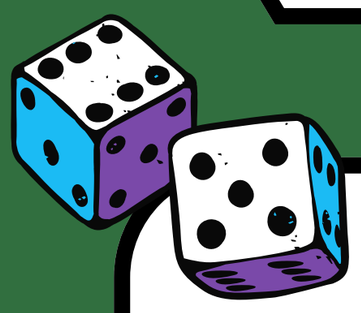
GROW GREEN GAME

Grow Green Game

Game Theme
Photosynthesis

Grade Level
V-VIII

Game Type
Board Game



Game Overview

- Grow Green is a concept-driven biology board game designed to help students explore and understand photosynthesis through a storyline and a mix of question-based and activity-based cards. The game follows Samina, a young garden guardian, who interacts with a magical leaf speaking in riddles. Students help her unlock the secrets of how plants make their food by correctly responding to tasks and questions about light, chlorophyll, carbon dioxide, water, glucose, oxygen, and the leaf's role.
- By the end of the gameplay, players will be able to identify the key components involved in photosynthesis, describe the process of photosynthesis, and analyse environmental factors that influence its efficiency.
- A complete game set, for one group, includes the following materials:
  - Game board
  - Cards = 31 cards
    - 5 activity cards
    - 26 question cards
  - Game material: leaves of different shape and color, white paper, crayons and pencils, magnifying glass, printed compound labels/slips, word slips,
  - Answer sheet
  - Dice and tokens

Gameplay Instructions

- Divide the class into groups of four. In a group, students will play the game in two teams.
- Provide each group with a board, game cards, and other materials.
- All activity cards should be arranged in numerical order and placed face down in their own separate pile, with card 1 in the flipped position on top. Similarly, all question cards should be arranged in numerical order and placed face down in a separate pile, ensuring the two types of cards are not mixed.
- Each team starts with their token on the 'Start' space.
- Players take turns rolling the dice and moving their token along the game board.
- When landing on a space, they must follow the instructions provided (e.g., draw a card, answer a question, or perform an activity).
- Circulate among groups to observe progress, clarify rules, and ensure smooth gameplay.
- Remind groups to check answers against the answer sheet and award points correctly. Students should assign 5 points for each correctly answered question. Additional points can be awarded for successfully completing activities as specified on the cards.
- After all teams reach the "FINISH" space or when time is up, tally the points.
- Announce the winning team based on the highest score (or earliest to finish if using that condition).

