

Climate Change and Agriculture

Author:

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Unit Overview

Target Audience: Grade 4

Est. Time: 45 minutes per lesson

Content Area(s): Climate change, Science, Environmental Science, Agricultural Literacy

Abstract:

This mini-unit explores the impact of climate change on agriculture and the environment. Students will learn about the causes and effects of climate change, with a focus on its agricultural consequences. Through hands-on activities, readings, and discussions, they will investigate: The science of climate change, how climate change affects crops, livestock, and food security, resilient plants and their role in sustainable agriculture, the use of greenhouses and organic farming methods and STEM careers in agriculture. The mini unit integrated STEM concepts with Agriculture, Food, and Natural Resources (AFNR) across all five lessons. It connected science concepts like climate change to their impact on agriculture, explored technological solutions for agricultural challenges, and engaged students in engineering practices by constructing mini-greenhouses. In addition, it collected and analyzed data to interpret the effect of heat on water levels and crops.

The unit culminates with students exploring global examples of climate change's impact on agriculture.

Unit Goals/Objectives:

Students will be able to:

1. explain the concept of climate change.
2. analyze and interpret data that demonstrates how weather has changed over time.
3. identify ways in which climate change can affect water levels, weather, soil, plants, and animals.
4. analyze the connection between climate change and agriculture.
5. investigate climate change as a global challenge requiring international collaboration by giving examples of it in the United States, Nigeria, and Saudi Arabia.
6. define agricultural vulnerability and identify its causes.
7. describe the impact of climate change on agriculture.
8. recognize the concept of agricultural vulnerability.
9. describe how climate change affects crops and livestock.
10. explore technological solutions to mitigate the impact of climate change on agriculture.
11. define sustainable agriculture.
12. identify key principles of sustainable agriculture.
13. explain the impact of the environment on agriculture.
14. recognize the importance of biodiversity in sustainable agriculture.
15. describe the use of organic farming methods in sustainable agriculture.
16. explain the basic concept of plant growth and its needs.
17. identify traditional ways humans help plants grow (watering, fertilizing).
18. define the concept of "plant helpers" and how scientists use them to improve agriculture.
19. differentiate between traditional and modern methods of helping plants grow using simple examples.
20. identify the connection between agriculture and STEM fields (Science, Technology, Engineering, and Math).

21. explore diverse career options related to STEM in agriculture.
22. explain the impact of STEM on modern agricultural practices.

Lesson Summaries:

Lesson 1 – Introduction to Climate Change and Agriculture:

- Students will be introduced to climate change.
- They will be asked to distinguish between the two concepts: climate and weather.
- They will analyze and interpret data that demonstrates how weather has changed over time.
- Students will identify ways in which climate change can affect water levels, weather, soil, plants, and animals.
- Students will give examples to demonstrate the connection between climate change and agriculture.
- Students will discuss climate change as a global challenge requiring international collaboration by giving examples of it in the United States, Nigeria, and Saudi Arabia.

Lesson 2 – Agricultural Vulnerability as a result of climate change:

- In this lesson, students will learn about agricultural vulnerability.
- After learning about agricultural vulnerability, students will identify its causes.
- They will describe the impact of climate change on agriculture.
- They will be asked to predict how climate change affects crops and livestock.
- Students will be asked to explore technological solutions to mitigate the impact of climate change on agriculture.
- Students will be able to build a mini greenhouse.

Lesson 3 – Sustainable Agriculture:

- Students will learn about sustainable agriculture to give it an appropriate definition.
- Students will be able to identify key principles of sustainable agriculture.
- Students will discuss the impact of the environment on agriculture.
- Students will be able to recognize the importance of biodiversity in sustainable agriculture.
- Students will describe the use of organic farming methods in sustainable agriculture.

Lesson 4 – Parts of a plant and the use of technology in agriculture:

- Students will be able to identify and label the parts of a plant.
- Students will be able to explain the basic concept of plant growth and its needs.
- Students will be able to identify traditional ways humans help plants grow (watering, fertilizing).
- Students will be able to explain the concept of "plant helpers" and how scientists use them to improve agriculture.
- Students will be able to differentiate between traditional and modern methods of helping plants grow using simple examples.

Lesson 5 – Sustainable Agriculture: STEM Careers in Agriculture:

- Students will be able to identify the connection between agriculture and STEM fields.
- Students will be able to explore diverse career options related to STEM in agriculture.
- Students will be able to define the impact of STEM on modern agricultural practices.

Lesson Timeline:

Lesson 1 – Introduction to Climate Change and Agriculture:

Introduction activity (5 minutes).

Weather Vs. Climate (5 minutes).

Global Warming activity (10 minutes).

Show students how to read the differences in temperature in different years by using the axes X and Y in the figure that they were given. Let students work on the global temperature data worksheet to answer the questions and interpret the results (10 minutes).

Examples of the impact of climate change in different countries worldwide (10 minutes).

Activity debriefs (5 minutes)

Wrap up (5 minutes)

Lesson 2 – Agricultural Vulnerability as a result of climate change

Recall the previous lesson, overview of the day's activities and goals (3 minutes)

Overview of the day's activity (2 minutes)

Activity mini greenhouse construction (35 minutes)

Wrap up and assessment (5 minutes)

Lesson 3 – Sustainable Agriculture

Recall the previous lesson, overview of the day's activities and goals (3 minutes)

Lead discussion and record observations on plant types in Indiana state (7 minutes)

Activity sustainable ecosystem model construction (30 minutes)

Wrap up and assessment (5 minutes)

Lesson 4 – Parts of a plant and the use of technology in agriculture:

Recall the previous lesson, overview of the day's activities and goals (3 minutes)

Watch a video about the Parts of a Plant (Label the Parts of a Plant activity) (6 minutes).

Overview Helping plants by providing water and fertilizer (10 minutes).

Introduce the concept of "plant helpers": Explain that scientists are like plant detectives, always looking for ways to help plants grow (12 minutes).

What is this "plant helper," and how does it help plants? (10 minutes).

Wrap up (4 minutes).

Lesson 5 – Sustainable Agriculture: STEM Careers in Agriculture:

Recall the previous lesson, overview of the day's activities and goals (3 minutes)

Warming-up activity: Play a brainstorming game (6 minutes).

Activity 1: Play STEM Detectives by introducing students to the concept of STEM and Presenting different scenarios related to various challenges in agriculture while challenging each group to be "STEM Detectives" (15 minutes).

Activity 2: Career Exploration by introducing the concept of STEM careers in agriculture, and presenting a list of potential STEM careers in agriculture (15 minutes)

Wrap-up (6 minutes).

Standards:

- Indiana Department of Education plant science curriculum (4th grade)
- Indiana Academic Standards Context and Purpose (Earth and Human Activity)
- Indiana Academic Standards Context and Purpose (Earth's Systems)
- Next Generation Science Standards (Weather and Climate)

- Next Generation Science Standards (Global Climate Change)
- Next Generation Science Standards (Human Sustainability)
- AFNR (Plant Systems Career Pathway)
- AFNR (Natural Resource Career Pathway)
- AFNR (Environmental Service Systems Career Pathway)
- Common Core Math Standards

STEM Integration within the Unit:

- Science, Technology, and Math: Global Warming Activity.
- Science and Math: Doing math and analyzing data in increasing the global temperature figure.
- Science, Technology, Math, and Engineering: Building a greenhouse.

Lesson 1: Introduction to Climate Change and Agriculture

Est. Time: 45 minutes

Lesson Learning Goals/Objectives:

Students will be able to:

- 1- explain the concept of climate change.
- 2- analyze and interpret data that demonstrates how weather has changed over time.
- 3- identify ways in which climate change can affect water levels, weather, soil, plants, and animals.
- 4- analyze the connection between climate change and agriculture.
- 5- investigate climate change as a global challenge requiring international collaboration by giving examples of it in the United States, Nigeria, and Saudi Arabia.

Standards:

Next Generation Science Standards:

Science and Engineering Practices

Analyzing and Interpreting Data

- Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- (K-LS1-1) Use observations (firsthand or from media) to describe patterns in the natural world to answer scientific questions.

Indiana Academic Standards

Grade 4 Integrated STEM

(4.DM.4) Choose data sets and analysis methods to support the inquiry process.

- Indiana Department of Education plant science curriculum

Life Science (LS)

4.LS.2 Use evidence to support the explanation that a change in the environment may result in a plant or animal surviving and reproducing, moving to a new location, or dying.

- Next Generation Science Standards

3. Weather and Climate

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

PS.03.01.02: conduct test associated with seed

	germination. - Indiana Department of Education plant science curriculum Life Science (LS) 4.LS.2 Use evidence to support the explanation that a change in the environment may result in a plant or animal surviving and reproducing, moving to a new location, or dying. - Next Generation Science Standards 3. Weather and Climate 3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.
Assessments: Pre-Assessment: Give the class (5 groups) a vocabulary worksheet (Match words and pictures) to assess their prior knowledge. After they finished working on it as groups, ask them, what have you noticed? What is the common word that we can use to describe what is happening in these pictures? Have you heard about climate? Are there any differences between weather and climate? Can you give examples that explain the difference? Have you heard about climate change? If yes, what does it mean? Formative: Exit card Summative: End of unit test	
Vocabulary: climate, weather, climate change, temperature, Fahrenheit, heat	
Materials & Technology Needed: computer and projector for instructor, slides, bulb light, 3 clear glasses, water, Thermometers, , worksheet, pencils/pen.	

Lesson Component	Instructions	Materials
Introduction 5 minutes	Pre-assessment (Active Learning) ● To pre-assess students' knowledge, each group of students were asked to work on the vocabulary worksheet to come up with answers. ● Give an overview of what we will be learning. ● Ask students to predict: What does climate change mean? ● Tell students they did a great job!	Supplementary slides Appendix A – Vocabulary Activity Worksheet

Instructional Activities 39 Minutes Activity 10 minutes Group activities 19 Minutes 10 Minutes	Introduce the concept of climate change by watching the video. (Contextual Learning) • Watch the video. • Define climate change. • Distinguish between climate change and weather. • Explain the affects of climate on environment, plants, animals, and humans. • Explain what climate change does to the earth by showing students how heat raises temperature and melts ice. (Inquiry-based Learning) • Groups will record the results they came up with and do math to calculate the differences in initial and final temperature. • After activity, • Call on student groups for answers. Have them explain their results. • Did the temperature increase or decrease? • Present the climate change affects. • Is it good or bad to have a very hot summer? • Why? • What does heat affect? • What cause a drought? • How do droughts affect plants? How about animals? • Are humans be affected? (Inquiry-based Learning with Math Integration) • Have students work as groups on a graph that shows the raise of global temperature between 1880 and 2016. • Show students how to read the differences in temperature in different years by using the axes X and Y in the figure that they were given. Let students work on the global temperature data worksheet to answer the questions and interpret the results. • Ask them to do math and find the differences in temperature in specific years. • Ask students how could this affect plants, animals, and humans? • If one country was affected by climate change, should we worry about our country?	https://youtu.be/QIQ-MEZgRGY 3 glasses Water Thermometers Pulp lamp. Appendix B – Hands- on Activity on environmental change Appendix C – Climate Change – Global tempreture worksheet
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	(Inquiry-based Learning) Examples of the impact of climate change in different countries worldwide, Saudi Arabia, Nigeria, and United States (While showing students these countries' locations on the globe map).	Appendix D – Map of the World
Wrap Up/Closure 4 minutes	Assessment: Exit card. Before Students leave, they should answer the following on a notecard about bad environmental habits that increase climate change and then, each group will discuss and suggest how to replace these bad habits with good ones. Tell students they did a great job!	Appendix E – Global Warming Fact and Discussion Cards

Resources:			
Gainesville.com, Earth sets hottest year record for third-straight time			
SETH	BORENSTEIN	AP	Science Writer
https://www.gainesville.com/story/news/nation-world/2017/01/18/earth-sets-hottest-year-record-for-third-straight-time/22598526007/			
https://www.liveworksheets.com/w/en/english-second-language-esl/1585268			
Live Worksheets 2024 Interactive Worksheets For all Languages and Subjects			
https://kidminds.org/how-to-explain-the-greenhouse-effect-to-kids-with-printables/			
Kid Minds			
https://www.independent.co.uk/climate-change/news/climate-change-poor-countries-world-hit-hardest-affected-india-ethiopia-kenya-moody-s-a7403076.html			
Independent Digital News			
https://www.twinkl.com/resource/t2-g-2567159-uks2-global-warming-fact-and-discussion-cards			

