Why is that so? *(Plants make their own food while animals do not)*

Note: *Show learners the sample food chain below and explain who eats who (plant produces food, the bugs eat the plants, chicken eats the bug and humans eat chicken).*

- *Once done, explain that such a representation shows dependence on each other for food is called a food chain.*
- *Highlight the producer (plant),* ***primary consumer*** *(bug),* ***secondary consumer*** *(chicken), and* ***tertiary consumer*** *(human)*



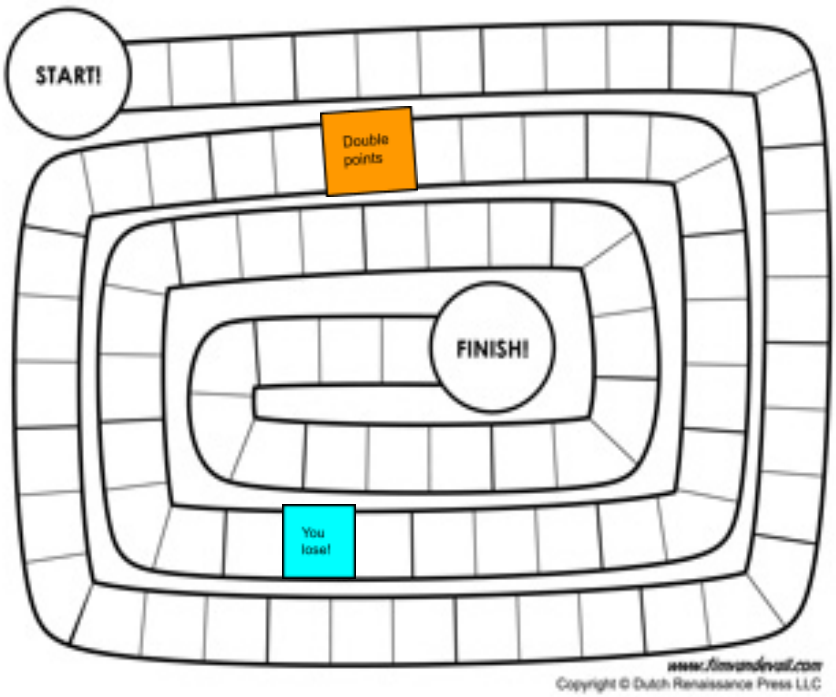
Now, make your own food chain! To do this:

- Think of a food chain in a different environment/ habitat that you are aware of (a jungle/ a desert/ a polar region etc)
- Draw your food chain and decorate it!
- You can create a pyramid showing the producer, primary consumer (e.g. bug), secondary consumer (e.g. chicken) and tertiary consumer (e.g. human).

Tip: *Share the examples below with students to inspire them to make their food chains creatively.*

10 minutes	**The Plant Game**
	Revisit the game we created yesterday and add modifications to make it your own!
	- You can change the rules to make it more fun.
	  - For example, you can add different things to the maze such as a point where the player earns double points and can move forward using the number on the die times 2.
	  - Or you can add a point where the player loses and goes back to square one, a point where the player has to answer 2 questions instead of one etc.
	- Make sure to update the list of questions in your card deck with the new information we learned today by adding questions about saprotrophs, insectivorous and parasitic plants and animals.

	
At home activities	- Explore the insectivorous plants, parasitic plants and fungi present in your surroundings and make a list of these to share with the class. Ask your parents for help identifying them if needed. - Talk to your parents, neighbours and community members and identify two challenges involving plants in your community. Examples: plants dying because of lack of rainfall, deforestation in surrounding areas etc. Be ready to present these to the class tomorrow.

Day 4 –

Today, you will explore transportation in plants and address a local challenge related to plants.

Time	Activity and Description
10 minutes	**Experiment - Transportation in Plants** We learned that plants need water from the soil to grow and that leaves synthesize food for the plant, but how does the plant transport these nutrients and water throughout its body to grow? Let's understand transportation in plants through an experiment! To perform this experiment: - Uproot a small part of a plant along with the roots, making sure not to damage the roots, and wash the plant to remove the dirt. - Now take a glass half filled with water and add red or blue ink or food colour.

<table>
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Place the plant in the glass and we will come back to it at the end of the class.
We will cut the plant vertically and horizontally. What do you think we will see?
Draw a table similar to the one you drew for the previous experiments and write your hypothesis (how do you think transportation takes place in plants), materials needed, and method.

<table>
<tr><td>Hypothesis:</td><td></td></tr>
<tr><td>Materials Needed:</td><td></td></tr>
<tr><td>Method:</td><td></td></tr>
<tr><td>Observation:</td><td></td></tr>
<tr><td>Inference:</td><td></td></tr>
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</td></tr>
<tr><td>10 minutes</td><td>
Solving a Local Challenge
After the previous class, you explored a few issues related to plants in your community.

What are some of these issues?
Do you think we need to solve them? Why?

