3M Young Scientist Lab

Classroon Activity | Grades K–2

Developing Possible Solutions: Slippery Soil

GUIDING QUESTIONS

How does the removal of a large number of trees impact the natural environment?

LEARNING OBJECTIVES

Students will be able to:

- explore impacts on land and soil using models.
- design solutions for environmentally friendly communities.

OVERVIEW

In session one, students are introduced to the main reasons humans remove large areas of trees from the natural environment. At different stations, young scientists explore the impacts on land/soil using a hill, tree, and rain models to test their predictions about the movement of soil on the hill before and after deforestation. Students draw conclusions about the important role of trees in soil stabilization.

In session two, students manipulate a model to portray the most environmentally friendly way to install six homes on a forested plot. Students generate design solutions based on assigned criteria and use evidence to justify their choices. To challenge students, the scenario is modified. Students reevaluate their solutions to determine if there is a need to redesign.

NEXT GENERATION SCIENCE STANDARDS

- ESS3.C: Human Impacts on Earth Systems
    - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (secondary to K-ESS2-2).

- ETS1.A: Defining and Delimiting an Engineering Problem
  - A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (K-2-ETS1-1)(secondary to KPS2-2).
  - Asking questions, making observations, and gathering information are helpful in thinking about problems. (secondary to K-ESS3-2)
  - Before beginning to design a solution, it is important to clearly understand the problem.
- ETS1.B: Developing Possible Solutions
  - Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-1)(secondary to K-ESS3-3)(secondary to 2-LS2-2)
- ETS1.C: Optimizing the Design Solution
  - Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-1)(secondary to 2-ESS2-1)

LESSON TIME FRAME

Two 45-minute lessons

BACKGROUND INFORMATION

Trees provide shade, help stabilize the land, return water back to the atmosphere, absorb greenhouse gasses, and provide habitats for living organisms. Without the shade of trees, soil is exposed to the sun's heat, which decreases the nutrients, cultures of helpful bacteria, and moisture levels in the soil. Soil with lower moisture levels is more likely to erode and negatively impact the watershed. Fewer trees returning water vapor to the atmosphere can lead to drought. If there are not enough trees to absorb greenhouse gasses, carbon dioxide can reach high/dangerous levels. High levels of carbon dioxide in Earth's atmosphere cause too much of the sun's heat to be trapped, upsetting the delicate balance of Earth's ecosystems. Many living organisms rely on trees for habitats. Cutting down large numbers of trees results in the endangerment/extinction of species. As a result of rainforest destruction, it is estimated that 137 species become extinct every day, or 50,000 per year. Global rates of deforestation are staggering. For example, South America has lost 70 percent of its rainforests, Madagascar has lost 95 percent, and the Philippines 90 percent. Due to the destruction caused by deforestation, governmental organizations have established laws, rules, and regulations in an effort to protect our trees.

For the purpose of this lesson, deforestation is when humans clear large areas of trees for non-forest use, like urban development, agricultural use (e.g. planting crops, grazing livestock), and natural resource extraction. Deforestation can also result from natural causes such as forest fires ignited by lightning and floods.

MATERIALS

Teacher Materials/Prep

- *The Lorax* by Dr. Seuss
- "Brainstorm Activator: Round Robin Strategy" student resource copied onto chart paper or projected onto interactive whiteboard
- 1 jar of soil
- 1 image of tree that illustrates root system in the ground
- 1 Undeveloped Land Plot Model
    - Use 4-inch squares of green paper to create a 40-inch square
    - Replace one green 4-inch square towards the middle with a blue 4-inch square
    - Cut out ten 2-inch brown squares and leave to the side
- Print/cut Stoplight Exit tickets for students (1 per student)
- Print Student Resources:
    - K-2:
        - Student Capture Sheet: The Best Way to Build (1 per group)
        - Student Capture Sheet: Slippery Soil Investigation Hills with Trees Observations (1 per group)
        - Student Capture Sheet: Slippery Soil Investigation Hills without Trees Observations (1 per group)
        - Student Capture Sheet: The Best Way to Build (1 per group)
        - Print Home Connection Resource: Slippery Soil (1 per student)
    - 2nd Grade only: (1 per student)
        - Student Capture Sheet: Brainstorm Activator, Round Robin Strategy
        - Student Capture Sheet: What if...?