Lesson 2: Agricultural Vulnerability as a Result of Climate Change	
Est. Time: 45 minutes	
Lesson Learning Goals/Objectives: Students will be able to: 1. Identify the factors contributing to agricultural vulnerability. 2. explain how temperature affects crop growth. 3. construct a mini-greenhouse to study the effect of different temperature zones on crops	Standards: State: Env1.6 Explain how temperature supports the growth of specific kinds of crops. Env5.1 Explain how variations within a species Increase the chances of survival of the crops under the changing environmental conditions 3-5.E.3 Construct and perform fair Investigation In which variables are controlled and failure points are considered to Identify aspects of Identity aspects of a

4. measure plant growth in different temperature	model or prototype. Indiana Academic Standards - Grade 4 Science 3-5-ETS1-1 Engineering Design Science and Engineering Practices SEP.1: Asking Questions and Defining Problems ETS1.B: Developing Possible Solutions
Assessments: Pre-Assessment: Ask the class: Has anyone ever planted a crop? Raise your hand if yes. Has anyone ever taken care of a dying plant? Raise your hand if yes. What about having a pet at home? Formative: Exit card Summative: End of unit test	
Vocabulary: vulnerability Agriculture, Greenhouse, Plants and Animals	
Concept Prerequisites or Background Knowledge Needed: N/A	
Materials & Technology Needed: computer and projector for instructor, slides, thermometer, seeds, soils, clear plastic containers	

Lesson Component	Instructions	Materials
Introduction 5 minutes	(Contextual Learning) Recall the previous lesson, overview of the day's activities and goals (3 minutes) Tell students they did a great job. Go over any issues and connect this lesson to the previous lesson on Introduction to Climate Change. Tell students we will be learning about agricultural vulnerability Pre-assessment. After discussion, transition into the lesson.	computer, projector, slides, thermometer, seeds, soils, clear plastic containers, notecards, and pencils.
Instructional Activities 35 minutes Activity 10 minutes	What is agricultural vulnerability? It Is the changes In rainfall patterns, deforestation, overgrazing, and extreme temperature over a long period making It harder for plants to grow, and already germinated plants die as a result of flood or drought. Ideally, a normal temperature supports the growth of plants and animals leading to agricultural productivity. (Inquiry-based Learning) - Ask: Do you think a corn tree growing In a desert and In a forest will grow the same way? - Which of the corn trees will grow better and produce more fruits Answer: Corn will grow better in forest regions than in the desert	Supplementary slides
Constructing a Mini greenhouse 15 minutes	(Inquiry-based Learning) + (Project-based Learning) We are going to do an activity by constructing a mini greenhouse representing different regions of the world. Which country do you think our corn will grow better Nigeria, Lafayette Indiana, and Saudi Arabia? We are going to find out which country will support the growth of our corn the most through this activity. Tell the students to count from 1-3, all the 1 should form group 1,	thermometer, seeds, soils, clear plastic containers, corn seeds notecards, and pencils, rulers

	all the 2s should form group 2 and all 3s should form group 3. Group 1 represents Lafayette Indiana. Group 2 represents Nigeria Group 3 represents Saudi Arabia. provide the students with the white plastic container, the soil, and the seeds. Ask the students to use their rulers to measure the length of the plastic container and determine In their groups what level of soil they want to fill Into their plastics before planting the seed. provide students with thermometers. After planting the corn, group 1 will keep their corn under shade within the school premises and water It twice a week. And measure the temperature daily. Group 2 should keep their plants outside under the sun, watering Them. Group three should keep their plant In the kitchen without watering It. The students should record the temperature daily and take note of the variations across the groups. If you noticed different levels of soil on the plastics • Ask: Can each group share with us the process of their mini greenhouse construction? • Which of these plants will grow first? Debrief: Group 1 and 2 plants will germinate and grow faster and better than Group 3 plants because of the temperature. This implies that when the temperature Is favorable It will support the growth of plants and animals. If the temperature rises for a long time without water plant 3 Is going to die because of the harsh climatic conditions. This is the case for all plants can animals. In the case where the plants do not die, the plant yield will be relatively low. Using the temperature readings In the thermometer, the students should note the temperature variation for each day.	
Wrap Up, Synthesis/Closure 5 minutes	Help students wrap up. Remind them of key concepts of climate vulnerability. Assessment: Exit card. Before they leave, students should answer the multiple-choice questions Tell students they did a great job!	Notecards, questions written on the board

Resources:

USDA hub on climate vulnerability and agriculture.

<https://www.climatehubs.usda.gov/vulnerabilities-agriculture-and-forestry>

Yale Climate Connections

<https://yaleclimateconnections.org/2023/05/climate-change-and-droughts-whats-the-connection/>

YALE CLIMATE CONNECTIONS

<https://www.journey2050.com/agricultural-resources>

Est. Time: 48 minutes	
Lesson Learning Goals/Objectives: Students will be able to: 1. explain how sustainable agriculture supports a system 2. identify potential sources of soil contamination. 3. explain how a healthy environment sustains agriculture 4. apply evidence-based reasoning to design a solution to address deforestation from a real-world case study.	Standards: State: 4.ESS 4. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate changes have influenced human activity. HS-ENV2-6. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. PS.03.04.01.b Analyze the alignment of modern technologies used in production system
Assessments: Pre-Assessment: Ask the class: Have you ever thought about living on the farm with everything present on it? Raise your hand if yes. Have you ever been concerned about the quality of your food due to soil or water contamination, or heard others share concerns about this? Raise your hand if yes. Formative: Exit card Summative: end of unit test	
Concept Prerequisites or Background Knowledge Needed: N/A	
Vocabulary: prototype, ecosystem	
Materials & Technology Needed:	
Materials & Technology Needed: computer and projector for the instructor, play-doh.	

Lesson Component	Instructions	Materials
Introduction 5 minutes	Recall the previous lesson, overview of the day's activities and goals (3 minutes) Review of formative assessment. Tell students they did a great job taking care of their plants. Go over any issues. Tell students we will be learning about sustainable agriculture. We will also think about available areas of land to construct our ecosystem Pre-assessment. After discussion, transition into the lesson. Tell students they did a great job!	Play-doh, markers, boards, paper notes, pencils, rulers
Instructional Activities 35 minutes	(Inquiry-based Learning) What is sustainable agriculture? Ask students first, then explain: It Is the system of farming that considers the long-term health of the environment. It involves crop rotation, the use of natural pest control, and precision agriculture for sustainability. • How can sustainable agriculture be achieved? • Ask: what is the difference between sustainable agriculture and agricultural vulnerability? • If you are to plant your crops again what will you do to support the environment of your plant?	

Model activities 15 minutes Size activities 10 minutes	(Inquiry-based Learning with Math Integration) • Discuss: Show a picture of a sustainable farm where all activities are been carried out and ask the students to discuss what they see. • Tell the students they are to model that they are going to build a sustainable ecosystem that supports agriculture on an acre of land. • Different colors of play-doh should be used to represent different parts of sustainable agriculture • The students be In 4 groups and each group should construct an ecosystem that Is sustaining agriculture. • Each group will be given a board that Is equivalent to an acre. An acre Is = 6 plots. • Each group will model a sustainable farm that Involves an agricultural value chain. Have students calculate how many plants they will plant on 2 plots of land one plot can accommodate 32 plants. Tell students they did a great job!	
Wrap Up, Synthesis/Closure 5 minutes	Assessment: Exit card. Before they leave, students should answer the following on a notecard: • 1. What makes an environment sustainable 2. Describe what should be found In a sustainable agricultural system • Summative assessment reminder: next class, students will have a test over the unit	Notecards, questions written

Resources: Sustainable agriculture: https://www.nal.usda.gov/farms-and-agricultural-production-systems/sustainable-agriculture National Agricultural Library https://www.ucsusa.org/resources/what-sustainable-agriculture Union of Concerned Scientists https://online.ucpress.edu/elementa/article/doi/10.1525/elementa.356/112494/Securing-the-future-of-US-agriculture-The-case-for University of California Press https://content.twinkl.co.uk/resource/7a/34/t-sc-1682927631-bean-plant-labelling-worksheet_ver_1.pdf?__to__ken__=exp=1713341034~acl=%2Fresource%2F7a%2F34%2Ft-sc-1682927631-bean-plant-labelling-worksheet_ver_1.pdf%2A~hmac=d6ce78424195c65b167f78a5d78a920e0ec30ef7ae1bda18ba95a006a317e678 Twinkl https://www.twinkl.com/hk/resource/au-sc-2046-plants-need-activity-sheet

Lesson 4: Parts of a Plant and the Use of Technology in Agriculture

Est. Time: 45 minutes

Lesson Learning Goals/Objectives:

Students will be able to:

- 1- identify and label the parts of a plant.
- 2- explain the basic concept of plant growth and its needs.
- 3- discover the plant helpers meaning and their use.
- 4- explain how could "plant helpers" be used to improve agriculture.
- 5- differentiate between traditional and modern methods of helping plants grow using simple examples.

Standards:

State:

- Indiana Department of Education plant science curriculum.

Engineering (E)

3-5.E.3 Construct and perform fair investigations in which variables are controlled, and failure points are considered to identify aspects of a model or prototype that can be improved. Assess and describe the impact environmental factors have on a crop.

- Indiana Academic Standards Context and Purpose

4-ESS3-1 Earth and Human Activity

CC.2: Cause and Effect

Cause and effect relationships are routinely identified and used to explain change.

- Indiana Academic Standards Context and Purpose

4-ESS2-1 Earth's Systems

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

- Next Generation Science Standards

3. Weather and Climate

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

PS.04.01.02.b create a design utilizing plants in their proper environment.

Assessments: Pre-Assessment: Warm-up activity: Students will first watch the following video.

<https://www.youtube.com/watch?v=TD60-3rqPXg>

And then, students will be asked to work in groups to identify the plant parts and flora structure using worksheet.

Formative: Exit card

Summative: end of unit test

Vocabulary: plant helpers, traditional and modern methods in farming.

Materials & Technology Needed: computer and projector for the teacher, worksheet, pencils/pen, two seeds of the same type (e.g., beans, peas), potting soil, two small pots, water.

Lesson Component	Instructions	Materials
Introduction 5 minutes	(Inquiry-based Learning) Recall the previous lesson, overview of the day's activities and goals (3 minutes) Tell students we will learn about plant growth and its needs. We will also discuss traditional and modern methods of helping plants grow using simple examples.	Appendix F – The parts of plant Worksheet Appendix G The parts of plant + Plant part (cross words)
Instructional Activities 15 Minutes	(Inquiry-based Learning) Introduce the concept of plant growth: Briefly explain that plants need certain things, like sunlight, water, and nutrients from the soil to grow healthy and strong. Ask students: What do you know about what plant needs for plant growth? (Here can start with the basics like light, and water, then guide them to start thinking of nutrients that plants need.) Tell students they did a great job!	Supplementar y slides Appendix H – Plant needs worksheet.
8 minutes	Discuss how farmers traditionally help plants by providing water and fertilizer. Introduce the concept of "plant helpers": Explain that scientists are like plant detectives, always looking for ways to help plants grow even better. These "plant helpers" can be different things, like beneficial insects that eat harmful pests or natural fertilizers that improve soil health. (Inquiry-based Learning) Activity: Plant Power! 1. Divide students into small groups. 2. Distribute the handout with illustrations of different "plant helpers". 3. Ask each group to discuss and answer the following questions: - o What is this "plant helper," and how does it help plants? - o How is this different from the traditional ways we help plants grow (watering, fertilizing)? 4. Have each group share their findings with the class. Encourage them to use their imagination and creativity to explain the concepts.	Appendix I – The life cycle of bean plant worksheet Appendix J – Garden in glove
7 minutes	(Inquiry-based Learning) Activity: Planting as a farmer: • To investigation plant growth, with your family's help, plant one seed in each pot with the same amount of soil.	Appendix K- The magic of

	● Create Different Environments: ● Plant A (Optimal Conditions): Place this pot in a sunny window and water it regularly. You can also add some of the "plant helpers" you chose (fertilizer, lights, humidity dome). ● Plant B (Limited Conditions): Place this pot in a dark location and water it sparingly. Avoid using any "plant helpers" for this plant. ● Observation Time! Over several weeks, observe and record your observations in a table. Here are some ideas for what to track: ● How tall does each plant grow? ● Does one plant have more leaves than the other? ● Does either plant appear wilted or unhealthy? ● Analyze the results and discuss it with your family: ● How did the different environments affect the plant growth? ● Which plant seemed healthier? Why do you think so? ● What role do you think "plant helpers" played in the experiment? (Inquiry-based Learning with Technology Integration) Activity: Examples of plant helpers and how they work to help plants. Students will be asked to use their iPads to search about the plant helpers. What are they? What are some examples of them? How do they work? By using this link, http://plantmagic.weebly.com/plant-helpers.html Could "plant helpers" be used to improve agriculture? How? Activity: Differentiating between traditional and modern methods of helping plants grow using simple examples. Representing a number of pictures and ask within their previously established groups, students will select a picture of agriculture from the past and the present. Students will be asked to pick two and compare and contrast traditional and modern methods of agriculture using their pictures. Tell students they did a great job!	growth: from seed to lemon tree THE Appendix M- Examples of plant helpers and how they work to help plants? Read the pictures activity to compare traditional and modern farming
Wrap Up, Synthesis/Closure 4 minutes	Assessment: Exit card. Before they leave, students should answer the following on a notecard: ● List 3 parts of plant. ● List 3 differences between traditional and modern methods of helping plants grow. ● Summative assessment reminder: next class, students will have a test over the unit	Notecards, questions written on board

