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 for 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. 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: 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: Tie to Standards (60 minutes)*
*This schedule assumes the teacher has given the observation assessments before SciTrek arrives on Days 1 and 6 of the module.

The exact module dates and times are posted on the SciTrek website (scitrek.chem.ucsb.edu/elementary) under the school/teacher. The times on the website include transportation time to and from the outside of Chem 1204. Thirty minutes are allotted for transportation before and after the module. Therefore, if a module was running from 10:00-11:00, then the module times on the website would be from 9:30-11:30.

Student Groups:

Students are divided into four groups of approximately 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 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 the amount of water absorbed by soil.
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 be able to 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 they acted 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 approximately five students.

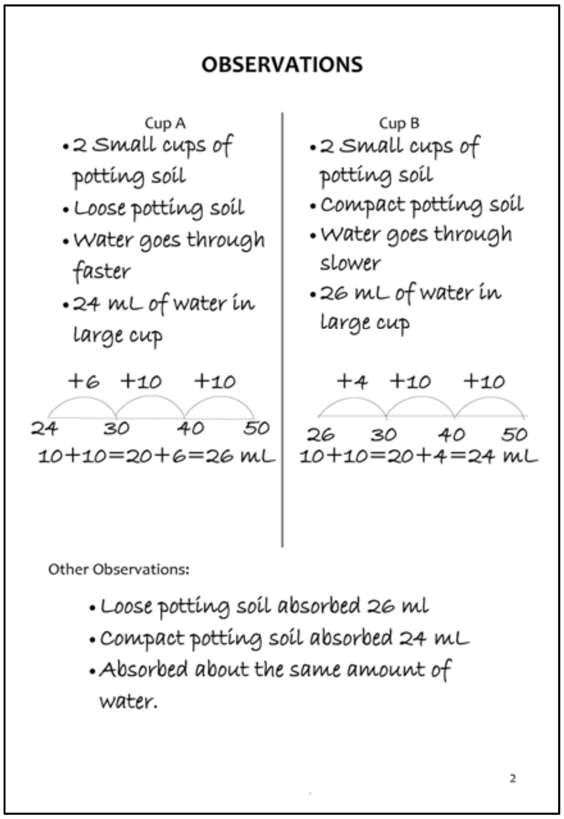
1. Year 1
    a. Classroom teacher <u>leads a group</u> (Role: Group Lead; this role is referred to as a volunteer in these instructions)
2. Year 2
    a. Classroom teacher <u>co-leads the modules</u> with a SciTrek staff member (Role: Co-Lead)
        i. Classroom teacher will be responsible for leading entire class discussions (Ex: observation activity).
        ii. Classroom teacher will be responsible for time management.
        iii. Classroom teacher will be responsible for overseeing volunteers and helping any groups who are struggling.
        iv. Classroom teacher will be responsible for all above activities. The SciTrek co-lead will only step in for emergencies.
        v. The SciTrek co-lead will run the tie to standards activity.
3. Year 3 and beyond
    a. Classroom teacher <u>leads the modules</u> (Role: Lead)
        i. Classroom teacher will be responsible for leading entire class discussions (Ex: observation activity).
        ii. Classroom teacher will be responsible for time management.
        iii. Classroom teacher will be responsible for overseeing volunteers and helping any groups who are struggling.
        iv. For year 3 a SciTrek staff member will co-lead the tie to standards activity with the classroom teacher, for subsequent years teachers will run the tie to standards activity independently.

SciTrek staff is 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 scitrekelementary@chem.ucsb.edu to learn more.

In addition, teachers are <u>required</u> to come to UCSB for the module orientation, approximately one week prior to the start of the module. Contact scitrekelementary@chem.ucsb.edu for exact times and dates, or see our website at scitrek.chem.ucsb.edu/elementary under your class's module times. At the orientation, teachers will go over module content, learn their responsibilities during the module, and meet the volunteers who 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 complete an orientation for the module will result in loss of priority registration for the following 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.



OBSERVATIONS

Cup A

- 2 Small cups of potting soil
- Loose potting soil
- Water goes through faster
- 24 mL of water in large cup

+6 +10 +10

24 30 40 50

10+10=20+6=26 mL

Cup B

- 2 Small cups of potting soil
- Compact potting soil
- Water goes through slower
- 26 mL of water in large cup

+4 +10 +10

26 30 40 50

10+10=20+4=24 mL

Other Observations:

- Loose potting soil absorbed 26 ml
- Compact potting soil absorbed 24 mL
- Absorbed about the same amount of water.

2

For Teacher During the Module:

Note: We **highly recommend** you complete the initial observation assessment prior to **Day 1** of the module and the final observation assessment prior to **Day 6** of 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 a SciTrek staff member at orientation.

Days 1-4:
    Have students' desks/tables moved into four groups, and cleared off.
Days 5-6:
    Have 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 (approximately one week before your module, exact orientation times are found at: scitrek.chem.ucsb.edu/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 **(highly recommended)**
2) Technique activity
3) Observation activity

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, 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 with your class, ***after*** SciTrek leaves.

Day 6:

If you would like more time for the tie to standards activity, you may give the observation assessment to your class, ***before*** SciTrek arrives **(highly recommended).**

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. Kellogg's Raised Bed and Potting Mix (Home Depot)
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. Digital Scale (OHAUS, max weight: 2000 g, readability: 1 g, Model No. H-2715) (Fisher Part Number: S40242-1)
13. Disposable pipets (droppers) (Fisher part number: 13-711-7M)

All printed materials used by SciTrek (notebooks, materials pages, picture packet, poster parts, instructions, and nametags) can be made available for use and/or editing by emailing scitrekelementary@chem.ucsb.edu.

Types of Documents:

Notebook:

One given to every student and is filled out by the student. The lead will use a notebook to write in as an example for students. The notebook the lead uses is referred to as the class notebook in these instructions.

Notepad:

One given to every group and is filled out by the volunteer. In these instructions, the examples are narrower and taller than the notebook pages.

Picture Packet:

One per class that, if needed, the lead fills out. In these instructions, the examples are labeled and, if applicable, filled out in blue.

In these instructions, all other example documents are labeled.

Day 1: Technique/Observation Activity/Observations

Note: We **highly recommend** teachers complete the observation assessment prior to Day 1 of the module. The suggested times in the lesson plan below are assuming the observation assessment was given prior to SciTrek's arrival.

Schedule:

Times if teacher gave assessment prior to SciTrek:	***Times if SciTrek must give assessment:***
Introduction (SciTrek Lead) – 2 minutes	Introduction (SciTrek Lead) – 2 minutes
Module Introduction (SciTrek Lead) – 5 minutes	Observation Assessment (SciTrek Lead) – 5 minutes
Technique (SciTrek Lead) – 13 minutes	Module Introduction (SciTrek Lead) – 5 minutes
Observation Activity (SciTrek Lead) – 15 minutes	Technique (SciTrek Lead) – 10 minutes
Observations (SciTrek Volunteers) – 20 minutes	Observation Activity (SciTrek Lead) – 13 minutes
Wrap-Up (SciTrek Lead) – 5 minutes	Observations (SciTrek Volunteers) – 20 minutes
	Wrap-Up (SciTrek Lead) – 5 minutes

Materials:

(4) Volunteer Boxes:

- ☐ Student nametags
- ☐ (NS+1) Notebooks
- ☐ Volunteer instructions
- ☐ Picture of experimental set-up
- ☐ Volunteer lab coat
- ☐ (2) Pencils
- ☐ (2) Grease pencils
- ☐ 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

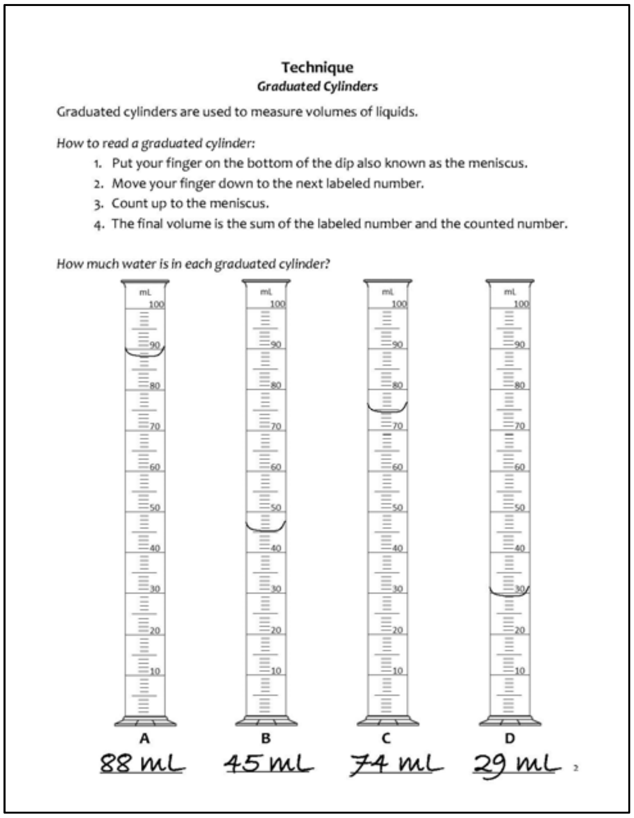
Other Supplies:

- ☐ (4) Notepads
- ☐ Bucket with lid
- ☐ (4) Trays
- ☐ 500 mL Graduated cylinder

Lead Box:

- ☐ (3) Blank nametags
- ☐ (3) Extra notebooks
- ☐ Picture of experimental set-up
- ☐ Lead instructions
- ☐ Soil water retention picture packet
- ☐ Lead lab coat
- ☐ Observation assessment (if teacher did not take assessments then (25) assessments and (25) paperclips)
- ☐ Time card
- ☐ (2) Pencils
- ☐ (2) Wet erase markers
- ☐ (2) Black pens
- ☐ (4) Markers (orange, blue, green, purple)
- ☐ 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, Notepad, and Picture Packet Pages:



Technique
Graduated Cylinders

Graduated cylinders are used to measure volumes of liquids.

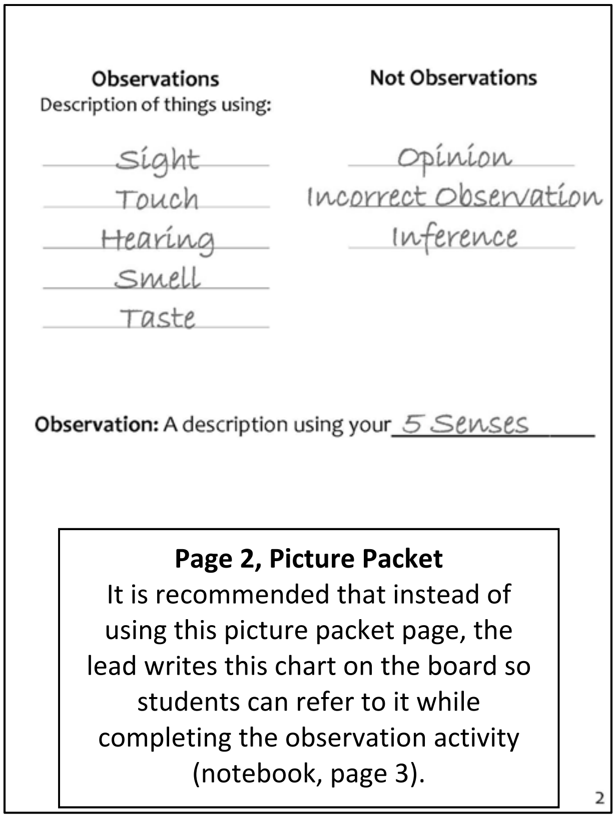
How to read a graduated cylinder:

1. Put your finger on the bottom of the dip also known as the meniscus.
2. Move your finger down to the next labeled number.
3. Count up to the meniscus.
4. The final volume is the sum of the labeled number and the counted number.

How much water is in each graduated cylinder?

A	B	C	D
88 mL	45 mL	74 mL	29 mL

2

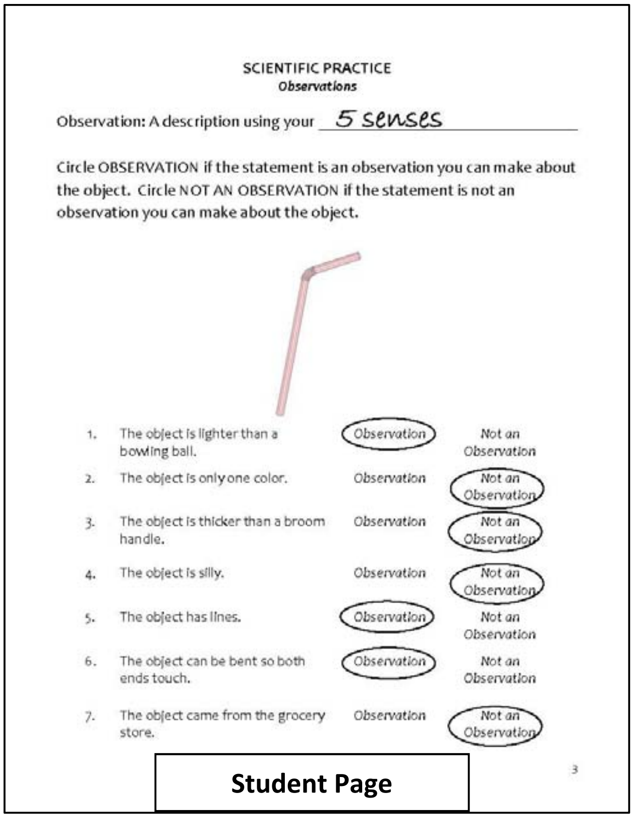


Observations Description of things using:	**Not Observations**
Sight	Opinion
Touch	Incorrect Observation
Hearing	Inference
Smell	
Taste	

Observation: A description using your 5 Senses

Page 2, Picture Packet
It is recommended that instead of using this picture packet page, the lead writes this chart on the board so students can refer to it while completing the observation activity (notebook, page 3).

2



SCIENTIFIC PRACTICE

Observations

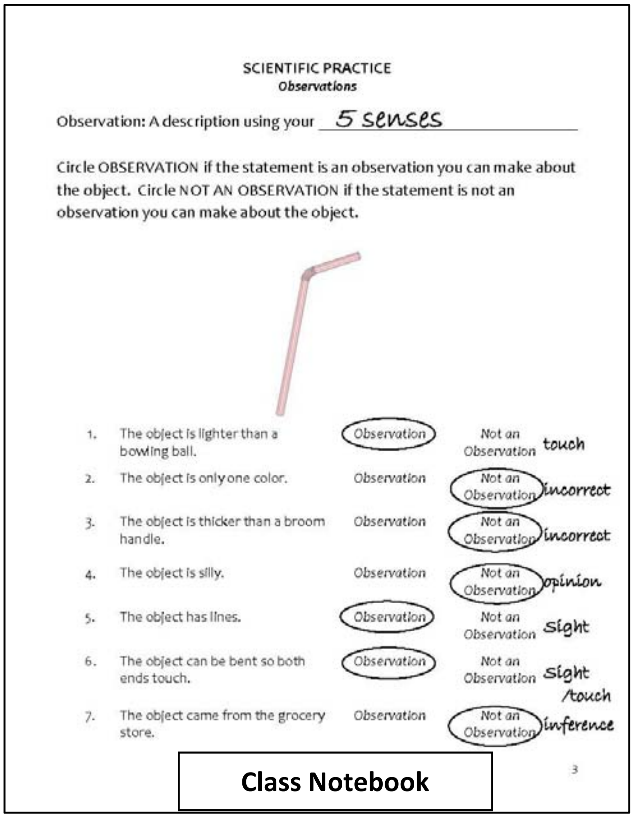
Observation: A description using your 5 senses

Circle OBSERVATION if the statement is an observation you can make about the object. Circle NOT AN OBSERVATION if the statement is not an observation you can make about the object.

1. The object is lighter than a bowling ball. [✓ Observation] Not an Observation
2. The object is only one color. Observation [✓ Not an Observation]
3. The object is thicker than a broom handle. Observation [✓ Not an Observation]
4. The object is silly. Observation [✓ Not an Observation]
5. The object has lines. [✓ Observation] Not an Observation
6. The object can be bent so both ends touch. [✓ Observation] Not an Observation
7. The object came from the grocery store. Observation [✓ Not an Observation]

3

Student Page



SCIENTIFIC PRACTICE

Observations

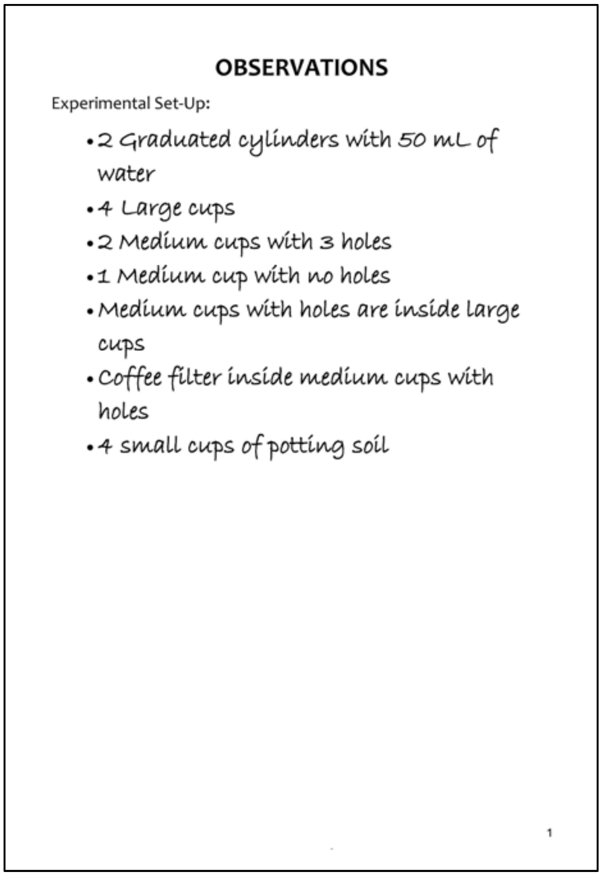
Observation: A description using your 5 senses

Circle OBSERVATION if the statement is an observation you can make about the object. Circle NOT AN OBSERVATION if the statement is not an observation you can make about the object.

