Module 1: Soil Water Retention
2nd Grade

About the Instructions:

This document is intended for use by classroom teachers, SciTrek leads, and SciTrek volunteers. The document has been composed with input from teachers, leads, volunteers, and SciTrek staff to provide suggestions to future teachers/leads/volunteers. The instructions are not intended to be used as a direct script but were written to provide teachers/leads/volunteers with a guideline to present the information that has worked in the past. Teachers/leads/volunteers should feel free to deviate from the instructions to help students reach the learning objectives of the module. Some places in which you can be creative and mold the program to meet your individual teaching style, or to meet the needs of students in the class are: during class discussions, managing the groups/class, generating alternative examples, and asking students leading questions. However, while running the module make sure to cover all the material each day within the scheduled 60 minutes. In addition, no changes should be made to the academic language surrounding observations or the observation activity.

Activity Schedule:
There are no scheduling restrictions for this module.

Day 1: Observation Assessment/Technique/Observation Activity/Observations (60 minutes)
Day 2: Question/Materials Page/Experimental Set-Up/Procedure/Results Table (60 minutes)
Day 3: Experiment/Graph/Results Summary (60 minutes)
Day 4: Poster Making (60 minutes)
Day 5: Poster Presentations (60 minutes)
Day 6: Observation Assessment/Tie to Standards (60 minutes)

The exact module dates and times are posted on the SciTrek website (http://www.chem.ucsb.edu/scitrek/elementary) under the school/teacher. The times on the website include transportation time to and from the SciTrek office (Chem 1105). Thirty minutes are allotted for transportation before and after the module, therefore, if a module was running from 10-11 then the module times on the website would be from 9:30-11:30.

Student Groups:

Students are divided into four groups of ~five students each for the entire module. One volunteer is assigned to help each group. We find groups work best when they are mixed levels and mixed language abilities.

NGSS Performance Expectation Addressed:

2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

Common Core Mathematics Standard Addressed:

2.MD-10 Measurement and Data (Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.)
Learning Objectives:

1. Students will be able to list at least two variables that affect how much water soil absorbs.
2. Students will know that water can change the shape of the land and that humans have found ways to prevent or limit these changes.
3. Students will know how to read and use a graduated cylinder.
4. Students will be able to generate at least three observations about a given system and identify statements that are not observations.
5. Students will be able to list at least one way that they behaved like scientists.

Classroom Teacher Responsibilities:

In order for SciTrek to be sustainable, the program needs to work with teachers on developing their abilities to run student-centered inquiry-based science lessons on their own in their classrooms. As teachers take over the role of SciTrek lead, SciTrek will expand to additional classrooms. Even when teachers lead the modules in their own classrooms, SciTrek will continue to provide volunteers and all of the materials needed to run the module. Below is a sample timeline for teachers to take over the role as the SciTrek lead.

* Groups are made up of ~5 students.
1. Module 1 & 2 (year 1)
   a. Classroom Teacher Leads a Group
2. Module 3 & 4 (year 2)
   a. Classroom Teacher Co-Leads the Class (an experienced SciTrek volunteer will be present to help out if needed)
      i. Classroom teacher will be responsible for leading entire class discussions (examples: observation activity, tie to standards, etc.).
      ii. Classroom teacher will be responsible for time management.
      iii. Classroom teacher will be responsible for overseeing volunteers and helping any groups that are struggling.
      iv. Classroom teacher will be responsible for all above activities, the SciTrek co-lead will only step in for emergencies.
3. Any Additional Modules (year 3 and beyond)
   a. Classroom Teacher Leads the Class
      i. Classroom teacher will be responsible for leading entire class discussions (examples: observation activity, tie to standards, etc.).
      ii. Classroom teacher will be responsible for time management.
      iii. Classroom teacher will be responsible for overseeing volunteers and helping any groups that are struggling.

SciTrek staff will be counting on teacher involvement. Teachers should notify the SciTrek staff if they will not be present on any day(s) of the module. Additional steps can be taken to become a SciTrek lead faster than the proposed schedule above. Contact scitrekadmin@chem.ucsb.edu to learn more.

In addition, teachers are required to come to UCSB for the module orientation, ~one week prior to the start of the module. Contact scitrekadmin@chem.ucsb.edu for exact times and dates, or see our website at http://www.chem.ucsb.edu/scitrek/elementary under your class’ module times. At the orientation teachers will go over module content, learn their responsibilities during the module, and meet the volunteers that will be helping in their classroom. If you are not able to come to the orientation at UCSB you must complete an online orientation. Failure to do an orientation for the module will result in loss of priority registration for next year.
Prior to the Module (at least 1 week):

1. Come to the SciTrek module orientation at UCSB.
2. Inform SciTrek staff if your class uses any method of subtraction other than what is shown below.

During the Module:

If possible, have a document camera available to the SciTrek lead every day of the module. If you do not have a document camera, please tell the SciTrek staff at orientation.

Days 1-4:
Have the students’ desks/tables moved into four groups and cleared off. This ensures that each student has a desk during SciTrek activities and that students can begin the module as soon as SciTrek arrives.

Days 5 and 6:
Have the students’ desks/tables cleared off. The desks/tables do not need to be moved into groups.

Scheduling Alternatives:

Some teachers have expressed interest in giving the students more time to work with the volunteers throughout the module. Below are options that will allow the students more time to work with the volunteers. If you plan to do any of the following options, please inform the SciTrek staff no later than your orientation date (~one week before your module, exact orientation times are found at: http://www.chem.ucsb.edu/scitrek/elementary). This will allow the SciTrek staff to provide you with all needed materials.
Day 1:  
If you would like to have more time for your students to make observations, you can do one, two, or all of the following activities before SciTrek arrives:  
1) Observation assessment  
2) Technique discussion  
3) Observation activity  
NOTE: We **highly recommend** that you complete the observation assessment prior to Day 1 of the module.

Day 2:  
If you would like to have more time for your students to design their experiments, you can go over the possible variables the students can choose from that are outlined in the introduction before SciTrek arrives.

Day 3:  
If you would like to have more time for your students to perform their experiments, you can do the introduction before SciTrek arrives.

Day 5:  
If you would like to have more time for your students to discuss their experiments during poster presentations, you may take more time for each presentation and finish the presentations after SciTrek leaves.

Day 6:  
If you would like more time for the tie to standards activity, you may give the observation assessment before SciTrek arrives.

**Materials Used for this Module:**

1. 9 oz Clear plastic cups (Smart and Final) with three 1 cm holes drilled in a triangle in the bottom  
2. 20 oz Clear plastic cups (Smart and Final)  
3. 1 oz Cups any material (Smart and Final)  
4. Coffee filters  
5. Potting soil blend (Santa Barbara Sand and Topsoil)  
6. Vermiculite (Home Depot)  
7. Play sand (Home Depot)  
8. Decorative groundcover bark (the smaller the size of the bark the better) (Home Depot)  
9. Rocks of three different sizes (small (1/8” la Paz), medium (1/4” pea gravel), large (1/2” pea gravel)) (Goleta Building Materials)  
10. ThickenUp Clear (any drugstore)  
   To make levels of liquid, add the following amount of ThickenUp to 200 mL of water:  
   - Liquid Level 0 – No ThickenUp  
   - Liquid Level 1 – 1/3 Tablespoon (or 1 teaspoon)  
   - Liquid Level 2 – 2/3 Tablespoon (or 2 teaspoons)  
   - Liquid Level 3 – 1 Tablespoon  
   - Liquid Level 4 – 1 1/3 Tablespoons  
   - Liquid Level 5 – 1 2/3 Tablespoons  
   - Liquid Level 6 – 2 Tablespoons  
   These solutions can only be stored for about 1 week.  
11. Nalgene graduated cylinders 100 mL (Fisher part number: 08-572D)  
12. Nalgene graduated cylinders 250 mL (Fisher part number: 3663-0250)  
13. Digital Scale (OHAUS, max weight: 2000 g, readability: 1 g, Model No. H-2715) (Fisher Part Number: S40242-1)  
14. Disposable pipets (droppers) (Fisher part number: 13-711-7M)
All printed materials used by SciTrek (student notebooks, materials pages, lead picture packet, poster parts, instructions, and nametags) can be made available for use and/or editing by emailing scitrekadmin@chem.ucsb.edu.

Day 1: Observation Assessment/Technique/Observation Activity/Observations

Schedule:

Introduction (SciTrek Lead) – 2 minutes
Observation Assessment (SciTrek Lead) – 5 minutes
Module Introduction (SciTrek Lead) – 5 minutes
Technique (SciTrek Lead) – 10 minutes
Observation Activity (SciTrek Lead) – 13 minutes
Observations (SciTrek Volunteers) – 20 minutes
Wrap-Up (SciTrek Lead) – 5 minutes

Materials:

(4) Volunteer Boxes:

- Student nametags
- (7) Student notebooks
- Picture of experimental set-up
- Volunteer instructions
- Volunteer lab coat
- (2) Pencil
- (2) Wet erase markers
- Ziploc bag (for wet soil)
- Paper towels
- Water (8 oz)
- (2) 100 mL Graduated cylinders
- (4) 20 oz Cups (1) labeled A, (1) labeled B, and (2) unlabeled
- (2) 9 oz Cup with holes in bottom labeled A and B
- 9 oz Cup with no holes
- (4) 1 oz Cups
- Potting soil
- (7) Bendy straws
- (2) Coffee filters
- Dropper

Other Supplies:

- (4) Large group notepads
- Bucket with lid
- (4) Trays
- 500 mL Graduated cylinder

Lead Box:

- (3) Blank nametags
- (3) Extra student notebooks
- Picture of experimental set-up
- Lead instructions
- Soil water retention picture packet
- Lead lab coat
- (25) Observation assessments
- Time card
- (2) Pencils
- (2) Wet erase markers
- (4) Markers (purple, green, blue, orange)
- Ziploc bag (for wet soil)
- Paper towels
- Water (8 oz)
- (2) 100 mL Graduated cylinders
- (4) 20 oz Cups (1) labeled A, (1) labeled B, and (2) unlabeled
- (2) 9 oz Cup with holes in bottom labeled A and B
- 9 oz Cup with no holes
- (4) 1 oz cups
- Potting soil
- (4) Coffee filters
- (25) Paperclips
- Dropper
**Notebook Pages and Notepad Pages:** (Note: Notebook pages are rectangular and filled out in black and notepad pages are squarer and filled out in blue.)

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**Set-Up:**

SciTrek Lead:

If the classroom has a document camera, ask the teacher to use it for the introduction (page 1, picture packet), technique activity (page 2, student notebook), and the observation activity (page 3, student notebook).
2, picture packet and page 3, student notebook). If the classroom does not have a document camera, then tape the example poster-size notebook pages to the front board.