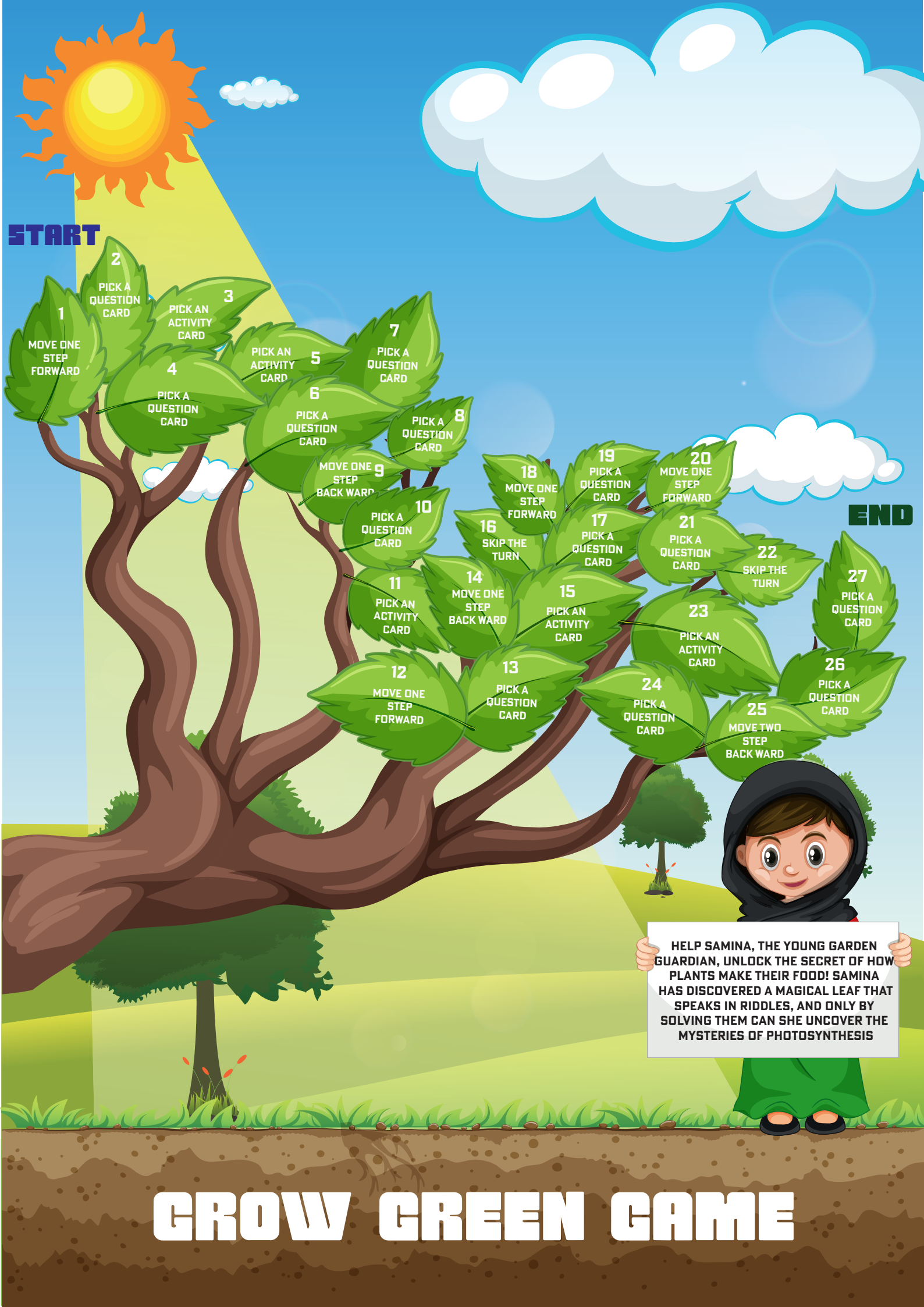
Debriefing and Reflection

After the game, guide students through a structured reflection:

- What are the essential ingredients plants need for photosynthesis?
- How would photosynthesis be affected without light or water?
- Why is photosynthesis called the most important biochemical process?
- What challenges did you face with the real-life scenarios (e.g., Moon, drought)?

Adaptations for Gamplay

- **For Lower Grades:** Simplify tasks to focus on basic identification of plant parts involved in photosynthesis and their primary functions. For example, use visual aids such as diagrams of leaves, stomata, and chloroplasts instead of complex written questions. Another idea is to include matching activities, such as pairing a plant part (e.g., leaf) with its function (e.g., absorbs sunlight).
- **For Higher Grades:** Incorporate advanced tasks that require students to analyze and apply their knowledge of photosynthesis. Include questions that require identifying how environmental factors (e.g., light intensity, water availability, carbon dioxide concentration) influence the rate of photosynthesis. You can also add tasks that involve sequencing the stages of photosynthesis, such as arranging the steps of light-dependent and light-independent reactions in order.


START
1
MOVE ONE STEP FORWARD
2
PICK A QUESTION CARD
3
PICK AN ACTIVITY CARD
4
PICK A QUESTION CARD
5
PICK AN ACTIVITY CARD
6
PICK A QUESTION CARD
7
PICK A QUESTION CARD
8
PICK A QUESTION CARD
9
MOVE ONE STEP BACK WARD
10
PICK A QUESTION CARD
11
PICK AN ACTIVITY CARD
12
MOVE ONE STEP FORWARD
13
PICK A QUESTION CARD
14
MOVE ONE STEP BACK WARD
15
PICK AN ACTIVITY CARD
16
SKIP THE TURN
17
PICK A QUESTION CARD
18
MOVE ONE STEP FORWARD
19
PICK A QUESTION CARD
20
MOVE ONE STEP FORWARD
21
PICK A QUESTION CARD
22
SKIP THE TURN
23
PICK AN ACTIVITY CARD
24
PICK A QUESTION CARD
25
MOVE TWO STEP BACK WARD
26
PICK A QUESTION CARD
27
PICK A QUESTION CARD
END
HELP SAMINA, THE YOUNG GARDEN GUARDIAN, UNLOCK THE SECRET OF HOW PLANTS MAKE THEIR FOOD! SAMINA HAS DISCOVERED A MAGICAL LEAF THAT SPEAKS IN RIDDLES, AND ONLY BY SOLVING THEM CAN SHE UNCOVER THE MYSTERIES OF PHOTOSYNTHESIS
GROW GREEN GAME

ACTIVITY CARD 1

Place a leaf under a piece of paper and gently rub a crayon or pencil over it to reveal the leaf's intricate veins. Discuss how these veins transport water and nutrients for photosynthesis.