Student Materials

- 12-inch square of ½ inch bubble wrap
- 12-inch square of plastic sheeting
- 1 32 ounce spray bottle per group
- 2 12-inch square pieces of thick cardboard
- 2 bricks (may substitute plastic tanks to create the hill)
- 1 cup of soil
- 2 12-inch long strips of laminated blue construction paper labeled stream (aluminum foil may be substituted)
- 1 yardstick

Materials per Student Group

- K-1: Chart paper
- Student Capture Sheet "What if…?" (1 per group, 2nd Grade)
- Student Capture Sheet: Slippery Soil Investigation Observation (1 per group)
- 1 pair safety goggles
- Student Capture Sheet: The Best Way to Build (1 per group)

CLASSROOM ACTIVITY

Teacher Prep for Stations:

Gather materials. Mount the bubble wrap and plastic wrap squares on cardboard squares. Fill each spray bottle with water and set the nozzle to mist. Pre-measure the soil. Obtain same-size bricks/plastic tanks to prop hills on an incline.

Station Set-Up:

- 1 bubble wrap square mounted and propped on an incline, sprinkled with 1/2 cup of soil, with a stream at the bottom of the hill.
- 1 plastic wrap square mounted and propped on an incline (equal to the bubble wrap square), sprinkled with one-half cup of soil, with a stream at the bottom of the hill.
- 1 spray bottle filled with water. Be sure to test and adjust nozzle spray level to produce optimal soil movement results prior to the student investigation.
- 1 yardstick (pre-determine an optimal height for spraying while testing nozzle spray level).

Day 1

1. Read and discuss *The Lorax* by Dr. Seuss.
    - Prompt students to ask and answer questions about the key details of the text. Explain and discuss the reasons (urban development, agricultural use, and natural resource extraction) humans remove trees from the natural environment.
    - Introduce the term deforestation. Explain that deforestation is when humans clear large areas of trees for non-forest use.
2. Create groups of four or partner students in a Think-Pair-Share to discuss the question, "How did removing the trees impact the environment?" Think about the air, water, land, and plants/animals. Allow students to share their ideas with the class.
3. **Grade 2:** Each group or pair of students will need the "How does removing trees change…" student capture sheet. Students discuss and take turns drawing pictures or writing words to document their ideas about how removing trees/forests impacts the land, water, air, and other living things. Encourage groups/pairs to list at least one idea

per square. Suggested Scaffold: Copy and cut up student capture sheets to make land, air, water, and plant/animal group cards. Distribute one card to each group of students, then generate and discuss ideas about how removing trees/forests impacts the land, water, and other living things as a class. Ask student groups to share their ideas. Post and discuss their contributions. Focus on their ideas about the land.
K-1: Lead a class discussion on how removing trees/forests impacts the environment. Allow student pairs to share their ideas as you move through land, water, air, and plant/animal habitats. On a chart, record student ideas. After students share, ask questions and provide summary statements to help students make connections between their ideas.

4. Hold up a jar of soil. Explain that trees play an important role in helping to keep soil in place. Ask students, "What holds a tree in the ground?" Explain that the roots of trees have many important roles including holding the soil in place. Use an image of a tree with a root system to reinforce this concept. Ask students, "Why is it important for the soil to stay in place?" Accept all answers with justification. Then clarify that if the soil washes away, it can pollute local waterways. Explain that too much soil in the water can kill plants, fish and other living organisms.
5. **Grade 2:** Direct student attention to a station and explain the set-up.
K-1: Direct student attention to the demonstration table with the materials for the investigation.
6. Describe how the models represent land plots. Notice the soil with trees (bubbles) and without trees (no bubbles). Explain that the spray bottle with water will be used to simulate rain.
7. **Grade 2:** Present the "What if…?" scenario student capture sheet. Ask individual students to make and record predictions about what will happen when it rains on the hill when it has trees and what will happen on the hill after all of the trees have been removed. Have students share their predictions with the other members of their group. Ask a couple of groups to share their predictions with the class.
K-1: Make groups of four. Ask students to make a prediction about what will happen to the soil on the hill when there are trees. Ask students to make a prediction about what will happen to the soil on the hill after the trees are cut down. Record their predictions on a class chart.
8. **Grade 2:** Facilitate the Slippery Soil Investigation at stations. Have student groups record their observations on the Slippery Soil Observations resource.
K-1: Conduct Slippery Soil Investigation as a class. Have individual students come up to produce rain showers in thirty-second intervals. Allow all students to record observations after each rain shower. Discuss student data as a class.
    - Explain that it is important that young scientists keep the rain simulation the same by keeping the spray nozzle the same throughout the entire investigation to obtain accurate results.