Resources:

<https://www.slideshare.net/KhushiSaini5/traditional-and-modern-agriculture>

Slideshare

<http://plantmagic.weebly.com/plant-helpers.html>

PLANT MAGIC

[https://content.twinkl.co.uk/resource/7a/34/t-sc-1682927631-bean-plant-labelling-worksheet_ver_1.pdf? to ken =exp=1713341034~acl=%2Fresource%2F7a%2F34%2Ft-sc-1682927631-bean-plant-labelling-worksh eet_ver_1.pdf%2A~hmac=d6ce78424195c65b167f78a5d78a920e0ec30ef7ae1bda18ba95a006a317e678](https://content.twinkl.co.uk/resource/7a/34/t-sc-1682927631-bean-plant-labelling-worksheet_ver_1.pdf?to ken =exp=1713341034~acl=%2Fresource%2F7a%2F34%2Ft-sc-1682927631-bean-plant-labelling-worksh eet_ver_1.pdf%2A~hmac=d6ce78424195c65b167f78a5d78a920e0ec30ef7ae1bda18ba95a006a317e678)
Twinkl <https://www.twinkl.com/hk/resource/au-sc-2046-plants-need-activity-sheet>

Lesson 5: STEM Careers in Agriculture

Est. Time: 45 minutes

Lesson Learning Goals/Objectives:

Students will be able to:

- identify the connection between agriculture and STEM fields (Science, Technology, Engineering, and Math).
- explore diverse career options related to STEM in agriculture.
- give examples of the impact of STEM on modern agricultural practices.

Standards:

Indiana Department of Education plant science curriculum

Engineering (E)

3-5.E.1 Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.

3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the problem's criteria and constraints.

3-5.E.3 Construct and perform fair investigations in which variables are controlled, and failure points are considered to identify aspects of a model or prototype that can be improved.

Indiana Academic Standards - Grade 4 Science

3-5-ETS1-1 Engineering Design

Science and Engineering Practices

SEP.1: Asking Questions and Defining Problems

ETS1.B: Developing Possible Solutions

PS.04.01. Analyze design to identify the use of design principles and elements

Indiana Academic Standards - Grade 4 Science

3-5-ETS1-1 Engineering Design

Science and Engineering Practices

SEP.1: Asking Questions and Defining Problems

ETS1.B: Developing Possible Solutions

Assessments:

Pre-Assessment:

- Ask the class: Would you please, tell me what does STEM stands for?
- Are there any connections between STEM and agriculture? What are they? Can you give me examples?

Formative: Exit card

Summative: end of unit test

Vocabulary: STEM, careers, agriculture
Materials & Technology Needed: computer and projector for instructor, slides

Lesson Component	Instructions	Materials
Introduction 5 minutes	(Inquiry-based Learning) Recall the previous lesson, overview of the day's activities and goals (3 minutes) Warm-up activity: Play a brainstorming game with students about where our food comes from. Ask them to share what they know about farms and farming. (Contextual Learning) Expand the picture: Explain that agriculture is much broader than just traditional farming. Show pictures showcasing diverse agricultural activities, such as food processing, research labs, and technology-driven farming practices. Emphasize the importance of these activities in bringing food to our tables. (Inquiry-based Learning) Watching the video, and then discuss as groups to find out and answer the question: Where Does Our Food Come From? Cross words worksheet Tell students they did a great job!	Diverse agricultural Pictures THE Appendix N- READ THE PICTURES ACTIVITY: COMAPER TRADITIONAL AND MODERN FARMING https://www.youtube.com/watch?v=7FDVRQ98O7c
Instructional Activities 39 minutes Instructional Activities 14 minutes	(Inquiry-based Learning) Activity: STEM Detectives: • Divide students into small groups. • Present different scenarios related to various challenges in agriculture (e.g., developing drought-resistant crops, monitoring soil health, creating sustainable food packaging). • Challenge each group to be "STEM Detectives": ◦ Identify which STEM field(s) would be most important in addressing the given challenge. ◦ Discuss how each STEM field can contribute to solving the problem in agriculture.	Supplementary slides

13 minutes 12 minutes	- Facilitate a class discussion: Have each group share their findings and encourage them to explain their reasoning and examples. (Inquiry-based Learning) Activity: Career Exploration: Introduce the concept of STEM careers in agriculture: Explain that many exciting jobs combine knowledge of science, technology, engineering, and math to solve problems and improve agricultural practices. Present a list of potential STEM careers in agriculture or encourage students to research and brainstorm their own ideas. These could include: - Agricultural engineer - Food scientist - Animal nutritionist - Environmental scientist - Entomology - Robotics engineer - Precision agriculture specialist.	
Wrap Up, Synthesis/Closure 4 minutes	Summarize the lesson's key points: Briefly reiterate the diverse nature of agriculture, the importance of STEM in this field, and the exciting career opportunities available. Encourage students to think about their interests and how they might connect with STEM in agriculture. Challenge students to imagine and draw their own "dream job" related to STEM and agriculture, showcasing their creativity and potential future aspirations. Assessment: Exit card. Before they leave, students should answer the following on a notecard: What are the examples of agriculture careers that are connected to STEM?	Notecards, questions written on the board

Resources: https://www.goodfirms.co/farm-management-software/blog/best-free-open-source-farm-management-software Goodfirms https://www.youtube.com/watch?v=7FDVRQ98O7c Where Does Our Food Come From? - Behind the News. YOUTUBE https://www.pinterest.com/pin/625367098275320303/ Pinterest

Assessment Plan

Summative Assessment Additional Explanation:

This assessment will be used for 4th grade students who have completed the Climate change and agriculture mini unit

Lesson 1 – Introduction to Climate Change and Agriculture

Lesson 2 – Agricultural Vulnerability as a result of climate change

Lesson 3 – Sustainable Agriculture

Lesson 4 – Parts of a plant and the use of technology in agriculture

Lesson 5 – Sustainable Agriculture: STEM Careers in Agriculture

Target Audience: Elementary School Students (grades 4th).

Objectives Assessed:

- Student will be able to explain the concept of climate change.
- Student will be able to analyze the connection between climate change and agriculture.
- Student will be able to describe the impact of climate change on agriculture.
- Student will be able to recognize the concept of agricultural vulnerability.
- Student will be able to describe how climate change affects crops and livestock.
- Student will be able to explore technological solutions to mitigate the impact of climate change on agriculture.
- Student will be able to define sustainable agriculture.
- Student will be able to describe the use of organic farming methods in sustainable agriculture.
- Student will be able to explain the basic concept of plant growth and its needs.
- Student will be able to identify traditional ways humans help plants grow (watering, fertilizing).
- Student will be able to define the concept of "plant helpers" and how scientists use them to improve agriculture.
- Student will be able to differentiate between traditional and modern methods of helping plants grow using simple examples.

End of Unit
Summative Assessment

Name _____

Date _____

Score /50

Instructions: Read each question carefully and answer to the best of your ability. Use complete sentences and diagrams where appropriate.

- 1- Explain the concept of climate change in 3-5 sentences. (5 points)
- 2- How can climate change affect agriculture? Circle all that apply. (4 points)
 - a) More frequent floods
 - b) More predictable weather patterns
 - c) Changes in rainfall patterns
 - d) Less extreme weather events
 - e) Increased average temperatures
- 3- Describe one impact of climate change on agriculture. (4 points)
- 4- What is agricultural vulnerability? (4 points)
- 5- Explain how climate change can affect crops and livestock. (6 points)
- 6- Imagine you are a scientist! What technological solution could help farmers deal with the effects of climate change? Briefly describe your idea. (4 points)
- 7- What is sustainable agriculture? (4 points)
- 8- Organic farming is one method used in sustainable agriculture. Describe one way organic farming helps the environment. (4 points)
- 9- Imagine a farm that used to get plenty of rain for its crops, but lately, there hasn't been much rain at all. How might this affect the crops? (5 points)
- 10- Scientists are always looking for ways to help farmers grow food even when the weather changes. What kind of technology could help farmers deal with less rain? (5 points)
- 11- Plants need certain things to grow healthy and strong. List two things plants need from the environment. (5 points)

**End of Unit
Summative Assessment + Answers**

Name _____

Date _____

Score _____ /100

Instructions: Read each question carefully and answer to the best of your ability. Use complete sentences and diagrams where appropriate.

1- Explain the concept of climate change in 3-5 sentences. (5 points)

Answer: Climate change is the long-term alteration of temperature and typical weather patterns in a place. It could be a change in a region's usual weather from hot and dry to cold and wet, or vice versa.

Grading:

5 points: Clear explanation of climate change as a long-term shift in weather patterns.

3 points: Partially correct explanation, mentions temperature change but may lack details on long-term or typical weather patterns.

1 point: Vague or incorrect explanation.

2- How can climate change affect agriculture? Circle all that apply. (3 points)

a) More frequent floods (**Yes**)

b) More predictable weather patterns (**No**)

c) Changes in rainfall patterns (**Yes**)

d) Less extreme weather events (**No**)

e) Increased average temperatures (**Yes**)

Grading: **3 points** for all correct answers circled (a, c, and e). **2 points** for 2 correct answers. **1 point** for 1 correct answer. **0 points** for no correct answers.

3- Describe one impact of climate change on agriculture. (4 points)

Answer: (Examples accepted: More frequent floods can damage crops and farmland. Changes in rainfall patterns can lead to droughts or floods, affecting crop growth. Increased temperatures can stress plants and reduce yields.)

Grading:

4 points: Clear and specific description of an impact, e.g., "Droughts caused by climate change can make it difficult for crops to get enough water, leading to lower yields."

2 points: Partially correct description, mentions an impact but lacks details.

0 points: Vague or incorrect description.

4- What is agricultural vulnerability? (4 points)

Answer: Agricultural vulnerability refers to the difficulty farms have in producing food due to changes in climate.

Grading:

4 points: Clear definition of agricultural vulnerability connecting it to climate change.

2 points: Partially correct definition, mentions difficulty but lacks connection to climate change.

0 points: Vague or incorrect definition.

5- Explain how climate change can affect crops and livestock. (6 points)

Answer: (Possible answers: Crops - Higher temperatures can stress plants, reduce yields, and increase pest problems. Droughts can limit water availability for crops. Livestock - Heat stress can affect animal health and productivity. Changes in rainfall patterns can impact the availability of food and water for grazing animals.)

Grading:

6 points: Clear explanation of how climate change affects both crops and livestock with specific examples.

3 points: Partially correct explanation focusing on one (crops or livestock) with some details.

0 points: Vague or incorrect explanation.

6- Imagine you are a scientist! What technological solution could help farmers deal with the effects of climate change? Briefly describe your idea. (4 points)

Answer: (Examples accepted: Developing drought-resistant crops, Using sensors to monitor soil moisture and optimize irrigation, Utilizing greenhouses with climate control technology.)

Grading:

4 points: Creative and relevant technological solution for farmers to address climate change impacts.

2 points: Partially developed idea with some connection to climate change.

0 points: Unrelated or unclear idea.

7- What is sustainable agriculture? (4 points)

Answer: Sustainable agriculture is a way of farming that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Grading:

4 points: Clear and accurate definition of sustainable agriculture.

2 points: Partially correct definition, mentions meeting needs but lacks long-term focus.

0 points: Vague or incorrect definition.

8- Organic farming is one method used in sustainable agriculture. Describe one way organic farming helps the environment. (4 points)

Answer: (Examples accepted: Organic farming avoids synthetic pesticides and fertilizers, reducing pollution in soil and water. It promotes soil health by using natural methods like composting.)

9- Imagine a farm that used to get plenty of rain for its crops, but lately, there hasn't been much rain at all. How might this affect the crops? (5 points)

Answer: The crops might not get enough water to grow properly. This could lead to smaller plants, fewer fruits or vegetables, or even dead plants.

Grading:

5 points: Explains how lack of rain reduces water availability for crops, impacting growth and yield.

3 points: Mentions lack of water but doesn't connect it to plant growth or yield.

1 point: Vague or incorrect answer.