ACTIVITY CARD 2

Observe the given leaf with the help of magnifying glass and discuss the following:

Difference between upper and lower surfaces

1 Is the leaf think or thick?
2 Is the leaf flat or bumpy?
3 Which surface has stomata?

ACTIVITY CARD 3

Match the formulas with the compound

H_2O	Oxygen
CO_2	Glucose
$C_6H_{12}O_6$	Carbon dioxide
O_2	Water

ACTIVITY CARD 4

Pick a term related to photosynthesis on the slip of paper and act out the term without speaking, while the rest of the class try to guess what it is.

Oxygen

Sunlight

Tree

Water

Carbon dioxide

ACTIVITY CARD 5

Observe the leaves of different colors and think, why leaves change color in the fall.
(Leaves of different colors)

QUESTION CARD 1A

5 points

In which part of plant photosynthesis takes place?

QUESTION CARD 1B

5 points

Name two important gases involved in photosynthesis

QUESTION CARD 2A

5 points

I am a producer and make food and provides oxygen for all the living things on Earth. I have good friendship with sunlight. Who am I?

QUESTION CARD 2B

5 points

I am a universal solvent, capable of dissolving various substances within me. I serve as a crucial component in the formation of food for plants by combining with carbon dioxide through the process of photosynthesis. Who am I?

QUESTION CARD 3A

5 points

Match the part of plant with its function.

Part	Function
Root	Carries water to leaves
Leaf	Absorbs water from the soil
Stem	Makes food for the plant

QUESTION CARD 3B

5 points

Which of the following plays the prime role in photosynthesis

a. Oxygen
b. carbon dioxide
c. sunlight
d.water

QUESTION CARD 4A

5 points

Does photosynthesis happen in leafless tree?

QUESTION CARD 4B

5 points

What role do stomata play in the process of photosynthesis?

QUESTION CARD 5A

5 points

Which one of the followings is the reactant of photosynthesis?

a)Glucose
b) Oxygen
c) Water
d) Nitrogen

QUESTION CARD 5B

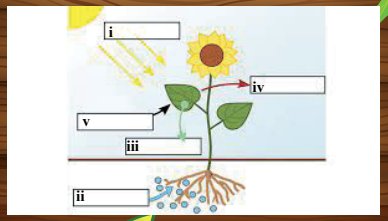
5 points

Why leaves are called the food factories of the plants?

QUESTION CARD 6A

5 points

Label the given diagram.



QUESTION CARD 6B

5 points

Write part of the leave in the given table

i)	
ii)	
iii)	
iv)	

QUESTION CARD 7A

5 points

Complete the given - word equation of photosynthesis.

_____ + Carbon dioxide —Sunlight/ Chlorophyll→ _____ + Oxygen

QUESTION CARD 7B

5 points

Write down the chemical equation for photosynthesis

QUESTION CARD 8A

5 points

Match each feature of leaf to its function

1) Wide and flat	Allow gases reach easily
2) Thin	Carry water into cells and extra glucose out
3) Veins	Absorb more sunlight and carbon dioxide

QUESTION CARD 8B

5 points

Why does the process of photosynthesis take place in leaves?

QUESTION CARD 9A

5 points

Why does the process of photosynthesis take place only in green plants?

QUESTION CARD 9B

5 points

Why is photosynthesis considered the most important biochemical process on Earth?

QUESTION CARD 10A

5 points

I am a green pigment and found in the chloroplast of green plants. I trap sunlight and play a crucial role in making food for the plant. Who am I?

QUESTION CARD 10B

5 points

I am one of the most important products of photosynthesis. Living organisms cannot survive without me, I always exist in gaseous form in nature. Who am I?

QUESTION CARD 11A

5 points

Ajwad brought a plant and left it in a dark room for a week, will the plant grow or not? Give reasons

QUESTION CARD 11B

5 points

Students of grade 6 conducted an experiment to determine the effect of light intensity on photosynthesis. They exposed identical plants to varying levels of light and measured the rate of oxygen production. What are the effects of light intensity on photosynthesis?

QUESTION CARD 12A

5 points

Alvira wants to go to the moon. She loves plants a lot and want to take a plant along with her to the moon. Will the plant grow or not and why?

QUESTION CARD 12B

5 points

Sara wants to grow a plant on Mars. What factors does she has to consider to successfully cultivate that plant on Mars?

QUESTION CARD 13A

5 points

Shaham purchased a plant wrapped with a plastic bag. She placed it in sunlight. After a few days, she noticed that the leaves had turned yellow. Shaham became concerned about the cause of this discoloration. To address the issue, what factors should she consider and why?