- Tell students that they will be testing how rain impacts soil on a forested hill first. Do a quick check by asking students to point to the hill covered with soil and trees (bubble wrap).
- Direct students to put their safety goggles on.
- Instruct students to use the yardstick to make sure they are holding their spray bottles at the same predetermined height for each trial (K-1: rotate students to hold the yardstick).
- Direct students to use the spray bottle to create rain for thirty seconds. Stop students after thirty seconds and have them record and share observations. Repeat 4–6 times.
- Move on to the deforested hill and repeat the process.
- Ask students questions to prompt them to recognize the amount/rate of soil movement. Possible questions could be, "Did the rain cause soil/sediment to wash into the stream?", "Are the trees helping the soil stay in place? How do you know?", "Did more soil move on the hill with or without trees? Explain." and/or "Is the soil moving faster or slower on the hill now that the trees have been removed?"

9. **Grade 2:** Have students generate a quick summary statement or conclusion based on their observations. Allow students time to reflect on their predictions.
   K-1: Use class data to generate a summary statement/conclusion.
10. **Enrich:** Show images of sediment control fencing being used to reduce erosion/prevent sediment from entering waterways/storm drains. Ask students to explain the rationale for the placement of the fencing/how the fencing will reduce soil/sediment runoff.

Day 2

1. Use green and blue construction squares to construct a model of an undeveloped land plot on the floor.

   Undeveloped Land-Plot Model Set-Up

   - Use 4-inch squares of green paper to create a 40-inch square
   - Replace one green 4-inch square towards the middle with a blue 4-inch square
   - Cut out ten 2-inch squares of brown paper and leave to the side
2. Gather students to sit in a circle around the undeveloped land plot. Display and explain the key below:
   Green Square = Forest
   Blue Square = Lake
   Brown Square = A House with Yard

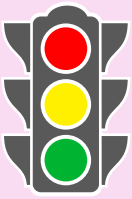
3. Emphasize that tree removal always impacts the environment, but that the impact can be reduced by making environmentally friendly choices. Tell students that a builder wants to build six homes in a forested area and is seeking their expertise/advice.
4. Prompt students to recall information from *The Lorax* and the Slippery Soil investigation to help them answer the question, "What is the best/most environmentally friendly way to construct six homes in a forested area?" Hold up brown squares and remind students that they represent areas where trees have been removed and a house with a yard has been installed.
5. As a class, have students manipulate the model to design and redesign until they agree on the environmentally friendly solution they feel is best to submit to the builder. Pose questions while students are working, "Does anyone have a different design idea/solution?", "Why did you decide to keep trees around the lake area?" or "Is there a way to modify the house and yard design to make it more environmentally friendly?"
6. Challenge students to rethink their solution by modifying the scenario. For example:
    - Move water/lake and ask students if the design is still the most environmentally friendly.
    - Tell students that the homeowners do not want to see their neighbors and ask if their design still works.
    - Tell students the homeowners want to be near their neighbors and ask if the design still works.
    - Tell students at least two homeowners who love to fish want to live near the lake. Ask students if they would make any modifications or recommendations to homeowners building near the lake (e.g. smaller yard, forested yard). If so, allow students to rip/cut the brown paper to illustrate their design ideas.
    - Use extra 2-inch brown squares to expand two of the homeowners' yards and require students to explain how these homeowners can make their yards more environmentally friendly (e.g. keep some of the existing trees, if applicable expand yard in a different direction to keep more trees around the lake). Ask students what they would say to convince the homeowners to modify their yard design. Suggested Scaffold: Ask students guiding questions such as, "We learned that too much soil/sediment run-off can be harmful to the fish and other living organisms in water. Is it the best idea to cut down the trees right around the lake to install the houses? Why or why not?"