1. The object is lighter than a bowling ball. [✓ Observation] Not an Observation touch
2. The object is only one color. Observation [✓ Not an Observation] incorrect
3. The object is thicker than a broom handle. Observation [✓ Not an Observation] incorrect
4. The object is silly. Observation [✓ Not an Observation] opinion
5. The object has lines. [✓ Observation] Not an Observation sight
6. The object can be bent so both ends touch. [✓ Observation] Not an Observation sight /touch
7. The object came from the grocery store. Observation [✓ Not an Observation] inference

3

Class Notebook

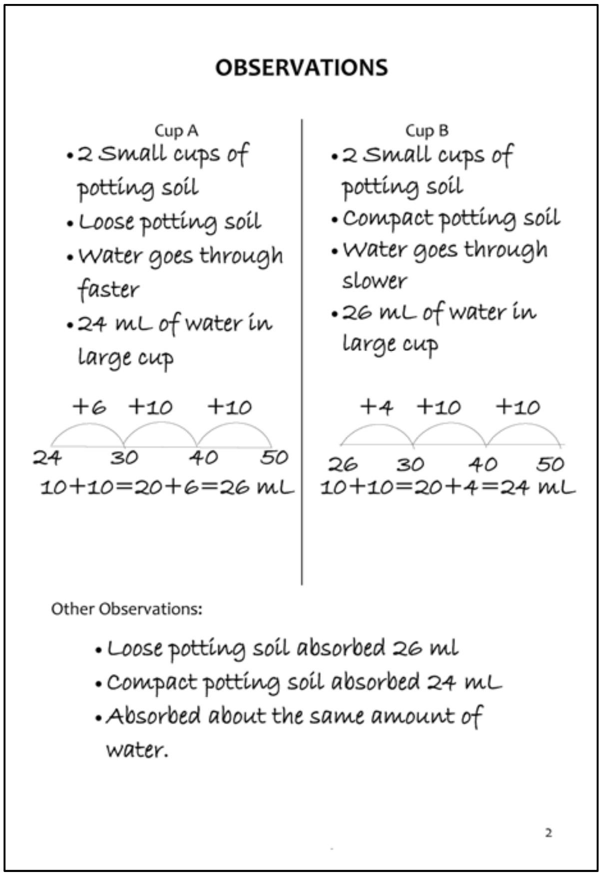


OBSERVATIONS

Experimental Set-Up:

- 2 Graduated cylinders with 50 mL of water
- 4 Large cups
- 2 Medium cups with 3 holes
- 1 Medium cup with no holes
- Medium cups with holes are inside large cups
- Coffee filter inside medium cups with holes
- 4 small cups of potting soil

1



OBSERVATIONS

Cup A	Cup B
• 2 Small cups of potting soil • Loose potting soil • Water goes through faster • 24 mL of water in large cup	• 2 Small cups of potting soil • Compact potting soil • Water goes through slower • 26 mL of water in large cup
+6 +10 +10 24 30 40 50 10+10=20+6=26 mL	+4 +10 +10 26 30 40 50 10+10=20+4=24 mL

Other Observations:

- Loose potting soil absorbed 26 ml
- Compact potting soil absorbed 24 mL
- Absorbed about the same amount of water.

2

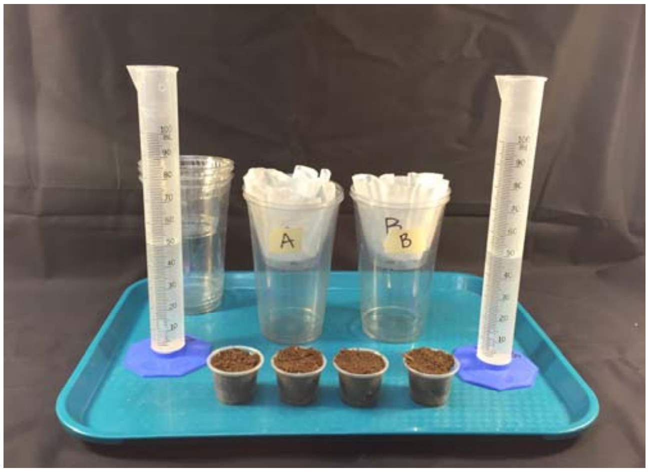
Preparation:

SciTrek Lead:

1. Get the observation assessments and put them in the lead box.
2. Make sure volunteers are writing their names and group colors on the whiteboard.
3. Make sure volunteers are passing out nametags.
4. Make sure volunteers are setting up for the initial observation. Details of how to do this are on a picture in the volunteer boxes.
5. Set up the document camera for the Introduction (picture packet, page 1), technique activity (notebook, page 2), and the observation activity (picture packet, page; notebook, page 3).
6. Copy the chart from page 2 of the picture packet onto the board.

SciTrek Volunteers:

1. On the front whiteboard in the classroom, write your name and the color of the group (orange, blue, green, or purple) you will be working with.
2. Pass out nametags.
   a. You may need to do this during the Introduction. Quietly set each student's nametag on their desk without talking to them. If names are not written on their desk, ask the classroom teacher or lead to help you when they are not talking with the class.
3. Assemble the experimental set-up (shown in picture below as well as in color in the experimental set-up picture in your group box) on a tray.
   a. Fill four, 1 oz (small) cups with potting soil (make sure all cups are filled to the top).
   b. Place a coffee filter inside each of the two labeled 9 oz (medium) cups with holes.
   c. Set the labeled medium cups inside the 20 oz (large) labeled cups and place them on the tray.
   d. Set two unlabeled large cups and one unlabeled medium cup (without holes) on the tray.
   e. Fill two graduated cylinders with 50 mL of water and set them on the tray.
4. Have notebooks and straws available to pass out.



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

For UCSB 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."

For Teacher Lead:

"I have asked some scientists from UCSB to come and help us with a long-term science investigation. We will make observations, come up with a class question, and you will design your own experiment to help answer the class question."

Allow the UCSB volunteers to introduce themselves and share their majors.

Observation Assessment:
(5 minutes – Full Class – Given By Classroom Teacher Prior to SciTrek)

Tell students, "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. Have students write their name, teacher's name, and date at the top of the assessment. Tell students, "When doing this assessment, you should work individually, so there should be no talking." As you are giving the assessment walk around the room and verify students have written their names on their assessments.

At the top of the page, have students write in what they think the definition of an observation is. Read the instructions aloud for questions *2-8*. Then, read each of the statements and tell students, "Circle 'observation' if the statement is an observation you can make about the object. Circle 'not an observation' if the statement is not an observation you can make about the object." When they are finished, collect the assessments and the paperclips and verify students' names are written on the papers.

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

Picture Packet, Page 1

Show students the picture of the landslide (picture packet, page 1). Ask students, "What happened in this picture?" Possible student response: the hillside slipped down. Tell students, "This is called a landslide." Ask students, "Have you ever seen a landslide before and if so what were the weather conditions when the landslide occurred?" By the end of the conversation make sure students understand many landslides happen during rain or right after it has rained. Discuss with students why landslides often are tied to rain, making sure by the end of the conversation they understand adding water increases the weight of the soil. If students are struggling with this concept, have them imagine holding a dry sponge and a wet sponge and asking them, "Which would be heavier?" Additionally, ask them, "If you are holding a light object and a heavy object, are you more likely to drop the light or heavy object?"

Tell students, "For this module, we will explore the question: 'What variables affect how much liquid a soil can absorb?'" Ask the class, "Do you know what the word 'absorb' means?" Make sure by the end of the conversation, they understand it means the amount of liquid the soil can hold. Tell students, "You will be working with liquids during the module, therefore you will need to learn how to measure the volume of liquids."

Technique:

(13 minutes – Full Class – SciTrek Lead)

Have volunteers pass out a notebook to each student.

Have students fill out their name, teacher's name, group color (color of their name on their nametag: orange, blue, green, or purple), and their volunteer's name (volunteers' 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 notebook. They will be placed in a group when the class divides into groups for observations and can fill out their group color and volunteer at that point.

Tell the class, "Today you 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 gradated cylinders by placing them on a flat surface, and putting their eyes at the same level as the level of the liquid. We 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 gradated 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.

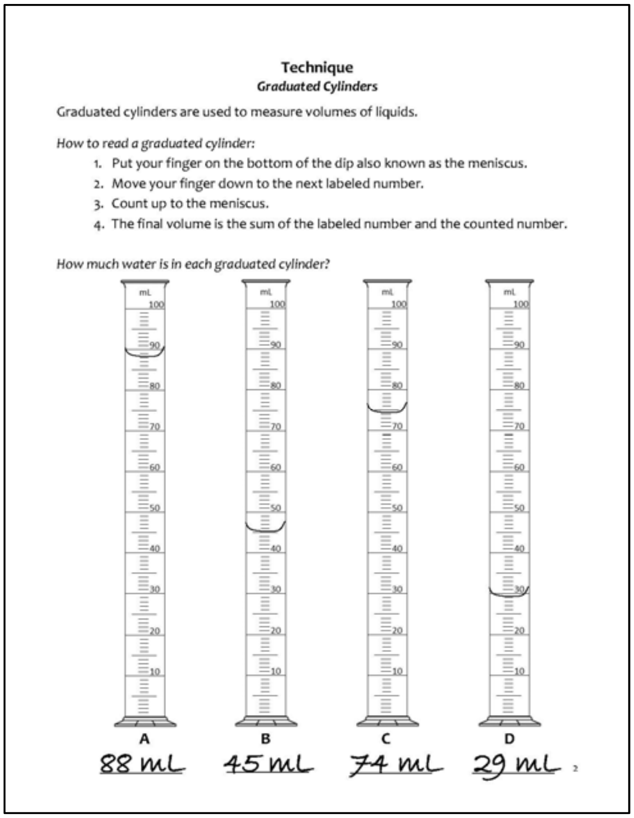
Have students turn to page 2 of their notebooks while you place the class notebook under the document camera and turn to page 2. Read the directions aloud to the class. Ask students the following questions:

> 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, you need to find the bottom of the meniscus." Have students put their finger on the meniscus in the first gradated cylinder and you do the same on the class notebook. 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 reply, "88 mL." Write this value on the line in the class notebook while they do the same in their notebooks.

Have students complete *B-D* by themselves. As 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. When a class consensus has been reached, write the amount in the class notebook.



Technique

Graduated Cylinders

Graduated cylinders are used to measure volumes of liquids.

How to read a graduated cylinder:

1. Put your finger on the bottom of the dip also known as the meniscus.
2. Move your finger down to the next labeled number.
3. Count up to the meniscus.
4. The final volume is the sum of the labeled number and the counted number.

How much water is in each graduated cylinder?

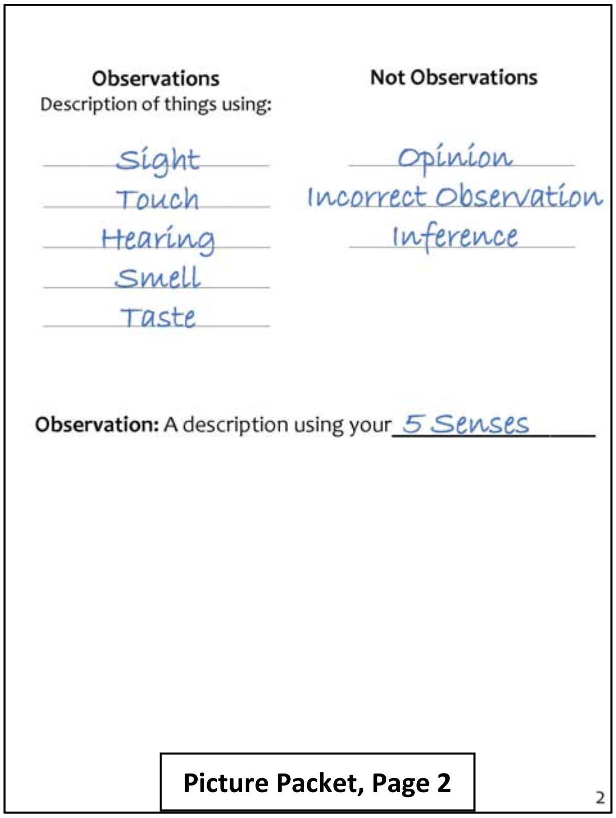
A 88 mL
B 45 mL
C 74 mL
D 29 mL

2

Tell students, “Now that you know how to read a graduated cylinder, you can measure the amount of water that passes through the soil, which will help you determine how much water the soil absorbs. To start, you are going to make some observations about the soil and water separately. But before we do this, we need to make sure that we understand observations.”

Observation Activity:
(15 minutes – Full Class – SciTrek Lead)

If the chart from page 2 of the picture packet is not copied onto the board, then put page 2 of the picture packet under the document camera (shown below). Tell students, “Scientists make many observations.” Ask students, “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, an observation is a description using your 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 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.



Observations Description of things using:	Not Observations
Sight	Opinion
Touch	Incorrect Observation
Hearing	Inference
Smell	
Taste	

Observation: A description using your 5 Senses

Picture Packet, Page 2

2

Ask the class, “Are there statements that are not observations?” Students should be able to generate opinions, incorrect observations, and inferences. Record these under “not observations” on the chart. Tell students, “Inferences are something you think might be true about an object/system based on past experiences and evidence you’ve collected. For instance, in the mini module, you they thought the object in the candleholder was a ‘candle’ before it was eaten.” Have students give you an example of a statement that is an opinion (Ex: chocolate chip cookies taste better than ice cream), incorrect observation, and inference (Ex: the white lab coats are bought from Target). If they are unable to generate these categories or cannot give you an example, give them an example statement in each category, then have them identify the type of statement.

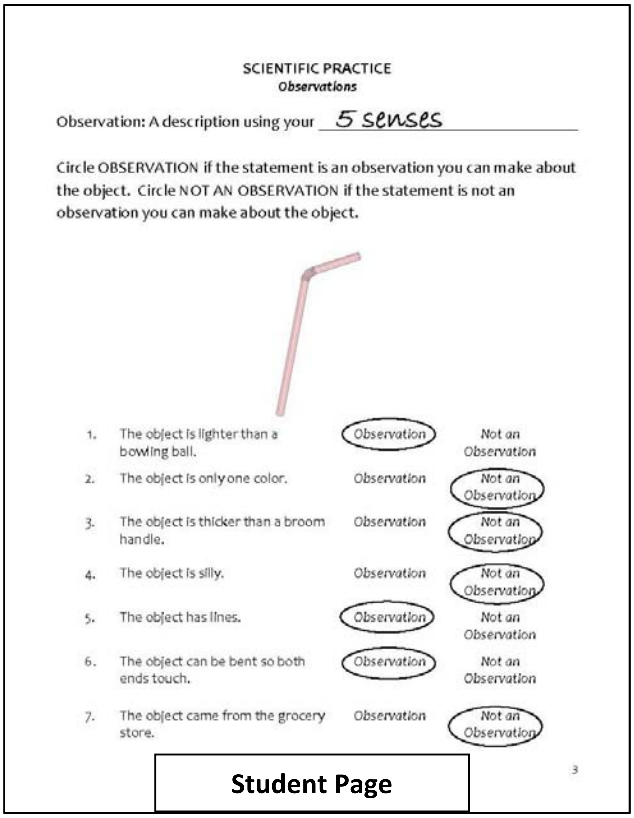
Have the volunteers pass-out a bendy straw, found in their group boxes, to each student.

Tell students, “We are now going to do an activity where you look at a list of possible observations about the object you just received (bendy straw). You will then decide whether each statement is an observation, or not an observation, about the object.”

Have students turn to page 3 of their notebooks and place the class 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 statement to students. For each statement, have a student share whether they think the statement is an observation or not. 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 another student explain why they disagree. If needed, let them have “mini conferences” with the students that are sitting in their area. After the class has come to a consensus, circle the correct answer in the class notebook, while they circle the correct answer in their notebook.

For each statement that is an observation, have students identify the sense (touch, taste, smell, hearing, or sight) that was used to make the observation. Write this in the margins of the class notebook. For each statement that is not an observation, have students identify why the statement is not an observation (incorrect observation, opinion, or inference). Write down why the statement is not an observation in the margins of the class notebook. Students do not need to write these in the margins in their notebook. See the example below for the student and lead pages.



SCIENTIFIC PRACTICE
Observations

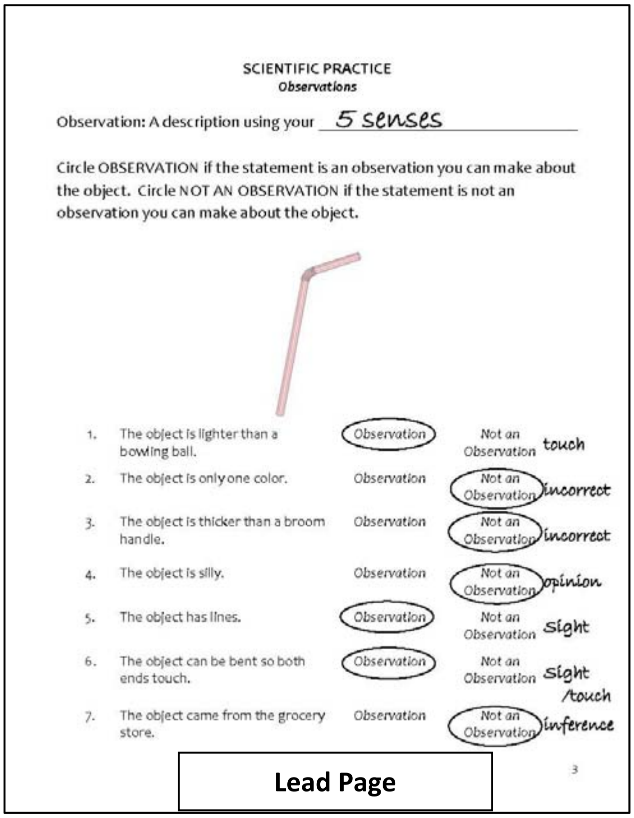
Observation: A description using your 5 senses

Circle OBSERVATION if the statement is an observation you can make about the object. Circle NOT AN OBSERVATION if the statement is not an observation you can make about the object.

1. The object is lighter than a bowling ball. [✓ Observation] Not an Observation
2. The object is only one color. Observation [✓ Not an Observation]
3. The object is thicker than a broom handle. Observation [✓ Not an Observation]
4. The object is silly. Observation [✓ Not an Observation]
5. The object has lines. [✓ Observation] Not an Observation
6. The object can be bent so both ends touch. [✓ Observation] Not an Observation
7. The object came from the grocery store. Observation [✓ Not an Observation]

3

Student Page



SCIENTIFIC PRACTICE
Observations

Observation: A description using your 5 senses

Circle OBSERVATION if the statement is an observation you can make about the object. Circle NOT AN OBSERVATION if the statement is not an observation you can make about the object.

1. The object is lighter than a bowling ball. [✓ Observation] Not an Observation touch
2. The object is only one color. Observation [✓ Not an Observation] incorrect
3. The object is thicker than a broom handle. Observation [✓ Not an Observation] incorrect
4. The object is silly. Observation [✓ Not an Observation] opinion
5. The object has lines. [✓ Observation] Not an Observation sight
6. The object can be bent so both ends touch. [✓ Observation] Not an Observation sight /touch
7. The object came from the grocery store. Observation [✓ Not an Observation] inference

3

Lead Page

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

1: The object is lighter than a bowling ball.

Is the statement an observation, or not an observation?

Observation

What sense did you use to make this observation?

Touch

2: The object is only one color.

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 (Incorrect observation).

What sense did you use to tell this?