On the board, write the four group colors (orange, blue, green, and purple) and the name(s) of the volunteer(s) that will be working with each group.

SciTrek Volunteer:
Put your name, the teacher’s name, and your group color on the top of your group notepad.

As students are taking the observation assessment, walk around the room and quietly place the students’ nametags, which are in your group box, on each student’s desk.

Have SciTrek notebooks and straws available to pass out after students complete their assessment.

Once you have passed out the nametags, assemble the experimental set-up (seen in picture below as well as in the experimental set-up picture in your group box) on a tray. Use the following steps to help you with the set-up:
1. Fill four, 1 oz (small) cups with potting soil (make sure that all cups are filled to the top).
2. Place a coffee filter inside each of the two labeled 9 oz (medium) cups with holes.
3. Set the labeled medium cups inside the 20 oz (large) labeled cups and place them on the tray.
4. Set two unlabeled large cups and one unlabeled medium cup (without holes) on the tray.
5. Fill two graduated cylinders with 50 mL of water and set them on the tray.

Introduction:
(2 minutes – Full Class – SciTrek Lead)

“Hi, we are scientists from UCSB and we want to show you what we do as scientists. We will show you an experiment and then you can make observations and design your own experiment to help answer the class question. We want to show you that you can do science and have fun.”
If you are a teacher that is leading the class tell your students that they are going to start a long-term science investigation and you have asked some scientists from UCSB to come and help. Allow the UCSB volunteers to introduce themselves and share their majors.

**Observation Assessment:**
*(5 minutes – Full Class – SciTrek Lead)*

As the students are taking the assessment, the volunteers should get the student nametags out of their group boxes and walk around the room locating their students. Have the volunteers quietly lay each student’s nametag on their desk. If students do not have their name on their paper remind them to do so. After volunteers have handed out the nametags they should assemble the experimental set-up.

“Before we start with the module we will determine how your ideas on observations are developing.” Pass-out the observation assessment and a paperclip to each student and tell students to fill out their name, teacher’s name, and date at the top of the assessment. Remind the students that it is important that they fill out this assessment on their own.

Read the instructions to the students. Then read each of the statements and tell students to circle “observation” for statements that are observations or “not an observation” for statements that are incorrect observations or statements that cannot be observations. When students are finished, collect the assessments and the paperclip and verify that the students’ names are on the top of the papers.

**Module Introduction:**
*(5 minutes – Full Class – SciTrek Lead)*

Show the students the picture of the landslide (page 1, picture packet), as seen on the right. Ask the students, “What happened in this picture?” Students should reply that the hillside slipped down. Tell students that this is called a landslide. Ask the students if they have ever seen a landslide before and if so, what the weather conditions were when they observed the landslide. By the end of the conversation make sure that students understand that many landslides happen during rain or right after it has rained. Tell students that because many landslides are observed after it has rained, we can predict that the amount of water might affect if a landslide will happen. Now ask the students if they can think of any other variables or factors, besides rain/amount of water, that might affect or cause a landslide. Some variables that the students might come up with are: soil type, soil compaction, rain speed, hill steepness, etc. Tell the students that “most of these variables that could affect or cause a landslide involve water or the soil. Therefore, for this module we are going to work together to try to answer the question: “What variables affect how much liquid a soil can absorb?” Ask the class if they know what the word “absorb” means. Make sure that by the end of the conversation, they understand that it means the amount of liquid that the soil can hold.

“To see how water and soil interact we are going to perform experiments using the variables you’ve suggested. Then, we will relate our results back to landslides. Since we will be dealing with liquids during this experiment, we will need to learn to measure the volume of liquids before we start the experiment.”
Have volunteers pass-out a SciTrek notebook to each student. Then have students write their name, teacher’s name, group color (color of their name on their nametag: orange, blue, green, or purple), and their volunteer’s name (volunteer’s names should be written on the board next to the group color they will be working with) on the front cover of their notebooks. If a student does not have a nametag, only have them fill out their name and teacher’s name on the cover of their SciTrek notebook. They will be placed in a group when the class gets into groups for observations and they can fill out their group color and volunteer at that point.

**Technique:**
*(10 minutes – Full Class – SciTrek Lead)*

Tell the class that today they are going to work with a piece of scientific equipment called a graduated cylinder. Show the class the 500 mL graduated cylinder. Tell the class “graduated cylinders are used to measure the volumes of liquids. Scientists read graduated cylinders by placing them on a flat surface and putting their eyes at the same level as the level of the liquid. They then read off the number on the graduated cylinder where the bottom of the liquid line is located. The liquid line will be curved; the curved liquid line is called the meniscus. The units on the graduated cylinder are in milliliters, which is abbreviated mL. You are going to practice reading graduated cylinders in your notebook which will prepare you to use them during your experiment.” Have the class say the word “milliliters” with you a couple of times to help them get used to it.

Tell students to turn to page 2 of their notebooks while you place a blank notebook under the document camera and turn to page 2. Read the directions aloud to the class. Ask the students the following questions:

- What do you think is the maximum amount of liquid that you could measure in the graduated cylinder on the sheet? (100 mL)
- What does each of the large labeled lines on the graduated cylinder represent? (10 mL)
- What do the medium lines on the graduated cylinder represent? (5 mL)
- What do the smallest lines on the graduated cylinder represent? (1 mL)

Tell students to determine the amount of liquid in the graduated cylinder, they need to find the bottom of the meniscus (the bottom of the curved line that the water forms in the graduated cylinder). Have students put their finger on the meniscus in the first graduated cylinder and you do the same on the document camera for students to copy. From there, have students move their finger to the nearest labeled number that is below the meniscus. Then, have the students count by ones until they reach the level of the meniscus. Count aloud so students can follow along. Then have students add the amount they counted to the number their finger was on. This will give the amount of liquid in the graduated cylinder. Ask students how much liquid is in the first graduated cylinder. Students should say that the graduated cylinder contains 88 mL of liquid.

Have the students complete B-D by themselves. As the students are working, volunteers should walk around and help students that are struggling.

Once students have completed reading the graduated cylinders, have them share their results with the class. Once an answer is shared, have the rest of the class vote if they think that the answer is correct/incorrect using thumbs up/thumbs down for agree/disagree. When a class consensus has been reached, write the correct number on the notebook under the document camera.
Tell students now that they know how to read a graduated cylinder, they can measure the amount of water that passes through the soil, which will help them to determine how water interacts with soil. Tell students that they are going to make some observations about a soil and water system. But before we can do this, we need to make sure that we understand observations.

**Observation Activity:**
(13 minutes – Full Class – SciTrek Lead)

Put page 2 of the picture packet under the document camera (seen below). Tell the students that scientists make many observations. Ask the class, “What is an observation? What are the types of things that you can record for an observation?” If they have trouble, show them an object and let them make observations. Help them realize that observations are descriptions of things using their five senses. As they come up with what they can use to make observations, record these on the chart. Then, write the definition of observation under the list and have the students tell you the definition a few times. Have students generate an observation about something in the classroom using each of their senses other than taste.
Ask the class if there are statements that are not observations. Students should be able to come up with opinions, incorrect observations, and inferences. Record these under “not observations” on the chart. Remind students that inferences are something that you think might be true based on past experiences. For instance, in the mini module when they thought the object in the candleholder was a “candle” before it was eaten. Have students give you examples of statements that are opinions (example: chocolate chip cookies taste better than ice cream), incorrect observations, and inferences (example: the white lab coats are bought from K-Mart). If they are unable to come up with these categories or cannot give you an example, give them an example statement in each category and then have them identify the type of statement. Afterwards, have students generate another example.

Have the volunteers pass-out a bendy straw, found in their group box, to each student.

Tell students they are now going to do an activity where they look at a list of possible observations about the object they just received (bendy straw). They will then decide if each statement is an observation or not an observation about the object.

Have students turn to page 3 of their notebooks and place a blank notebook under the document camera and turn to page 3. Have students fill in the blank in the observation definition at the top of the page. Then have them repeat the definition to you a few times.

Read the directions aloud to the class. Tell students we will go over each of the statements as a class. Read each of the statements to the students and then ask for a student to tell you whether it is an observation or not an observation about the object and why. Then, have the class vote using thumbs up/thumbs down if they agree/disagree with the student’s reasoning. If many students in the class disagree with the response of the original student, have the other students tell why they do not agree. If needed, let them have “mini conferences” with the students that are sitting in their area. After the class has come to a consensus, tell students they will now circle the correct answer. Mark the correct answer on the class notebook.
For each statement, have students identify the sense that they used to classify the statement. If the statement is an observation, write down which sense students used and if the statement is not an observation, write down why it is not an observation in the example notebook. Students do not need to write these in their notebook.

Below are the answers to 1-7 on page 3 in detail.

**Number 1:** The object is lighter than a bowling ball.
*Observation – With Sense (Comparison)*

- Is the statement an observation or not an observation?
  - Observation
- What sense did you use to make this observation?
  - Touch

**Number 2:** The object is only one color.
*Not an Observation – False with Sight*

- Is this statement an observation or not an observation?
  - Not an observation
- Why is this statement not an observation?
  - The object is two colors and not one. (False observation.)
- What sense did you use to tell this?
  - Sight
**Number 3:** The object is thicker than a broom handle.
*Not an Observation – False with Sight (Comparison)*

Is this statement an observation or not an observation?
  - Not an observation

Why is this statement not an observation?
  - The object is thinner than a broom handle, not thicker. (False observation.)

What sense did you use to tell this?
  - Sight

**Number 4:** The object is silly.
*Not an Observation – Opinion*

Is this statement an observation or not an observation?
  - Not an observation

Why is this statement not an observation?
  - This statement is an opinion. Some people might think that bendy straws are silly but others might think they are sensible.

**Number 5:** The object has lines.
*Observation – With Sight*

Is this statement an observation or not an observation?
  - Observation

What sense did you use to make this observation?
  - Sight

**Number 6:** The object can be bent so both ends touch.
*Observation – With Sense (Need to Test)*

Is this statement an observation or not an observation?
  - If you have bent the straw so both ends touch then the statement is an observation.
  - If you have not tested it then the statement is not an observation, it is an inference.

*Note:* Make sure that all students bend the object so that both ends touch making this statement an observation.

What sense did you use to make this an observation?
  - Touch and sight

**Number 7:** The object came from the grocery store.
*Not an Observation – Inference*

Is this statement an observation or not an observation?
  - Not an observation

Why is this statement not an observation?
  - This statement is an inference because there is no way to tell if the object came from the grocery store. The grocery store does have straws so the straw could have come from the grocery store but it also could have come from a fast food restaurant.