QUESTION CARD 13B

5 points

A farmer in a drought-affected region observes stunted growth in their crops despite ample sunlight. What factor does the farmer may be overlooking for proper photosynthetic activity and improving crop yields?

SCORE SHEET

EACH CORRECT ANSWER 5 POINTS

Player's Name	Player's Name	Player's Name	Player's Name

ANSWER SHEET

- Activity 1: Just like our bodies have veins for blood, leaves have veins that transport water from the roots and nutrients to different parts of the plant. These veins are essential for photosynthesis, as they bring the necessary ingredients to the leaves where the magic happens!
- Activity 2: When using a magnifying glass, students might notice:
  - The upper surface is often smoother and has a waxy coating, while the lower surface may be rougher.
  - Leaves can be either thin or thick depending on the plant species.
  - Some leaves have a flat surface, while others have a bumpy or ridged surface.
  - Generally, the stomata are more concentrated on the lower surface to regulate water loss through transpiration.
- Activity 3: Match the Formula of the Compounds
  - H2O (Water)
  - CO2 (Carbon Dioxide)
  - C6H12O6 (Glucose)
  - O2 (Oxygen)
- Activity 5: Leaves contain pigments like chlorophyll (green), carotenoids (orange), and anthocyanins (red) which are usually masked by chlorophyll during the growing season. In the fall, chlorophyll

ANSWER SHEET (CONT'D)

- Card 1(a): Leaves (specifically the chloroplasts within the cells)
- Card 1(b): Oxygen (O2) and Carbon Dioxide (CO2)
- Card 2(a): A plant
- Card 2(b): Water (H2O)
- Card 3(a):
  - Root - Absorbs water from the soil
  - Leaf - Makes food for the plant
  - Stem - Carries water to leaves
- Card 3b: c) sunlight
- Card 4(a): Some trees, like evergreens, have leaves in the form of needles which can photosynthesize. Leafless trees during certain seasons or conditions typically do not
- Card 4(b) : CO_2 uptake, oxygen release, water vapour release and gas exchange

ANSWER SHEET (CONT'D)

- Card 5a: c) Water (H_2O)
- Card 5b: Leaves are called food factories because this is where photosynthesis occurs, converting sunlight into energy (glucose) for the plant.
- Card 6a
    i. Sunlight
    ii. Water and nutrients
    iii. Glucose
    iv. Oxygen
    v. Carbon di oxide
- Card 6b
    i. Petiole: The stalk that attaches the leaf to the stem.
    ii. Midrib: The central vein running down the middle of the leaf, providing structural support and transport for water and nutrients.
    iii. Veins: The vascular structure that branches from the midrib to transport water, nutrients, and sugars.
    iv. Leaf Blade (Lamina): The broad, flat part of the leaf that is the primary site for photosynthesis due to the presence of chloroplasts in its cells.
- Card 7a: Water + Carbon Dioxide + Sunlight/Chlorophyll = Glucose + Oxygen
- Card 7b: $6CO_2 + 6H_2O$ + light energy $\rightarrow C_6H_{12}O_6 + 6O_2$
- Card 8a:
    - Wide and flat - Absorb more sunlight and carbon dioxide
    - Thin - Allows gases to reach easily
    - Veins - Carry water into cells and extra glucose out
- Card 8b: The process of photosynthesis takes place in leaves because they have chloroplasts which contain chlorophyll, the pigment that captures sunlight.
- Card 9a: Photosynthesis takes place only in green plants because they have chlorophyll, which is necessary for capturing the energy from sunlight.
- Card 9b: Photosynthesis is considered the most important biochemical process on Earth because it is the foundation of the food chain, and it produces oxygen which is essential for most life forms.

ANSWER SHEET (CONT'D)

- Card 10a: Chlorophyll
- Card 10b: Oxygen (O2)
- Card 11a: The plant may not grow well because light is a key component of photosynthesis, which is required for the plant to create its food.
- Card 11b: Light intensity can affect the rate of photosynthesis, with higher light intensity typically increasing the rate of oxygen production, to a point.
- Card 12a: The plant will not grow on the moon without significant human intervention to provide an appropriate environment, including light, water, air, and nutrients.
- Card 12b: Sara would need to consider factors such as atmospheric conditions, soil, water availability, light exposure, and temperature.
- Card 13a: Shaham should consider whether the plant has had adequate water and nutrients, and if it's been exposed to too much direct sunlight. The plastic bag may have also created a greenhouse effect, causing overheating.
- Card 13b: The farmer may need to consider water availability, as drought conditions can limit the plant's ability to photosynthesize effectively, regardless of the amount of sunlight.