Sight

3: The object is thicker than a broom handle.

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 (Incorrect observation).

What sense did you use to tell this?

Sight

*4***:** The object is silly.

Is this statement an observation, or not an observation?

Not an observation

Why is this statement not an observation?

Some people might think that bendy straws are silly, but others might think they are sensible (opinion).

5: The object has lines.

Is this statement an observation, or not an observation?

Observation

What sense did you use to make this observation?

Sight

6: The object can be bent so both ends touch.

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 this yet, 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. Tell students, "Sometimes inferences can be turned into observations by testing them."

What sense did you use to make this an observation?

Touch and sight

7: The object came from the grocery store.

Is this statement an observation or not an observation?

Not an observation

Why is this statement not an observation?

There is no way to tell if the object came from the grocery store. The grocery store does have straws, the straw could have come from the grocery store but it also could have come from a fast food restaurant (inference).

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, "Do you remember the question the class will be investigating?" They should reply, "What variables affect how much liquid a soil can absorb?" If students do not remember, show them where to find it on the front of the notebook. Remind students that we are interested in this because it will help us learn about landslides. Tell students, "You will now get into your groups and make observations. To determine your group, you will need to look at the color of your nametag (orange, blue, green, or purple)." Tell each colored group where to go, and to bring their notebook.

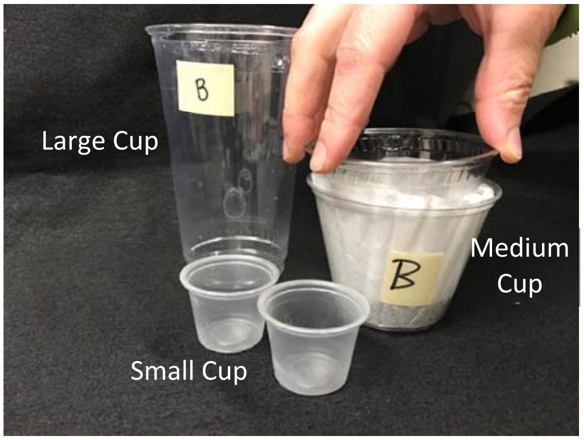
If a student does not have a nametag, identify the group color with the least number of students in it, and write the student's name on one of the extra nametags in the lead box, using that color of marker.

Observations:

(20 minutes – Groups – SciTrek Volunteers)

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

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

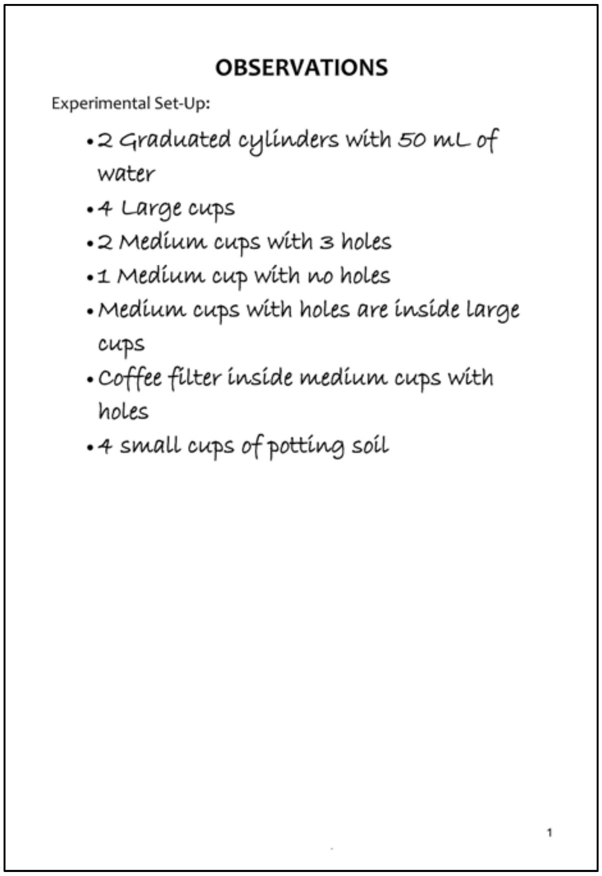


Make sure there is a coffee filter in both of the medium cups (9 oz), then pour two small (1 oz) cups of potting soil into both cups. Make sure the soil is spread evenly in the cups. Then, use the medium cup (without holes) to compact the potting soil in cup B. When you compact the potting soil, remove the medium cup with holes (labeled *B*) from the large cup, and place it on the table before compacting the potting soil (see picture). 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 students generate observations about what is happening in the cup system and record them (notepad, page 2). 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 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, “If we poured in 50 mL, and less than 50 mL comes out of the soil, where did the rest of the water go?” Allow students to touch the potting soil with one finger. They should realize some of the water stayed in the potting soil. Ask them, “Can we determine how much water stayed in the potting soil and if so, how?” Possible student response: 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 subtraction with the group to determine the amount of water each soil absorbed. Be sure you are doing the appropriate form of subtraction as dictated by the classroom teacher. Students should find the compact and loose soil both absorbed about the same amount of water.

If there is additional time, have students summarize what they saw and learned. Make sure 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 filled out initial observations is shown below.

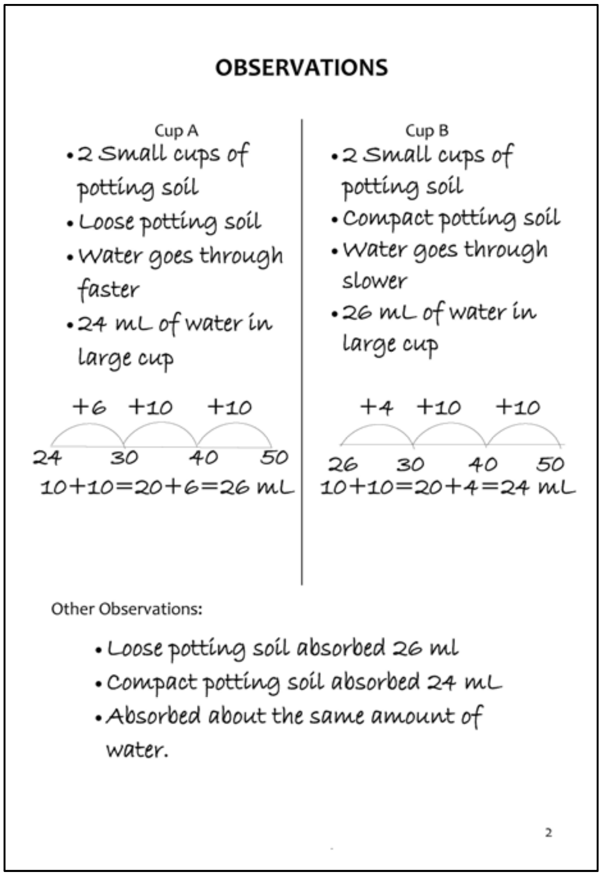


OBSERVATIONS

Experimental Set-Up:

- 2 Graduated cylinders with 50 mL of water
- 4 Large cups
- 2 Medium cups with 3 holes
- 1 Medium cup with no holes
- Medium cups with holes are inside large cups
- Coffee filter inside medium cups with holes
- 4 small cups of potting soil

1



OBSERVATIONS

Cup A

- 2 Small cups of potting soil
- Loose potting soil
- Water goes through faster
- 24 mL of water in large cup

+6 +10 +10

24 30 40 50

10+10=20+6=26 mL

Cup B

- 2 Small cups of potting soil
- Compact potting soil
- Water goes through slower
- 26 mL of water in large cup

+4 +10 +10

26 30 40 50

10+10=20+4=24 mL

Other Observations:

- Loose potting soil absorbed 26 ml
- Compact potting soil absorbed 24 mL
- Absorbed about the same amount of water.

2

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 whole class, what was in each cup, and what happened to the water that was poured over the two cups. It is helpful to write “loose” and “compact” on the board and then write each group’s data underneath.

Ask students, “Does soil compactness affect how much liquid a soil can absorb, and what evidence do you have to support this?” Possible student response: although the two cups absorbed different amounts of water, they were fairly close to each other. The big difference between the two systems was the water passed through the compact soil much slower than the loose soil. Discuss with students that groups that calculated 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, “We will now relate these findings back to landslides. Imagine 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 students, “What happens to the amount of water absorbed by both of these hills?” Possible student response: the hill that has loose soil will absorb more water because the water will absorb faster into the loose soil before it runs off down the hill, while the hill that has compact soil will absorb less water because most of this water will run off down the hill 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 response: the hill with loose soil will be more likely to have a landslide because it absorbs more water, making it heavier.

Ask students, “What happens when it rains on both of these hills for multiple days?” Possible student response: 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 will now be more likely to have a landslide?” Possible student response: 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 students, “You taught me about how the compactness of the soil affects water absorption and landslides. Now I know the more compact the soil, the longer the soil takes to absorb the water.”

Tell students, “Next session, you will design an experiment to answer the class question: What variables affect how much liquid a soil can absorb?”

Clean-Up:

1. Collect notebooks with attached nametags
2. Pour the wet soil into the Ziploc bag provided. Make sure to seal this bag so it does not spill.
3. Put the used water, cups (make sure to stack), and graduated cylinder into the bucket.
4. Place all other materials in your group box and bring them back to UCSB.

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:

- ☐ Nametags
- ☐ Notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ Materials pages (one for each possible variable, 3 total)
- ☐ (2) Pencils
- ☐ (2) Grease pencil
- ☐ Scotch tape

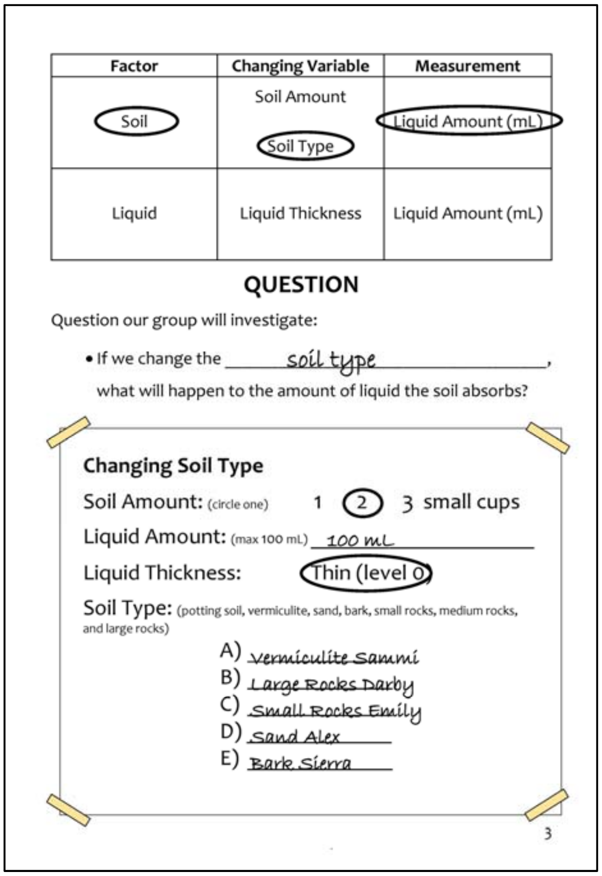
Other Supplies:

- ☐ (4) Notepads

Lead Box:

- ☐ (3) Blank nametags
- ☐ (3) Extra notebooks
- ☐ Lead instructions
- ☐ Soil water retention picture packet
- ☐ Lead lab coat
- ☐ Materials pages (one for each possible variable, 3 total)
- ☐ Time card
- ☐ (2) Pencils
- ☐ (2) Wet erase markers
- ☐ (2) Black pens
- ☐ (4) Markers (orange, blue, green, purple)
- ☐ Scotch tape
- ☐ Scale
- ☐ Vermiculite

Notebook and Notepad Pages:



Factor	Changing Variable	Measurement
[✓ Soil]	Soil Amount [✓ Soil Type]	[✓ Liquid Amount (mL)]
Liquid	Liquid Thickness	Liquid Amount (mL)

QUESTION

Question our group will investigate:

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

Changing Soil Type

Soil Amount: (circle one) 1 [✓ 2] 3 small cups

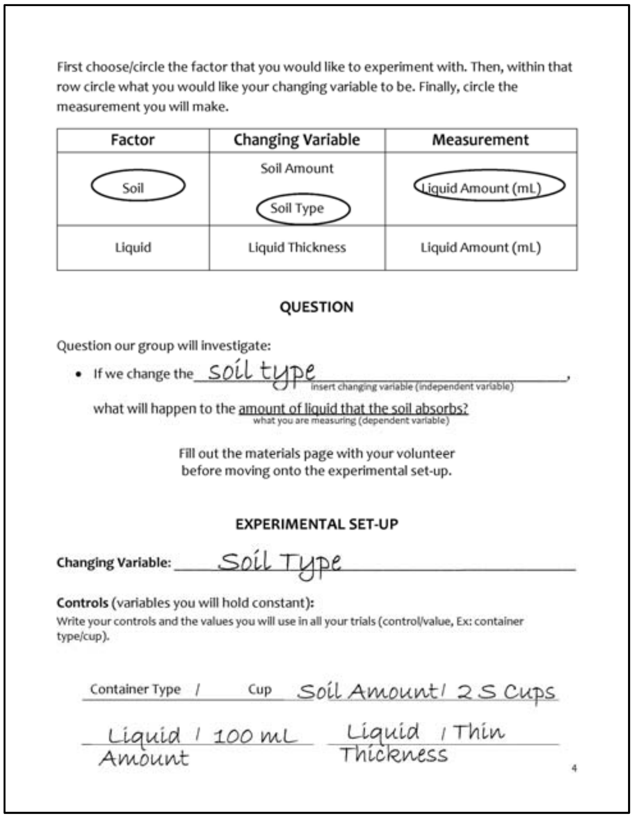
Liquid Amount: (max 100 mL) 100 mL

Liquid Thickness: [✓ Thin (level 0)]

Soil Type: (potting soil, vermiculite, sand, bark, small rocks, medium rocks, and large rocks)

A) Vermiculite Sammi
B) Large Rocks Darby
C) Small Rocks Emily
D) Sand Alex
E) Bark Sierra

3



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.

Factor	Changing Variable	Measurement
[✓ Soil]	Soil Amount [✓ Soil Type]	[✓ Liquid Amount (mL)]
Liquid	Liquid Thickness	Liquid Amount (mL)

QUESTION

Question our group will investigate:

- If we change the soil type (insert changing variable (independent variable)), what will happen to the amount of liquid that the soil absorbs? (what you are measuring (dependent variable))

Fill out the materials page with your volunteer before moving onto the experimental set-up.

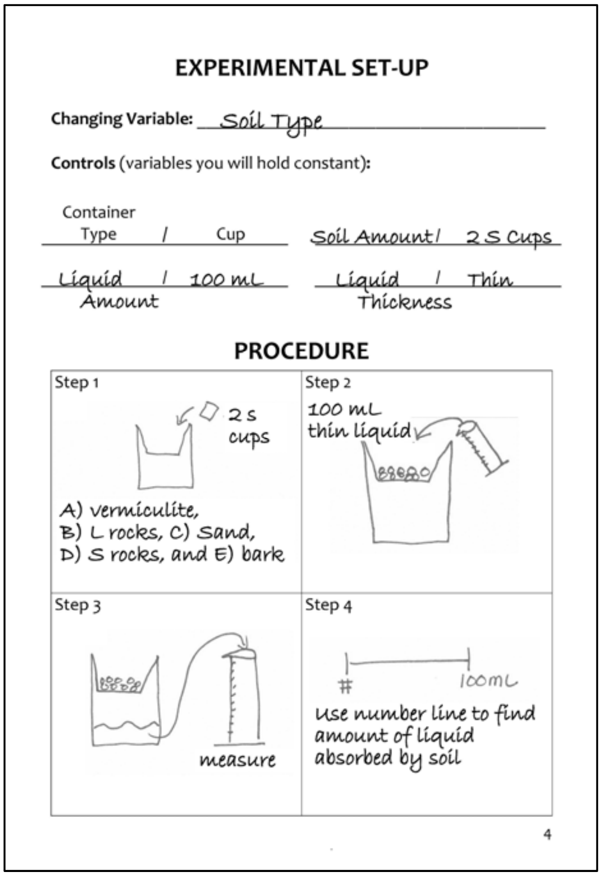
EXPERIMENTAL SET-UP

Changing Variable: Soil Type

Controls (variables you will hold constant):
Write your controls and the values you will use in all your trials (control/value, Ex: container type/cup).

