Drought

Earth & Space Science | Lesson Guide

5th Grade

Photo Description

This image shows dry, cracked soil with deep gaps between broken pieces of earth. Small green plants are trying to grow through some of the cracks. The soil looks very dry and hard, like it hasn't had water for a long time.

Scientific Phenomena

The anchoring phenomenon here is soil desiccation and drought stress on plant ecosystems. This occurs when soil loses moisture faster than it can be replenished through precipitation or irrigation. As water evaporates from soil particles, the clay and organic matter shrink and contract, creating the characteristic polygonal crack patterns. The stress fractures form because the surface layer dries faster than deeper soil layers, creating tension that literally pulls the earth apart.

Core Science Concepts

1. Water Cycle Disruption: When precipitation decreases or evaporation increases, soil moisture becomes depleted, affecting plant growth and soil structure.

2. Soil Composition and Properties: Clay-rich soils are particularly prone to cracking because clay particles expand when wet and contract dramatically when dry.

3. Plant Adaptations: The small plants visible in the cracks demonstrate how some species can survive in harsh, dry conditions by growing deep roots and conserving water.

4. Weathering and Erosion: Cracked soil is more vulnerable to wind and water erosion, which can carry away valuable topsoil.

Pedagogical Tip:

Use this image to help students make connections between the water cycle they've learned about and real-world consequences. Ask them to trace backwards from this cracked soil to identify what parts of the water cycle might be missing or reduced.

UDL Suggestions:

Provide tactile experiences by bringing in samples of wet clay that students can observe drying over several days. This hands-on approach supports kinesthetic learners and makes the abstract concept of soil contraction concrete and observable.

Zoom In / Zoom Out

1. Zoom In: At the microscopic level, soil particles are held together by thin films of water. When this water evaporates, the attractive forces between clay particles cause them to pull closer together, creating the physical stress that forms cracks.

2. Zoom Out: This cracked soil is part of larger drought patterns that can affect entire watersheds, agricultural regions, and climate systems. Widespread soil drying contributes to reduced groundwater recharge, increased dust storms, and changes in local weather patterns.

Discussion Questions

1. What evidence do you see that tells you about the water cycle in this location? (Bloom's: Analyze | DOK: 2)

2. How might the plants growing in these cracks be different from plants that grow in well-watered soil? (Bloom's: Evaluate | DOK: 3)

3. If you were a farmer looking at this field, what steps could you take to help the soil and plants? (Bloom's: Create | DOK: 3)

4. What do you predict would happen to this soil if it rained heavily tomorrow? (Bloom's: Apply | DOK: 2)

Potential Student Misconceptions

1. Misconception: "The cracks formed because the ground got too hot from the sun."
   Clarification: While heat increases evaporation, the cracks form specifically from water loss and soil shrinkage, not directly from temperature.

2. Misconception: "Plants can't grow in cracked, dry soil."
   Clarification: Some plants are specially adapted to survive drought conditions and may actually find it easier to establish roots in the cracks where there might be slightly more moisture.

3. Misconception: "All soil cracks the same way when it dries out."
   Clarification: Different soil types behave differently - sandy soils rarely crack because sand particles don't shrink much, while clay-rich soils crack dramatically.

Cross-Curricular Ideas

1. Math - Data Collection and Graphing: Have students measure the width of soil cracks in different areas of the photo using a ruler. Then create a bar graph showing which areas have the widest cracks. This connects to measurement skills and data representation while reinforcing that drought affects soil differently in different locations.

2. ELA - Narrative Writing: Ask students to write a short story from the perspective of a plant trying to survive in the cracked, dry soil. What challenges does it face? How does it adapt? This creative writing activity helps students empathize with organisms affected by environmental stress and practice descriptive language.

3. Social Studies - Agricultural Impact: Research and discuss how droughts affect farmers and communities that depend on agriculture. Students can create a poster or presentation showing the human impact of soil desiccation on food production, water availability, and people's lives. This connects environmental science to real-world social and economic consequences.

4. Art - Texture and Pattern Study: Use the crack patterns in this photo as inspiration for an art project. Students can create their own cracked soil designs using clay, paint, or collage materials. This helps them observe and reproduce natural patterns while exploring how physical forces (like water loss) create patterns in nature.

STEM Career Connection

1. Soil Scientist (Pedologist): Soil scientists study soil composition, health, and how soil changes over time. They figure out why soil cracks, how to help plants grow better, and how to protect soil from damage. They might work for farms, environmental agencies, or universities. Average Salary: $65,000 - $75,000 per year

2. Hydrologist: Hydrologists study water movement through Earth's systems, including how water moves through and out of soil. They predict droughts, help plan water use, and figure out how to keep water available for people and plants. Average Salary: $80,000 - $90,000 per year

3. Agricultural Engineer: These engineers design systems and tools to help farmers deal with problems like drought and poor soil. They might create better irrigation systems, develop drought-resistant crops, or design equipment that helps soil stay healthy. Average Salary: $75,000 - $85,000 per year

NGSS Connections

- Performance Expectation: 5-ESS2-1 - Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- Disciplinary Core Ideas: 5-ESS2.A - Earth's major systems interact through physical and chemical processes
- Disciplinary Core Ideas: 5-LS2.A - The food of almost any kind of animal can be traced back to plants
- Crosscutting Concepts: Systems and System Models - A system can be described in terms of its components and their interactions
- Crosscutting Concepts: Cause and Effect - Cause and effect relationships are routinely identified and used to explain change

Science Vocabulary

* Desiccation: The process of something becoming completely dried out
* Drought: A long period of time with little or no rainfall
* Evaporation: When liquid water changes into invisible water vapor and rises into the air
* Soil composition: The different materials that make up soil, like clay, sand, and organic matter
* Adaptation: Special features that help living things survive in their environment
* Erosion: The process of soil and rock being worn away and moved by wind or water

External Resources

Children's Books:
- The Magic School Bus Meets the Rot Squad: A Book About Decomposition by Joanna Cole
- Soil by Sally M. Walker
- A Seed Is Sleepy by Dianna Hutts Aston