NATIONAL GEOGRAPHIC

Activity*develop*

Climate and Crop Growth

How does the weather affect plant growth?

Overview

Students explore climate graphs and an interactive computational model to discover the role of temperature and precipitation on the growth of crops. They examine how the extremes of precipitation (drought and flood) affect plant growth and they use maps of average precipitation and temperature to predict which area will be best suited for agricultural production.

For the complete activity with media resources, visit:
http://education.nationalgeographic.org/activity/climate-crop-growth/

Directions

1. Engage students in learning about climate and crop growth.

Tell students that plants need water and sunlight to grow. Some plants have long growing seasons while others have shorter growing seasons. Show the **Climate Graphs** image. (Download the image from the media carousel above by clicking on the down arrow in the lower right corner of the carousel window.) These graphs provide climate information for Quibdó, Colombia; Minneapolis, Minnesota; and El Paso, Texas. Ask:

- *Will a crop grow the same in Quibdó, Colombia and Minneapolis, Minnesota?* (No, the crops will grow differently. There is no dry season in Quibdó, and the temperature remains warm year-round. The climate in Minneapolis is very different.)
- *Would you plant a crop that needs a lot of moisture in El Paso, Texas?* (No, a crop that requires a lot of moisture would not do well in El Paso unless there was irrigation. El Paso has a very dry climate.)

2. Discuss the role of uncertainty in the scientific process.

Tell students that science is a process of learning how the world works and that scientists do not know the “right” answers when they start to investigate a question. Tell students that they can see examples of scientists' uncertainty in forecasting crop yields. Show the **Projection of Maize Crop Yields in France** graphs. (Download the image by clicking on the down arrow in the lower right corner of the carousel window.) Tell students that these graphs show the average daily precipitation, number of hot days, and yield of maize. The gray line shows the predictions for crop yield based on technological improvements. The pink shading shows the expected yield based on temperature and precipitation influences. The total uncertainty is shown by the red lines outside the pink shading. Ask:

- *Does the technology trend (gray line) accurately predict crop yields?* (No, the technology trend does not adequately predict crop yields. This is because crop yields are dependent on temperature and precipitation as well as technological improvements.)
- *Why do you think the crop models still have uncertainty even after accounting for precipitation and temperature differences year to year?* (Student answers will vary. The crop yield could be affected by a pest infestation.)

Tell students they will be asked questions about the certainty of their predictions. Let students know that they should think about what scientific data is available as they assess their certainty with their answers. Encourage them to discuss the scientific evidence with each other to better assess their level of certainty with their predictions.

3. Introduce the concept of stocks and flows in a system.

Tell students that materials flow into and out of systems. The flow of the materials over time can change and can be influenced by many different factors and interacting parts.

Scientists think about how one part of the system can affect other parts of the system. Give students a simple example of a stock and flow in a system, as described in the scenario below.

There is a bathtub with water flowing in from the faucet and water leaving through the drain. Ask:

- *When the drain is plugged, what happens to the level of water in the bathtub?* (The water level will increase because the outflow of water is stopped, but water keeps coming in from the faucet.)
- *When the faucet is turned off, what happens to the level of water in the bathtub?* (The water level will decrease because the inflow of water is stopped, but the water keeps leaving through the drain.)
- *How can the level of water in the bathtub be kept at the same level?* (The water in the bathtub can be kept at the same level by making the inflow equal to the outflow. Then the water that comes in through the faucet will be offset by the water that leaves through the drain.)

Tell students they will be following the flow of materials, in this case the amount of topsoil and nutrients, through a system. Let students know they will be exploring some environmental and human factors that contribute to changes in the quality of soil in the modeled system.

4. Introduce and discuss the use of computational models.

Introduce the concept of computational models and give students an example of a computational model they may have seen, such as forecasting the weather. Project the **NOAA Weather Forecast Model**, which provides a good example of a computational model. Tell students that scientists use weather models to predict future conditions based on current information about the energy and moisture in the atmosphere. There are many different types of models. Scientists can use soil models to predict the movement and quality of soil in a region. Let students know that they will be using models of soil movement and quality.

5. Have students launch the Climate and Crop Growth interactive.

Provide students with the link to the Climate and Crop Growth interactive. Divide students into groups of two or three, with two being the ideal grouping to allow groups to share a computer workstation. Tell students they will be working through a series of pages of questions related to the data in the interactive. Ask students to work through the interactive in their groups, discussing and responding to questions as they go.

Tell students that this is Activity 3 of the **Can We Feed the Growing Population?** lesson.

6. Discuss the issues.

After students have completed the activity, bring the groups back together and lead a discussion focusing on these questions:

- *What happens in the model (***Model 3: Landscapes with Climate Controls***) when there is very little precipitation?* (The plants don't grow as well as they did when there was more precipitation.)
- *If you know the climate of an area, can you predict its ability to grow crops?* (If you know the climate of an area, you can start to predict its ability to grow crops, but you cannot accurately predict its ability to grow crops. This is because climate is only one part of growing crops. You also need to have good soil to grow crops. If the climate is suitable, it doesn't mean the soil is suitable.)
- *What can farmers do to grow crops even when the weather isn't cooperative?* (Farmers can irrigate their fields during dry weather. During wet weather, they can try to drain their fields more quickly so the plants don't drown.)

Tip

If you would like to save student data for grading online, register your class for free at the High-Adventure Science portal page.

Tip

This activity is part of a sequence of activities in the Can We Feed the Growing Population? lesson. The activities work best if used in sequence.