Container Type / Cup
Soil Amount / 2 S Cups
Liquid Amount / 100 mL
Liquid Thickness / Thin

4



EXPERIMENTAL SET-UP

Changing Variable: Soil Type

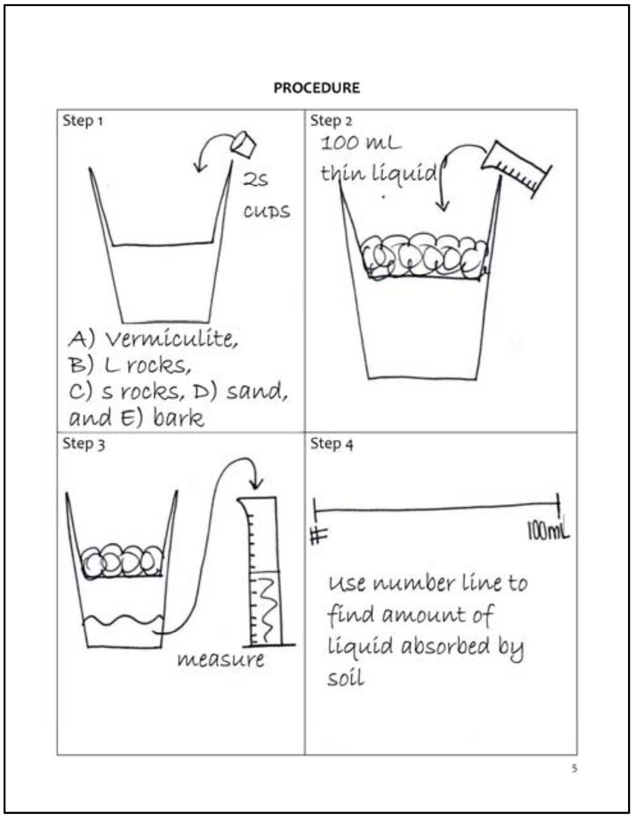
Controls (variables you will hold constant):

Container Type / Cup
Soil Amount / 2 S Cups
Liquid Amount / 100 mL
Liquid Thickness / Thin

PROCEDURE

Step 1 2 s cups A) vermiculite, B) L rocks, C) Sand, D) S rocks, and E) bark	Step 2 100 mL thin liquid
Step 3 measure	Step 4 # 100mL Use number line to find amount of liquid absorbed by soil

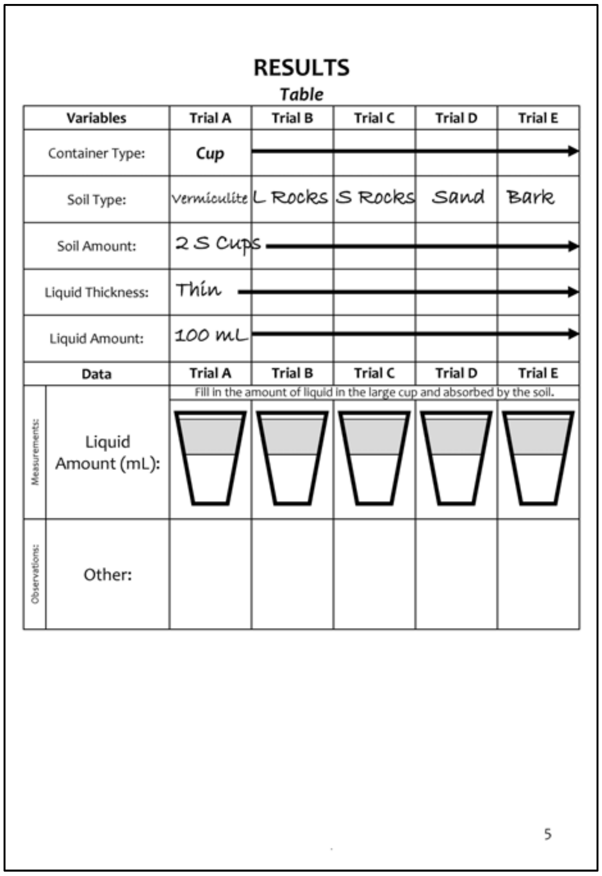
4



PROCEDURE

Step 1 2s cups A) Vermiculite, B) L rocks, C) s rocks, D) sand, and E) bark	Step 2 100 mL thin liquid
Step 3 measure	Step 4 # 100mL Use number line to find amount of liquid absorbed by soil

5

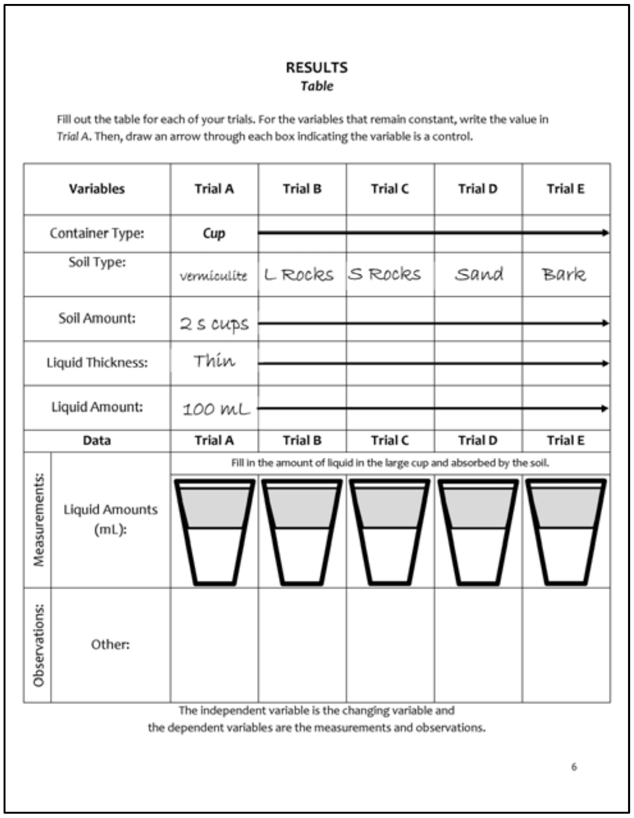


RESULTS

Table

Variables	Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:	Cup	→	→	→	→
Soil Type:	Vermiculite	L Rocks	S Rocks	Sand	Bark
Soil Amount:	2 S Cups	→	→	→	→
Liquid Thickness:	Thin	→	→	→	→
Liquid Amount:	100 mL	→	→	→	→
Data	**Trial A**	**Trial B**	**Trial C**	**Trial D**	**Trial E**
Measurements: Liquid Amount (mL):	Fill in the amount of liquid in the large cup and absorbed by the soil.				
Observations: Other:					

5



RESULTS

Table

Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

Variables	Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:	Cup	→	→	→	→
Soil Type:	vermiculite	L Rocks	S Rocks	Sand	Bark
Soil Amount:	2 s cups	→	→	→	→
Liquid Thickness:	Thin	→	→	→	→
Liquid Amount:	100 mL	→	→	→	→
Data	**Trial A**	**Trial B**	**Trial C**	**Trial D**	**Trial E**
Measurements: Liquid Amounts (mL):	Fill in the amount of liquid in the large cup and absorbed by the soil.				
Observations: Other:					

The independent variable is the changing variable and
the dependent variables are the measurements and observations.

6

Preparation:

SciTrek Lead:

1. Make sure volunteers are setting out notebooks.
2. Set up the document camera for the wrap-up discussion (picture packet, page 3).
3. Have a scale and the vermiculite available to show students during the Introduction.

SciTrek Volunteers:

1. Set out notebooks/nametags.

Note: Set notebooks where students will sit during the module even if another student is currently at that desk. If needed, students will move to these spots after the Introduction.

Introduction:

(7 minutes – Full Class – SciTrek Lead)

If students are not in their groups, tell them, “A notebook will be put on your desk, which is not your notebook and you should not move it. You will move to your groups after the Introduction.”

Ask students, “What did we do and learn during our last meeting?” Possible student response: we did an experiment in which we observed water going through loose and compact potting soil. We 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, “What is the class question we will be investigating?” Students should reply, “What variables affect how much liquid a soil can absorb?”

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

Tell students, “One-way scientists answer questions is by performing experiments; today you are going to pick a variable with your group to investigate.” Make sure students understand variables are parts of the experiment that can be changed. Tell students, “You can choose to explore whether something about the soil, or the liquid, affects the amount of liquid that a soil can absorb. If you are interested in exploring how something about the liquid affects the amount of liquid a soil can absorb, you can change the liquid thickness. If you choose to investigate liquid thickness you have to use medium rocks as your soil type, whereas all other groups will get to pick the soil type they will use.” Ask students, “What do you think the thickness of the liquid represents in a real-life scenario?” Make sure by the end of the conversation students know thick liquids are liquids like snow or mud that comes in from other areas. Tell students, “If you are interested in exploring how something about the soil affects the amount of liquid the soil can absorb, you can change either the soil type, or the soil amount. If you change the soil amount, you will be able to use a scale to weigh the amount of soil you will use (show students the scale). If you change the soil type, you will get to choose from seven different soil types. One of the seven soil types you will get to choose from is called vermiculite.” Show students the vermiculite (ver-mick-yew-lite) and have them say the word with you a few times. Tell students, “You will now get into your groups and vote for the changing variable you would like to explore which will allow you to determine your groups experimental question.”

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

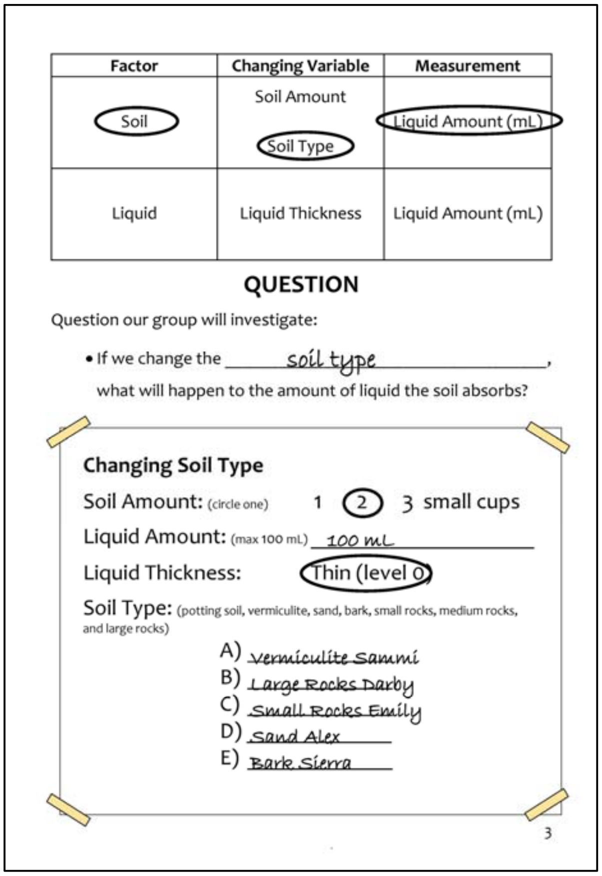
Question:

(10 minutes – Groups – SciTrek Volunteers)

Have students turn to page 4 of their notebooks while you turn to page 3 of the notepad. Then, have them decide (by voting) whether they are interested in investigating how the soil or liquid affects the amount of liquid a soil can absorb. If there is a tie, then you, the volunteer, will provide the deciding vote. Once they have decided on the factor they will investigate, circle it on the notepad while students do the same in their notebooks. Then, have them decide what their changing variable will be. If they decide to investigate a soil factor, have them choose (by voting) whether their changing variable will be soil amount or soil type. If they decide to investigate a liquid factor, their changing variable will be liquid thickness. It is best if groups have different changing variables. The lead will help coordinate between groups to ensure there is a variety of changing variables. Circle the groups changing variable on the notepad while students circle this in their notebooks. All experiments will measure the liquid amount that passes through the soil. Circle this on the notepad while students circle it in their notebooks. Students will subtract the amount of liquid that passes through the soil from the initial liquid amount to determine the amount of liquid the soil has absorbed.

Use their changing variable to generate the question the group is going to investigate. Write the question in the notepad, and have students copy it into their notebooks. An example filled out question is shown below.

Select a student to read the group question during the wrap-up.



Factor	Changing Variable	Measurement
[✓ Soil]	Soil Amount [✓ Soil Type]	[✓ Liquid Amount (mL)]
Liquid	Liquid Thickness	Liquid Amount (mL)

QUESTION

Question our group will investigate:

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

Changing Soil Type

Soil Amount: (circle one) 1 [✓ 2] 3 small cups

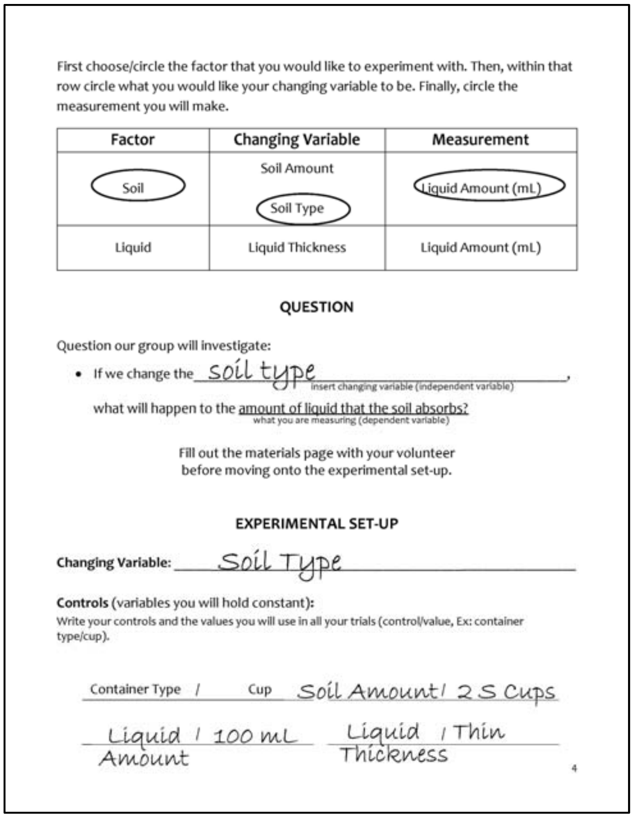
Liquid Amount: (max 100 mL) 100 mL

Liquid Thickness: [✓ Thin (level 0)]

Soil Type: (potting soil, vermiculite, sand, bark, small rocks, medium rocks, and large rocks)

A) Vermiculite Sammi
B) Large Rocks Darby
C) Small Rocks Emily
D) Sand Alex
E) Bark Sierra

3



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.

Factor	Changing Variable	Measurement
[✓ Soil]	Soil Amount [✓ Soil Type]	[✓ Liquid Amount (mL)]
Liquid	Liquid Thickness	Liquid Amount (mL)

QUESTION

Question our group will investigate:

- If we change the soil type,
  insert changing variable (independent variable)
  what will happen to the amount of liquid that the soil absorbs?
  what you are measuring (dependent variable)

Fill out the materials page with your volunteer
before moving onto the experimental set-up.

EXPERIMENTAL SET-UP

Changing Variable: Soil Type

Controls (variables you will hold constant):
Write your controls and the values you will use in all your trials (control/value, Ex: container type/cup).

Container Type / Cup
Soil Amount / 2 S Cups
Liquid Amount / 100 mL
Liquid Thickness / Thin

4

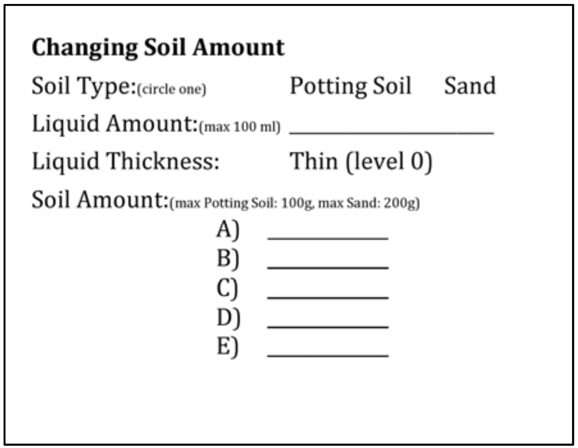
Materials Page:
(5 minutes – Groups – SciTrek Volunteers)

Get the materials page (shown below) that corresponds to the changing variable your group selected, and tape it into the notepad. Have students use the materials page to choose the values of their controls and changing variable.

For controls in which students can pick more than one value (soil type, soil amount, and liquid amount), have students discuss whether 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.

When selecting the values of the changing variable, ask students, “Do you think a wide or a narrow range of values would help you more effectively answer your question?” Make sure they understand a wide range of values will make it easier for them to see a difference in their results, and thus have a better understanding of the answer to the class question. For each changing variable value, write the student’s name who will be in charge of the trial next to the value.

Make sure students have picked liquid amounts that are within the limitations set on the materials page. Examples of all materials pages are shown below.



Changing Soil Amount

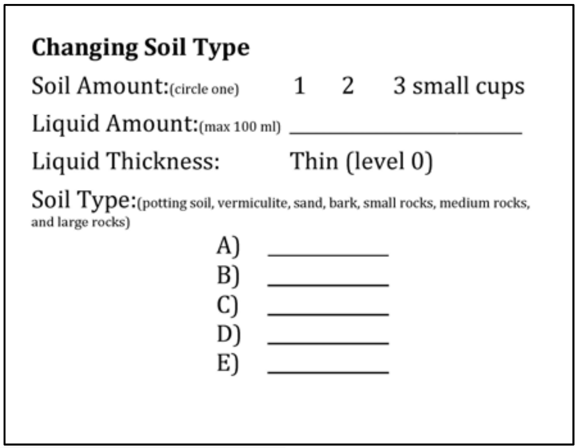
Soil Type:(circle one) Potting Soil Sand

Liquid Amount:(max 100 ml) ____________________

Liquid Thickness: Thin (level 0)

Soil Amount:(max Potting Soil: 100g, max Sand: 200g)

A) ____________
B) ____________
C) ____________
D) ____________
E) ____________



Changing Soil Type

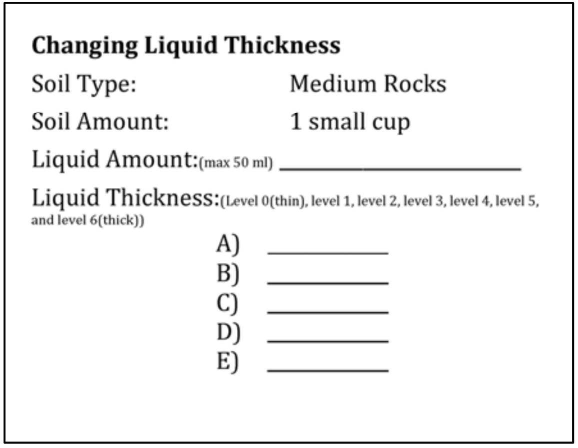
Soil Amount:(circle one) 1 2 3 small cups

Liquid Amount:(max 100 ml) ____________________

Liquid Thickness: Thin (level 0)

Soil Type:(potting soil, vermiculite, sand, bark, small rocks, medium rocks, and large rocks)

A) ____________
B) ____________
C) ____________
D) ____________
E) ____________



Changing Liquid Thickness

Soil Type: Medium Rocks

Soil Amount: 1 small cup

Liquid Amount:(max 50 ml) ____________________

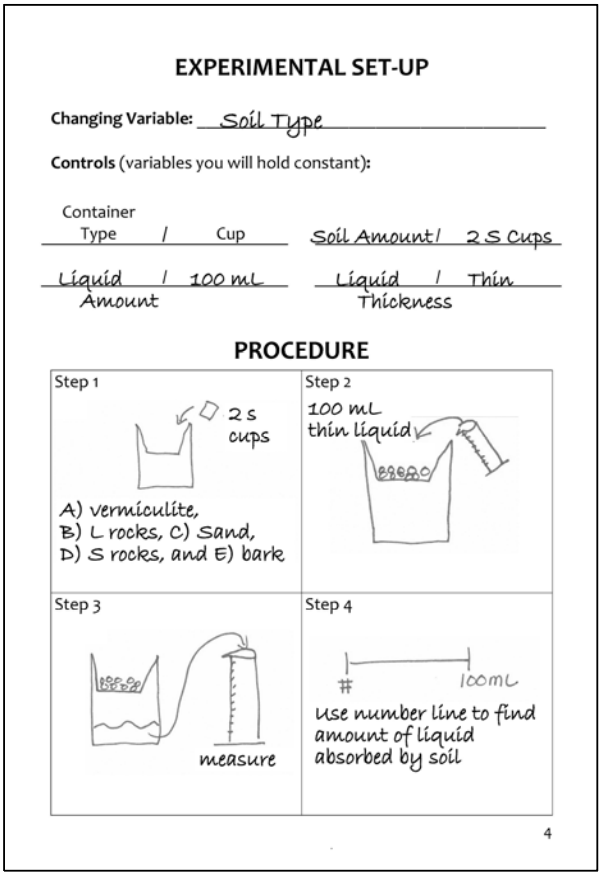
Liquid Thickness:(Level 0(thin), level 1, level 2, level 3, level 4, level 5, and level 6(thick))

A) ____________
B) ____________
C) ____________
D) ____________
E) ____________

Experimental Set-Up:
(5 minutes – Groups – SciTrek Volunteers)

Turn to page 4 of the notepad (students will still be working on page 4 in their notebooks). Ask your group, “What did we decide was going to be the changing variable?” Record this on the notepad. After, have students copy the changing variable into their notebooks.