10-Scientists are always looking for ways to help farmers grow food even when the weather changes. What kind of technology could help farmers deal with less rain? (5 points)

Answer: Possible answers include:

Special machines that spray water on the crops (irrigation systems).

Sensors that tell farmers how much water is in the soil.

Seeds that grow well even with less water.

Grading:

5 points: Describes a relevant technology that helps farmers manage water in dry conditions.

3 points: Mentions a technology but lacks details on how it helps with less rain.

1 point: Vague or irrelevant answer.

11-Plants need certain things to grow healthy and strong. List two things plants need from the environment. (5 points)

Answer: (Possible answers: sunlight, water, air, nutrients from soil)

Grading:

5 points: Lists two essential needs for plant growth.

3 points: Lists one correct need and one incorrect need.

1 point: Lists no correct needs or irrelevant answers.

Assessment Plan

Climate change and agriculture

Target Audience: Elementary School Students (Grade 4) who have completed the unit in a formal classroom setting.

Objectives Assessed:

- o Differentiate between weather and climate.
- o locate and use online soil data to learn more about soil properties in a selected location in the U.S.
- o Explain the effect of climate change on AFNR.
- o conduct a pH test and analyze a pH soil sample using Inquiry-based learning and Evidence Based Reasoning.

Instructions:

- Students will answer pre-assessment questions as a class at the beginning of the lessons as directed by the teacher.
- Students will complete the exit ticket notecards at the end of all three lessons as directed by the teacher.

Total Points: Not graded, part of participation points.

Formative Assessments Overview

Pre-assessment questions: The teacher will ask the class the following questions, using the following scripts, before lessons to gauge their prior knowledge of Climate change and agriculture.

1.

Lesson 1:

- o What is the common word that we can use to describe what is happening in these pictures?
- o Have you heard about climate?
- o Are there any differences between weather and climate?
- o Can you give examples that explain the difference?
- o Have you heard about climate change?

Lesson 2:

- o What is agricultural vulnerability?
- o What does the extreme temperature over a long period do?
- o How do flood or drought affect plants?
- o Do you think a corn tree is growing better in a desert or in a forest? Why?
- o Which of the corn trees will grow better and produce more fruits?

Lesson 3:

- o Have you ever thought about living on the farm with everything present on it? Raise your hand if yes.
- o Have you ever been concerned about the quality of your food due to soil or water contamination, or heard others share concerns about this? Raise your hand if yes.

Lesson 4:

- o By using worksheet, identify the plant parts and flora structure.
- o What does a plant need to grow?

- o Give examples of traditional and modern methods of helping plants grow?

Lesson 5:

- o Where Does Our Food Come From?
- o What does STEM stand for?
- o Are there any connections between STEM and agriculture?
- o Can you give me examples?

2. Exit Tickets: The teacher will pass out notecards at the end of each lesson. Students will answer the following questions for each lesson:

Lesson 1: By using Appendix E – Global Warming Fact and Discussion Cards, each group will discuss and suggest how to replace the bad habits with good ones.

Summative Assessment with Identified Objectives

Summative Assessment: Multiple Choice for the objective Temperature and Crop Growth (1 point each)

Instructions: Choose the best answer for each question.

- How can very hot temperatures affect crops?
 - a) They help plants grow taller and faster.
 - b) They make plants more resistant to pests.
 - c) They provide more water for the plants.
 - d) They improve the taste of fruits and vegetables.
- Why might plants struggle to grow in very cold weather?
 - a) Cold temperatures encourage faster seed germination.
 - b) They can freeze and damage the plant cells.
 - c) Cold helps plants store more energy for the next season.
 - d) They make the soil richer in nutrients.
- Which of these is NOT a way that temperature affects plant growth?
 - a) By influencing the rate of photosynthesis (food production)
 - b) By affecting the amount of water plants need
 - c) By determining which seeds will germinate (Germination is more influenced by moisture and light)
 - d) By impacting the speed at which plants mature
- What is the ideal temperature for ALL types of crops?
 - a) There is no single ideal temperature for all crops.
 - b) The colder the better, as cold temperatures prevent pests.
 - c) The hotter the better, as hot weather encourages faster growth.
 - d) Plants grow best in temperatures that fluctuate wildly.
- Imagine you planted two identical tomato plants. One plant receives more sunlight and warmth than the other. Which plant is likely to grow taller and produce more tomatoes?
 - a) The plant that receives more sunlight and warmth.
 - b) The plant that receives less sunlight and warmth.
 - c) Both plants will grow equally well.
 - d) It depends on the type of tomato plant.

Answers: A, B, C, A, A

Summative Assessment: Multiple Choice for the objective Greenhouse Project (1 point each)

Instructions: Choose the best answer for each question about building a mini-greenhouse to study temperature and plant growth.

1. Why is it important to have two sections in your mini-greenhouse?
 - a) You can store extra gardening tools in one section.
 - b) It allows you to create two different lighting conditions.
 - c) It helps you compare plant growth in different temperature zones.
 - d) You can plant different types of seeds in each section without them mixing.
2. Which material is NOT necessary for building your mini-greenhouse?
 - a) Construction paper b) Cardboard boxes (Construction paper is not typically used) c) Clear plastic wrap d) Scissors
3. How can you ensure your mini-greenhouse has proper ventilation?
 - a) Seal all openings completely to trap heat.
 - b) Poke small holes in the cardboard boxes with a pencil.
 - c) Leave the lid of one box open slightly.
 - d) Ventilation is not important for this project.
4. When planting seeds in your mini-greenhouse, what should you do to ensure a fair comparison?
 - a) Plant a different type of seed in each section.
 - b) Plant a different number of seeds in each section.
 - c) Plant the seeds at different depths in each section.
 - d) Plant the same number of seeds at a similar depth in each section.
5. What data should you collect during your experiment to analyze the effect of temperature?
 - a) The color of the cardboard boxes used
 - b) The size and shape of the leaves on the plants
 - c) How many times you water the plants each day
 - d) The brand of seeds you planted

Answers: C, A, B, D, B

Summative Assessment: Multiple Choice for the objective Measuring Plant Growth (1 point each)

Instructions: Choose the best answer for each question about measuring plant growth in different temperatures.

1. How can you measure the height of your plants in the mini-greenhouse experiment?
 - a) By estimating their height with your eye.
 - b) By using a ruler to measure from the soil to the tip of the tallest leaf.
 - c) By counting the number of leaves on each plant.
 - d) By weighing the plants on a scale.
2. When comparing plant growth in different temperature zones, which observation would be the LEAST helpful?
 - a) The color of the plants (green vs. yellowish)
 - b) The number of leaves each plant has grown.
 - c) The overall size and fullness of the plants. (Overall size is a combination of height and leaf growth)
 - d) The presence or absence of flowers or buds (if the plants produce them).
3. Why is it important to record your observations consistently throughout the experiment?
 - a) To see how pretty the plants look each day.
 - b) To track any changes in plant growth over time.
 - c) To make sure you water the plants on schedule.
 - d) To compare your plants to pictures in a gardening book.
4. Imagine one plant in your mini-greenhouse grew 5 cm in a week, while another plant in a different zone grew only 2 cm. What can you conclude?
 - a) The taller plant received more water.

- b) The taller plant likely experienced a warmer temperature.
 - c) The shorter plant must be a different type of seed.
 - d) There is not enough information to conclude.
5. Which of the following is NOT a good way to record your plant growth observations?
- a) Taking pictures of the plants each day.
 - b) Drawing pictures of the plants with measurements noted. (Drawings may not be as accurate as measurements)
 - c) Creating a chart that tracks height and other observations for each plant.
 - d) Write a detailed description of the plants each day.

Answers: B, C, B, B, B

Summative Assessment: Multiple Choice for the objective Farming practices (1 point each)

Instructions: Choose the best answer for each question about how farming practices can affect the environment.

1. Why might a farmer use cover crops (plants grown between main crops) in their fields?
 - a) To decorate the field with colorful flowers.
 - b) To help prevent soil erosion and improve soil health.
 - c) To attract more insects to pollinate the main crops.
 - d) To provide shade for the main crops during hot weather.
2. Farmers who practice crop rotation plant different crops in the same field each year. What is the benefit of crop rotation?
 - a) It helps control weeds that might target specific crops.
 - b) It allows farmers to harvest the same crop year after year.
 - c) It reduces the need for watering the crops.
 - d) It makes the harvest season longer.
3. Imagine a farmer using rainwater harvesting techniques to collect water for their crops. How does this benefit the environment?
 - a) It reduces the need for using harmful chemical fertilizers.
 - b) It helps conserve water resources and reduces reliance on pumping groundwater.
 - c) It attracts more birds and other wildlife to the farm.
 - d) It increases the temperature of the soil, making it ideal for all crops.
4. Why might a farmer choose to raise chickens alongside their vegetable crops?
 - a) Chickens can help scare away other animals that might damage crops.
 - b) Chicken manure can be used as a natural fertilizer for the vegetables.
 - c) Chickens need to eat vegetables as part of their diet. d) Chickens help pollinate the vegetable crops.
5. Sustainable agriculture practices often focus on reducing waste. Which of these is NOT a way a farmer might reduce waste?
 - a) Composting leftover plant materials to create nutrient-rich soil.
 - b) Using drip irrigation to deliver water directly to plant roots.
 - c) Planting only the amount of crops they know they can sell. (Planting extra is not waste reduction)
 - d) Choosing crops that are naturally resistant to pests, reducing the need for pesticides.

Answers: B,A,B,B,C

Summative Assessment: Multiple Choice for the objective Healthy Environments and Agriculture (1 point each)

Instructions: Choose the best answer for each question about how a healthy environment helps agriculture.

1. Healthy soil is important for farmers because it provides:
 - a) A smooth surface for planting seeds.
 - b) Nutrients and water that plants need to grow.
 - c) A place for children to play in the dirt.
 - d) A hiding spot for insects that damage crops.
2. Clean water is essential for agriculture because?
 - a) Farmers can use it to wash their equipment.
 - b) Plants need water to grow and thrive.
 - c) It attracts birds that might eat pests from the crops.
 - d) It helps keep the soil cool during hot weather.
3. Why might a healthy population of bees be beneficial for agriculture?
 - a) Bees compete with other insects for food sources.
 - b) Bees help pollinate many crops, leading to better yields.
 - c) Bees can damage crops by chewing on leaves and flowers.
 - d) Bees attract other animals that might eat the crops.
4. Forests can help protect farmland from?
 - a) Too much rain, which can damage crops.
 - b) Not enough rain, leading to drought conditions.
 - c) Having too many different types of crops planted.
 - d) Farmers need to use pesticides on their crops.
5. Imagine a farm located near a polluted river. Why might this be a problem for the farmer?
 - a) The polluted water might attract helpful insects to the crops.
 - b) The farmer cannot use the river water to irrigate their crops safely.
 - c) The pollution makes the soil warmer and more fertile.
 - d) The polluted water helps control weeds in the fields.

Answers: B,B,B,A,B

Multiple choice for the objective Sustainable farm Models (1 point each)

Instructions: Choose the best answer for each question about creating a sustainable farm model.

1. Why might a farmer choose to use cover crops on their land?
 - a) To decorate the fields with colorful flowers.
 - b) To help prevent soil erosion and improve soil health. CORRECT
 - c) To attract more birds to the farm, which might eat pests.
 - d) To provide extra shade for the main crops during hot weather.
2. Imagine a farm that raises chickens alongside their vegetable crops. What is one benefit of this practice?
 - a) Chickens can help scare away other animals that might damage crops. CORRECT
 - b) Chickens provide shade for the vegetables, protecting them from the sun.
 - c) Chickens can pollinate vegetable crops, which helps them grow fruit.
 - d) Chickens need to eat vegetables as part of their diet, so it saves money.
3. Water is a valuable resource for agriculture. How can a farmer use water more sustainably?
 - a) By watering their crops every day, no matter the weather.
 - b) By using drip irrigation that delivers water directly to plant roots. CORRECT

c) By leaving sprinklers on all night to ensure the crops are soaked. d) By planting only crops that require very little water.

4. What is one advantage of using natural fertilizers like compost on a farm?

- a) They are more expensive than chemical fertilizers.
- b) They can help improve soil health and fertility over time. CORRECT
- c) They are more likely to harm crops if not used correctly.
- d) They require special equipment to apply to the fields.

5. A farmer wants to reduce waste on their farm. Which of these is NOT a sustainable practice?

- a) Composting leftover plant materials to create nutrient-rich soil.
- b) Planting only the amount of crops they know they can sell or store. CORRECT (Planting extra is not waste reduction)
- c) Using recycled materials for things like fencing or signs.
- d) Choosing crops that are naturally resistant to pests, reducing the need for pesticides.