Once students have completed the observation activity, see if they can give you one or two more observations about the object. While students are giving other observations, the volunteers should walk around and collect the straws from students and put them back in their group boxes.

Tell students we will now use the skills that we learned to make observations. Ask students if they remember the question the class will be investigating. (What variables affect how much liquid a soil can absorb?) If students do not remember, show them it is on the front of the notebook. Remind students that we are interested in this because it will help us learn about landslides. Ask the students, what were some of the variables that they came up with that might affect if a landslide could happen. Possible
answers: water amount, soil type, soil amount, etc. Tell the class that today they will explore if compacting the soil affects the amount of water that a soil can absorb.

Tell students that their SciTrek volunteer will show them the experimental set-up. After making observations about the experimental set-up, they will pour 50 mL of water through compact soil and 50 mL of water through the loose soil and make more observations. Remind students that it is important to only generate observations and not inferences/opinions. Tell the class they will now get in their groups. Tell each colored group where to go and to bring their notebook.

If a student does not have a nametag, identify the group with the least number of students in it and write the student’s name on one of the extra nametags that are in the lead box using that color of marker.

**Observations:**
(20 minutes – Groups – SciTrek Volunteers)

Once the students come over to your group, have them sit in boy/girl fashion and collect their notebooks. Put the notebooks in the group box, students will not need these until the next SciTrek visit. Verify the table is set-up as described in the set-up section.

As a group, have the students come up with observations about the experimental set-up before they pour water into the cups. As the students make observations, record them on page 1 of the group notepad. Make sure that students measure the amount of water in the graduated cylinders (50 mL), the amount of potting soil (4 small cups) that will be put into each cup as well as define the sizes of cups as small, medium, and large (see picture below). This should take no longer than 6 minutes.

Make sure there is a coffee filter in both of the medium cups (9 oz) and then pour two small (1 oz) cups of potting soil into both cups. Then use the medium cup (without holes) to compact the potting soil that is in cup B. When you compact the potting soil remove the medium cup with holes from the large cup and place it on the table before compacting the potting soil (see picture on right). Place the medium cup B back into the large cup B. Leave the potting soil in cup A loose. Then pour the water (50 mL) from each of the graduated cylinders into the two medium cups at the same time.

Have the students make observations about what is happening in the cup system and record them on page 2 of the group notepad. As soon as the water has passed through the potting soil (~2 minutes), students can move the cups that contain the wet potting soil into the two extra, large cups and then pour the water that passed through each of the cups into a graduated cylinder to determine the volume of water that passed through each. Ask students, where did the water go? Allow students to feel the potting soil. They should realize that some of the water stayed in the potting soil. Ask them if they can determine how much water stayed in the potting soil. They should say that if you take the initial amount of water and subtract the water in the large cup you will get the amount of water that is in the potting soil. Do the math with the group to determine the amount of water each soil absorbed. Be sure that you are doing the appropriate form of subtraction as dictated by the classroom teacher. Students should find that the compact and loose soil both absorbed about the same amount of water.
If there is additional time, have the students summarize what they saw and learned. Make sure that students know that for this experiment, the changing variable was soil compactness and they were learning how this variable affected the amount of water that the soil could absorb.

An example group notepad is seen below; feel free to deviate from the example. Students do not need to record their observations into their notebooks.

![Observations Example](image)

**Wrap-Up:**
*(5 minutes – Full Class – SciTrek Lead)*

Have one student from each group share an observation with the rest of the class.

Review with the class what was in each cup and what happened to the water that was poured over the two cups.

Ask the students if soil compactness affects how much liquid a soil can absorb and what evidence they have to support this. The students should reply that although the two cups absorbed different amounts of water, they were fairly close to each other. The big difference between the two systems was that the water passed through the compact soil much slower than the uncompacted soil. Discuss with students that groups that calculated that the compact soil absorbed more liquid may not have allowed the water to drip completely through the cup. By doing this, there will still be water above the soil rather than inside of the soil so the compact soil did not actually absorb more water than the loose soil.

Tell students that we now want to relate what they found back to landslides. Tell students to imagine that there are two hills, one with compact soil and one with loose soil and it rains on both of these hills for one hour. Ask the students, what happens to the amount of water absorbed by both of these hills? Possible student answer: the hill that has loose soil will absorb more water because the water will absorb faster into the loose soil before it runs off, while the hill that has compact soil will absorb less water because most of this water will run off into other areas before it can be absorbed by the compact soil. Ask students which hill would be more likely to have a landslide and why. Possible student answer: the hill with loose soil will be more likely to have a landslide because it absorbs more water. Ask students why
absorbing water might cause a landslide. How has the soil changed? Students should realize that as the soil absorbs water the mass of the soil (and now water) will increase.

To help students understand this, have a student hold a cup with wet potting soil and a cup with dry potting soil and describe them for the class. The heavier the soil is the more likely the hill will be to slide.

Ask students what happens when it rains on both of these hills for multiple days? Possible student answer: while initially the hill with the loose soil will absorb more water, as it continues to rain the hill with the compact soil will absorb the same amount of water as the hill with loose soil. Ask students which hill now will be more likely to have a landslide. Possible student answer: since both hills absorbed the same amount of water they will now both be approximately the same mass and therefore equally likely to have a landslide.

Tell the students that they have taught you a lot about how the compactness of the soil affects water absorption and landslides. You now know that the more compact the soil, the longer the soil takes to absorb the water.

Tell the students that the next time we meet they will design an experiment to answer the class question, “What variables affect how much liquid a soil can absorb?”

**Clean-Up:**

Before you leave, collect student nametags and attach them to their notebooks, which are in the group box. Pour the wet soil into the bag provided. Make sure to seal this bag so that water does not spill in your box. Put the used water into the bucket. Stack all of the cups and place the cups and graduated cylinders into the bucket. Bring all materials back to UCSB. In addition, put your lab coat into your group box.

**Day 2: Question/Materials Page/Experimental Set-Up/Procedure/Results Table**

**Schedule:**

- Introduction (SciTrek Lead) – 7 minutes
- Question (SciTrek Volunteers) – 10 minutes
- Materials Page (SciTrek Volunteers) – 5 minutes
- Experimental Set-Up (SciTrek Volunteers) – 5 minutes
- Procedure (SciTrek Volunteers) – 20 minutes
- Results Table (SciTrek Volunteers) – 5 minutes
- Wrap-Up (SciTrek Lead) – 8 minutes

**Materials:**

- (4) Volunteer Boxes:
  - □ Student nametags
  - □ Student notebooks
  - □ Volunteer instructions
  - □ Volunteer lab coat
  - □ Materials pages (one for each possible variable)
  - □ (2) Pencils
  - □ (2) Wet erase markers
  - □ Scotch tape

- Other Supplies:
  - □ (4) Large group notepads
Lead Box:
- ☐ (3) Blank nametags
- ☐ (3) Extra student notebooks
- ☐ Lead instructions
- ☐ Soil water retention picture packet
- ☐ Lead lab coat

☐ Materials pages (one for each possible variable 4 total)
☐ Time card
☐ (2) Pencils
☐ (2) Wet erase markers
☐ (4) Markers (purple, green, blue, orange)
☐ Scotch tape
☐ Scale
☐ (2) 250 mL Graduated cylinder
☐ Vermiculite

Notebook Pages and Notepad Pages:

First choose/circle the factor that you would like to experiment with. Then within that row, circle what you would like your changing variable to be. Finally, circle the measurement you will make.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Changing Variable</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>Soil Amount</td>
<td>Liquid Amount [ml]</td>
</tr>
<tr>
<td></td>
<td>Soil Type</td>
<td></td>
</tr>
<tr>
<td>Liquid</td>
<td>Liquid Amount</td>
<td>Liquid Amount [ml]</td>
</tr>
<tr>
<td></td>
<td>Liquid Thickness</td>
<td></td>
</tr>
</tbody>
</table>

Question our group will investigate:

If we change the liquid amount, what will happen to the amount of liquid that the soil absorbs?

Fill out the materials page with your full team members before moving into the experimental set-up.
**EXPERIMENTAL SET-UP**

<table>
<thead>
<tr>
<th>Changing Variable:</th>
<th>Liquid Amount</th>
</tr>
</thead>
</table>

**Controls** (variables you will hold constant):
- Cup Material: Plastic
- Soil Amount: 2 cups
- Soil Type: Potting Soil
- Liquid Thickness: 1/3 in (level 0)

**PROCEDURE**
1. Fill each cup with 2 small cups of potting soil.
2. Pour A) 50 mL, B) 150 mL, C) 20 mL, D) 150 mL, E) 100 mL of thin liquid through cup.
3. Measure the amount of water that comes out.
4. Subtract to find the water absorbed.

**RESULTS**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
<th>Trial E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cup Material:</td>
<td>Plastic</td>
<td>Plastic</td>
<td>Plastic</td>
<td>Plastic</td>
<td>Plastic</td>
</tr>
<tr>
<td>Soil Type:</td>
<td>Potting Soil</td>
<td>Potting Soil</td>
<td>Potting Soil</td>
<td>Potting Soil</td>
<td>Potting Soil</td>
</tr>
<tr>
<td>Soil Amount:</td>
<td>2 small cups</td>
<td>2 small cups</td>
<td>2 small cups</td>
<td>2 small cups</td>
<td>2 small cups</td>
</tr>
<tr>
<td>Liquid Thickness:</td>
<td>plains</td>
<td>plains</td>
<td>plains</td>
<td>plains</td>
<td>plains</td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>50 mL, 150 mL, 20 mL, 150 mL, 100 mL</td>
<td>50 mL, 150 mL, 20 mL, 150 mL, 100 mL</td>
<td>50 mL, 150 mL, 20 mL, 150 mL, 100 mL</td>
<td>50 mL, 150 mL, 20 mL, 150 mL, 100 mL</td>
<td>50 mL, 150 mL, 20 mL, 150 mL, 100 mL</td>
</tr>
</tbody>
</table>

**Data**

<table>
<thead>
<tr>
<th>Date</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
<th>Trial E</th>
</tr>
</thead>
</table>

**Final Observations/Measurements**

- Liquid Amount (mL)
- Soil Type
- Soil Material
- Cup Material
- Liquid Thickness

The independent variable is the changing variable and the dependent variables are the final observation/measurements.
Set-Up:

SciTrek Lead:

If the classroom has a document camera, ask the teacher to use it for the wrap-up discussion (page 3, picture packet). If the classroom does not have a document camera, then draw the two cups on the front board.

Have the 250 mL graduated cylinder, scale, and the vermiculite available to show students during the introduction.