Ask your group, “What controls and values did we select?” Write the control on the left side of the slash and the value of the control on the right side of the slash (Ex: soil type / sand). In addition, have students copy these into their notebooks. An example filled out experimental set-up is shown below (for volunteers) and above (for students).



EXPERIMENTAL SET-UP

Changing Variable: Soil Type

Controls (variables you will hold constant):

Container Type / Cup

Soil Amount / 2 S Cups

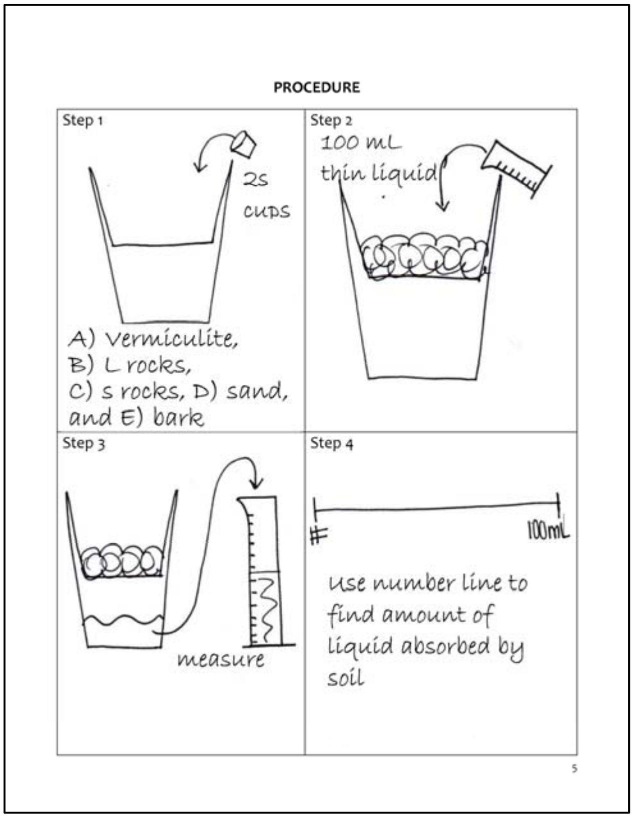
Liquid Amount / 100 mL

Liquid Thickness / Thin

PROCEDURE

Step 1 2 s cups A) vermiculite, B) L rocks, C) Sand, D) S rocks, and E) bark	Step 2 100 mL thin liquid
Step 3 measure	Step 4 # 100mL Use number line to find amount of liquid absorbed by soil

4



PROCEDURE

Step 1 2s cups A) Vermiculite, B) L rocks, C) s rocks, D) sand, and E) bark	Step 2 100 mL thin liquid
Step 3 measure	Step 4 # 100mL Use number line to find amount of liquid absorbed by soil

5

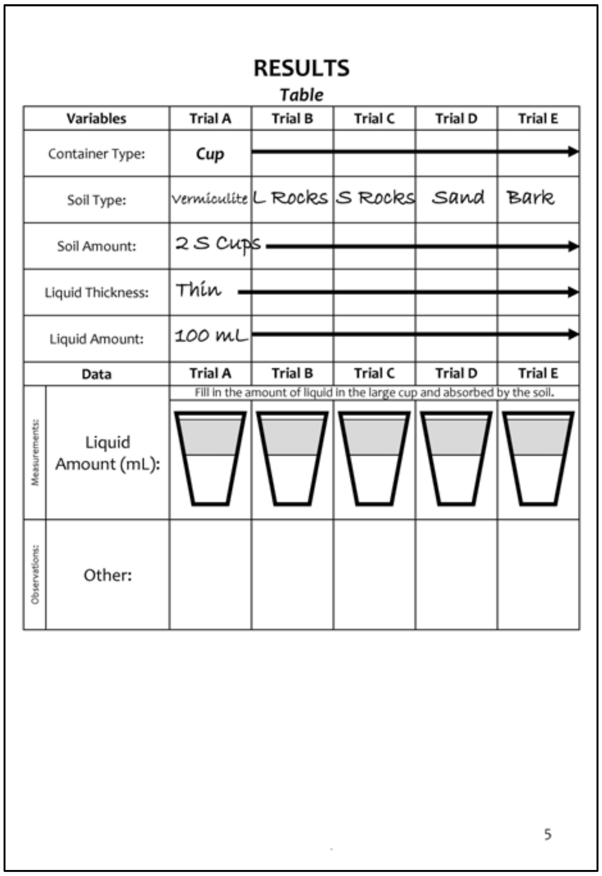
Procedure:

(20 minutes – Groups – SciTrek Volunteers)

Tell students, “We will now generate a procedure for our experiment.” Ask students, “What is a procedure?” Lead them to understand that it is a set of steps to conduct an experiment. Tell students, “We will draw one picture for each procedural step.” Ask students, “What is the first step in conducting our experiment?” Lead them to understand it is putting soil into the cups. Within the drawing, write the soil type(s) and amount(s). Ask students, “What is the next step?” Lead them to understand it is pouring liquid over the soil. Within the drawing, write the liquid amount and liquid thickness(es). Ask students, “What is the next step?” Lead them to understand it is measuring the water that comes out of the soil. Within the drawing, write the word “measure.” Ask students, “What is the last step?” Lead them to understand it is using a number line to determine the amount of liquid absorbed. Make sure to list all values of your changing variable for the step that includes your changing variable. Make sure all students in your group have drawn and labeled a procedure step before moving onto the next step. An example filled out procedure is shown in the Experimental Set-Up section.

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

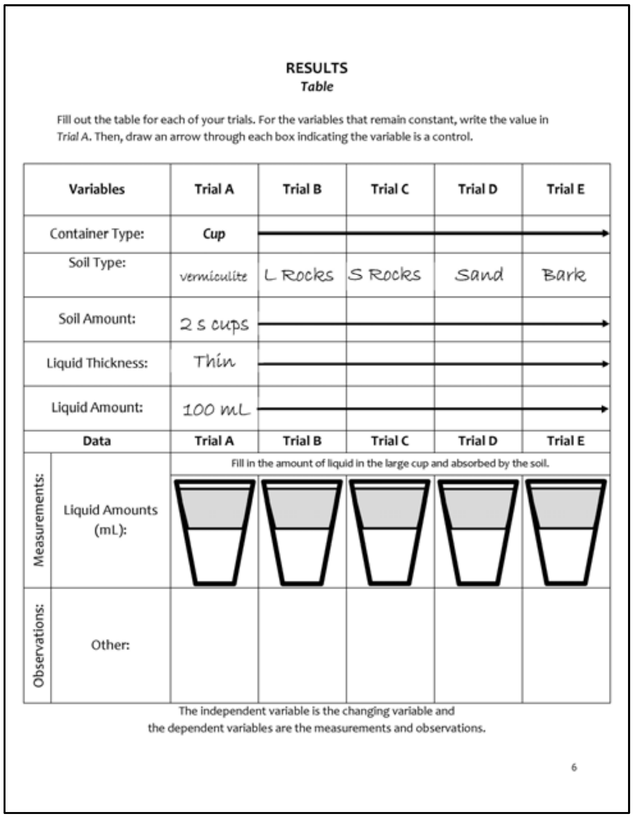
Fill out the variables section of the results table (notepad, page 5) while students fill out the same section (notebook, page 6). When writing the values, make sure, for controls, they only write the value of the control in the *Trial A* box. Then, draw an arrow through the remaining trials' boxes. For the changing variable, they should write the value in each trial's corresponding box. An example filled out results table is shown below.



RESULTS
Table

Variables		Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:		Cup	⟶	⟶	⟶	⟶
Soil Type:		Vermiculite	L Rocks	S Rocks	Sand	Bark
Soil Amount:		2 S Cups	⟶	⟶	⟶	⟶
Liquid Thickness:		Thin	⟶	⟶	⟶	⟶
Liquid Amount:		100 mL	⟶	⟶	⟶	⟶
Data		Trial A	Trial B	Trial C	Trial D	Trial E
Measurements:		Fill in the amount of liquid in the large cup and absorbed by the soil.				
	Liquid Amount (mL):					
Observations:	Other:					

5



RESULTS
Table

Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

Variables		Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:		Cup	⟶	⟶	⟶	⟶
Soil Type:		vermiculite	L Rocks	S Rocks	Sand	Bark
Soil Amount:		2 s cups	⟶	⟶	⟶	⟶
Liquid Thickness:		Thin	⟶	⟶	⟶	⟶
Liquid Amount:		100 mL	⟶	⟶	⟶	⟶
Data		Trial A	Trial B	Trial C	Trial D	Trial E
Measurements:		Fill in the amount of liquid in the large cup and absorbed by the soil.				
	Liquid Amounts (mL):					
Observations:	Other:					

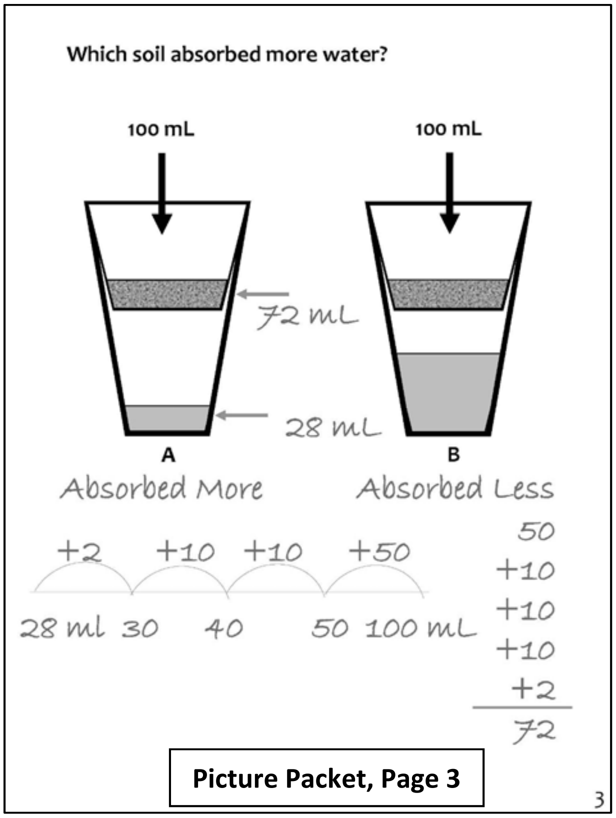
The independent variable is the changing variable and
the dependent variables are the measurements and observations.

6

If there is extra time, have your students 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 more about landslides.

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

Have one student from each group share the question they will investigate. Tell students, "During the next session, you will start your experiments and you will have to identify which of your soils absorbs the most liquid." Put page 3 of the picture packet under the document camera. Tell students, "I poured 100 mL of water over both soils." Ask students, "Which soil absorbed more water?" Students should identify 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 will you determine how much water the soil absorbs?" 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 additional time, do the *Observation Extra Practice* as a class (notebook, page 13).

Tell students, "Next session, you will do your experiment. All of your experiments will help us answer the class question: What variables affect how much liquid a soil can absorb? This will help us learn more about landslides."

Clean-Up:

1. Collect notebooks with attached nametags.
2. Place all materials into your group box and bring them back to UCSB.

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:

- ☐ Nametags
- ☐ Notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ (8) Partial graph pieces
- ☐ (2) Pencils
- ☐ (2) Wet erase markers
- ☐ (2) Grease pencils
- ☐ Scotch tape
- ☐ Paper towels
- ☐ (3) Water (8 oz) 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)

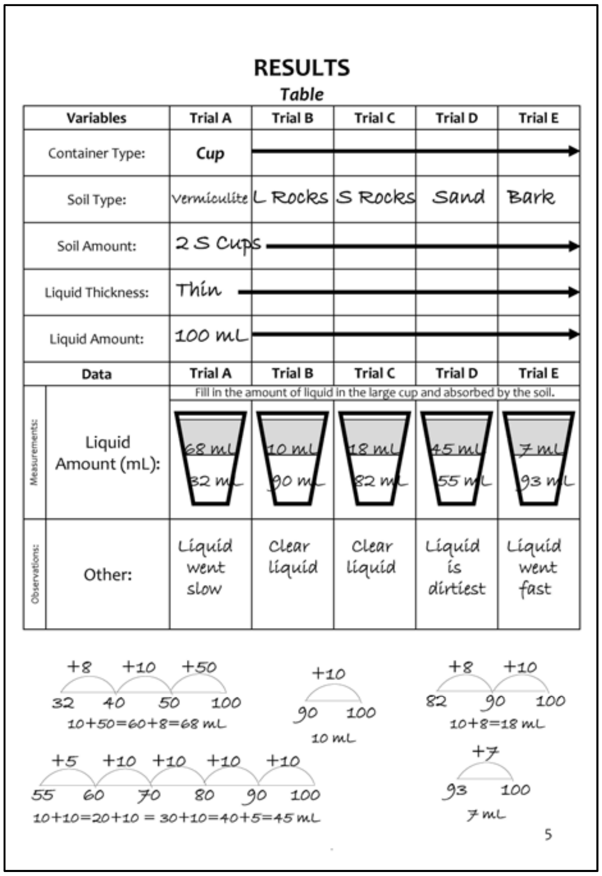
Other Supplies:

- ☐ (4) Notepads
- ☐ (2) Buckets with lids

Lead Box:

- ☐ (3) Extra notebooks
- ☐ Lead instructions
- ☐ Soil water retention picture packet
- ☐ Lead lab coat
- ☐ Time card
- ☐ (8) Partial graph pieces
- ☐ (2) Pencils
- ☐ (2) Wet erase marker
- ☐ (2) Black pens
- ☐ Scotch tape
- ☐ Paper towels
- ☐ (3) Water (8 oz)
- ☐ 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
- ☐ (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 and Notepad Pages:



RESULTS

Table

Variables	Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:	Cup	→	→	→	→
Soil Type:	Vermiculite	L Rocks	S Rocks	Sand	Bark
Soil Amount:	2 S Cups	→	→	→	→
Liquid Thickness:	Thin	→	→	→	→
Liquid Amount:	100 mL	→	→	→	→
Data	**Trial A**	**Trial B**	**Trial C**	**Trial D**	**Trial E**
	Fill in the amount of liquid in the large cup and absorbed by the soil.				
Measurements: Liquid Amount (mL):	68 mL 32 mL	10 mL 90 mL	18 mL 82 mL	45 mL 55 mL	7 mL 93 mL
Observations: Other:	Liquid went slow	Clear liquid	Clear liquid	Liquid is dirtiest	Liquid went fast

+8 +10 +50
32 40 50 100
10+50=60+8=68 mL

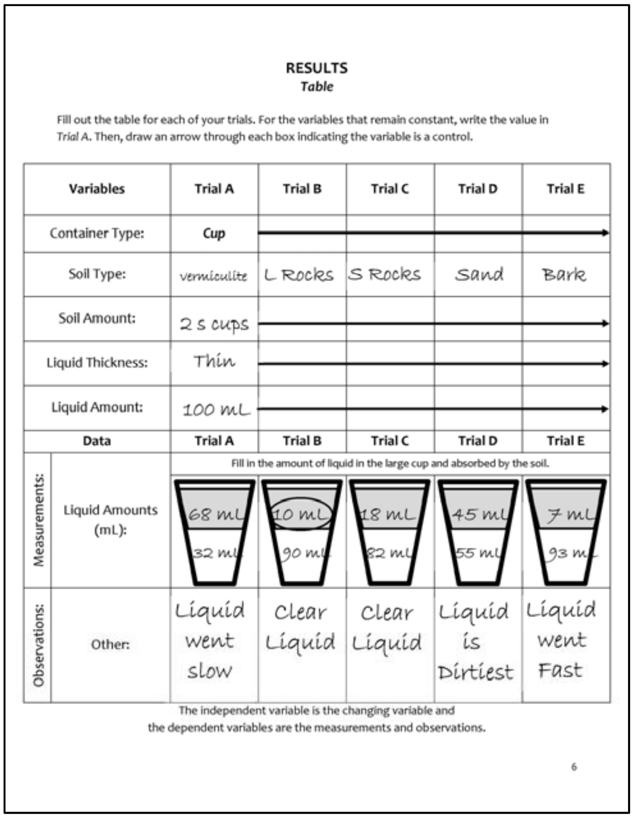
+10
90 100
10 mL

+8 +10
82 90 100
10+8=18 mL

+5 +10 +10 +10 +10
55 60 70 80 90 100
10+10=20+10 = 30+10=40+5=45 mL

+7
93 100
7 mL

5



RESULTS

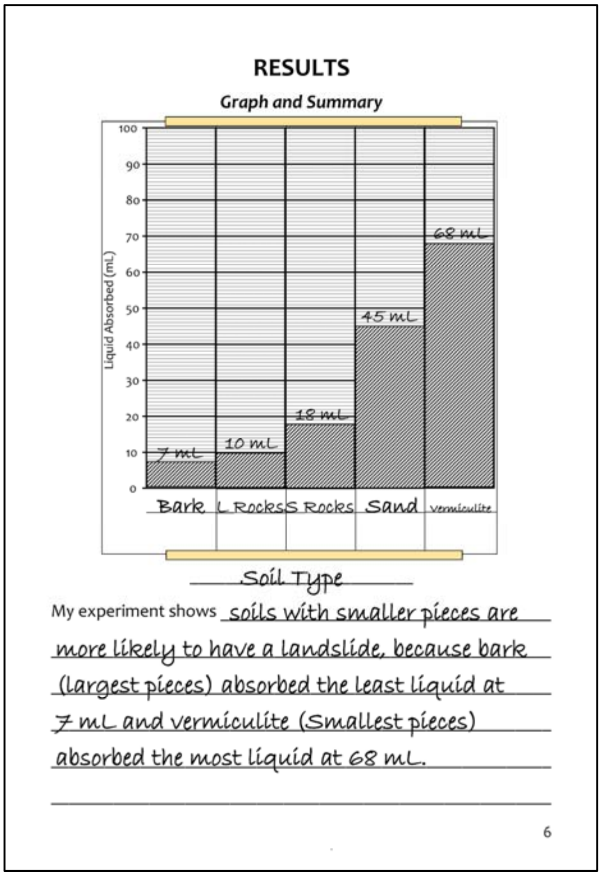
Table

Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

Variables	Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:	Cup	→	→	→	→
Soil Type:	vermiculite	L Rocks	S Rocks	Sand	Bark
Soil Amount:	2 s cups	→	→	→	→
Liquid Thickness:	Thin	→	→	→	→
Liquid Amount:	100 mL	→	→	→	→
Data	**Trial A**	**Trial B**	**Trial C**	**Trial D**	**Trial E**
	Fill in the amount of liquid in the large cup and absorbed by the soil.				
Measurements: Liquid Amounts (mL):	68 mL 32 mL	10 mL 90 mL	18 mL 82 mL	45 mL 55 mL	7 mL 93 mL
Observations: Other:	Liquid went slow	Clear Liquid	Clear Liquid	Liquid is Dirtiest	Liquid went Fast

The independent variable is the changing variable and
the dependent variables are the measurements and observations.

