PUZZLE: DEMONSTRATE HOW TO TAKE “SOIL” CORE SAMPLES TO DETERMINE SOIL FERTILITY

STANDARDS & CONNECTIONS: NGSS.3-5-ETS1, NGSS.MS-ETS1

SUGGESTED MATERIALS: Playdough (soil), straws (soil probes), paper boat food trays, three different colors of nonpareil sprinkles (NPK nutrients)

BACKGROUND: Soil is a major source of nutrients needed by plants for growth. The three main nutrients found in healthy soil are nitrogen (N), phosphorus (P) and potassium (K). Nitrogen is a key element in plant growth. It is found in all plant cells, in plant proteins and hormones, and in chlorophyll. Phosphorus is a major component in plant DNA and RNA. Phosphorus is also critical in root development, crop maturity and seed production. The role of potassium in the plant is indirect, meaning that it does not make up any plant part. Potassium is associated with the movement of water, nutrients and carbohydrates in plant tissue. It’s involved with enzyme activation within the plant, which affects protein, starch and adenosine triphosphate (ATP) production.1 Farmers and ranchers will collect soil samples and send them in to a University laboratory to be analyzed for their nutrients and fertility levels.

1. IDENTIFY: Share the background information with the students, then share the puzzle to be solved. Determine constraints (e.g., time allotted, space, materials provided, etc.) and divide students into small groups.

2. IMAGINE: Ask a series of questions to help students brainstorm solutions to the puzzle. Encourage students to list all ideas – don’t hold back! Before moving on, make sure each group selects a solution that fits within the constraints.

   • Ask: How can you solve this puzzle? Which of your ideas can you build a prototype for given the constraints?

3. DESIGN: Students diagram the prototype, identify the materials needed to build the prototype, and write out the steps to take. Students describe the expected outcomes.

   • Ask: What steps will you take to create your solution? What do you expect your solution to look like and be able to do?

4. CREATE: Students follow their design plan and build their prototypes. Monitor their progress and remind them about how much time they have.

5. TEST & IMPROVE: Students evaluate their creation and compare it with the expected outcomes. Students seek areas of improvement and make changes where needed.

6. SHARE: Students share their solution to the puzzle and communicate lessons learned.

   • Ask: What was your biggest takeaway? What would you do differently?

ADDITIONAL RESOURCES: For more background information on this topic, please visit www.purpleplow.org.

Assign N, P, and K a sprinkle color. Students can take “soil” core samples, squeeze them out, and determine the the ratio of NPK in their soil by counting the sprinkles.

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