Answers: B,A,B,B,B

Assessment Plan

Climate change and agriculture

Target Audience: Elementary School Students (Grade 4) who have completed the unit in a formal classroom setting.

Objectives Assessed:

The following objectives will be measured on this assessment:

- Student will be able to explain the concept of climate change.
- Student will be able to analyze the connection between climate change and agriculture.
- Student will be able to describe the impact of climate change on agriculture.
- Student will be able to recognize the concept of agricultural vulnerability.
- Student will be able to describe how climate change affects crops and livestock.
- Student will be able to explore technological solutions to mitigate the impact of climate change on agriculture.
- Student will be able to define sustainable agriculture.
- Student will be able to describe the use of organic farming methods in sustainable agriculture.
- Student will be able to explain the basic concept of plant growth and its needs.
- Student will be able to identify traditional ways humans help plants grow (watering, fertilizing).
- Student will be able to define the concept of "plant helpers" and how scientists use them to improve agriculture.

Instructions for Students: Follow the directions for each section to complete the paper-pencil test.

Example Test Questions: See Climate change and agriculture. End of Unit - Summative Assessment

Rubric for Instructor: See Climate change and agriculture. End of Unit - Summative Assessment + Answers

Name _____ Class _____ No. _____

Vocabulary worksheet - weather

Exercise 1: match words and pictures.

sunny	☐
cloudy	☐
dry	☐
foggy	☐
windy	☐
snowy	☐
rainy	☐
thunder storm	☐
summer	☐
winter	☐
spring	☐
autumn (fall)	☐



Exercise 2: fill in the blank with the words given.

season	temperature	weather forecast
spring	summer	autumn
	winter	

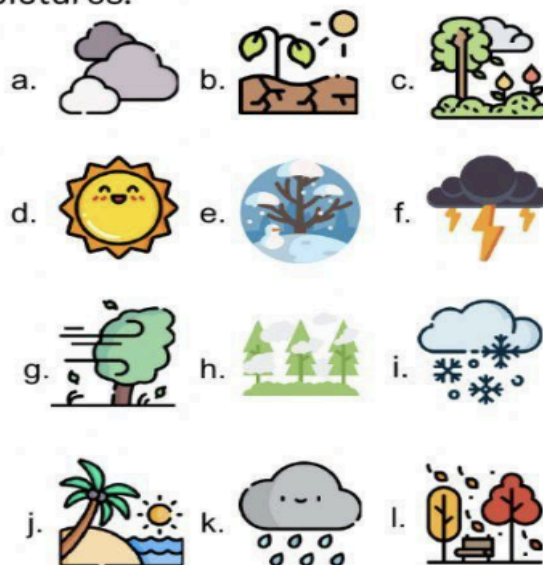
- Jane didn't bring her umbrella because she forgot to check the _____.
- In Chiang Mai, the lowest _____ during winter is 15°.
- Maple leaves turn red and fall in _____.
- Peter likes _____ because he can build a snowman with his friends.
- _____ is the best season to go to the beach.

Name Class No.

Vocabulary worksheet - weather

Exercise 1: match words and pictures.

sunny	d
cloudy	i
dry	b
foggy	a
windy	g
snowy	e
rainy	k
thunder storm	f
summer	j
winter	h
spring	c
autumn (fall)	l



Exercise 2: fill in the blank with the words given.

season temperature weather forecast
spring summer autumn winter

- Jane didn't bring her umbrella because she forgot to check the weather forecast.
- In Chiang Mai, the lowest temperature during winter is 15°.
- Maple leaves turn red and fall in autumn.
- Peter likes winter because he can build a snowman with his friends.
- Summer is the best season to go to the beach.

Hands-on activity on environmental temperature change



This activity aims to show students the environmental changes in temperature that occur as a result of temperature impacting plants and animals.

Materials:

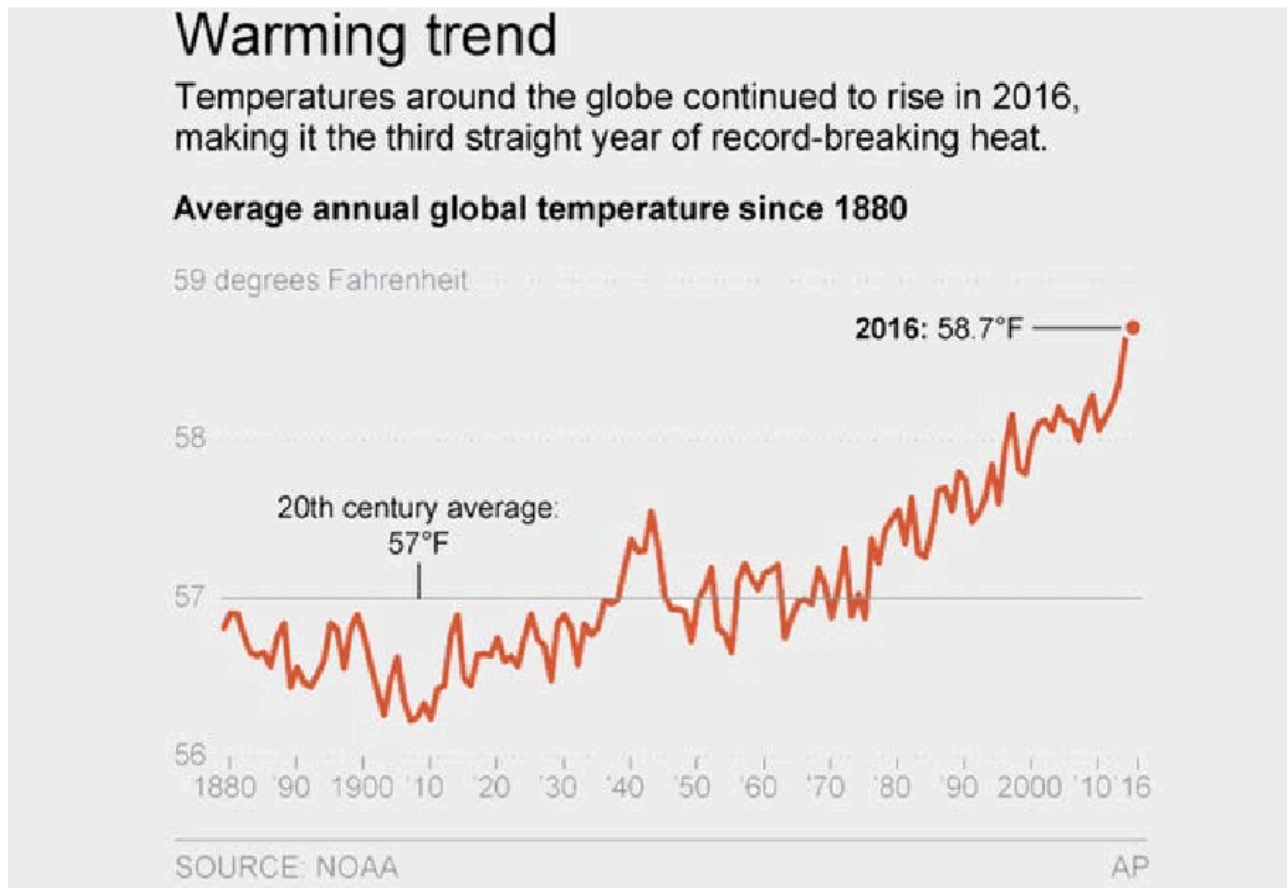
Three clear glasses
Thermometers
Lamp with heat bulb
Timer (Cellphone)
Recording sheet

Experiment:

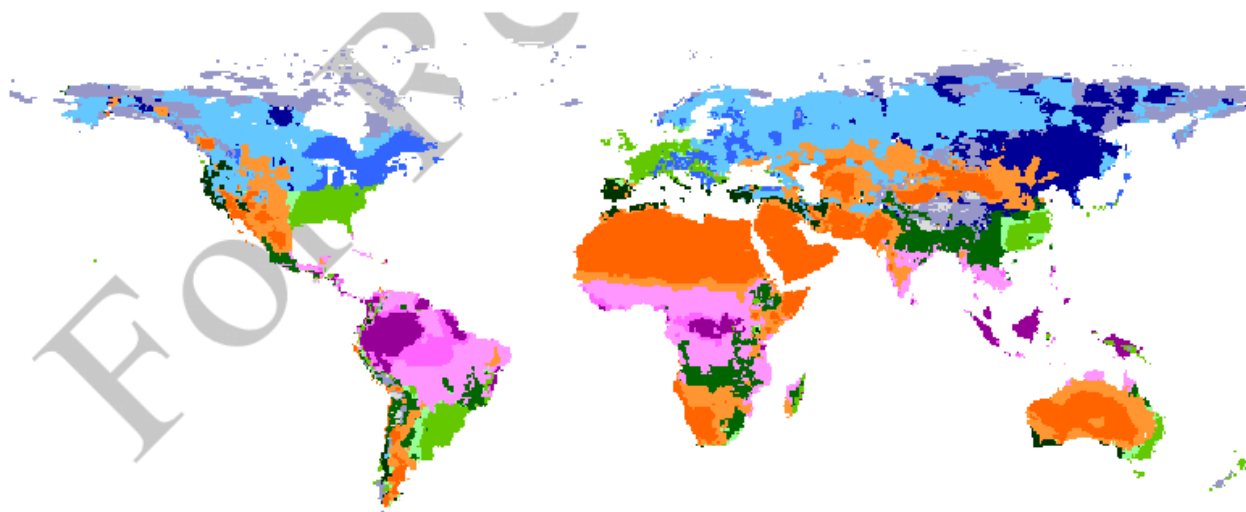
- Record Initial Temperatures: Take the initial temperature readings from the three thermometers and record them on the recording sheet

Climate Change Indicators: U.S. and Global Temperature

Based on what you can see in this figure, please answer the following questions:



- How much has Earth's average surface temperature risen since 1880?
- How has the rate of warming changed since 1980?
- Which year was the warmest on record?
- What is the trend in global temperatures over the past decade?

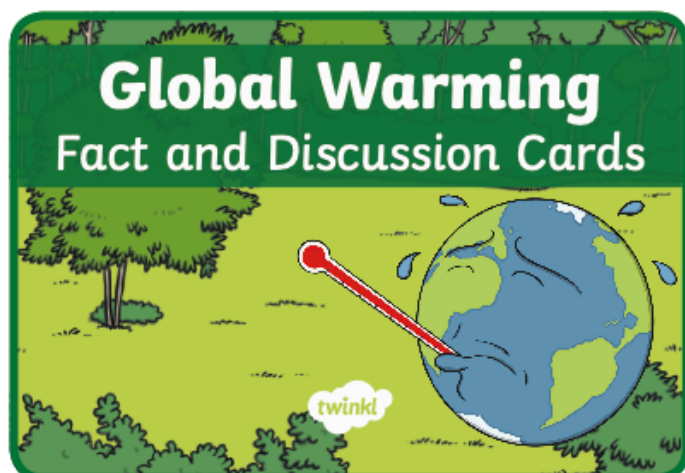


Koeppen's Climate Classification

by FAO - SDRN - Agrometeorology Group - 1997



Appendix E – Global Warming Fact and Discussion Cards



Global Warming Fact and Discussion Cards

1. "I don't live near the sea, so it doesn't matter to me if the sea gets higher," said James.

Discuss: Do you think James is right?

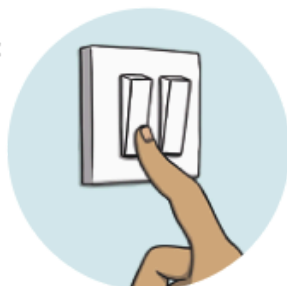
Explain your reasons.



Global Warming Fact and Discussion Cards

2. Saving electricity is a good way to help stop global warming.

Discuss: What different ways can you think of to save electricity?



Global Warming Fact and Discussion Cards

3. Heat is trapped in the Earth by things called greenhouse gases.

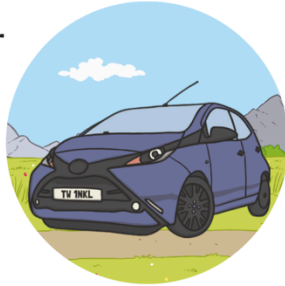
Discuss: What is a greenhouse and what are they used for?



Global Warming Fact and Discussion Cards

4. Taking fewer car journeys can help stop global warming.

Discuss: What are other ways can you make journeys?



Global Warming Fact and Discussion Cards

5. One cause of global warming is forests being chopped down. Sometimes they are chopped down to make room to build houses for people to live in.

Discuss: What do you think is more important, having forests, or building houses? Explain your answer.



Global Warming Fact and Discussion Cards

6. Using less plastic is a good way to help stop global warming.

Discuss: What ways can you think of to use less plastic?