REFLECTION

Distribute one Stoplight Exit Ticket to each student. Students will complete the Stoplight Exit Ticket to show their understanding of the lesson. On their Stoplight Exit Ticket handout, students will color in the section of the stoplight that explains their understanding of the lesson.

Refer back to the Guiding Question for the lesson: How does the removal of a large number of trees impact the natural environment?

Tell the students they should keep this question in mind while filling out their exit ticket.



Stoplight Exit Ticket

- **Red:** I do not understand today's lesson.
- **Yellow:** I almost understand today's lesson.
- **Green:** I get it! I understand today's lesson.

HOME CONNECTION

Send home the Home Connection Resource: Slippery Soil. After the lesson, families should have conversations about the community design their young scientist selected to be the most environmentally friendly.

They can choose to discuss ways the family can help reduce deforestation from the list below.

- What can I do?
- Share information about deforestation and its effects with others
- Plant trees
- Go paperless
- Recycle and buy recycled products
- Look for Forest Stewardship Council (FSC) certification on wood and wood prodcuts

BRAINSTORM ACTIVATOR: ROUND ROBIN STRATEGY

Group Name _____

How does removing trees change...

Land?	Water?
Air?	**Plant and Animal Habitats?**

Directions: Make predictions and reflect using pictures or words.

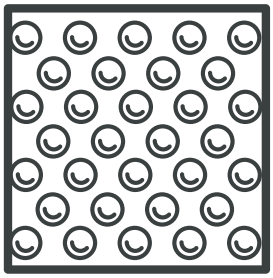
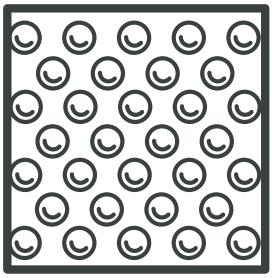
Make a prediction about what will happen to the soil when it rains on the hill with trees.

Make a prediction about what will happen to the soil when it rains on the hill where there are no trees (trees were cut down).

Reflect: Would removing all of the trees from a hill cause changes to the local stream or wildlife? Why or why not?

SLIPPERY SOIL INVESTIGATION OBSERVATIONS HILL WITH TREES

Directions: Make predictions and reflect using pictures or words.

Before rain 	30 Seconds 
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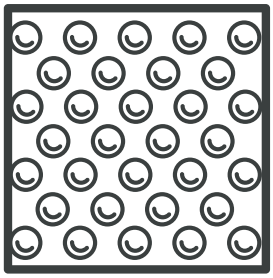
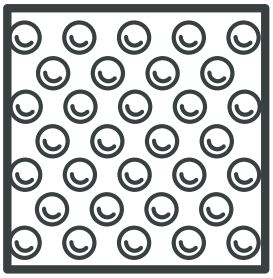
1 Minute 	90 Seconds 
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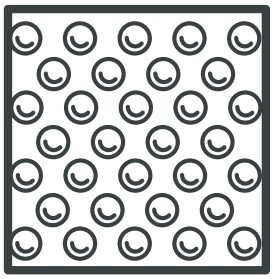
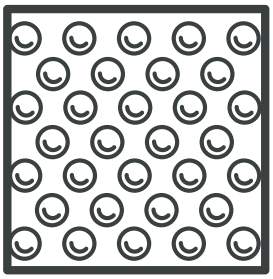
120 Seconds 	150 Seconds 
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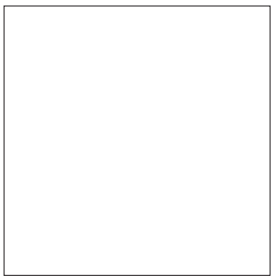
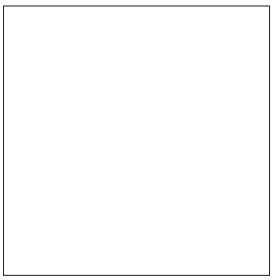
SLIPPERY SOIL INVESTIGATION OBSERVATIONS HILL WITHOUT TREES

Directions: Make predictions and reflect using pictures or words.