SciTrek Volunteer:

Set out student notebooks.

- If students are not in the classroom before SciTrek starts, set out the notebooks where students should sit when they come into the classroom.
- If students are in the classroom before SciTrek starts, set out the notebooks where students should sit during the module, they will move to these spots after the introduction.

Introduction:

(7 minutes – Full Class – SciTrek Lead)

If needed, while you are doing the introduction have the SciTrek volunteers set out the SciTrek notebooks/nametags where they would like students to sit. Tell students that a notebook will be put on their desk, which is not their notebook and they should not move it.

Ask students what they did during the last meeting with SciTrek. They should reply they did an experiment in which they observed water going through loose and compact potting soil. They learned that the loose potting soil allowed the water to pass through faster than the compact potting soil. But in the end, both the loose and compact potting soils absorbed approximately the same amount of water. Ask the class if they remember the class question they will investigate. They should reply, “What variables affect how much liquid a soil can absorb?”

Ask the students why scientists might study how much liquid a soil can absorb. Students should explain that studying how much liquid a soil can absorb will help them understand the most likely conditions for landslides. For instance, the more water that the soil absorbs, the heavier the soil and the more likely a landslide.

Tell the students that one way scientists answer questions is by performing experiments; today they are going to pick a variable to investigate. They can pick to explore if either soil or liquid affects the amount of liquid that a soil can absorb. If they are interested in exploring how liquid affects the amount of liquid that a soil can absorb, they can manipulate either the liquid amount or the liquid thickness. If they change the liquid amount, they get to use the big 250 mL graduated cylinder (show students the graduated cylinder) while everyone else uses the 100 mL graduated cylinders. If they choose the liquid thickness they have to use medium rock, whereas all other groups will get to pick the soil type that they will use. Ask the students, “What do you think the thickness of the liquid physically represents?” Students may reply that the thickness of the liquid could represent snow instead of rain or mud that is coming in from another area. If they are interested in exploring how soil affects the amount of liquid that the soil can absorb, they can manipulate either the soil type or the soil amount. If they change the soil amount, they will be able to use a scale to weigh the amount of soil they will use (show students the scale). If they change the soil type, they will get to choose from seven different soil types. One of the soil types that they will get to choose from is called vermiculite. Show students the vermiculite and have them say the word with you a
Tell students they will now vote in their groups about what changing variable they want to explore. This will let them determine the question for their experiment.

Teacher Note: It is important to “sell” all of the variables except for liquid thickness. Otherwise, students will all pick liquid thickness to investigate.

If needed, tell students they will now get into their groups.

**Question:**
*(10 minutes – Groups – SciTrek Volunteers)*

Have students turn to page 4 of their notebooks. Then have them decide (by voting) if they are interested in investigating how the soil or the liquid affects the amount of liquid that soil can absorb. If there is a tie, then the volunteer will make the deciding vote. Once they have decided on which factor they will investigate, have students circle what they chose in their notebooks. Then have them decide what their changing variable will be. If they decide to investigate a soil factor, have them choose if their changing variable will be the soil amount or the soil type. If they decide to investigate a liquid factor, have them choose if their changing variable will be liquid amount or the liquid thickness. Encourage your group to have a changing variable that is not being explored by other groups. All experiments will measure the liquid amount that passes through the soil. They will then subtract the amount of liquid that passes through the soil from the initial liquid amount to determine the amount of liquid that the soil has absorbed.

As a group, discuss why/how they think their changing variable will affect how much liquid the soil will absorb.

Use their changing variable to generate the question that the group is going to investigate. Write the question in the group notepad, and have students copy it into their notebooks. An example of the group notepad/student notebook is seen below.

Select one group member to read their question during the wrap-up.
There are two 250 mL graduated cylinders in the lead box. The lead should give one of these graduated cylinders to each group that decided to change liquid amount so that students can picture how much liquid they will be pouring over the soil.

**Materials Page:**

*(5 minutes – Groups – SciTrek Volunteers)*

If your group is changing liquid amount, get a 250 mL graduated cylinder from the lead to aid your group in picking their liquid amounts. Feel free to use the wet erase pen to mark amounts on the graduated cylinder.

Get the materials page (seen below) that corresponds to the changing variable that your group selected and tape it into the group notepad. Have students use the materials page to determine the values for their changing variable and controls. When selecting the values of the changing variable, ask students if they think a wide or a narrow range of values would help them more effectively answer their question. For changing variable values write the student’s name that will be in charge of each trial next to each value.

For controls in which students can pick more than one value (soil type, soil amount, liquid amount, etc.), have students discuss if the value that they select for their control would make it easier or harder to answer their question. For example, if students chose a liquid amount of 5 mL, ask them how this would affect answering their question. This might get them to realize that 5 mL is a very small amount of liquid, most likely resulting in the liquid being completely absorbed which would result in the same amount of liquid absorbed for all trials. If they decide a different control value is better, allow them to switch control values.

Make sure that students have picked liquid amounts that are within the limitations set on the materials page. Examples of all materials pages are seen below.
**Experimental Set-Up:**

*(5 minutes – Groups – SciTrek Volunteers)*

Have students turn to page 5 in their notebooks while you turn to page 4 of the group notepad. Ask your group what they decided was going to be their changing variable and record this on the group notepad. After, have students copy the changing variable into their notebooks.

Ask your group what controls and values they selected. Write the control on the left side of the slash and the value of the control on the right side of the slash (example: soil type / sand). In addition, have students copy these into their notebook. An example experimental set-up can be seen below.

### Changing Soil Amount

<table>
<thead>
<tr>
<th>Soil Type:</th>
<th>Potting Soil</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Amount: <em>(max 100 ml)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Thickness:</td>
<td>Thin (level 0)</td>
<td></td>
</tr>
<tr>
<td>Soil Amount: <em>(max Potting Soil: 100g, max Sand: 200g)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Changing Liquid Amount

<table>
<thead>
<tr>
<th>Soil Type:</th>
<th>Potting Soil</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Amount: <em>(circle one)</em></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Liquid Thickness:</td>
<td>Thin (level 0)</td>
<td></td>
</tr>
<tr>
<td>Liquid Amount: <em>(20-200 ml, value of variable must be a factor of 10)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Changing Soil Type

<table>
<thead>
<tr>
<th>Soil Type:</th>
<th>1</th>
<th>2</th>
<th>3 small cups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Amount: <em>(max 100 ml)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Thickness:</td>
<td>Thin (level 0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Type: <em>(potting soil, vermiculite, sand, bark, small rocks, medium rocks, and large rocks)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>D)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Changing Liquid Thickness

<table>
<thead>
<tr>
<th>Soil Type:</th>
<th>Medium Rocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Amount:</td>
<td>1 small cup</td>
</tr>
<tr>
<td>Liquid Amount: <em>(max 50 ml)</em></td>
<td></td>
</tr>
<tr>
<td>Liquid Thickness: <em>(Level 0: thin, level 1, level 2, level 3, level 4, level 5, and level 6: thick)</em></td>
<td></td>
</tr>
<tr>
<td>A)</td>
<td></td>
</tr>
<tr>
<td>B)</td>
<td></td>
</tr>
<tr>
<td>C)</td>
<td></td>
</tr>
<tr>
<td>D)</td>
<td></td>
</tr>
<tr>
<td>E)</td>
<td></td>
</tr>
</tbody>
</table>
Procedure:
(20 minutes – Groups – SciTrek Volunteers)

Tell students they will now generate a procedure for their experiment. Ask students what a procedure is. They should tell you that it is a set of steps to conduct an experiment. Then, help students generate a procedure. Keep the procedure as brief as possible while still including the important information (key control values, changing variable values, and what data they will collect). An example step if liquid amount is the changing variable would be: “Pour water through each cup A) 25 mL, B) 50 mL, C) 100 mL, D) 150 mL, and E) 175 mL.” Have students dictate the procedure to you while you transcribe it onto the group notepad. As each step is completed, have students copy it from the group notepad into their notebooks. Make sure that you do not continue on to the next step until each student has completed writing that step. An example procedure can be seen above.

Results Table:
(5 minutes – Groups – SciTrek Volunteers)

Fill out the variable section of the results table while students fill out the same section in their notebook. When writing the values, make sure that for controls, they only write the value of the control in Trial A and then draw an arrow through the remaining trials; for the changing variable, they write the value in each of the boxes.

If there is extra time, have the group close their notebooks and explain to each other what they will do for their experiment as well as predict what they think will happen and why. In addition, have students explain to you how their experiment will help them learn about landslides. An example results table can be seen below.
Wrap-Up:
(8 minutes – Full Class – SciTrek Lead)

Have one student from each group share the question that they will investigate. Tell students that on the next SciTrek visit, they will start their experiments and they will have to identity which of their soils absorbs the most liquid. Put page 3 of the picture packet under the document camera. Tell students that you poured 100 mL of water over both soils. Ask students which soil absorbed more water. Students should identify that the cup with less water in the bottom had the soil that absorbed more. Label the cups with absorbed more and absorbed less. Ask students how they will determine how much water the soil absorbed. Get them to realize they will subtract the amount of water in the large cup from the water that was poured through. Do an example of the math with the students. See example below.
If there is extra time do the observation extra practice as a class, page 13, student notebook.

Tell students that you are excited to see their experiments next meeting because all of their experiments will help us be able to answer the question: What variables affect how much liquid a soil can absorb? Answering this question will help us learn about landslides.

**Clean-Up:**

Before you leave, have students attach their nametags to their notebooks and place them in the group box. Bring all materials back to UCSB. In addition, put your lab coat into your group box.