Global Warming Fact and Discussion Cards

7. Global warming might sound nice because it means we will have more hot summers.

Discuss: Why isn't global warming a good thing? What problems does it cause?



Global Warming Fact and Discussion Cards

8. One cause of global warming is forests being destroyed.

Discuss: Have you ever been in a forest? What was it like? What could you see, hear and smell?



Global Warming Fact and Discussion Cards

9. Antarctica and the Arctic, also known as the south pole and the north pole areas, are covered in ice. Global warming means this ice is melting and animals such as polar bears, penguins and seals won't have anywhere to live.

Discuss: What is your favourite animal and why? forests, or building houses? Explain your answer.



Global Warming Fact and Discussion Cards

10. Global warming means hotter summers. Being out in the sun can be dangerous if you don't take care.

Discuss: How can you keep safe in the sun?



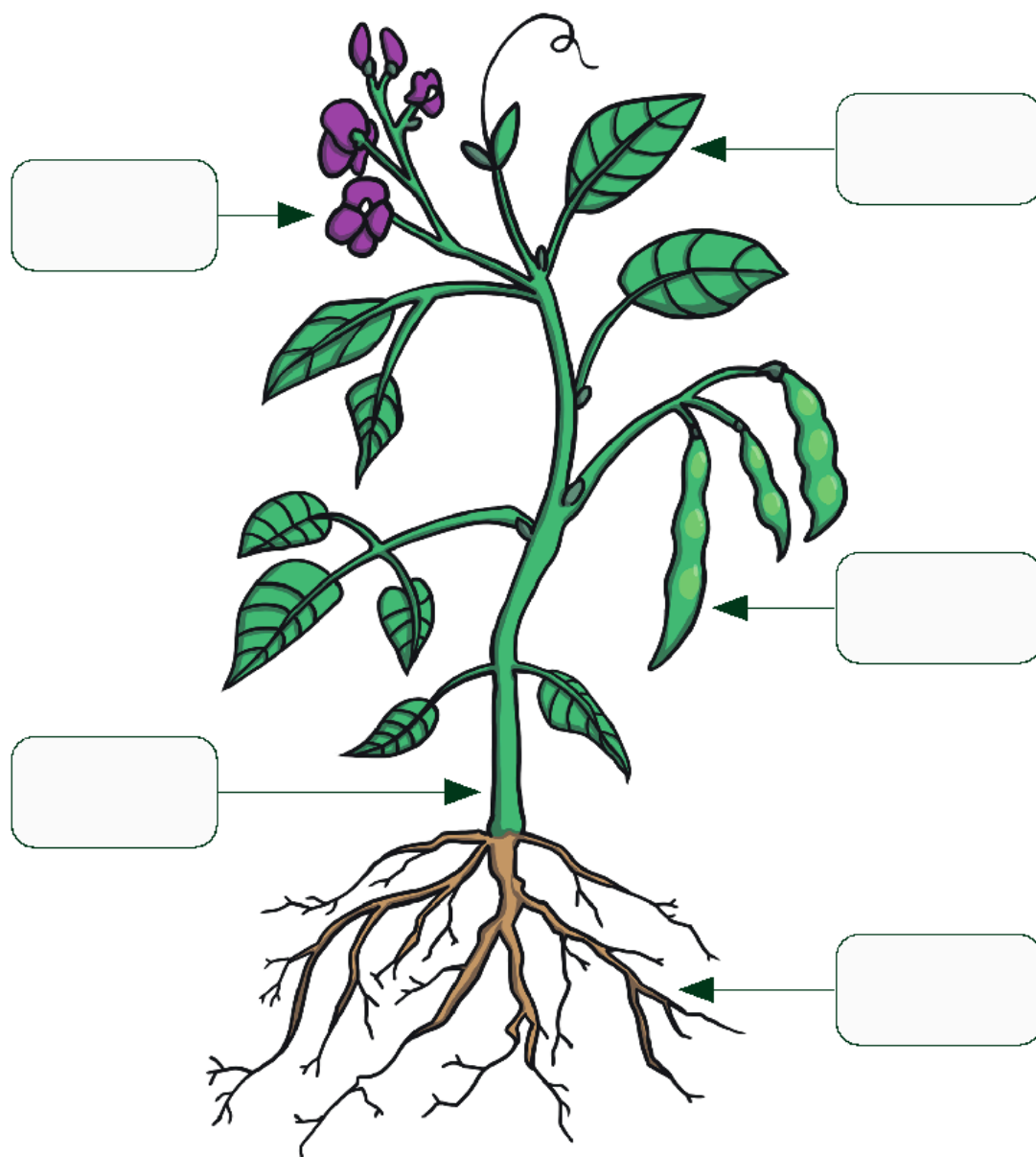
Global Warming Fact and Discussion Cards

11. Recycling can help reduce global warming. Recycling means using things again instead of just throwing them in the bin.

Discuss: What do you recycle? Can you think of any extra recycling you could do?



Parts of a Bean Plant



flower

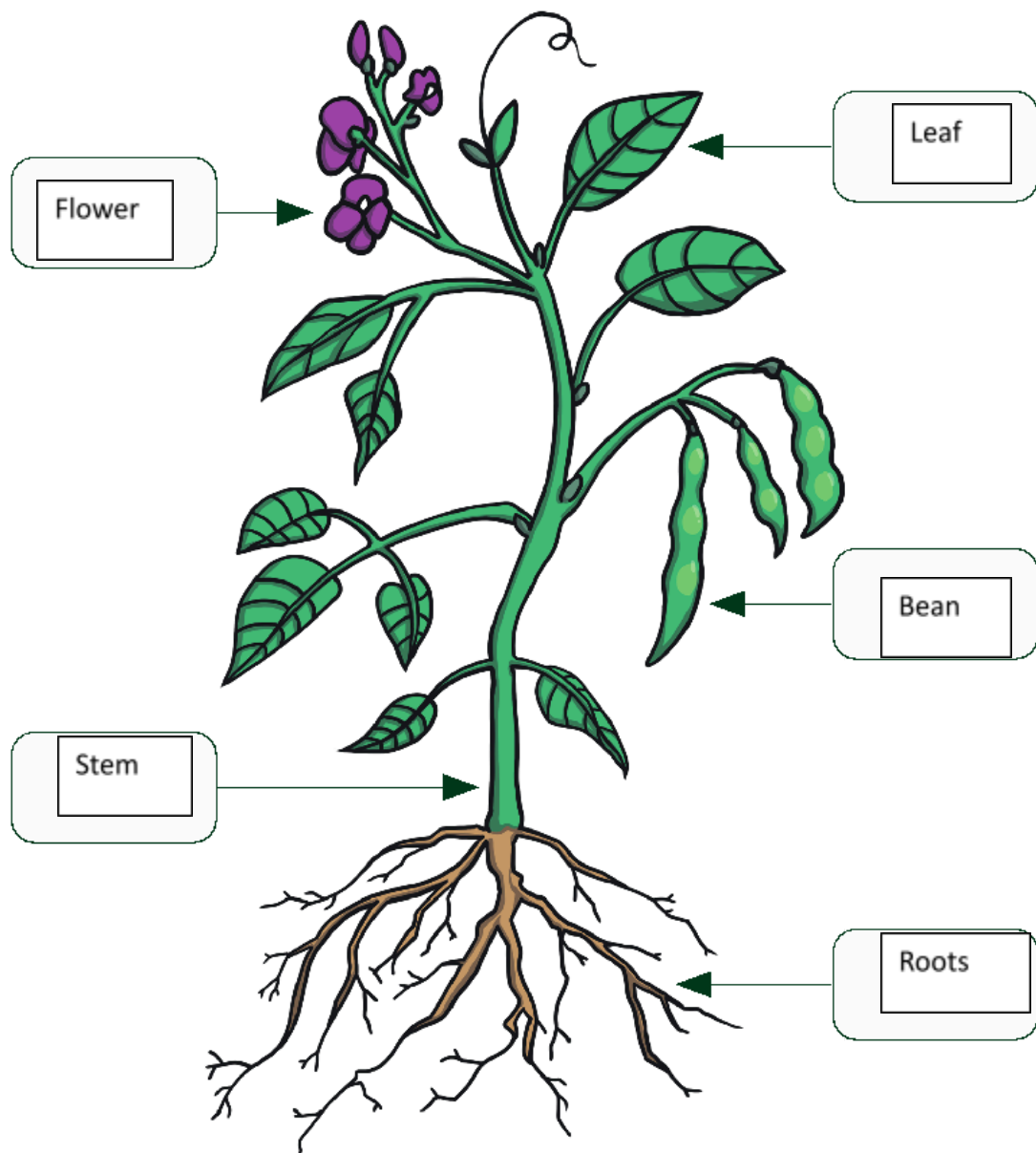
leaf

bean

stem

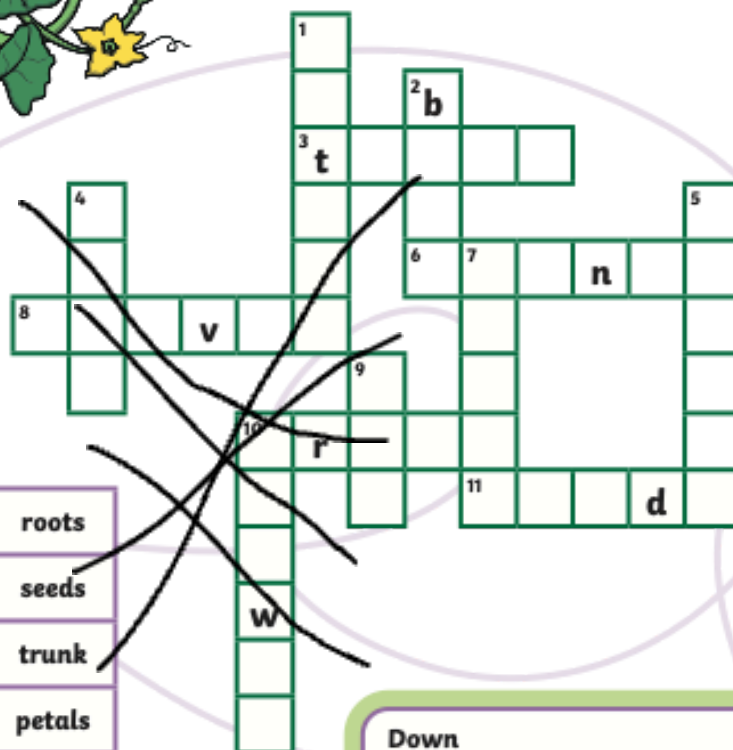
roots

Parts of a Bean Plant



flower	leaf	bean	stem	roots
--------	------	------	------	-------

Plant Parts



Word Bank

leaves	branch	roots
bud	stem	seeds
fruit	bulb	trunk
thorns	flower	petals

Across

- The main stem of a tree. Branches come from this.
- A part of a tree growing from the main trunk.
- The _____ of a plant grow on the stem. They make food for the plant.
- Some plants grow _____ that we can eat. Inside are seeds.
- New plants can grow from _____.

Down

- Part of a flower that can be colourful.
- Round and holds a new plant shoot. For example, daffodils, tulips and onions.
- The _____ holds the plant up straight.
- Stiff and sharp points that stick out of the stem or other part of a plant.
- Will grow underground. They take-up nutrients and water.
- The beginnings of a flower or leaf.
- Part of a plant that has petals and makes seeds.

Parts of a Plant

Amazing Fact

Figs contain digested fig wasps, which crawl inside as part of the pollination process and can't get back out.

Challenge

Match up the words and their meanings.

petals	releases pollen which brushes onto insects when they land on a flower
leaves	absorb water and minerals from the soil
stem	attract insects and birds to the plant
roots	make food for the plant from CO ₂ and sunlight
anther	transports water around the plant

You could also try to find out:

- about the unusual life cycle of the fig wasp and how figs depend on them;
- about other extraordinary life cycles;
- what pollination is;
- methods used by other plants for pollination.



Parts of a Plant

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Figs contain digested fig wasps, which crawl inside as part of the pollination process and can't get back out.

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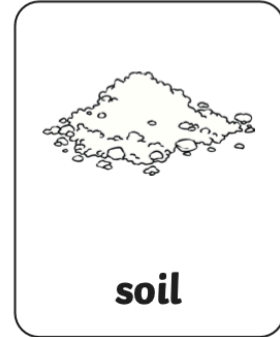
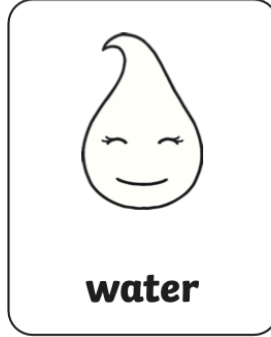
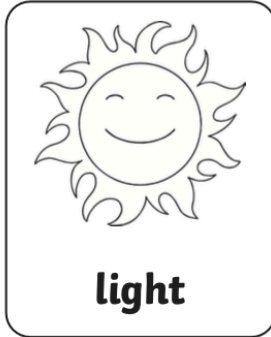
You could also try to find out:

- about the unusual life cycle of the fig wasp and how figs depend on them;
- about other extraordinary life cycles;
- what pollination is;
- methods used by other plants for pollination.