Plants are crucial for our survival because they produce oxygen during photosynthesis as we learned. Plants also give us food either directly or by feeding the animals we eat. There are countless benefits to protecting plants.

Note: Ask learners to draw the following table and fill it in their notebooks. Once done, ask learners to share the problem, why they think it is a problem, the solution they arrived at, and the resources they need to solve the problem.
<table>
<tr><td>Problem faced</td><td>Why is this a problem?</td><td>Possible solution</td><td>Resources needed</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
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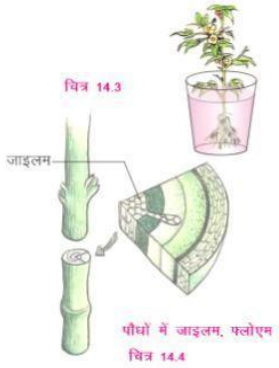
<tr><td>10 minutes</td><td>
Transportation in Plants
Let’s come back to the set up we did earlier now that some time has passed. What do you observe?

Note: Ask learners to fill in their observations and inferences in the table.
</td></tr>
</table>

	Plant roots have thread-like structures called "root hairs" that help take water and minerals upward. If we detach the root from the soil, water and minerals will not reach the leaves which means that photosynthesis will not happen and the plant will not grow. - Let's cut the stem to see what happened. Do you see the coloured spots in the inner part of the plant? Why do you think we see this? Think and share! - This happens because of the colour mixed in the water. The roots transported the coloured water to different parts of the plant. - Plants have pipe-like vessels inside to transport water and nutrients from the soil just like humans have blood vessels that transport nutrients to the body. - The coloured part that we see in the cross-section of the stem is called the **xylem** - it is the group of vessels that are responsible for transporting water and minerals to the plants, and the part responsible for the transport of food is called the **phloem** 
10 minutes	**The Plant Game** Add new questions to your game board cards based on what we learned today. You can also add badges like "plant conservation hero" for players who complete big milestones (for example 30 steps)!
At home activities	- Share the list of actions with your parents and siblings and brainstorm additional ways you can take action to address the issues related to plants in your community - Do at least one of the things on the list with your friends or family. - Invite your friends to play the Plant Game that you designed in the next class!

Day 5 -

Today, you will finalise your board games and play them with your friends!

Time	Activity and Description
5 minutes	**Recap** In the previous class, you were challenged to take action to protect plants and address some of the issues we learned about by doing one thing on your list. - What did you do? - How did it go?

10 minutes	**Nutrition in Saprotrophic Plants** Let us revisit the bread experiment we did on Day 3. - What do you observe? - Fill out your observations and inferences. You will see that spots or scales like light brown, green, white or dark black coloured structures now appear on the bread. Observe it and use a magnifying lens if available. What are these thread-like structures? These organisms are called **fungi**. - They have a different mode of nutrition compared to plants. - They absorb the nutrients from the bread. - Saprotrophs take in nutrients from dead and decaying matter
5 minutes	**Finalising the Plant Game** Finalise your game board and add any finishing touches! Check your questions and make sure you have all the material to play the game! If you need anything else, take 5 minutes to get/ make it!
15 minutes	**Playing the Plant Game** Play the Plant Game with your friend(s)! Share who wins at the end of the game!

5 minutes	**Reflection**
	Think and share:
	- How did you find the game? How many questions did you get right?
	- What do you still have questions about?
	- Could you make a board game based on how nutrition and transportation work in plants?
	  - What went well for you?
	  - What could you have done better?

Additional enrichment activities:	Learners can demonstrate the carbohydrates produced during photosynthesis through an experiment: - The carbohydrates produced during this process are either used immediately by the cells or stored as insoluble starch. Let's see this in action! - Place a leaf in boiling water for 30 seconds. - Then place it in a jar filled with ethanol (alcohol) in a water bath for 2 minutes. This should take away the chlorophyll so we can see the reaction. - Wash the leaf then add iodine. Observe what happens. - The parts of the leaf that contain starch (from photosynthesis) will turn the iodine from brown to blue. This is because iodine is an indicator that turns blue in the presence of starch. Learners can create a food web like the one below to show more complex consumption patterns.

	 Learners can urge their local government to take action to protect plants by: - Designing a poster to raise awareness about 2-3 of the issues they have identified and suggestions for solving them - Writing a letter to their local government highlighting 2-3 issues and proposing a few solutions - Designing something else that can be used to communicate these issues to their local government
Modifications for simplification	Reduce the number of experiments and focus on explaining the main concepts of photosynthesis and transportation and use these to create the questions for the game. Eliminate the section on nutrition in different animals and other plants including parasitic plants, insectivorous plants and saprotrophs.

ASSESSMENT CRITERIA

A majority of my students were able to:

☐ Describe the process of photosynthesis.
☐ List the raw materials required in the photosynthesis process.
☐ Identify modes of nutrition in parasitic plants, insectivorous, and saprotrophic plants.
☐ Identify the parts of plants that support transportation.
☐ Make a board game, with clear rules, based on concepts of nutrition and transportation in plants.