**Day 3: Experiment/Graph/Results Summary**

**Schedule:**

- Introduction (SciTrek Lead) – 5 minutes
- Experiment (SciTrek Volunteers) – 27 minutes
- Graph (SciTrek Volunteers) – 10 minutes
- Results Summary (SciTrek Volunteers) – 16 minutes
- Wrap-Up (SciTrek Lead) – 2 minutes
Materials:

(4) Volunteer Boxes:
☐ Student nametags
☐ Student notebooks
☐ Volunteer instructions
☐ Volunteer lab coat
☐ (8) Partial graph pieces
☐ (2) Pencil
☐ (2) Wet erase markers
☐ Scotch tape
☐ Paper towels
☐ (3) Water (8 oz bottles) or requested liquids
☐ Ziploc bag (for wet soils)
☐ (5) 100 mL Graduated cylinders
☐ (10) 20 oz Cups (5) labeled A-E (5) unlabeled
☐ (5) 9 oz Cups with holes in bottom labeled A – E
☐ (2) 9 oz Cup with no holes (groups changing soil amount only)
☐ (5) 1 oz cups
☐ (6) Coffee filters
☐ (5) Dropper
☐ Requested soil(s)
☐ (2) Scales (groups changing soil amount only)

Other Supplies:
☐ (4) Large group notepads
☐ (2) Buckets with lids
☐ Box with (5) 250 mL graduated cylinders for each group doing liquid amount

Lead Box:
☐ (3) Extra student notebooks
☐ Lead instructions
☐ Soil water retention picture packet
☐ Lead lab coat
☐ Time card
☐ (8) Partial graph pieces
☐ (2) Pencils
☐ (2) Wet erase marker
☐ Scotch tape
☐ Paper towels
☐ (3) Water (8 oz bottles)
☐ Ziploc bag (for wet soil)
☐ (2) 100 mL Graduated cylinders
☐ (2) 250 mL Graduated cylinders
☐ (10) 20 oz Cups (5) labeled A-E (5) unlabeled
☐ (5) 9 oz Cups with holes in bottom labeled A-E
☐ (3) 9 oz Cup with no holes (groups changing soil amount only)
☐ (5) 1 oz cups
☐ (6) Coffee filters
☐ (5) Droppers
☐ Bag of 7 soil types (Potting soil, vermiculite, sand, small rocks, medium rocks, large rocks, bark)
**Notebook Pages and Notepad Pages:**

**RESULTS Table**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trial A</th>
<th>Trial B</th>
<th>Trial C</th>
<th>Trial D</th>
<th>Trial E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Type:</td>
<td>Potting Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Amount:</td>
<td>2 small CUPS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Thickness:</td>
<td>Thin and 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Amount:</td>
<td>50 mL, 180 mL, 20 mL, 150 mL, 100 mL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Observations/Measurements:**

- [ ] 50 mL
- [ ] 75 mL
- [ ] 20 mL
- [ ] 75 mL
- [ ] 75 mL

*The independent variable is the changing variable and the dependent variable are the final observation/measurements.*

**RESULTS Graph**

- [ ] Liquid Absorbed (mL)
- [ ] Liquid Absorbed (mL)
- [ ] Liquid Absorbed (mL)
- [ ] Liquid Absorbed (mL)
- [ ] Liquid Absorbed (mL)

*My experiment shows that the two cups of potting soil absorb 75 mL of water despite the amount of water poured through because when 100 mL was poured through the soil absorbed 75 mL and when 180 mL was poured through the soil absorbed 75 mL.*
Set-Up:

SciTrek Lead:
If the classroom has a document camera, ask the teacher to use it for the introduction (page 4, picture packet). If the teacher does not have a document camera, then draw the example cup on the board. Have a graduated cylinder and a dropper available to show students during the introduction.

SciTrek Volunteer:
Set out student notebooks.
- If students are not in the classroom before SciTrek starts, set out the notebooks where students should sit when they come into the classroom.
- If students are in the classroom before SciTrek starts, set out the notebooks where students should sit during the module, they will move to these spots after the introduction.

Introduction:
(5 minutes – Full Class – SciTrek Lead)

If needed, while you are doing the introduction have the SciTrek volunteers set out the SciTrek notebooks/nametags where they would like students to sit. Tell students that a notebook will be put on their desk, which is not their notebook and they should not move it.

Ask the class what we have been working on the last two meetings and what the real life application is. They should be able to tell you that they have been exploring water and soil interactions and that they have found that the more compact the soil, the slower the water absorbs into the soil. This shows us that landslides are more likely to occur on loose soil than compact soil. They should also state they designed an experiment to test another variable that might affect the amount of liquid that the soil can absorb. Have each group tell you the variable that they are going to investigate.

Tell the class that today they will be working in their groups to complete their experiments using the procedures they developed last session.

Tell students that today they will be using graduated cylinders. Show students the graduated cylinder. Tell them they will need to fill the graduated cylinder to the correct amount; to do this they should put the graduated cylinder on a flat surface. They will then pour liquid into the cylinder until it is approximately 10 mL from the desired amount. At this point, they should add the remaining liquid drop-wise with a dropper. Show students the dropper. They should then verify the volume by making sure they are eye level with the liquid level and reading the graduated cylinder.

Once they have poured the water through the soil, they will need to figure out how much liquid the soil absorbs. Have a discussion with students about what it means for a soil to absorb a liquid. By the end of the conversation, make sure students understand that absorb means that the soil takes in and holds onto the liquid. Show students the picture of the example cup (page 4, picture packet). Ask the students what they will do in their experiment. They should reply that they will fill their medium cups with the appropriate amount of the correct soil type. Draw soil in the medium cup on the picture. Then, ask students what they will do next. They should reply that they will fill their graduated cylinders with the appropriate liquid amount and pour the liquid over the soil. Draw water being poured over the soil on the picture and label the water 50 mL to indicate that 50 mL of water was poured over the soil. Ask students what they expect to happen. They should respond that some of the water will be absorbed into the soil and the rest will go through the holes into the larger cup. Draw water sitting at the bottom of the large cup. Ask students what they will do with the water that is in the large cup. They should respond that they
will measure it using the graduated cylinder. Label the water at the bottom of the large cup 20 mL to indicate that 20 mL of water has gone through the holes of the small cup and dripped into the large cup. Once students understand the process, ask them how they will figure out how much liquid was absorbed by the soil. They should respond that they will subtract the amount of liquid in the bottom cup from the amount of liquid that was poured over the soil. Perform the subtraction 50 mL - 23 mL on the picture page, making sure that you are doing the appropriate form of subtraction as dictated by the teacher. Note: it does not matter what amount of water you put going in and coming out, however, it is best not to do a factor of 10 for the water going out so volunteers can see how to do the subtraction with students. See example below.

Tell students after they are finished with their experiment and recording their results, they will then use the data to make a graph to see how their changing variable has affected the amount of liquid a soil can absorb.

Tell the students that they will now start their experiments.

If needed, tell the students to get into their groups.

Experiment:
(27 minutes – Groups – SciTrek Volunteers)

Before students start their experiment, make sure that they have filled out the variables section of the results table on page 6.

Help students set-up and complete their experiment. To help keep track of which graduated cylinder goes with which trial, you can write the letter on the graduated cylinder using the wet erase pen that is used on the group notepads. Have each student be in charge of at least one of the trials. For each student’s trial have them put a coffee filter and the appropriate type and amount of soil in the cup, fill the graduated
cylinder, and measure the amount of liquid that goes through the system. Make sure the students pour the liquid over the soil slowly and carefully. Wait until the water is no longer dripping from the small cup into the large cup or let the experiment run for five minutes, whichever comes first, and then have students set the medium cup in an extra, large cup and measure the amount of liquid that passed through the soil using a graduated cylinder. Have each student read their graduated cylinder and tell you their measurement and record these on page 5 of the group notepad under liquid amount in large cup. Then have students copy the measurements onto page 6 of their notebook (see sample group notepad below).

Ask the students, how they will figure out how much water the soil in each of the trials absorbed. They should say that if they take the initial amount of water they can subtract the amount of water that was in the large cup (the amount of water that passed through the soil) and the difference will be the amount of water that the soil absorbed. As a group, do the math for each of the trials in the group notepad, making sure to use the appropriate subtraction method as dictated by the teacher. If more room is needed to do the math, use the backside of a notepad page. Students only need to record the liquid absorbed in their notebooks, not the math process to determine the amount.

Encourage students to make observations other than the amount of water passing through, such as liquid color, speed with which the liquid came through, texture of the soil, etc. These can be recorded in the results table under other observations.
Graph:
(10 minutes – Groups – SciTrek Volunteers)

Once the results table has been completed and each student has every trial filled out, pass out one partial graph piece to each student and have them fill out the piece for the cup they oversaw. There is an extra partial graph piece in the group box that can be used as an example. On the bottom line, have students write the value of their changing variable (example: sand), not the trial letter or the changing variable (example: B or soil type). This way when the pieces are rearranged, they will be able to see the values for each of the trials. Have students draw a line showing the appropriate absorbed liquid amount as well as write in the absorbed liquid amount on top of the line and then quickly shade below the line. Once each student has completed their graph piece, have students help you arrange the partial graph pieces so that they are in increasing order as done in the example below. In the example experiment discussed, the trials were graphed in the following order: C, A, E, D, B. Tape the partial graphs to the group notepad so that they look like a complete graph (see example group notepad below). When taping the graph pieces to the group notepad, make sure that each graph piece overlaps with the one next to it so that you only see the y-axis for the first graph piece.

After the pieces of the graph are taped into the group notepad, ask the students what their changing variable was. Record this answer for the x-axis title and have students copy this into their notebooks.
Results Summary:
(16 minutes – Groups – SciTrek Volunteers)

Have students summarize their findings. Challenge students to think about how their changing variable did or did not affect the amount of liquid a soil can absorb.

When writing their results summary, make sure that students start the statement with a claim about the trend or pattern in their data and then write “because” and use data to back up the claim. The data from this experiment is in the form of measurements.

If the values of their changing variable have an order (example: 20 mL → 50 mL → 100 mL) then that variable affected the amount of liquid the soil could absorb. If, on the other hand, there was no order for their changing variable (example 50 mL → 100 mL → 20 mL) and the difference between the liquid absorbed for each trial is small, then that variable did not affect the amount of liquid the soil could absorb. If possible, try to have students generate a claim that allows them to make a prediction about something that they have not tested. An appropriate claim could be: 2 small cups of potting soil can only absorb about 75 mL of water. This is an appropriate claim because it allows the students to make a prediction about what would happen if new values of their changing variable were introduced. After generating a claim about the experiment, write the word “because” and follow it with supporting data (when less than 75 mL of water was poured through the potting soil, all of the water was absorbed and when more than 75 mL of water was poured through the soil, only about 75 mL of water was absorbed). The supporting data should be the two most convincing data points, typically the minimum and maximum amount of liquid absorbed.

The results summary is still valid, and important, if it shows that the changing variable tested did not affect the amount of liquid the soil could absorb. Even if their results summary is contrary to what you think, have students make a claim based solely on their data. Help students copy this statement into their notebooks on page 7.

Once students have filled out their results summary, have them fill in the sentence frame (page 8): “I acted like a scientist when________.” This response should be unique and specific for each of the students and should not be “when I did an experiment.” If students are having trouble with this sentence frame, ask them what they did during each SciTrek visit.

If there is extra time, talk to your students about how their results relate to landsides.

Wrap-Up:
(2 minutes – Full Class – SciTrek Lead)

Tell students that during the next SciTrek visit they will make a poster, which they will use to present their findings to the class. These posters will help us learn about what variables affect the amount of liquid a soil can absorb.