Plants Need...

Use the words below to finish the sentences.



Many plants need _____ from the sun.

Many plants need _____ or they will dry out.

Many plants use _____ to grow their roots in.
They get the nutrients they need from the soil.

Plants need _____ and _____ that they use to make food.

Plants need these three things:

Plants Need...	My Pictures of What Plants Need
1. w _ _ _ _	
2. s _ _ _	
3. l _ _ _ _	



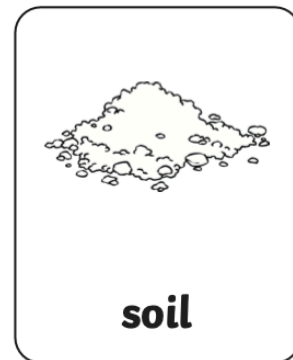
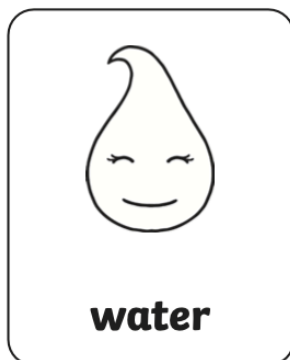
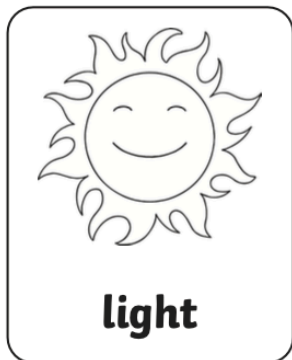
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Plants Need... Answers

Use the words below to finish the sentences.



Many plants need **light** from the sun.

Many plants need **water** or they will dry out.

Many plants use **soil** to grow their roots in.

They get the nutrients they need from the soil.

Plants need **light** and **water** which they use to make food.

Plants need these three things:

Plants Need...	My Pictures of What Plants Need
1. water	
2. soil	
3. light	



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this topic safely.

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The Life Cycle of a Bean Plant

Beans are a type of plant.

The bean plant goes through six stages in a life cycle.

1



The Seed Germinates

The plant starts life as a seed. The seed begins to germinate, or grow. A shoot emerges in about two to three days.

2



The Plant Grows

The seedling continues to grow, and a stem and leaves appear. Roots continue to grow underground.

3



The Plant Flowers

The plant produces flowers. Bean plant flower petals can be red, white, or yellow. You can usually see flowers after six to eight weeks.

4



The Flower Produces Fruit

The bean plant produces pods of beans after 12 to 14 weeks. These pods are what we can pick and eat.

5



The Fruit Releases Seeds

The flower shrivels, and seeds fall onto the ground.

6



The Plant Dies

The final stage is when the plant dies. The seeds that are left produce new plants.

Did you know?

- Annuals complete their life cycle in one year.
- Biennials complete their life cycle in two years.

Questions

- How many stages are in a bean plant life cycle?
 - ☐ three
 - ☐ four
 - ☐ five
 - ☐ six
- During which stage does the seed germinate?
 - ☐ one
 - ☐ two
 - ☐ three
 - ☐ four
- How long will it take a pod of beans to grow on the plant?
 - ☐ two to three days
 - ☐ four to five days
 - ☐ 12 to 14 days
 - ☐ 12 to 14 weeks
- What is a possible color for bean plant flowers?
 - ☐ orange
 - ☐ pink
 - ☐ red
 - ☐ green
- What might help a seed to germinate?

- How do bean plants continue to grow after one dies?

Answers

- How many stages are in a bean plant life cycle?
 - ☐ three
 - ☐ four
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- During which stage does the seed germinate?
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- How long will it take a pod of beans to grow on the plant?
 - ☐ two to three days
 - ☐ four to five days
 - ☐ 12 to 14 days
 - ☒ 12 to 14 weeks
- What is a possible color for bean plant flowers?
 - ☐ orange
 - ☐ pink
 - ☒ red
 - ☐ green
- What might help a seed to germinate?
Answers may vary. A possible answer is: Light, water, and warmth may help a seed germinate.
- How do bean plants continue to grow after one dies?
Answers may vary. A possible answer is: Bean plants leave seeds behind when they die. These seeds grow into new plants.

Appendix K - Garden in glove

3. GARDEN IN A GLOVE

Teach students about seed germination using gloves and cotton balls.

Materials Needed:

- Clear plastic glove
- 5 cotton balls
- 5 types of seeds, 3-4 seeds of each (examples: lettuce, carrot, cucumber, tomato, broccoli)
- Pencil
- Water
- Marker

- Write your name on a clear plastic glove.
- Wet five cotton balls and wring them out.
- Place 3-4 seeds of the same type on each cotton ball (or dip the cotton balls in the seeds to pick them up). You may want to keep track of which seed is in which finger.
- Put a cotton ball with the seeds attached into each finger of the glove. Hint: You may have to use a pencil to get the cotton ball all the way to the tips of the glove fingers.
- Blow up the plastic glove and close it with a twist tie.
- Tape the glove to a window, chalkboard, or wall. You may want to hang a clothes line under a chalk tray and use clothes pins to hold the gloves on.
- The seeds will germinate in 3 to 5 days. Keep a plant diary and look at the seeds under a microscope.
- Transplant the seeds about 1 $\frac{1}{2}$ to 2 weeks by cutting the tips of the fingers off the glove. Transplant the cotton ball and small plants into soil or sphagnum moss.
- After growing to full size, plants can be made into a salad.

THE Appendix L- The magic of growth: from seed to lemon tree

BOTANY SCIENCE

experiment

GROW LEMON TREES FROM SEEDS



Download Now



KidMinds.org



Not only does it provide hands-on learning about the natural world, it instills patience, responsibility, and the introduction to the magic of growth.

I love doing easy, hands-on science projects for my kids, not just because it's such a memorable way to learn (for them) but also because it's a fun opportunity for me to bond with them. Something I will always remember fondly, even when my kids are all grown up.



**BOTANY ACTIVITY:
GROW A LEMON TREE
FROM A SEED**

**FREE
DOWNLOAD**

Science Notes
GROW A LEMON TREE

WHAT YOU NEED:
kitchen
razor,
paper or
scissors

**WHAT
HAPPENED**

**The Scientific Method
GROW A LEMON TREE**

ASK A QUESTION
- Observe
- Wonder
- Identify a problem or
an area of interest or
curiosity
- Ask: What do I want
to learn more about?
OR
What would happen
if...

GATHER INFORMATION AND RESOURCES
- What do I already know?
- What information do I need to find
an answer to my question?
- What resources do I have/need?

FORM A HYPOTHESIS
Predict what you think will happen based
on what you already know.

EXPERIMENT
- How can I test my hypothesis?
- What material do I need?
- What is my plan?
- What are the steps of my
experiment?

ANALYZE THE RESULTS
- What happened?
- What did I learn?
- Was my prediction right?

**SHARE
WHAT YOU
LEARNED**
- From this experiment I
know that... for
instance...
- Based on what
happened, I...
- According to...
- The problem with this
experiment is...
- What I want to find out
now is...

THE MAGIC OF GROWING!

KidMinds.org

How to Grow a Lemon Tree from a Seed

Let's transform these simple lemon seeds into thriving trees and turn education into a zestful journey (get it? Zest :). So, next time you have a lemon, make the most of it – grow a lemon tree!

1. Cut a lemon in half

Cut a lemon in half and remove those lemon seeds. Are you kids intrigued to find out that a whole lemon can grow from such a little seed?



2. Soak the Seeds

Soak the seeds in water to soften the outside layer for about 12 hours. While you are waiting, show your kids a lemon, the seeds, and perhaps photos of a fully-grown lemon tree you can find on the internet. Point out the dramatic transformation that a tiny seed can undergo. This will create an ‘image’ in their minds and will make them excited to start the process themselves.



3. Germination

Wet a paper towel and line a mason jar with it. Allow your kids to do as much as they can independently. I know you can do it better, straighter, and with less mess, but this hands-on experience is not just fun; it also helps them understand the process and makes them feel involved.



Place the seeds between the outside of the jar and the wet paper towel. Encourage your kids to ask questions about why and how of the experiment in particular and the science of growing in general. This will make the process more interactive and educational.

Fill the center of the jar with towels, cotton balls, or pebbles. This step prevents the seeds from moving. Interestingly enough, we discovered that if the seed is moved, it makes it stop growing.

Place the mason jar in a warm, dark place, like a corner in your kitchen. As the seeds start to sprout and grow, ask your kids to observe and comment on the changes. If you are keeping an Observation Journal, make note-taking a regular part of your routine.

Add more water when the paper towel dries up, but avoid waterlogging the seeds.

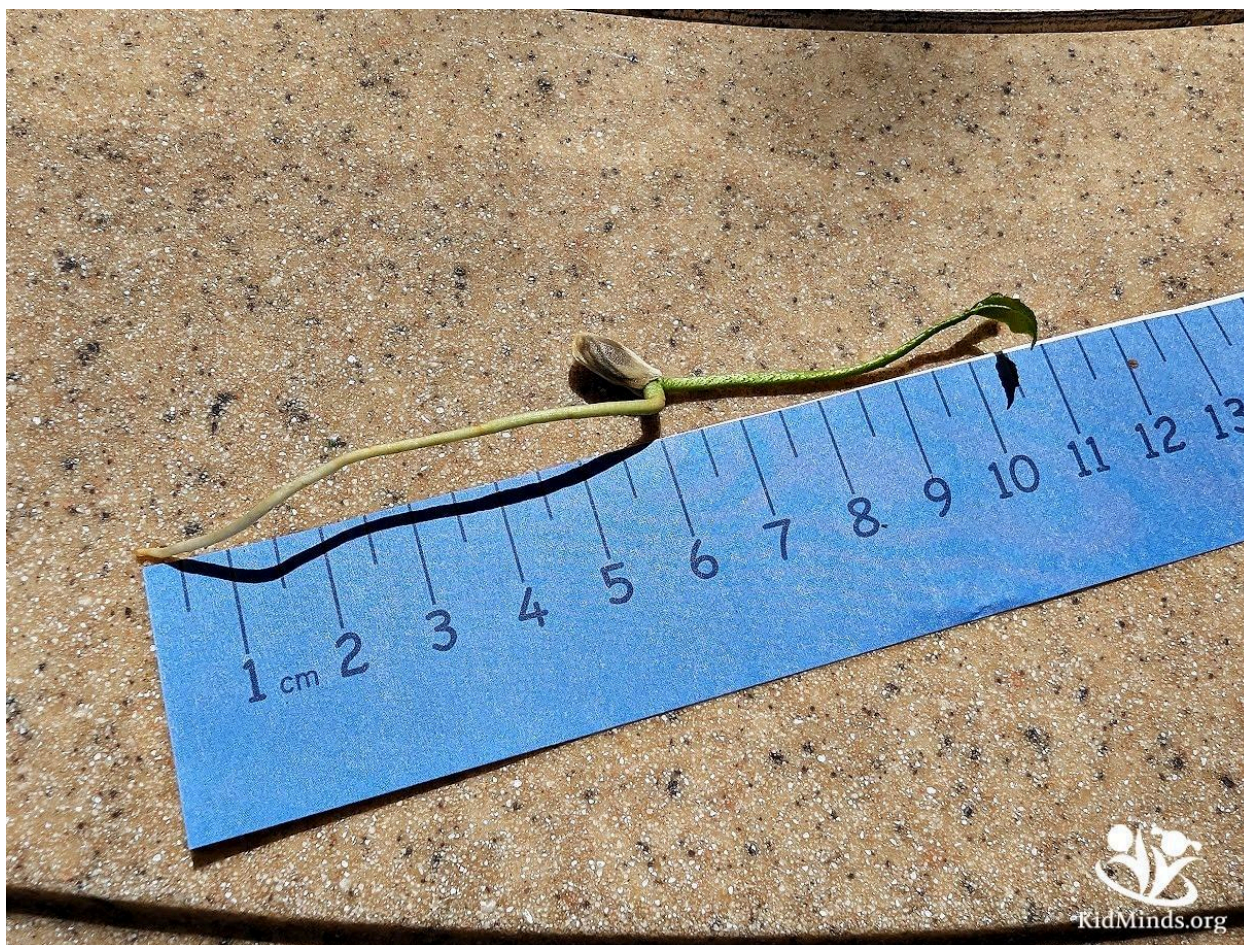
4. Growth

It took 13 days for us to see the first lemon seed sprouting. But it seemed like an eternity. And here is how our seeds looked at 4 weeks!