Before rain 	30 Seconds 
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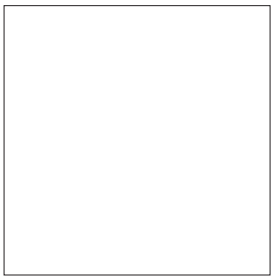
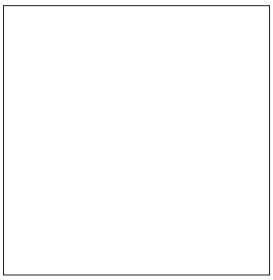
1 Minute 	90 Seconds 
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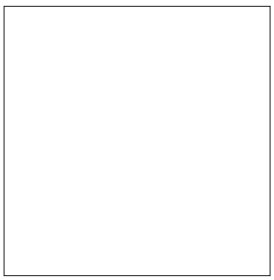
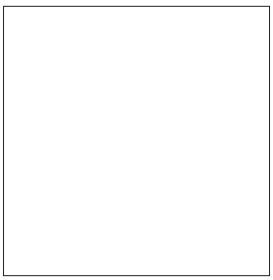
120 Seconds 	150 Seconds 
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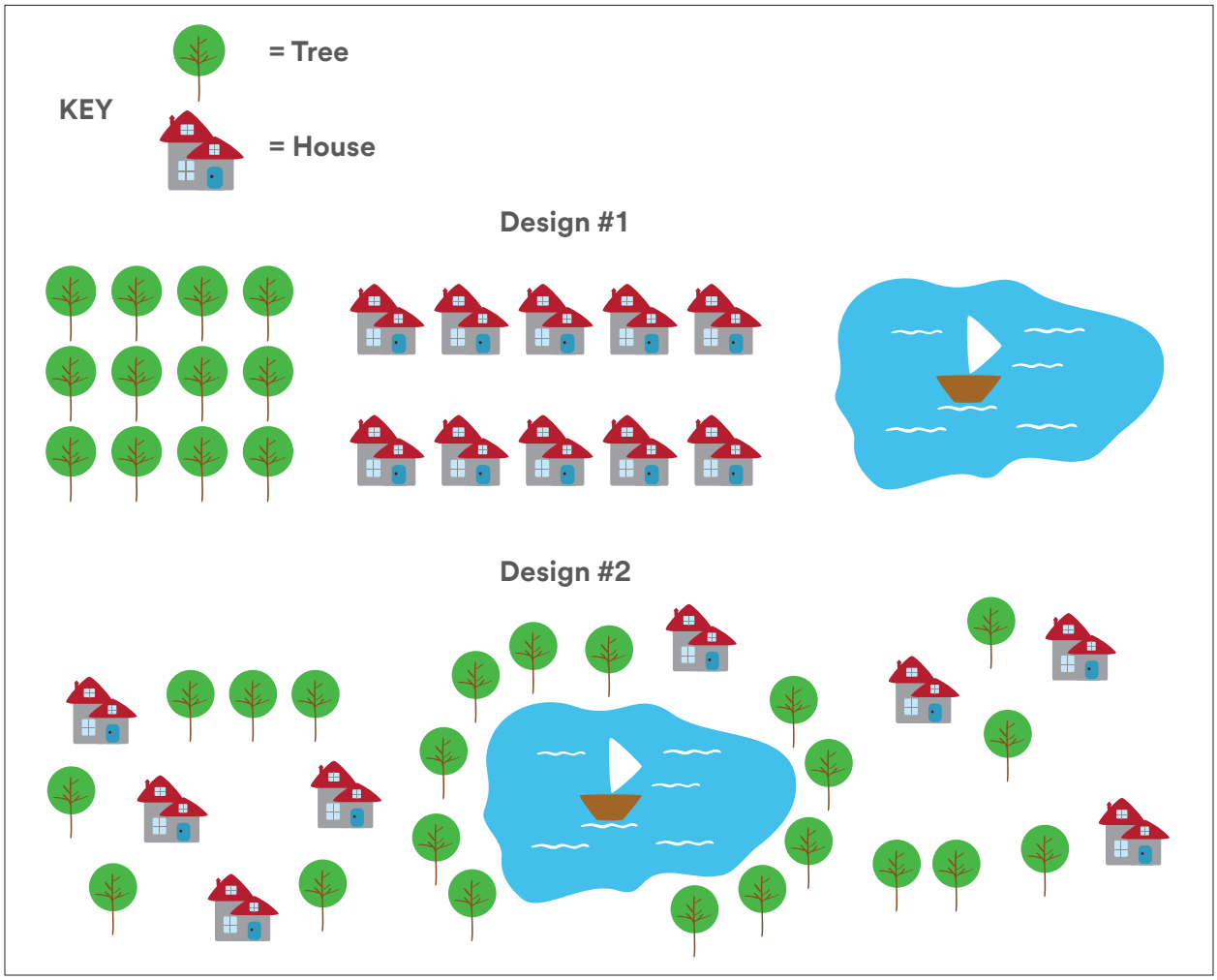
THE BEST WAY TO BUILD EXIT CARD