Clean-Up:

Before you leave, have students attach their nametags to their notebooks and place them in the group box. Pour the wet “soil” into the Ziploc bag provided. Make sure to seal this bag so that water does not spill in your box. Put the used water into one of the buckets. Stack all of the cups and place the cups and graduated cylinders into the buckets. Bring all materials back to UCSB. In addition, put your lab coat into your group box.
Day 4: Poster Making

Schedule:

Introduction (SciTrek Lead) – 2 minutes
Experimental Discussion (SciTrek Volunteers) – 17 minutes
Poster Making (SciTrek Volunteers) – 36 minutes
Wrap-Up (SciTrek Lead) – 5 minutes

Materials:

(4) Volunteer Boxes:
- Student nametags
- Student notebooks
- Volunteer instructions
- Volunteer lab coat
- Poster diagram (full page)

(2) Pencils

(2) Paperclips

(2) Wet erase markers

Highlighter

Scissors

(2) Glues

Poster Parts:
- Scientists’ names
- Question
- Experimental set-up

- Procedure
- Results table
- Results graph

- Results summary

(6) “I acted like a scientist when ________”

(6) Picture spaces

Other Supplies:
- (4) Large group notepads
- Poster paper tube

Lead Box:
- (3) Extra student notebooks
- Lead instructions
- Soil water retention picture packet
- Lead lab coat
- Poster diagram (full page)
- Time card

- (2) Sticker sets for how to present graph (changing soil type or water amount/ changing soil or water amount)
- (2) Pencils
- (5) Paperclips

- (2) Wet erase markers
- (2) Highlighters
- Scissors
- (2) Glues
- Scotch tape
- Poster Part Packet (1 each color)

Set-Up:

SciTrek Lead:
Ask the classroom teacher for a place to leave the student posters in the classroom.

SciTrek Volunteer:
Set out student notebooks.
- If students are not in the classroom before SciTrek starts, set out the notebooks where students should sit when they come into the classroom.
- If students are in the classroom before SciTrek starts, set out the notebooks where students should sit during the module, they will move to these spots after the introduction.
**Introduction:**
*(2 minutes – Full Class – SciTrek Lead)*

If needed, while you are doing the introduction have the SciTrek volunteers set out the SciTrek notebooks/nametags where they would like students to sit. Tell students that a notebook will be put on their desk, which is not their notebook and they should not move it.

Ask the class, “What is the class question that we have been investigating?” Students should reply, “What variables affect how much liquid a soil can absorb?” Ask the class, “Why are we interested in this question?” They should say that learning about water and soil interactions can help us learn about landslides. Inform the students that they will be making posters to present their findings to the class. This presentation will be their chance to tell the class what their group has discovered about the class question. Tell them they should write as neatly as possible on the poster parts so that the other class members can read their poster.

Tell the groups if they have not filled in the results summary or “I acted like a scientist when ______,” they should finish these before starting on their poster.

In addition, tell students that before they start their poster they should explain the experiment they did to their volunteer along with what they found out. They should try to do this without looking at their notebooks.

If needed, tell students to get into their groups.

**Experimental Discussion:**
*(17 minutes – Groups – SciTrek Volunteers)*

If students have not finished their results summary or “I acted like a scientist when______,” then have them complete these before discussing their experiment or starting their poster.

Have your students explain their experiment as well as their findings to you without looking at their notebooks. Ask each student in the group a question about the experiment. Questions can be about what the students did as well as what they learned. Also try to ask students to make predictions using their data about experiments that they did not do.

**Poster Making:**
*(36 minutes – Groups – SciTrek Volunteers)*

Pass-out the writing portions (general poster parts and “I acted like a scientist when____”) and have students write their names on them and complete them. In addition, have each student write their name on the scientists’ names part. Use the following guidelines when assigning poster parts:
<table>
<thead>
<tr>
<th>Number of Students in Group</th>
<th>Poster Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Each student gets an “I acted like a scientist when____” and picture space.</td>
</tr>
<tr>
<td></td>
<td>1. Question 2. Experimental Set-Up 3. Procedure 4. Results Graph* 5. Results Summary</td>
</tr>
<tr>
<td></td>
<td>Student that finishes 1st completes the results table (not presented)</td>
</tr>
<tr>
<td>6</td>
<td>1. Question 2. Experimental Set-Up 3. Procedure (Presents 1st half of procedure) 4. Results Table (Presents 2nd half of the procedure) 5. Results Graph* 6. Results Summary</td>
</tr>
<tr>
<td>7</td>
<td>1. Results Table (Presents names) 2. Question 3. Experimental Set-Up 4. 1st Half of Procedure 5. 2nd Half of Procedure 6. Results Graph* 7. Results Summary</td>
</tr>
<tr>
<td></td>
<td>Procedure can be cut in half.</td>
</tr>
</tbody>
</table>

*Give the results graph to the student that is most confident in presenting.

Once all writing sections are completed, have students draw a picture of their experiment or how they acted like a scientist.

In the students’ notebooks, highlight and number the section that they will present. The parts should be numbered as follows: 1) scientists’ names, 2) question, 3) experimental set-up, 4) procedure, 5) results graph, and 6) results summary (see example below). Students will NOT present the results table or “I acted like a scientist when____” parts from their poster. If a student is presenting multiple sections, use the paperclips in your group box to clip together the sections that they are reading so that when presenting, it will be easy to flip back and forth between pages.
Place one of the following sentence frame stickers on the top of the notebook page of the student that is completing the results graph (page 7).

**Changing Soil Type/Liquid Thickness**

When the _______ was _______ the soil absorbed _______ mL.

*(you should fill this blank out for the student)*

**Changing Soil Amount/Liquid Amount**

The cup with _______ of _______ absorbed _______ mL.

*(you should fill this blank out for the student)*

Then practice reading the five sentences with that student. For the poster below, the sentence would be: The cup with 10 mL of water absorbed 10 mL. Make sure you fill the first blank in the first sentence frame or the second blank in the second sentence frame (example: soil type or water) for the student in the sentence frame but leave the other blanks (“changing variable value” and “measurement”) empty.

As soon as students have completed some of their pieces, start gluing them onto the large poster paper **exactly** as they are arranged in the example below. Do not wait until students have completed all the pieces to start gluing them onto the poster.

Once the poster is complete, have students start practicing for the presentation. Make sure that students read from their notebooks instead of off the poster.
If there is additional time, tell students that the other students will ask them questions during their poster presentations. Tell them that they should think about what questions they will be asked and then think of the answers to those questions so that they will be prepared during their presentation.

**Wrap-Up:**
*(5 minutes – Full Class – SciTrek Lead)*

Ask the students the following questions:
- How did you act like a scientist during this project?
- What did you do that scientists do?

After having a discussion about how they acted like scientists and talking about how everyone does things that scientists do in their everyday lives, tell students that they will present their findings during the next SciTrek visit and that you are looking forward to hearing about all of their experiments.

**Clean-Up:**

Before you leave, have students attach their nametag to their notebook and place them in the group box. Leave student posters in the classroom. Bring all materials back to UCSB. In addition, put your lab coat into your group box.

**Day 5: Poster Presentations**

**Schedule:**

- Introduction (SciTrek Lead) – 2 minutes
- Practice Posters (SciTrek Volunteers) – 15 minutes
- Poster Presentations (SciTrek Volunteers/SciTrek Lead) – 41 minutes
- Wrap-Up (SciTrek Lead) – 2 minutes
### Materials:

- **Volunteer Boxes:**
  - ☐ Student nametags
  - ☐ Student notebooks
  - ☐ Volunteer instructions
  - ☐ Volunteer lab coat
  - ☐ (2) Pencils
  - ☐ (2) Paperclips
  - ☐ Highlighter
  - ☐ (6) Sharpened SciTrek pencils (all same color)

- **Lead Box:**
  - ☐ (3) Extra student notebooks
  - ☐ Lead instructions
  - ☐ Soil water retention picture packet
  - ☐ Lead lab coat
  - ☐ Scotch tape
  - ☐ Time card
  - ☐ (2) Sticker sets for how to present graph (changing soil type or water amount / changing soil or water amount)
  - ☐ (2) Pencils
  - ☐ (2) Wet erase markers
  - ☐ (4) Paperclips
  - ☐ (2) Highlighters
  - ☐ Scotch tape

*Student posters should already be in the classroom.*

### Picture Packet Page:

![Graphs showing variable effects on soil absorption](image-url)

### Set-Up:

**SciTrek Lead:**

If the classroom has a document camera, ask the teacher to use it for the notes on presentations (page 5, picture packet). If the classroom does not have a document camera, then write the class question on the board, “What variables affect how much liquid a soil can absorb?” Leave enough room to record student findings under the question.

Organize the posters so that groups that had the same changing variable present back to back.
SciTrek Volunteer:

Set out the SciTrek notebooks/nametags. Today students will be sitting in their regular classroom seats during poster presentations. Have pencils ready to distribute to your group after the poster presentations.

**Introduction:**

(2 minutes – Full Class – SciTrek Lead)

Tell students that today they will present their poster to the class. Inform students that this is a common practice in science. Scientists go to conferences where they present posters about the experiments they conducted. At these presentations, other scientists give them feedback on their experiments, which allows them to return to the lab with new ideas for future experiments.

Tell the students that they will have 15 minutes to discuss their experiment results and practice presenting their poster with their group. While discussing their experiment results, students should not look at their notebooks or poster. Remind students to read from their notebooks when presenting. Tell students that after practicing they will return to their normal classroom seats.

**Practice Posters:**

(15 minutes – Groups – SciTrek Volunteers)

If the posters are not already in order, the lead should organize the posters so the experiments featuring the same changing variable are presented back to back.

Once students have gotten to your group, have students explain what they did and what they learned from their experiment. Ask students questions to make sure that they understand what they did during their experiment. Make sure that you also have them use their results to predict what would happen for other systems that they did not test. Remind them to think about patterns or trends that they saw for their own results and apply these trends to make predictions about how much liquid a soil can absorb. For instance, if the group’s changing variable was liquid thickness ask them to predict how much liquid would pass through the cup if they used a liquid that was even thicker than liquid level 6 (this would be a thickness that they did not test). Possible answer: more liquid would be absorbed with level 6 liquid and more liquid would sit on top of the soil. Try to make sure that each student in your group answers one question.

Once your group has an understanding of their experiment, have them practice their poster presentation, making sure they are reading the poster parts in the correct order (scientists’ names, question, experimental set-up, procedure, results graph, and results summary). Make sure each student’s part is highlighted in their notebook. If students are reading from multiple pages, use a paperclip to clip these pages together to make it easier for them to flip back and forth. Remind students to read from their notebook rather than from their poster.