6

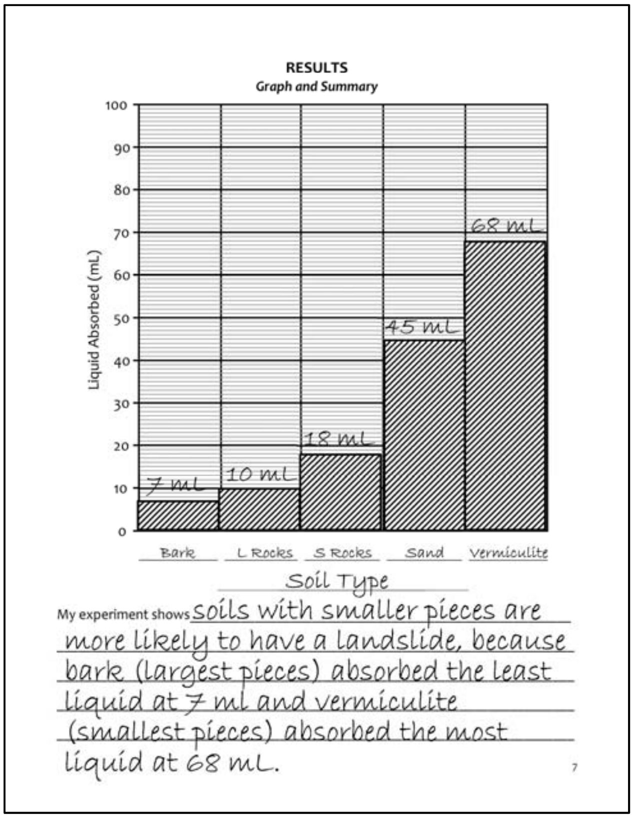


RESULTS

Graph and Summary

My experiment shows soils with smaller pieces are more likely to have a landslide, because bark (largest pieces) absorbed the least liquid at 7 mL and vermiculite (Smallest pieces) absorbed the most liquid at 68 mL.

6



RESULTS

Graph and Summary

My experiment shows Soils with smaller pieces are more likely to have a landslide, because bark (largest pieces) absorbed the least liquid at 7 mL and vermiculite (smallest pieces) absorbed the most liquid at 68 mL.

7

Preparation:

SciTrek Lead:
1. Make sure volunteers are setting out notebooks.
2. Set up the document camera for the Introduction (picture packet, page 4).

SciTrek Volunteers:
1. Set out notebooks/nametags.

Note: Set notebooks where students will sit during the module even if another student is currently at that desk. If needed, students will move to these spots after the Introduction.

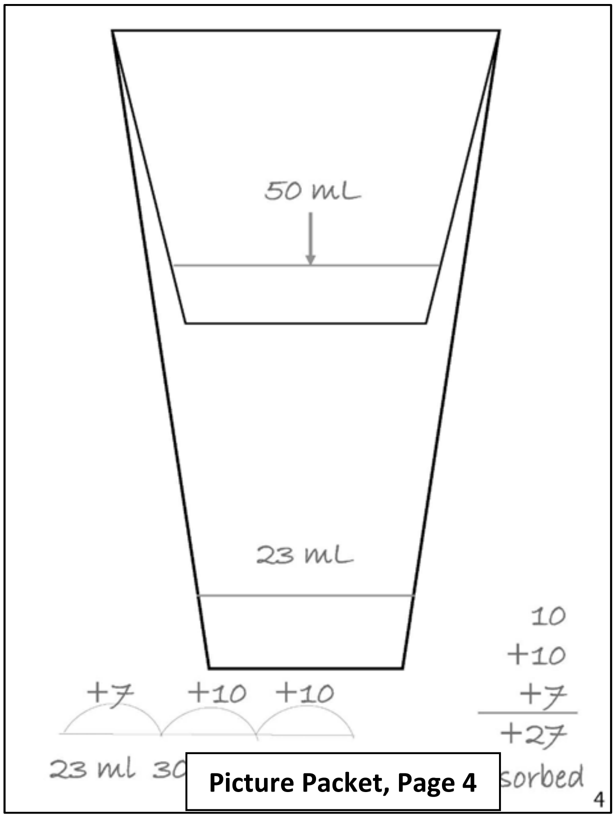
Introduction:
(5 minutes – Full Class – SciTrek Lead)

If students are not in their groups, tell them, "A notebook will be put on your desk, which is not your notebook and you should not move it. You will move to your groups after the Introduction."

Ask the class, "What have we been working on the last two meetings, and what real-life application does it have?" Possible student response: we have been exploring water and soil interactions and we found that the more compact the soil, the slower the water absorbs into the soil. This shows us landslides are more likely to occur at the start of a rainstorm in loose soil than compact soil. They should also state they designed an experiment to test another variable that might affect the amount of liquid the soil can absorb. Have each group tell you the variable they are going to investigate.

Tell the class, "Today you will be working in your groups to complete your experiments using the procedures you developed last session. To do this you will be using graduated cylinders." Show students the graduated cylinder. Tell students, "You will need to fill the graduated cylinder to the correct amount; to do this you should put the graduated cylinder on a flat surface. You will then pour liquid into the cylinder until it is approximately 10 mL from the desired amount. At this point, you should add the remaining liquid drop-wise with a dropper." Show students the dropper. Tell students, "You should then verify the volume by making sure you are eye level with the liquid level and reading the graduated cylinder. When you are ready to pour your liquid over your soil, you should hold your cup in one hand and use the other to **slowly** pour the liquid over the soil. This will help you prevent spills."

Tell students, "Once you have poured the water through the soil, you will need to figure out how much liquid the soil absorbed." 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 "absorb" means the soil takes in and holds onto the liquid. Show students the picture of the example cup (picture packet, page 4). Ask students, "What is the first step in carrying out your experiment?" Possible student response: we will fill our medium cups with the appropriate amount of the correct soil type. Draw soil in the medium cup on the picture. Then, ask students, "What will you do next?" Possible student response: we will fill our 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. Ask students, "What do you expect to happen?" Possible student response: 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 will you do with the water that is in the large cup?" Possible student response: we will measure it using the graduated cylinder. Label the water at the bottom of the large cup "23 mL" to indicate that 23 mL of water has gone through the holes of the medium cup and dripped into the large cup. Once students understand the process, ask them, "How will you figure out how much liquid was absorbed by the soil?" Possible student response: we will subtract the amount of liquid in the large 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.



Picture Packet, Page 4

Tell students, "After you are finished with your experiment and recording your results, you will use the data to make a graph to see how your changing variable has affected the amount of liquid a soil can absorb. You can now start your experiment."

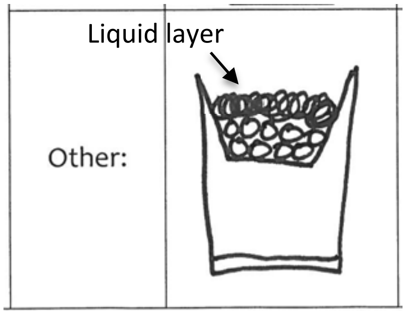
Experiment:
(27 minutes – Groups – SciTrek Volunteers)

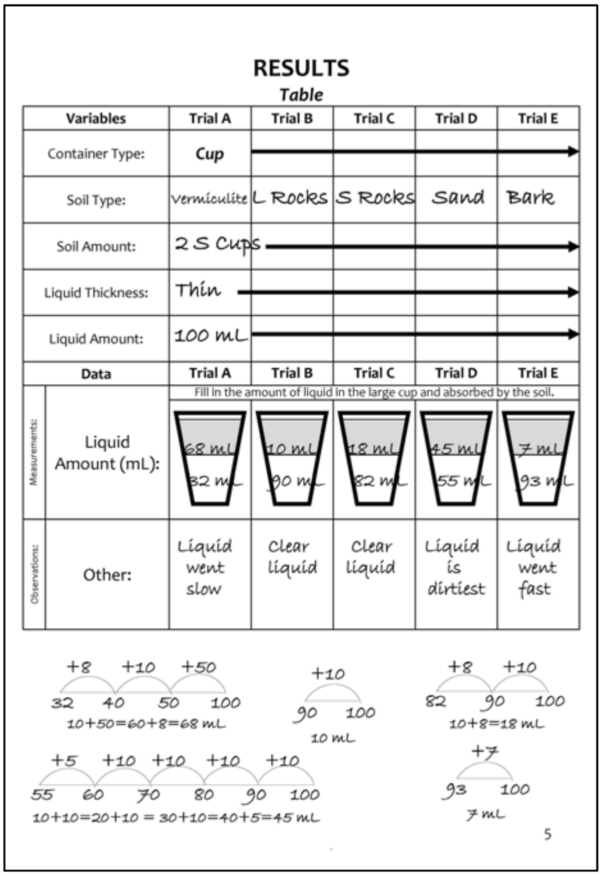
Before students start their experiment, make sure that they have filled out the variables section of the results table (notebook, page 6).

Help students set up and complete their experiment. To help keep track of which graduated cylinder goes with each trial, or how much liquid to add, you can write the trial letter or draw a line on the graduated cylinder using the blue wet erase pen that is in your group box. 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 students pour the liquid over the soil slowly and carefully. Wait until the water is no longer dripping from the medium cup into the large cup, or let the experiment run for five minutes, whichever comes first, then have students set the medium cup in an extra, unlabeled large cup and measure the amount of liquid that passed through the soil using a gradated cylinder. Have each student read their graduated cylinder and tell you their measurement, and record these (notepad, page 5) in the bottom half of the picture of the large cup. Then have students copy the measurements onto page 6 of their notebook (see example notepad below).

Ask students, “How will we figure out how much water the soil in each of the trials absorbed?” Possible student response: we can use a number line to find the difference between the initial amount of liquid we poured over the soil and the amount of liquid that is in the large cup (the amount of water that passed through the soil). As a group, do the math for each of the trials on the bottom of page 5 in the notepad, making sure to use the appropriate subtraction method as dictated by the teacher. If more room is needed for number lines use the backside of a notepad page. Students only need to record the liquid absorbed in their notebooks, not the 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. If your group changed liquid thickness, the higher level liquid thicknesses may not be able to pass through the soil to the large cup. If this is the case for your group, you should draw a picture diagram of your cup in the other observations section to remind your students which trials had liquid that sat on top of the soil. An example of what the picture might look like is shown on the right.





RESULTS

Table

Variables	Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:	Cup	→	→	→	→
Soil Type:	vermiculite	L Rocks	S Rocks	Sand	Bark
Soil Amount:	2 S Cups	→	→	→	→
Liquid Thickness:	Thin	→	→	→	→
Liquid Amount:	100 mL	→	→	→	→
Data	**Trial A**	**Trial B**	**Trial C**	**Trial D**	**Trial E**
Measurements: Liquid Amount (mL):	Fill in the amount of liquid in the large cup and absorbed by the soil.				
	68 mL 32 mL	10 mL 90 mL	18 mL 82 mL	45 mL 55 mL	7 mL 93 mL
Observations: Other:	Liquid went slow	Clear liquid	Clear liquid	Liquid is dirtiest	Liquid went fast

+8 +10 +50
32 40 50 100
10+50=60+8=68 mL

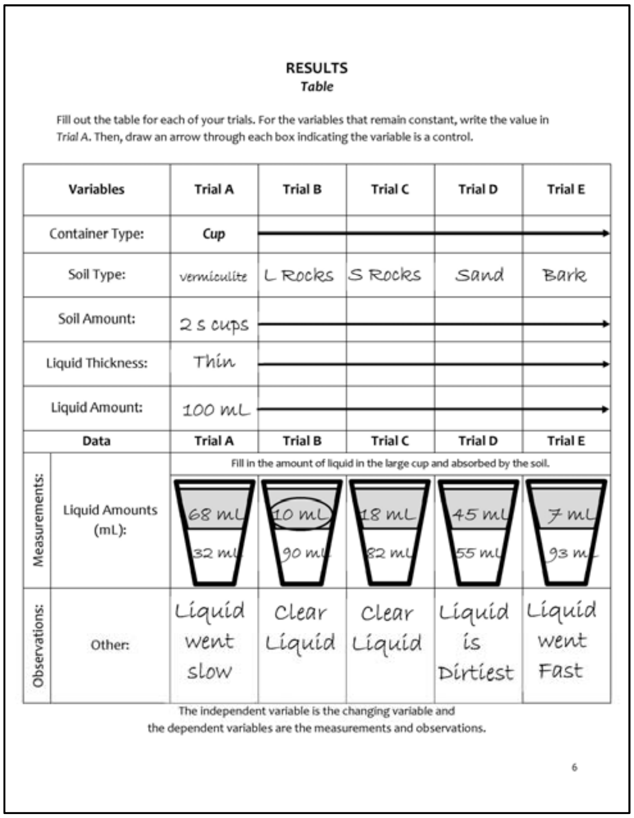
+10
90 100
10 mL

+8 +10
82 90 100
10+8=18 mL

+5 +10 +10 +10 +10
55 60 70 80 90 100
10+10=20+10 = 30+10=40+5=45 mL

+7
93 100
7 mL

5



RESULTS

Table

Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

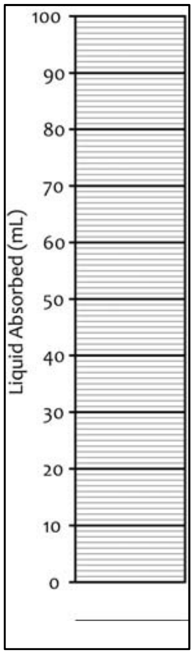
Variables	Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:	Cup	→	→	→	→
Soil Type:	vermiculite	L Rocks	S Rocks	Sand	Bark
Soil Amount:	2 s cups	→	→	→	→
Liquid Thickness:	Thin	→	→	→	→
Liquid Amount:	100 mL	→	→	→	→
Data	**Trial A**	**Trial B**	**Trial C**	**Trial D**	**Trial E**
Measurements: Liquid Amounts (mL):	Fill in the amount of liquid in the large cup and absorbed by the soil.				
	68 mL 32 mL	10 mL 90 mL	18 mL 82 mL	45 mL 55 mL	7 mL 93 mL
Observations: Other:	Liquid went slow	Clear Liquid	Clear Liquid	Liquid is Dirtiest	Liquid went Fast

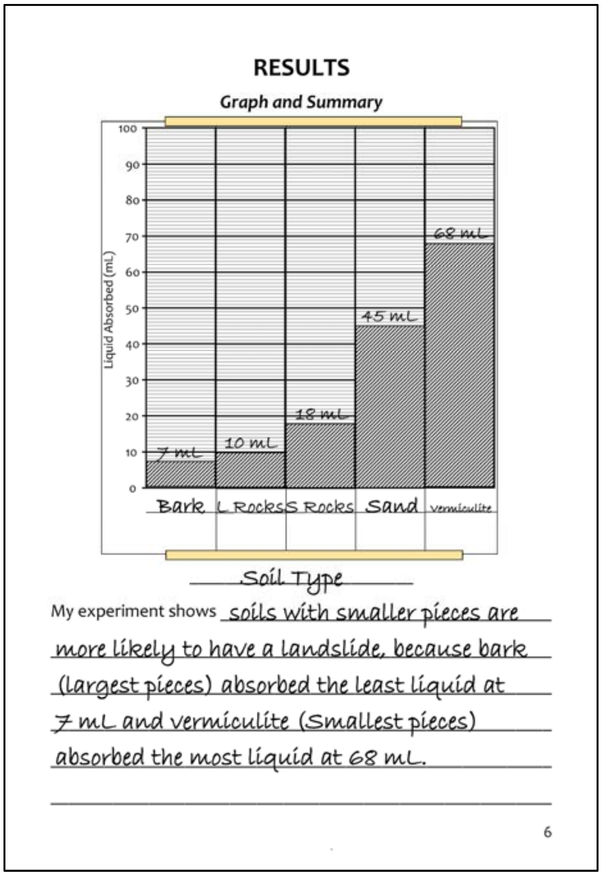
The independent variable is the changing variable and the dependent variables are the measurements and observations.

6

Graph:
(10 minutes – Groups – SciTrek Volunteers)

Pass out one partial graph piece to each student, and have them fill out the piece for the cup they oversaw. To help students know what to graph, circle the amount of water that was absorbed for their trial (see results table picture in experiment section). There is an extra partial graph piece in the group box that you should use as an example. On the bottom line, have students write the value of their changing variable (Ex: sand), not the trial letter or the changing variable (Ex: B or soil type). This way, when the pieces are rearranged, they will be able to see the changing variable values for each of the trials to help them identify any patterns. Have students draw a line across the column showing the appropriate amount of absorbed liquid, write in the numerical value of the amount of absorbed liquid 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 they are in increasing order as done in the example below. In the example experiment discussed, the trials were graphed in the following order: E, B, C, D, A. Tape the partial graphs to the notepad so that they look like a complete graph (see example notepad below). When taping the graph pieces to the 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 pieces.

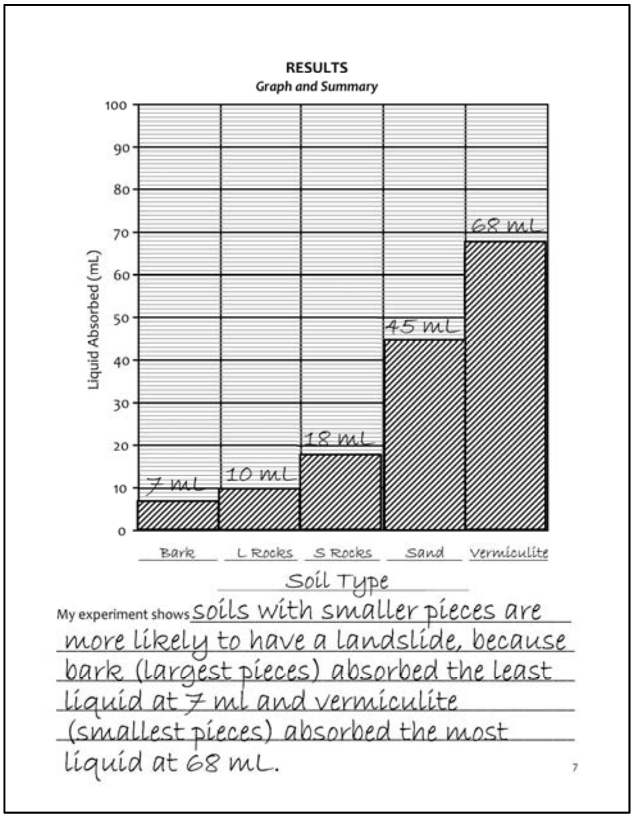



RESULTS

Graph and Summary

Soil Type

My experiment shows soils with smaller pieces are more likely to have a landslide, because bark (largest pieces) absorbed the least liquid at 7 mL and vermiculite (Smallest pieces) absorbed the most liquid at 68 mL.