Circle the community design you think is the most environmentally friendly. Use pictures or words to explain your choice on the back of this sheet.



STOPLIGHT EXIT TICKET

Color in the stoplight to show your understanding of today's lesson.

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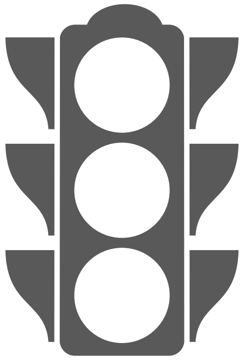

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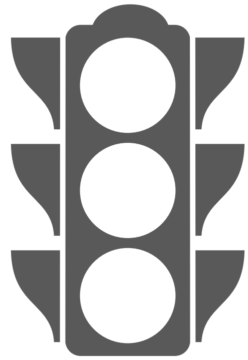

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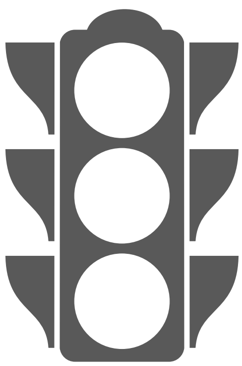

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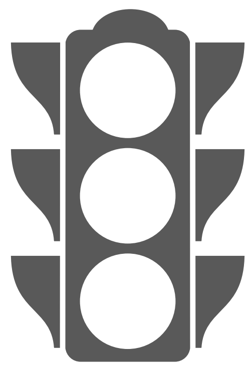

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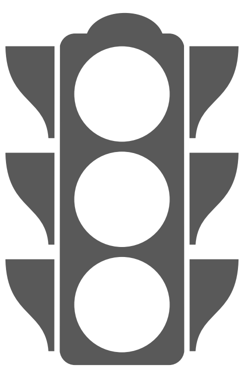

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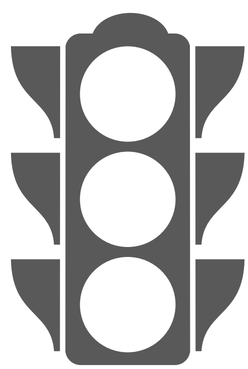

HOME CONNECTION RESOURCE

Dear Family,

Your young scientist has been learning about the impacts of deforestation. For the purpose of our lesson, deforestation was defined as when humans clear large numbers of trees for non-forest use. Non-forest uses include urban development, growing crops, grazing livestock, and obtaining natural resources such as wood. This week, your young scientist participated in an investigation to explore how removing trees impacts the land. In groups, the students used models to compare how well soil stayed in place in areas with and without trees.

Complete the following tasks together with your young scientist to help reinforce and apply their understanding of the science concepts addressed in this lesson:

- Ask your young scientist to describe why they selected the community design on the attached exit card as the most environmentally friendly.
- Discuss ways your family can help reduce deforestation from the list below.
    - What can I do?
    - Share information about deforestation and its effects with others
    - Plant trees
    - Go paperless
    - Recycle and buy recycled products

For more family activities that support your student's learning: https://www.youngscientistlab.com/parents/family-activities.

We hope you continue learning together with us about the power of science.

See you in science class!