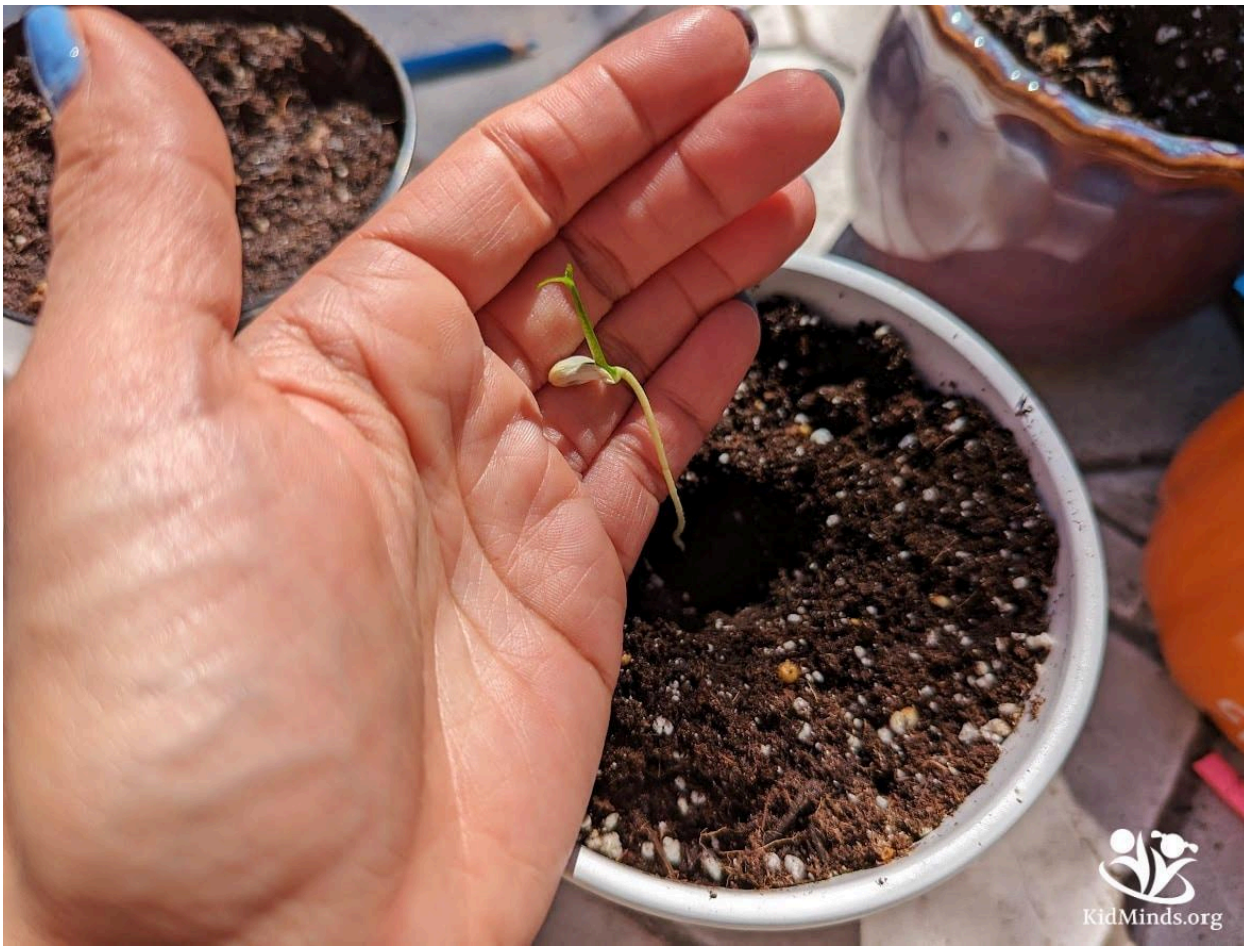
At the 5-week mark, we got a ruler out and measured our sprouted seeds for the fun of it. 11 centimeters! Or about 4.3 inches.



5. Planting the Seed

The next step in growing lemon trees is planting the seeds. It's best if you plant the seed in a pot filled with good-quality potting soil.

The seed needs to be covered with about half an inch of soil.



6. Keeping plants alive

Much care goes into nurturing the sprouting seeds into a full-grown tree: air, water, sunlight, and love.

As the seedling begins to grow, it stretches towards the sun. The sun provides energy through a process called photosynthesis, which the plant needs to grow. The leaves capture sunlight and convert it into energy to fuel the plant's growth. Meanwhile, the roots of the seedling anchor it in the ground and absorb water and nutrients from the soil.



7. Maturation

Growing trees from seeds is a fascinating project for kids. It's also meaningful, rewarding, and educational.



We planted all our sprouted seeds! Yep, we are growing a whole bunch of lemon trees. What's notable, though, is that they are all growing at different rates depending on where my kids positioned them.

We are at a six-month mark right now, and our lemon trees continue to grow, getting taller and stronger.

We know that, eventually, our trees will start to flower. And if we put our pots outside, the flowers can get pollinated by bees or other insects, and from these pollinated flowers, lemons will start to grow! I will update here when that happens!

THE Appendix M- Examples of plant helpers and how they work to help plants?

PLANT HELPERS

There are many creatures that help to keep plants happy and healthy.

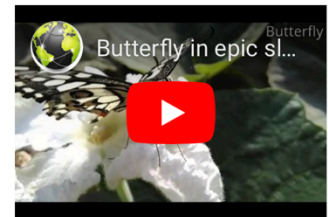
Can you name some?

Look below for information on plant helpers - butterflies, bees, ladybugs, hummingbirds and earthworms.



BUTTERFLIES

Besides being beautiful, butterflies help plants by pollinating. They are attracted to brightly colored, fragrant flowers and feed on the nectar produced by flowers. As the butterflies travel from one flower to another, they pollinate the plants, which means the plant will be able to make seeds to reproduce itself or it will make food for us to eat.



This **Youtube video** shows a butterfly pollinating a plant in slow motion.

BEES

Why do we like to have bees in the garden? Pollination!

Without bees there would be no fruit.

All fruits start out as flowers, but the flowers won't turn into fruits unless they are pollinated. So if we don't have bees we would miss out on fruits such as apples, cherries, plums, peaches, blueberries, strawberries and vegetable such as tomatoes, cucumbers, squash, zucchini and pumpkins.

There are hundreds of foods that we would no longer have if we lost our bees.

Click on the link for more info and activities on

[HONEYBEES](#), what they are facing and how we can help.

Also check out the [fruits, flowers and pollination](#) page.





LADYBUGS

Most people are fond of ladybugs because of their fun, colourful and spotted appearance. But farmers and gardeners love them for their appetite as they happily consume plant-eating insects, such as aphids, and in doing so they help to protect crops. Ladybugs lay hundreds of eggs in the colonies of aphids and other plant-eating pests.

Did you know there are over 300 types of ladybugs that live in North America? Ladybugs come in many colors besides red: like pink, yellow, white, orange and black.

Click here to see an image of [ladybug larvae](#).

(its not what you expect! They look a little like baby alligators)

BIRDS

Having birds in our garden is very important for the health and well being of our plants. They are also just beautiful to look at!

Click on the link [BIRDS](#) for more information and activities.

Click on this link to see [Vancouver Island Birds](#) images and [Southern Vancouver Island](#) images

Click on this link to see what plants attract [hummingbirds](#) into the garden



EARTHWORMS

Q: What do you know about worms?

Do they have legs? How do they move?

Do they have mouths? Teeth? How do they eat?

Do they have eyes? How do they see?

Are their bodies dry or wet?

THE Appendix N- READ THE PICTURES ACTIVITY: COMAPER TRADITIONAL AND MODERN FARMING



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TRADITIONAL AND MODERN AGRICULTURE

Save slide



TRADITIONAL AGRICULTURE (1600s -1700s)

Save slide

Traditional Agriculture can be defined as a primitive style of **farming** that involves the intensive use of indigenous knowledge, **traditional** tools, natural resources, organic fertilizer and cultural beliefs of the farmers.

In other words , **plant** and **animals** are used for consumption and survival as a way of life



MODERN AGRICULTURE

(TODAY'S AGRICULTURE)

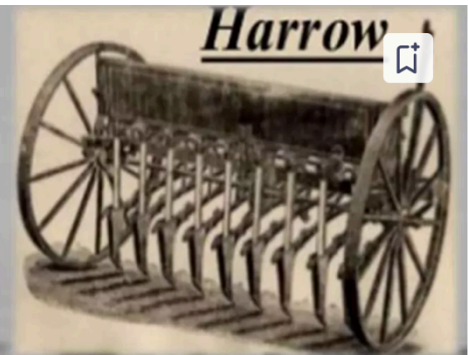
Modern agriculture is an evolving approach to **agricultural** innovations and **farming** practices that help farmers increase efficiency and reduce the number of natural resources like water, land, and energy necessary to meet the world's food, fuel, and fiber needs.

The **agribusiness**, **intensive farming**, **organic farming**, and **sustainable agriculture** are other names of modern agriculture.

LAND PREPRATION

Tillage (working the soil with hoes, plows or other equipment)

Seedbed shaping (leveling land or making raised beds or ridges)



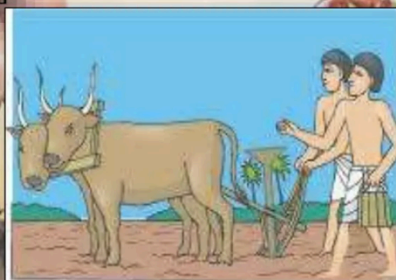
LAND PREPRATION

OLD CONCEPT
DISK PLOUGH
HARROW
PLOUGH
MB PLOUGH
LAND LEVELLER

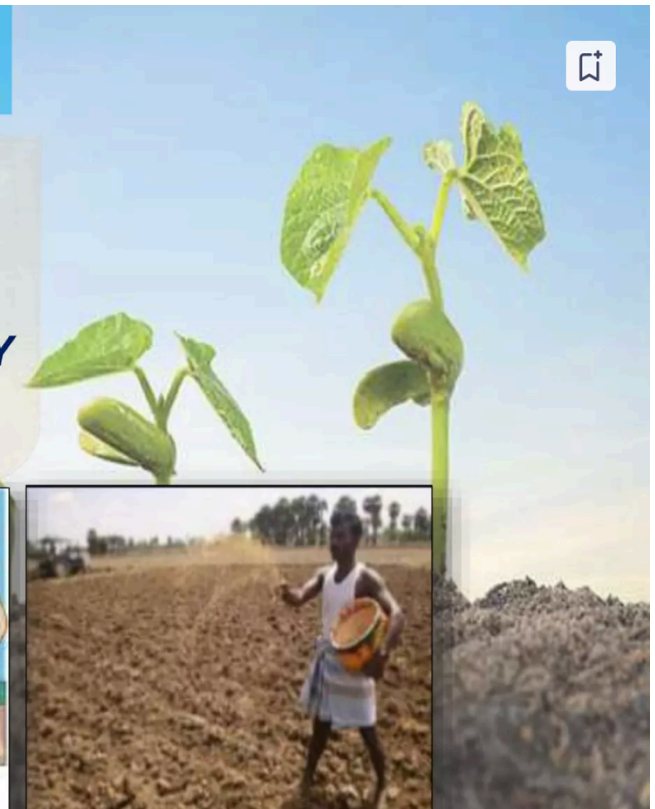


SOWING & PLANTING

- BY HAND
- FUNNEL
- GOOD QUALITY
- PROPER



Sowing



SOWING & PLANTING

- MORE QUICKLY
- MORE ACCURATELY



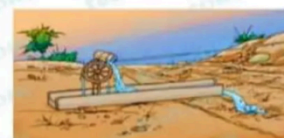
IRRIGATION

TRADITIONAL

- TYPES : Moat , Chain Pump, Dhekli , Rahat.
- TURN BY TURN EVERYONE



Moat (Pulley System)



Chain Pump



Dhekli



Rahat (Lever system)



MODERN

- AUTOMATIC
- MICROIRRIGATION
- DRIP IRRIGATION
- SPRINKLE IRRIGATION

WEEDING

- Use to remove the weeds.
- To alter the microclimate below the plants.
- More time consuming.



HARVESTING

TRADITIONAL

- KNIFE
- SICKLE



MODERN
BACKHOE
COMBINE
ROBOTIC HARVESTING