RESULTS

Graph and Summary

Soil Type

My experiment shows soils with smaller pieces are more likely to have a landslide, because bark (largest pieces) absorbed the least liquid at 7 ml and vermiculite (smallest pieces) absorbed the most liquid at 68 mL.

After the pieces of the graph are taped into the notepad, ask students, “What is our changing variable?” Record this answer as the x-axis title, and have students copy this into their notebooks.

Results Summary:
(16 minutes – Groups – SciTrek Volunteers)

Have your group use their graph to look for a pattern in their data. Challenge your group to think about how their changing variable did or did not affect landslides.

When writing their results summary (notebook, page 7), make sure your group begins the statement with a claim (a statement that can be tested) about the trend, or pattern, in their data, and tie their results back to landslides. If the values of their changing variable have an order (Ex: 20 mL→ 50 mL → 100 mL), then that variable does have an effect on the amount of liquid the soil could absorb. If, on the other hand, there was no order for their changing variable values (Ex: 50 mL →100 mL → 20 mL), and/or the difference between the liquid absorbed for each trial is small, then that variable does not have an effect on the amount of liquid the soil could absorb. If possible, try to have your group generate a claim that allows them to make predictions about something they have not tested. To tie their data to landslides, remind students that the more liquid the soil absorbs, the more likely a landslide. An appropriate claim could be: soils with smaller pieces are more likely to have landslides. This is an appropriate claim because it allows groups to make a prediction about what would happen if new values of their changing variable were introduced, and identify which value would be most likely to cause a landslide.

After generating a claim about their experiment, write the word "because," and follow it with supporting data. Their supporting data should include at least two pieces of data, typically the minimum, and maximum, amounts of liquid absorbed. Make sure your group is using their changing variable values (not trial letters), and specific measurements, to support their claim. The supporting data for the previously mentioned claim would be: because bark (largest pieces) absorbed the least liquid at 7 mL and vermiculite (smallest pieces) absorbed the most liquid at 68 mL.

Results summaries are still valid, and important, if they show the changing variable tested does not affect the amount of liquid the soil could absorb. Even if their results summary is contrary to what you think, have your group make a claim based solely on their data. Help students copy this statement into their notebooks.

Once students have filled out their results summary, have them fill in the sentence frame (notebook, page 8), *I acted like a scientist when*. Each student's response should be unique and specific. They should **not** write, "when I did an experiment," because this is general, and applies to all of the students in the class. If students are having trouble with this sentence frame, ask them, "What did you do during SciTrek?"

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, "Next session, you will make a poster to share your results with the class. These posters will help us learn about what variables affect the amount of liquid a soil can absorb."

Clean-Up:

1. Collect notebooks with attached nametags.
2. Pour the wet "soil" into the Ziploc bag provided. Make sure to seal this bag so that it does not spill.
3. Put the used liquid, cups (make sure to stack), and graduated cylinders into the buckets.
4. Place all other materials into your group box and bring them back to UCSB.

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:

- ☐ Nametags
- ☐ Notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ Poster diagram
- ☐ Appropriate sticker for how to present graph (changing soil type/liquid thickness or soil amount)
- ☐ (2) Pencils
- ☐ (Bag) Paperclips
- ☐ (2) grease pencils
- ☐ Highlighter
- ☐ Scissors
- ☐ (2) Glues
- ☐ Poster parts pack (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) Notepads
- ☐ Poster paper tube

Lead Box:

- ☐ (3) Extra notebooks
- ☐ Lead instructions
- ☐ Soil water retention picture packet
- ☐ Poster diagram
- ☐ Lead lab coat
- ☐ Time card
- ☐ (2) Sticker sets for how to present graph (changing soil type/liquid thickness or soil amount)
- ☐ (2) Pencils
- ☐ (Bag) Paperclips
- ☐ (2) Wet erase markers
- ☐ (2) Black pens
- ☐ (2) Highlighters
- ☐ Scissors
- ☐ (2) Glues
- ☐ Scotch tape
- ☐ (1 each color) Poster part packs

Preparation:

SciTrek Lead:

1. Make sure volunteers are setting out notebooks.
2. Find a place to leave student posters.

SciTrek Volunteers:

1. Set out notebooks/nametags.

Note: Set notebooks where students will sit during the module even if another student is currently at that desk. If needed, students will move to these spots after the introduction.

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

If students are not in their groups, tell them, “A notebook will be put on your desk, which is not your notebook and you should not move it. You will move to your groups after the Introduction.”

Ask the class, “What is the class question 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?” Possible student response: learning about water and soil interactions can help us learn about landslides. Tell students, “If you have not filled in the results summary or *I acted like a scientist when*, you need to finish these. Then, you will explain your experiment, without looking at your notebook, to your volunteer and tell them what these results taught you about landslides.

Tell students “When scientists complete their experiment, they make a poster to present their work to other scientists. Each group will create a poster to present to the class during the next session. This presentation will be your chance to tell the class what your group has discovered about the class question. You should write as neatly as possible on the poster parts, so other class members can read your poster. You will now start working with your group to explain your experiment to your volunteer, and then make a poster.”

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 changing variable values they did not actually test.

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

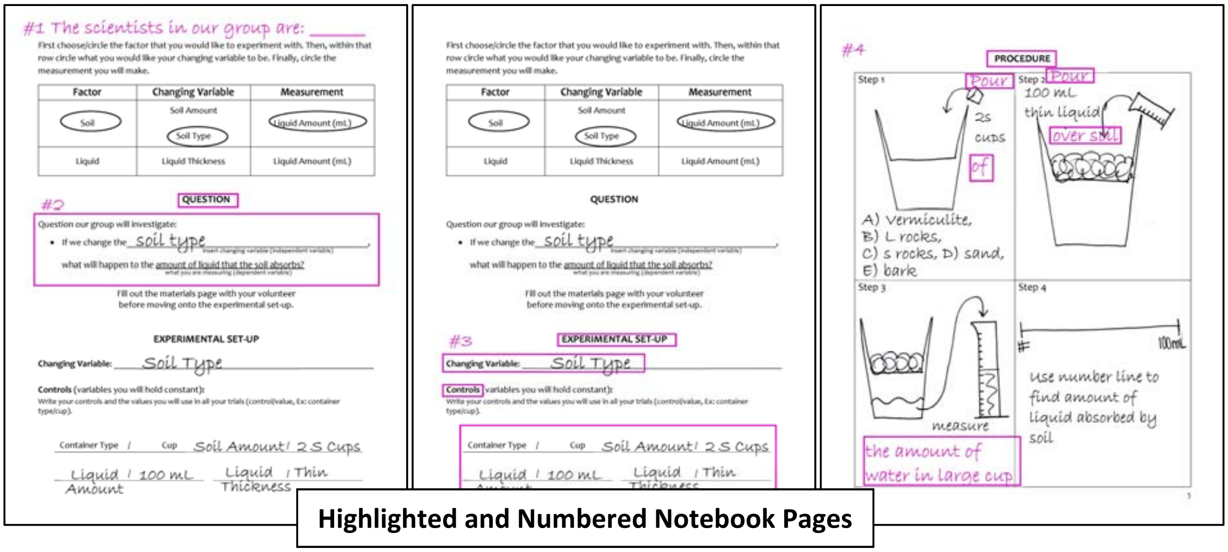
Pass out the writing portions (general poster parts and *I acted like a scientist when*) and have students write their names on them and complete them. In addition, have each student write their name on the scientists’ names poster part. Use the following guidelines when assigning poster parts:

Number of Students in Group	Poster Division Each student gets an *I acted like a scientist when* and picture space.
4	1. Question and Experimental Set-Up 2. Procedure 3. Results Graph* 4. Results Summary Student that finishes 1st completes the results table (not presented)
5	1. Question 2. Experimental Set-Up 3. Procedure 4. Results Graph* 5. Results Summary Student that finishes 1st completes the results table (not presented)
6	1. Question 2. Experimental Set-Up 3. Procedure (Presents 1st half of procedure) 4. Results Table (Presents 2nd half of procedure) 5. Results Graph* 6. Results Summary

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

Once students have finished their written section(s), have them draw a picture of their experiment or how they acted like a scientist.

In the students' notebooks, highlight and number the section(s) 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 they are reading, so that when presenting, it will be easy for them to flip back and forth between the pages.



#1 The scientists in our group are: ______

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.

Factor	Changing Variable	Measurement
[✓ Soil]	Soil Amount [✓ Soil Type]	[✓ Liquid Amount (mL)]
Liquid	Liquid Thickness	Liquid Amount (mL)

#2

QUESTION

Question our group will investigate:

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

Fill out the materials page with your volunteer before moving onto the experimental set-up.

EXPERIMENTAL SET-UP

Changing Variable: Soil Type

Controls (variables you will hold constant):
Write your controls and the values you will use in all your trials (control/value, Ex: container type/cup).

Container Type / Cup   Soil Amount / 2.5 Cups

Liquid Amount / 100 mL   Liquid Thickness / Thin

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.

Factor	Changing Variable	Measurement
[✓ Soil]	Soil Amount [✓ Soil Type]	[✓ Liquid Amount (mL)]
Liquid	Liquid Thickness	Liquid Amount (mL)

QUESTION

Question our group will investigate:

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

Fill out the materials page with your volunteer before moving onto the experimental set-up.

#3

EXPERIMENTAL SET-UP

Changing Variable: Soil Type

Controls (variables you will hold constant):
Write your controls and the values you will use in all your trials (control/value, Ex: container type/cup).

Container Type / Cup   Soil Amount / 2.5 Cups

Liquid Amount / 100 mL   Liquid Thickness / Thin

#4

PROCEDURE

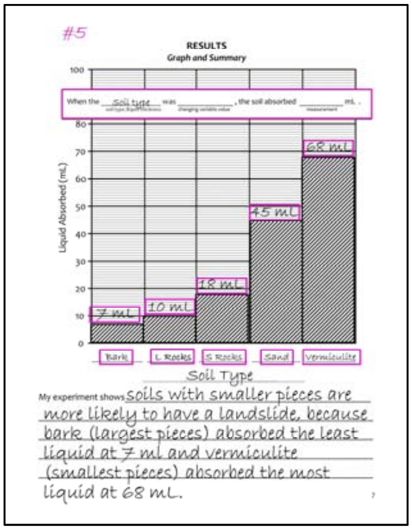
Step 1: Pour 2.5 cups of A) vermiculite, B) L rocks, C) s rocks, D) sand, E) bark

Step 2: Pour 100 mL thin liquid over soil

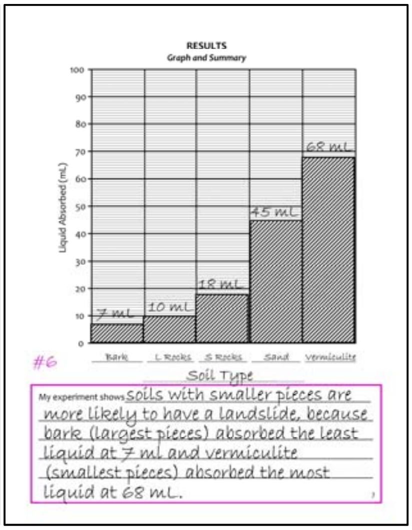
Step 3: measure the amount of water in large cup

Step 4: Use number line to find amount of liquid absorbed by soil

Highlighted and Numbered Notebook Pages



My experiment shows soils with smaller pieces are more likely to have a landslide, because bark (largest pieces) absorbed the least liquid at 7 mL and vermiculite (smallest pieces) absorbed the most liquid at 68 mL.



My experiment shows soils with smaller pieces are more likely to have a landslide, because bark (largest pieces) absorbed the least liquid at 7 mL and vermiculite (smallest pieces) absorbed the most liquid at 68 mL.

Place one of the following sentence frame stickers on the notebook page of the student who is presenting the results graph (notebook, page 7).

Changing Soil Type/Liquid Thickness:

When the ___(you should fill this blank out for the student)___ was ______________________ ,the soil absorbed _________ mL.
soil type/liquid thickness — changing variable value — measurement

Changing Soil Amount:

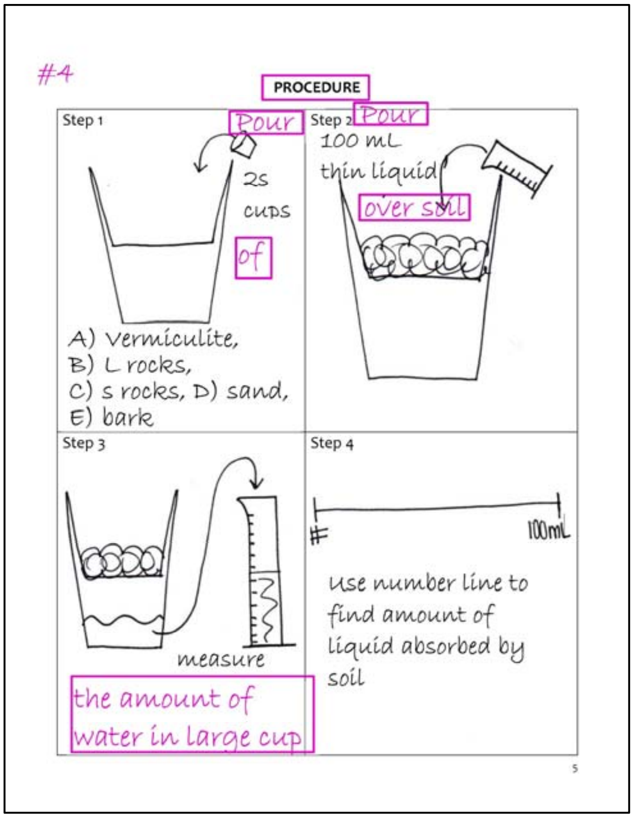
The cup with ____________________ of soil, absorbed_____________ mL.
changing variable value — measurement

Then, practice reading the five sentences with that student. For the graph above, the first sentence would read: When the **soil type** was **bark,** the soil absorbed **7** mL. Make sure you fill in the first blank in the first sentence frame (Ex: soil type) for the student, but leave the *changing variable value* and *measurement* blanks empty. An example of one of the presented sentences for a group that changed soil amount would be: The cup with **20 g** of soil, absorbed **50** mL. Leave the *changing variable value* and *measurement* blanks empty.

Ask the student who is presenting the procedure to tell you in their own words what they did in each step, and then you (the volunteer) write their words on each picture to form complete sentences. In the procedure below, the boxed words were added to the student's notebook. Therefore, the student would read:

Step 1: Pour 2 small cups of A) vermiculite, B) large rocks, C) small rocks, D) sand, and E) bark in medium cup.
Step 2: Pour 100 mL of thin liquid over soil.
Step 3: Measure the amount of liquid in large cup.
Step 4: Use number line to find the amount of liquid absorbed by the soil

Note: Students should not copy the boxed words onto the poster part.



#4

PROCEDURE

Step 1 Pour

2s cups of

A) Vermiculite,
B) L rocks,
C) s rocks, D) sand,
E) bark

Step 2 Pour 100 mL thin liquid over soil

Step 3

measure the amount of water in large cup

Step 4

#

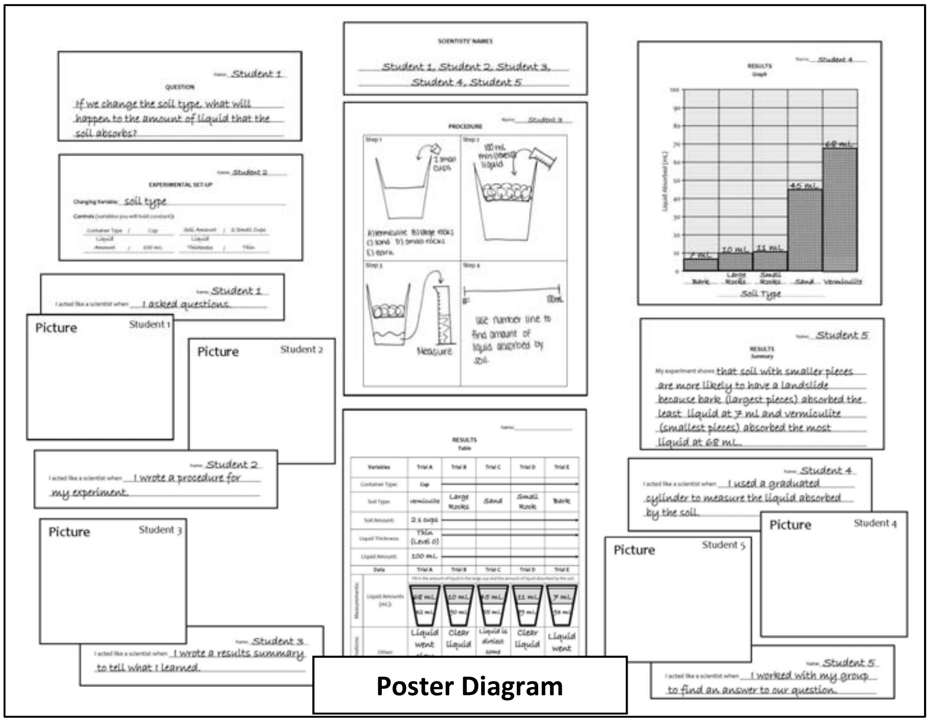
100mL

Use number line to find amount of liquid absorbed by soil

5

As soon as students have completed some of their pieces, start gluing them onto the large poster paper, in landscape orientation, **exactly** as they are arranged in the example below. Do not allow students to glue the poster parts on the poster. 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 students read from their notebooks, instead of from the poster.



Name: Student 1

QUESTION

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

Name: Student 2

EXPERIMENTAL SET-UP

Changing Variable: soil type

Name: Student 1

I acted like a scientist when I asked questions.

Picture Student 1

Picture Student 2

Name: Student 2

I acted like a scientist when I wrote a procedure for my experiment.

Picture Student 3

Name: Student 3

I acted like a scientist when I wrote a results summary to tell what I learned.

SCIENTISTS' NAMES

Student 1, Student 2, Student 3, Student 4, Student 5

PROCEDURE

RESULTS

Table

Variables	Trial A	Trial B	Trial C	Trial D	Trial E
Container Type:	Cup				
Soil Type:	vermiculite	Large Rocks	Sand	Small Rock	Bark
Soil Amount:	2 s cups				
Liquid Thickness:	Thin (Level 0)				
Liquid Amount:	100 mL				

Name: Student 4

RESULTS

Graph

Name: Student 5

RESULTS

Summary

My experiment shows that soil with smaller pieces are more likely to have a landslide because bark (largest pieces) absorbed the least liquid at 7 ml and vermiculite (smallest pieces) absorbed the most liquid at 68 mL.

Name: Student 4

I acted like a scientist when I used a graduated cylinder to measure the liquid absorbed by the soil.