Modification

This activity may be used individually or in groups of two or three students. It may also be modified for a whole-class format. If using as a whole-class activity, use an LCD projector or interactive whiteboard to project the activity. Turn embedded questions into class discussions. Uncertainty items allow for classroom debates over the evidence.

Informal Assessment

1. Check students' comprehension by asking them the following questions:

- What happens to plant growth if there is not enough precipitation?
- What happens to plant growth if there is too much precipitation?
- What climates are common among agriculturally suitable lands around the world?

2. Use the answer key to check students' answers on embedded assessments

Objectives

Subjects & Disciplines

Science

- Earth science
- General science

Learning Objectives

Students will:

- describe the role of precipitation in plant growth
- describe the role of temperature in plant growth

Teaching Approach

- Learning-for-use

Teaching Methods

- Discussions
- Multimedia instruction
- Self-paced learning
- Visual instruction
- Writing

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information, Communications, and Technology Literacy
  - Learning and Innovation Skills
    - Critical Thinking and Problem Solving
- 21st Century Themes
  - Global Awareness
- Critical Thinking Skills
  - Analyzing
  - Evaluating
  - Understanding

National Standards, Principles, and Practices

National Science Education Standards

• **(5-8) Standard A-1:**
Abilities necessary to do scientific inquiry
• **(5-8) Standard D-1:**
Structure of the earth system
• **(5-8) Standard F-1:**
Personal health
• **(5-8) Standard F-4:**
Risks and benefits
• **(9-12) Standard A-1:**
Abilities necessary to do scientific inquiry
• **(9-12) Standard A-2:**
Understandings about scientific inquiry
• **(9-12) Standard C-5:**
Matter, energy, and organization in living systems
• **(9-12) Standard F-1:**
Personal and community health
• **(9-12) Standard F-2:**
Population growth
• **(9-12) Standard F-4:**
Environmental quality
• **(9-12) Standard F-5:**
Natural and human-induced hazards

Common Core State Standards for English Language Arts & Literacy

• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.6-8.3
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.11-12.3
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.11-12.1
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Craft and Structure, RST.9-10.4
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.9-10.3
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.9-10.1
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Craft and Structure, RST.6-8.4
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.6-8.1
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Craft and Structure, RST.11-12.4

ISTE Standards for Students (ISTE Standards*S)

• **Standard 3:**
Research and Information Fluency
• **Standard 4:**
Critical Thinking, Problem Solving, and Decision Making

Next Generation Science Standards

• **Crosscutting Concept 1:**
Patterns
• **Crosscutting Concept 2:**
Cause and effect: Mechanism and prediction
• **Crosscutting Concept 3:**
Scale, proportion, and quantity
• **Crosscutting Concept 4:**
Systems and system models
• **Crosscutting Concept 5:**
Energy and matter: Flows, cycles, and conservation
• **Crosscutting Concept 7:**
Stability and change
• **Science and Engineering Practice 1:**
Asking questions and defining problems
• **Science and Engineering Practice 2:**
Developing and using models
• **Science and Engineering Practice 3:**

Planning and carrying out investigations
• **Science and Engineering Practice 4:**
Analyzing and interpreting data
• **Science and Engineering Practice 5:**
Using mathematics and computational thinking
• **Science and Engineering Practice 6:**
Constructing explanations and designing solutions
• **Science and Engineering Practice 7:**
Engaging in argument from evidence
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information

Preparation

What You'll Need

Required Technology

- Internet Access: Required
- Tech Setup: 1 computer per learner, 1 computer per small group, Interactive whiteboard, Projector

Physical Space

- Classroom
- Computer lab
- Media Center/Library

Grouping

- Heterogeneous grouping
- Homogeneous grouping
- Large-group instruction
- Small-group instruction

Resources Provided: Websites

- NOAA Weather Forecast Model

Resources Provided: Handouts & Worksheets

- Answer Key - Climate and Crop Growth

Resources Provided: Interactives

- Climate and Crop Growth interactive

Resources Provided: Images

- Climate Graphs
- Projection of Maize Crop Yields in France

Background & Vocabulary

Background Information

An area's climate affects the types of plants that can grow there. Plant growth is dependent on precipitation and temperature. If the precipitation level is too high or too low or if the temperature is too high or too low, plants may not grow well.

Some climates are better for growing crops than others. Agriculturally suitable lands have adequate precipitation and moderate temperatures as well as good soils. Farmers regularly have to contend with wet and dry events to grow crops, even in hospitable climates.

Prior Knowledge

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Recommended Prior Activities

- Preserving Soils
- Using the Land

Vocabulary

Term	Part of Speech	Definition
agriculture	*noun*	the art and science of cultivating the land for growing crops (farming) or raising livestock (ranching).
biosphere	*noun*	part of the Earth where life exists.
climate	*noun*	all weather conditions for a given location over a period of time.
drought	*noun*	period of greatly reduced precipitation.
landscape	*noun*	the geographic features of a region.
model, computational	*noun*	a mathematical model that requires extensive computational resources to study the behavior of a complex system by computer simulation.
soil	*noun*	top layer of the Earth's surface where plants can grow.
system	*noun*	collection of items or organisms that are linked and related, functioning as a whole.

For Further Exploration

Reference

- National Geographic Encyclopedic Entry: rural area
- National Geographic Encyclopedic Entry: urban area
- National Geographic Encyclopedic Entry: agriculture

- National Geographic Encyclopedic Entry: fertility
- National Geographic Encyclopedic Entry: humus

Funder

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Partner