It there is additional time, tell students that the other students will ask them questions during their poster presentations. Tell them that they should think about what questions they will be asked and then think of the answers to those questions so that they will be prepared during their presentation.

**Poster Presentations:**

(41 minutes – Full Class – SciTrek Volunteers/SciTrek Lead)

Have students return to their original class seats. Ask the class, “What is the question that we have been working on solving?” Students should tell you, “What variables affect how much liquid a soil can absorb?” Ask the class, “Why are we interested in answering this question?” Students should say that if they can
determine the variables that affect the amount of liquid a soil can absorb, they will be able to understand and predict landslides. Tell students that during the presentations you are going to take notes. Turn to page 5 in the picture packet. Tell them that they need to tell you each group’s changing variable after the group says their question so that you can record it. You will then record the values of the changing variable and the data that was taken when the group presents the graph.

After each presentation, students will be given the opportunity to ask scientific questions to the presenting group to help them determine if/how the variable investigated affected how much liquid the soil could absorb. Tell them these questions are important because they will have to summarize for you what they learned from the group so you can record it on the group notes. Therefore, their questions should focus on helping them be able to summarize the group’s findings. Tell them that if they ask a scientific question during the presentation, they will get a SciTrek pencil at the end of the presentations.

Volunteers should make sure that students are quiet and respectful when other groups are presenting. When your group is presenting, go to the front of the room with them; prompt students if they do not know who talks next and remind them to read from their notebooks.

During the student question time, the SciTrek lead and/or volunteers should ask at least one question. Examples of possible questions are: “How do you know...?” or “Is there anything else you can do to get more information about your question?” Each group should answer approximately five questions (one question per student).

Below is an example of notes that the lead could have taken during the poster presentations.

![Image of notes]

After all poster presentations have been given, ask the class, “What did we learn about how much liquid a soil can absorb? Have them summarize the class findings. The highlights from many experiments are seen below. Do not expect students to know highlights from experiments that were not run.

- The more “space” between the pieces of the soil, the less liquid that will be absorbed
• The more soil, the more liquid that can be absorbed
• The more liquid, the more liquid that will be absorbed until you reach the saturation point of that soil. At that point, no matter how much more liquid you pour through the sample, it will absorb approximately the same amount of liquid
• The thicker the liquid, it seems like the more the soil absorbs due to the math. However, students will notice not all of the liquid is being absorbed by the soil. Instead, the thick liquids sit on top of the soil. To bring this back to landslides, talk about how the thick liquid could represent snow or mud and these would not absorb into the soil but they would add weight to the soil. Therefore, they could cause either the land to slide or the thick materials to slide. For instance with snow this is called an avalanche.

When summarizing experiments, use students’ collected data and not what they should have found from the list above. Ask students what values of variables they would need to get the soil to absorb the most liquid.
• Soil amount: as much as possible
• Soil type: Vermiculite or sand
• Liquid amount: as much liquid as possible up to a certain point
• Liquid thickness: Liquid level 6

If no one in the class did experiments on one of the variables above, then they will not know how that variable affects soil absorbency and do not expect them to tell you which value to use. Tell students they have taught you a lot about soil absorbency.

**Wrap-Up:**
(2 minutes – Full Class – SciTrek Lead)

Tell the students that the volunteers that have been working with them are undergraduate and graduate students that volunteer their time so that they can do experiments. Have the students say thank you to the volunteers. This is the last day with their SciTrek volunteers, therefore, they should say goodbye to them. Tell students that you will be back one more time.

Tell students to remove the paper part of their nametag from the plastic holder and that they can keep the paper nametag but they need to give the plastic holder back to their SciTrek volunteer.

Have volunteers pass out pencils to the students that asked questions. If a student did not ask a question during the poster presentations, have them ask/answer a question about the experiments before the volunteer gives them a pencil.

**Clean-Up:**

Before you leave, collect the plastic nametag holders and put them in the group box. Students can keep the paper part of their nametag. Collect notebooks and place them in the group box. Leave student posters in the classroom. Bring all materials back to UCSB. Remove tape from the lid of your group box and place inside. In addition, remove all materials from lab coat pockets, remove your nametag, unroll lab coat sleeves, and put your lab coat in the dirty clothes bag at UCSB.

**Day 6: Observation Assessment/Tie to Standards**

**Schedule:**

Observation Assessment (SciTrek Lead) – 5 minutes
Tie to Standards (SciTrek Lead) – 55 minutes
**Materials:**

- [ ] (3) Extra student notebooks
- [ ] Student notebooks
- [ ] Lead instructions
- [ ] Soil water retention picture packet
- [ ] Lead lab coat
- [ ] (25) Observation assessments
- [ ] Time card
- [ ] (2) Pencils
- [ ] (2) Wet erase marker
- [ ] (25) Rubber bands
- [ ] Paper towels
- [ ] (2) Water (8 oz bottles)
- [ ] Ziploc bag (for wet soil)
- [ ] (4) 100 mL Graduated cylinders
- [ ] (4) 20 oz Cups
- [ ] (4) 9 oz Cups with holes in bottom
- [ ] (3) 1 oz cups
- [ ] Bag of 4 soil types (vermiculite, sand, small rocks, and large rocks)
- [ ] (8) Precut coffee filters
- [ ] (2) Droppers

**Other Materials:**

- [ ] Poster with findings
- [ ] Bucket

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**Notebook Pages and Finding Page:**

I acted like a scientist when I measured the liquid that came out of the soil.

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**TIE TO STANDARDS**

1. Absorb: The ability to hold liquid.
2. Circle the soil that absorbed the most liquid.
   - A
   - B
3. The [ ] soil is the more likely to cause a landslide.
   - Lighter

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**Possible Factor 1: Liquid Amount (for 1 small cup of potting soil)**

4. Is there a limit to the amount of water that soil can absorb?
   - [ ] Yes
   - [ ] No

5. 1 small cup of potting soil can hold ______ mL of water.

6. How much water can 2 cups of soil absorb? ______ mL

7. Adding water to soil makes the soil [ ]
   - Heavy
   - Lighter

8. The water in the soil is the more likely to cause a landslide.
   - [ ] Lighter
   - [ ] Heavy
*All findings should be covered so that they can be revealed one by one as the SciTrek lead goes through the tie to standards activity.*
**Set-Up:**

SciTrek Lead:

If the classroom has a document camera, ask the teacher to use it for the tie to standards activity (pages 8-11, student notebook and pages 6-13, picture packet). If the classroom does not have a document camera, then tape example poster-size notebook pages to the front board.

Assemble the tie to standards set-up. Use the following steps to help you with the set-up:

1. Fill the 4 graduated cylinders with 100 mL of water each.
2. Place a pre-cut coffee filter circle inside each of the four medium (9 oz) cups with holes.
3. Place the medium cups inside the large (20 oz) cups.
4. Pour three small (1 oz) cups (completely full and level) of each of the following soil types into the four cups with coffee filters: sand, small rocks, large rocks, and vermiculite.

Pass-out notebooks to students. If you do not have time to get set-up before the start of the module ask the teacher to pass-out the notebooks during the observation assessment.

Tape the findings poster to the front board. Make sure that the findings are covered.

Remind the teacher to give you their lab coat at the end of the day.

**Observation Assessment:**
*(5 minutes – Full Class – SciTrek Lead)*

“Before we start our activity today we will determine how your ideas on observations are developing. One of the ways that we get program funding is by demonstrating the program effectiveness. Therefore, we need you to do your best on the assessment” Pass-out the observation assessment and a rubber band to each student. Tell students to fill out their name, teacher’s name, and date on the top of the assessment. Remind the students that it is important that they fill out this assessment on their own.

Read the instructions to the students. Then read each of the statements and tell the students to circle “observation” for statements that are observations or “not an observation” for statements that are incorrect observations or statements that cannot be observations. When students are finished, collect the assessments and the rubber bands and verify that the students’ names are on the top of the papers.

**Tie to Standards:**
*(55 minutes – Full Class – SciTrek Lead)*

**Review:** *(7 minutes)*

Tell the class that you enjoyed their poster presentations the last time you were there. Today we are going to revisit all of the variables that they have been investigating and determine how they affect how much liquid soil can absorb. But before we do that, we will review what absorb means, how to tell which soil absorbs the most liquid, and what this implies for landslides. Have the students turn to page 8 of their notebooks. Place an example notebook on the document camera and turn to page 8.

Have students fill in the blank for the definition of absorb for question 1 (Absorb: the ability to hold liquid). Then, have them look at the cups and identify which cup absorbed the most liquid. Make sure that students understand that the more liquid in the big cup, the less liquid that the soil absorbed.
Ask students what causes landslides to happen. Help them realize that the heavier the soil is, the more likely a landslide and have them fill in the blank for question 3 (The heavier the soil the more likely a landslide). Remove the clips showing finding 1 on the findings poster.

Finding 1: The heavier the soil the more likely a landslide.

Possible Factor 1: Liquid Amount (15 minutes)

Tell students that we will now look at different factors and see how they would affect landslides. The first factor that we will discuss is how changing the water amount affects how much 1 small cup of potting soil can absorb. Tell students to look at the graph on page 9. Show them that the amount of water that was poured over the potting soil is shown on the x-axis. Ask the students how much water was poured over the potting soil for trial 1. (10 mL) On the first cup, (page 6, picture packet) draw 10 mL of water going into the soil. Show them that the amount of water that was absorbed by the soil is shown on the y-axis. Ask the students how much water was absorbed by the soil for the first trial. (10 mL) Write 10 mL with an arrow pointing to the soil to indicate the 10 mL of water that was absorbed by the soil. Ask the students if we poured 10 mL of water over the soil and 10 mL of water was absorbed, how much water would be in the large cup under the small cup? (0 mL)
Tell the students that we will now look at trial 2. Ask the students for this trial how much water was poured over the soil (20 mL) as well as how much water was absorbed by the soil (20 mL). Draw 20 mL of water being poured into the soil and 20 mL being absorbed by the soil on the second cup (page 6, picture packet) (example above). Ask the students if we poured 20 mL of water over the soil and 20 mL of water was absorbed, how much water would be in the large cup under the small cup. (0 mL)

Tell the students that we will now look at trial 3. Ask the students how much water was poured over the soil (30 mL) as well as how much water was absorbed by the soil (25 mL) for this trial. Draw 30 mL of water being poured into the soil and 25 mL being absorbed by the soil on the third cup (page 4, picture packet) (example above). Ask the students if we poured 30 mL of water over the soil and only 25 mL of water was absorbed, how much water would be in the large cup under the small cup. (5 mL) If needed, do the math to determine the amount of water absorbed by the soil next to the example cup. Write 5 mL on the bottom of the large cup.

Ask the students why the first two cups absorbed all the water and this cup did not. (Possible answer: the soil was not fully wet in the first two cups but now it is fully wet.)

Repeat this process for the trials that poured 40 mL and 50 mL of water over the soil.

Ask the class question 4, “Is there a limit to the amount of water that soil can absorb?” By the end of the conversation make sure that students understand that the answer is yes. Have the class fill in the blank for question 5 (1 small cup of potting soil can hold 25 mL of water). Ask students question 6, how much water can 2 cups of soil absorb?, make sure by the end of the conversation they realize that two cups of soil could hold 50 mL because we have doubled the amount of soil that we have.

Have students look at the picture on page 9 and put the full size colored picture under the document camera (page 7, picture packet, seen below). Ask the students to explain what happened. By the end of the conversation make sure students understand that the soil absorbed all of the water that it could and could not hold any more water. Since the soil did not have a cup under it to collect the extra water, the extra water pooled on the top of the soil.
Tell students that we are now going to apply what we know to landslides. “Pretend that you are standing on a hill and it starts raining. You take a soil sample and find the mass. Will that soil sample have a greater or smaller mass when it is wet or dry?” (It will have a greater mass when the soil is wet). Have students fill in question 7 (Adding water to soil makes the soil **heavier**.) Ask them how this applies to landslides (the heavier the soil the more likely a landslide) and have them fill in question 8 (The **more** water in the soil the more likely a landslide.) “Pretend that it continues to rain for the next 20 hours. During this time you keep taking soil samples. Do the mass of the soil samples keep going up?” Students should realize that after the soil is saturated with water (completely full) the soil will not be able to hold any more water and therefore, the mass will not increase anymore. In addition, any more water/rain in that area will run off/pool in another area because it will not be able to be absorbed by the soil.

Ask students, when it rains what are the chances that a landslide will happen and why? They should say that as it rains, the chances of a landslide happening go up because the mass of the soil goes up.

Tell students that we have now learned that adding a liquid to soil increases the chance of a landslide. However, there is also a limit to the amount of liquid that a soil can absorb. Remove the clips showing finding 2 on the findings poster.

**Finding 2:** Adding a liquid to soil increases the chance of a landslide. There is a maximum amount of liquid that soil can absorb.

An example of this page in the student notebook can be seen above.
Possible Factor 2: Soil Type (13 minutes)

If a group tested soil type, ask the students to predict which of the soil types (small rock, large rocks, and sand) will be the least absorbent, which types will be the most absorbent, and why. Do not have students write their predictions in their notebook. You can write the class predictions in the class notebook. If no group tested soil type, do not have students make a prediction. After, have a volunteer help you pour 100 mL of water through each of the three soil types. Make sure that the liquid is poured over the soils at the same time. Have students observe what happens. Ask students, did the soil that absorbed the most have the most or the least water in the large cup? (the least water). Then, have students put the soil types in order from least absorbent (1) to most absorbent (3) for question 10 (large rocks (least absorbent - 1), small rocks, and sand (most absorbent - 3)). If needed, show students picture packet page 8 (seen below left), showing the same experiment with the water poured back into the graduated cylinders so that they can more easily see the amount that was in the large cup.

Ask students if different soil types absorb different amounts of water. (Yes) Ask the students what pattern they notice about the amount of water that the soil can absorb. The larger the piece size of the soil, the less the soil absorbs. Record piece size for question 10. Ask the students, if they add the maximum amount of water that each soil type can absorb, which of the four soil types would have the largest weight change and why. (The sand because it has the smallest pieces and therefore can absorb the most water.) Therefore, which soil type would be the most likely to have a landslide? (sand). Have students circle the correct answers for question 11.

Have the students look at the two pictures on page 10 and show students the corresponding colored pictures (page 9, picture packet, seen above right). Ask students to describe the objects. They should describe the first object as a sponge and the second object as a rock. Ask the students if the objects are approximately the same size. (Yes) Ask students if you poured water over each of the objects, what would happen. Students should reply that water will be absorbed by the sponge but would just run off of the rock. Tell students that this shows us that the other factor that affects the amount of water that soil can
absorb and is known as **material absorbency**. Record this answer for question 12. Ask students if small rocks, large rocks, and sand have the same material absorbency and if they have a low or high absorbency. Students should respond that all of those soil types have similar material absorbency and that it is low. If a group tested soil type and used vermiculite, ask students if they can tell you a type of soil that has a very large material absorbency. (Vermiculite) If no group worked with this substance, show students the vermiculite and tell them that it has a high material absorbency. Tell students that you want to confirm that material absorbency affects the amount of liquid a soil can absorb. Ask the class what soil from the list of soils in their notebook has about the same piece size as the vermiculite. (Sand) Tell the class that you will now pour 100 mL of water over the vermiculite to see what happens. Pour the water over the vermiculite and have students make observations and then compare back to the sand cup.

Ask the students, if they add the maximum amount of water that sand and vermiculite can absorb, which of the soils would have the largest weight change and why. (The vermiculite because it has the largest material absorbency.) Therefore, which soil type would be the most likely to have a landslide? (Vermiculite). Have student circle the correct answers for question 13.

Tell students that they have now taught you that soil types are very different from each other because of the size of the pieces in the soil as well as the material absorbency. Remove the clips showing finding 3 on the class poster.

Finding 3: The smaller the piece size and the larger the material absorbency the more liquid the soil can absorb therefore, the more likely a landslide is to happen.

An example of this section in the student notebook can be seen below.
Other Possible Factors (14 minutes)

Have the students turn to page 11 of their notebook. Turn the example notebook to page 11. Ask students if they were standing on the field at their school, would they be worried about a landslide and why or why not. Students should respond that they would not be worried because the field is flat and landslides are more likely to occur on sloped surfaces. Have students fill in slope for question 14. Have students complete the pictures showing a house position whose residents should worry about landslides and a house whose residents would not worry about landslides.

Tell students we have now learned another important variable about landslides. That the steeper the slope, the more likely it is to have a landslide. Remove the clips showing finding 4 on the class poster.

Finding 4: The steeper the slope, the more likely a landslide.

Show student page 10 of the picture packet (seen below left) and ask them to describe the two pictures. Then, ask students which of the hills is more likely to have a landslide and why. By the end of the conversation make sure that they understand that the hill with plants on it is less likely to have a landslide because the roots of the plants will hold the soil in place.

Have students draw in the roots of the plants in question 17. Tell students that another factor that affects landslides is called soil consistency. Soil consistency is the ability of a soil to stick to itself. Have students fill in question 18. Ask students if plants affect the soil consistency and why. They should respond that plants increase the soil consistency because they hold the soil together. Have students circle the correct answers for question 19. An example of this section in the student notebook is seen above.

Tell students we have now learned another important variable about landslides, the weaker the soil consistency the more likely a landslide. Remove the clips showing finding 4 on the class poster.
Finding 4: The weaker the soil consistency, the more likely a landslide.

**Possible Ways to Prevent Landslides (6 minutes)**

Tell students that you know that water amount, particle size, material absorbency, slope, and soil consistency all affect if a landslide will happen. Tell students that one field of science is called engineering and these types of scientists try to solve problems. One of the problems that engineers have tried to solve is how to stop landslides. We are now going to look at two solutions that engineers came up with.

Have students turn to page 12 of their notebook and put page 11 of the picture packet (below left) on the document camera. Ask a student to describe the top picture and tell you how this might stop a landslide. By the end of the conversation make sure that students have described the picture and talk about how this idea would work because the sloped section is only very small so even if there were a landslide, it would only be in very small area (one section of the stairs). If students have not brought up the word terracing tell students that this idea is called terracing. This means that the ground is graded so that it is sloped and then flat, making stair like structures in the ground. Ask students which variable this method tries to solve and have them write this method on the line (slope).

Have students look at the bottom picture on page 11 of the picture packet (above left). Tell students that this picture shows another idea that engineers came up with. Ask a student to describe the picture and tell you how this might stop a landslide. By the end of the conversation make sure that students have described the picture and talk about how replacing potting soil with rocks will increase the piece size and therefore the soil will not retain as much water. In addition, the plants would help increase the soil consistency by holding the rocks together. Ask students which variable this method tries to solve and have them write this method on the line (soil type/soil consistency).

An example of this section in the student notebook can be seen above on the right.
Tell students that they can keep their SciTrek notebook and that you have enjoyed working and learning with them and that SciTrek will be back later in the year to run another module.

**Clean-Up:**

Bring all materials back to UCSB.

**Extra Practice Solutions:**

**Module Extension**

**Other Ways Water Changes the Earth**

If you would like to expand on the module by talking to students about other ways that water shapes the land and how engineers try to prevent it you can have the following discussion with students. Feel free to use any picture of a river and of wave damage. If you would like the pictures seen below, e-mail scitrekadmin@chem.ucsb.edu and these pictures will be sent to you.

Tell the students that we have been focusing on landslides. One of the variables that affects landslides is water. However, landslides are one of the ways that water can change the shape of the land. Ask the students if they know of any other situations or ways that water can change the shape of the land. Talk to students about how rivers and the ocean shape the land and how humans try to prevent unwanted shaping of the land.
Rivers shape the land through three different methods: erosion, transportation, and deposition. **Erosion** occurs when the land is worn down where a river flows over it. **Transportation** occurs when the river moves rocks through the water from one place to another. **Deposition** is the step where the rocks are deposited into another spot. Depending upon what happens through each step and how much rock is moved, different landforms form around the river. Rivers tend to form V shaped valleys. The mountains in areas where rivers have shaped the land are pointed. **Human prevention** of rivers changing the land is to build dykes or walls if we do not want the water to go in a certain area. Many times these dykes are built so that they are only used when the river gets too high and if they were not there, water would flood the area. Rivers also deposit sediments into areas which boats need to travel. When this happens humans drudge, or use a large shallow ship, to remove the sediment.

The ocean shapes the land through three different methods: erosion, transportation, and deposition. **Erosion** occurs when the waves hit the side of a cliff taking away soil and rocks. **Transportation** occurs when the waves/tides move soil/sand to other areas. **Deposition** occurs when the soil and sand are deposited either on the ocean floor or on another beach. **Human prevention** of waves changing the land is to build sea walls so that the waves cannot go over them. Another method is to line softer material, like sand, with rocks so the waves hit the harder material instead of the softer material. In areas where humans do not think they can stop the erosion they will build buildings on stilts so that if the hillside does erode the house is still attached to the stilts. The waves also deposit material like sand into unwanted areas. For instance, sand is always being deposited in the Santa Barbara harbor, and just like for rivers, Santa Barbara drudges the harbor to remove the unwanted sand.