Picture Student 4

Picture Student 5

Name: Student 5

I acted like a scientist when I worked with my group to find an answer to our question.

Poster Diagram

Ask your group a few questions about their poster. Have them use their findings to predict what would happen to the amount of water absorbed for other changing variable values they did not perform tests on. In addition, have them state how their findings apply to landslides. For instance, if the group's results summary was, "My experiment shows soils with smaller pieces are more likely to have a landslide because bark (largest pieces) absorbed the least liquid at 7 mL, and vermiculite (smallest pieces) absorbed the most liquid at 68 mL," ask the group, "If you tested extra-large rocks, how much water would it absorb, and would it be more or less likely to have a landslide?" They should be able to predict that it would absorb ~5 mL, and would be less likely to have a landslide.

If there is additional time, tell students, "Other students will ask you questions during your poster presentations. We should think about what questions you might be asked, and then think of the answers to those questions, so you will be prepared during your presentation."

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

Ask students the following questions:

How did you act like a scientist during this project?
What did you do, that scientists do?

After discussing how they acted like scientists, and talking about how everyone does things that scientists do in their everyday lives, tell students, "Next session, you will present your findings to the class, and I am looking forward to hearing about all of your experiments."

Clean-Up:

1. Collect notebooks with attached nametags.
2. Leave posters in the classroom.
3. Place all other materials into your group box and bring them back to UCSB.

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:

(4) Volunteer Boxes:

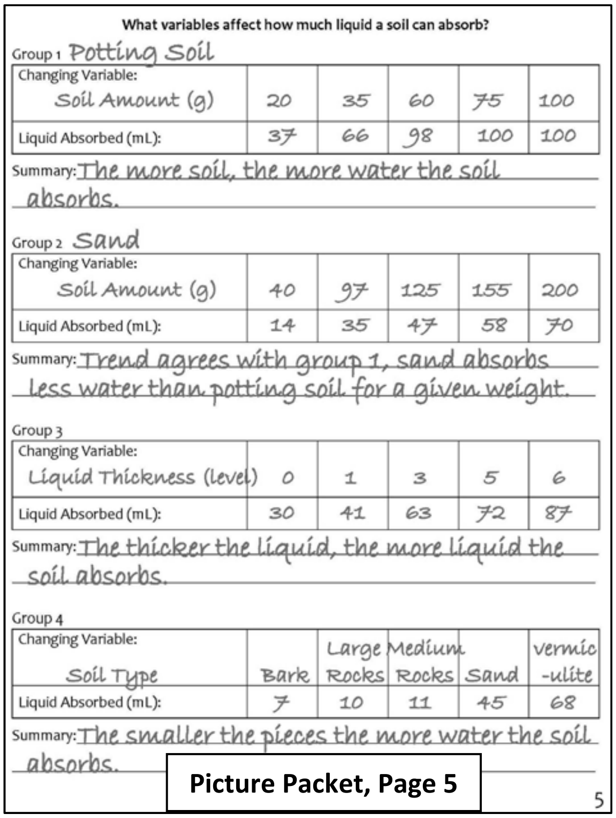
- ☐ Nametags
- ☐ Notebooks
- ☐ Volunteer instructions
- ☐ Volunteer lab coat
- ☐ (2) Pencils
- ☐ (2) Grease pencils
- ☐ (Bag) Paperclips
- ☐ Highlighter
- ☐ (6) Sharpened SciTrek pencils (all same color)

Lead Box:

☐ (3) Extra notebooks
☐ Lead instructions
☐ Soil water retention picture packet
☐ Lead lab coat
☐ Time card
☐ (2) Sticker sets for how to present graph (changing soil type/liquid thickness and soil amount)
☐ (2) Pencils
☐ (2) Wet erase markers
☐ (2) Black pans
☐ (Bag) Paperclips
☐ (2) Highlighters
☐ Scotch tape

*Student posters should already be in the classroom.

Picture Packet Page:



What variables affect how much liquid a soil can absorb?

Group 1 Potting Soil

Changing Variable: Soil Amount (g)	20	35	60	75	100
Liquid Absorbed (mL):	37	66	98	100	100

Summary: The more soil, the more water the soil absorbs.

Group 2 Sand

Changing Variable: Soil Amount (g)	40	97	125	155	200
Liquid Absorbed (mL):	14	35	47	58	70

Summary: Trend agrees with group 1, sand absorbs less water than potting soil for a given weight.

Group 3

Changing Variable: Liquid Thickness (level)	0	1	3	5	6
Liquid Absorbed (mL):	30	41	63	72	87

Summary: The thicker the liquid, the more liquid the soil absorbs.

Group 4

Changing Variable: Soil Type	Bark	Large Rocks	Medium Rocks	Sand	vermic-ulite
Liquid Absorbed (mL):	7	10	11	45	68

Summary: The smaller the pieces the more water the soil absorbs.

Picture Packet, Page 5

5

Preparation:

SciTrek Lead:

1. Make sure volunteers are setting out notebooks.
2. Assign volunteers a new group to work with.
3. Set up the document camera for the *Notes on Presentations* (picture packet, page 5).
4. Organize posters so experiments featuring the same changing variable will be presented back-to-back and posters are presented from simplest to understand, to most difficult to understand (suggested order: soil amount, liquid thickness, soil type).

SciTrek Volunteers:

1. Today you will initially work with a new group of students. When your original group presents their poster, go up with them.
2. Set out notebooks/nametags.
3. Have pencils ready to distribute to your group **after** the poster presentations.

Note: Set notebooks where students will sit during the module even if another student is currently at that desk. If needed, students will move to these spots after the Introduction.

Introduction:

(2 minutes – Full Class – SciTrek Lead)

If students are not in their groups, tell them, "A notebook will be put on your desk, which is not your notebook and you should not move it. You will move to your group after the Introduction."

Tell students, "Today you will present your posters to the class. 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. Today, you will work with a new volunteer. You will have 15 minutes to discuss your experiments and results, as well as practice presenting your posters with your groups. When you present you should read from your notebooks, not the posters. After practicing, you will return to your normal classroom seats."

Practice Posters:

(15 minutes – Groups – SciTrek Volunteers)

Have volunteers rotate groups.

Have students explain what they did and what they learned from their experiment, without looking at their notebooks, if possible. Ask students questions to make sure they understand what they did during their experiment. Make sure you also have them use their results to predict what would happen for other systems they did not actually test. Remind them to think about patterns or trends 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, "How much liquid would pass through the cup if you used level 7 liquid (this would be a thickness that they did not test)? Possible student response: more liquid would be absorbed with level 7 liquid and more liquid would sit on top of the soil. Try to make sure each student in your group answers one question.

Once the group understands their experiment and findings, 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.

If there is additional time, tell the group, "Other students will ask you questions during your poster presentations. We should think about what questions you might be asked and think of the answers to those questions so you will be prepared during your presentation."

Do not let poster practice go over 15 minutes.

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 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 answering this question?" Possible student response: if we can determine the variables that affect the amount of liquid a soil can absorb, we will be able to understand and predict landslides. Tell students, "During the presentations, I will take notes, but you will have to help me by telling me the changing variable of the group after they say their question. I will also record the groups' changing variable values and the amount of liquid absorbed." Turn to page 5 in the picture packet.

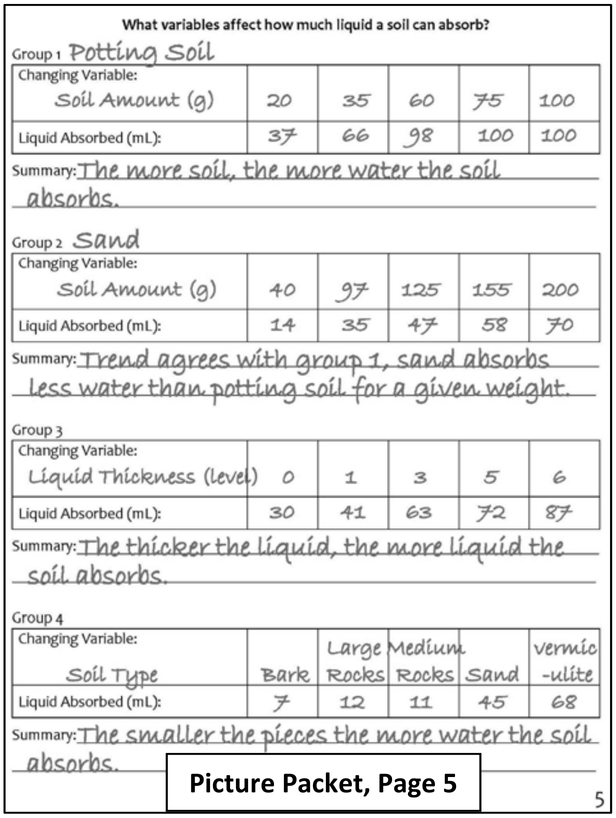
Tell students, "You will get the chance to ask scientific questions after each presentation. These questions are important, because you will have to summarize what you learned from the group so I can record it on the group notes. Therefore, your questions should focus on helping you be able to summarize the group's findings. If you ask a scientific question during the presentation, you will get a SciTrek pencil at the end of the presentations."

Volunteers should make sure 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 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?" or "Can you predict what the amount of liquid absorbed would be if you used (untested changing variable value)?" Each group should answer approximately five questions (one question per student).

When students are done asking questions, have them summarize what the group found. This is challenging for 2nd graders, therefore, you need to break it down into the following five questions 1) What was the group's changing variable? 2) (point to the notes where you recorded the values of the changing variable) What pattern do you see in the (insert changing variable)? 3) (point to the notes where you recorded liquid absorbed) What pattern do you see in the liquid absorbed? 4) What does this mean about landslides? 5) Can someone put what we learned into a sentence? If they are still having trouble, give them the sentence frame, "As the (insert changing variable) (insert pattern) the soil absorbed (more/less liquid) and the chance of having a landslide (increases or decrease)" Ex: As the piece size of the soil gets smaller the soil absorbs more water and the chance of having a landslide increases. Once they have generated a summary, record this on the notes page.

An example filled out notes on presentations, is shown below.



What variables affect how much liquid a soil can absorb?

Group 1 Potting Soil

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Group 2 Sand

Changing Variable: Soil Amount (g)	40	97	125	155	200
Liquid Absorbed (mL):	14	35	47	58	70

Summary: Trend agrees with group 1, sand absorbs less water than potting soil for a given weight.

Group 3

Changing Variable: Liquid Thickness (level)	0	1	3	5	6
Liquid Absorbed (mL):	30	41	63	72	87

Summary: The thicker the liquid, the more liquid the soil absorbs.

Group 4

Changing Variable: Soil Type	Bark	Large Rocks	Medium Rocks	Sand	vermic-ulite
Liquid Absorbed (mL):	7	12	11	45	68

Summary: The smaller the pieces the more water the soil absorbs.

5

Picture Packet, Page 5

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

- The greater the *soil amount*, the more liquid can be absorbed.
- The thicker the *liquid thickness*, it seems like the more liquid 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.
- The more “space” between the pieces of a given *soil type*, the less liquid that will be absorbed.

When summarizing experiments, use student-collected data and not what they should have found from the list above. Ask students, “What are the conditions that would allow a soil to absorb the most liquid?”

- Soli compactness: Either loose or compact
- Soil amount: As much as possible
- Liquid thickness: Liquid level 6
- Soil type: Vermiculite or sand

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

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

Tell students, "The mentors who have been working with you are undergraduate and graduate students who volunteer their time, so you can do experiments. This is the last day you will see your volunteers, so we should say thank you and goodbye to them. I will come back and work with you one more day."

Have students remove the paper parts of their nametags (which they can keep) from the plastic holders and return the plastic holders to their volunteers.

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:

1. Collect plastic nametag holders and allow students to keep the paper parts of their nametag.
2. Collect notebooks.
3. Leave posters in the classroom.
4. Place all other materials in your group box and bring them back to UCSB.
5. If you will not be attending the tie to standards day, remove all materials from your lab coat pockets, remove your nametag, unroll your lab coat sleeves, and put your lab coat into the dirty clothes bag at UCSB.

Day 6: Tie to Standards

Note: We **highly recommend** teachers give the observation assessment prior to Day 6 of the module. The suggested times in the lesson plan below are assuming the observation assessment was given prior to SciTrek's arrival.

Schedule:

Times if teacher gave assessment prior to SciTrek:	***Times if SciTrek must give assessment:***
Tie to Standards (SciTrek Lead) – 60 minutes	Observation Assessment (SciTrek Lead) – 5 minutes
	Tie to Standards (SciTrek Lead) – 55 minutes

Materials:

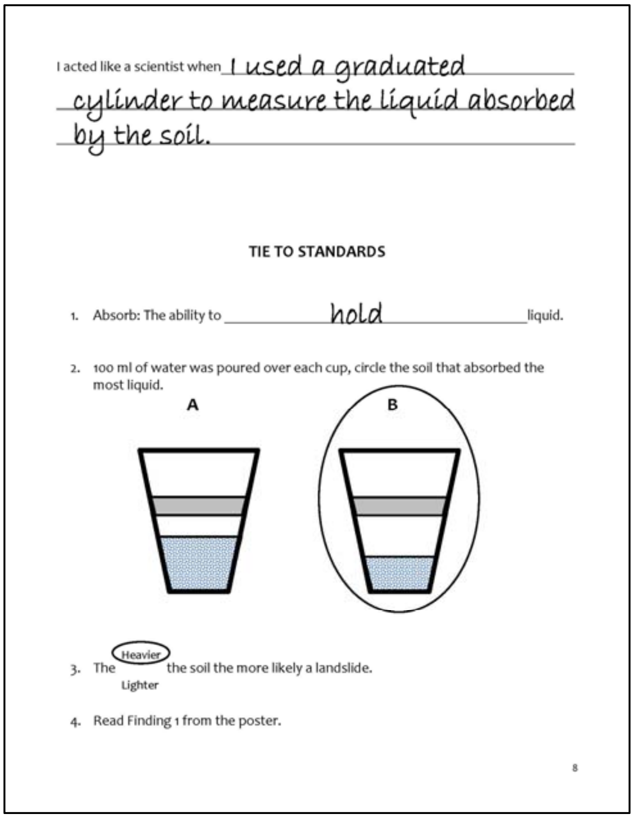
Lead Box:

☐ (3) Extra notebooks
☐ Notebooks
☐ Lead instructions
☐ Soil water retention picture packet
☐ Lead lab coat
☐ Observation assessment (if teacher did not take assessments, then (25) assessments and (25) rubber bands)
☐ Time card
☐ (2) Pencils
☐ (2) Wet erase mark
☐ (2) Black pens
☐ Paper towels
☐ (2) Water (8 oz)
☐ 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

Notebook and Finding Pages:



I acted like a scientist when I used a graduated cylinder to measure the liquid absorbed by the soil.

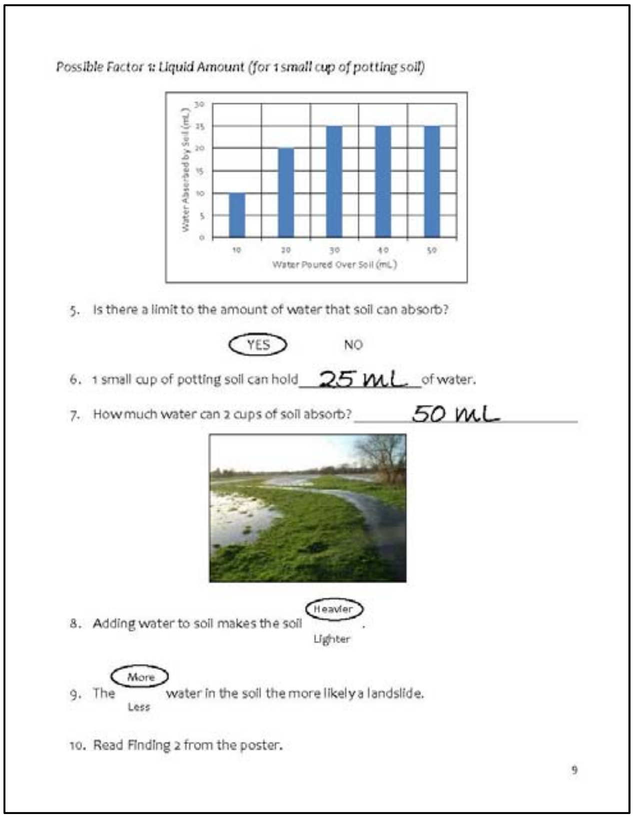
TIE TO STANDARDS

1. Absorb: The ability to hold liquid.
2. 100 ml of water was poured over each cup, circle the soil that absorbed the most liquid.

   A [✓ B]

3. The [✓ Heavier] Lighter the soil the more likely a landslide.
4. Read Finding 1 from the poster.

8



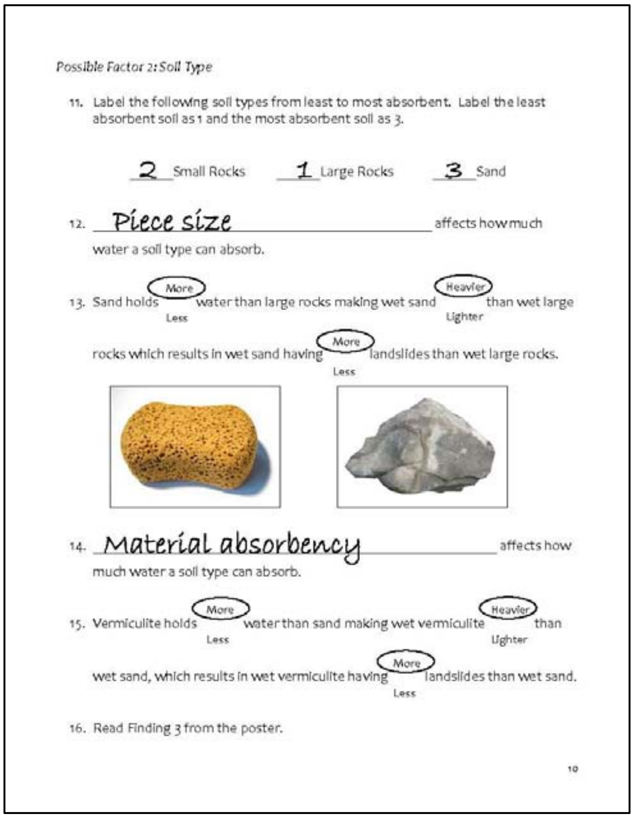
Possible Factor 1: Liquid Amount (for 1 small cup of potting soil)

5. Is there a limit to the amount of water that soil can absorb?

   [✓ YES] NO

6. 1 small cup of potting soil can hold 25 mL of water.
7. How much water can 2 cups of soil absorb? 50 mL
8. Adding water to soil makes the soil [✓ Heavier] Lighter.
9. The [✓ More] Less water in the soil the more likely a landslide.
10. Read Finding 2 from the poster.

9



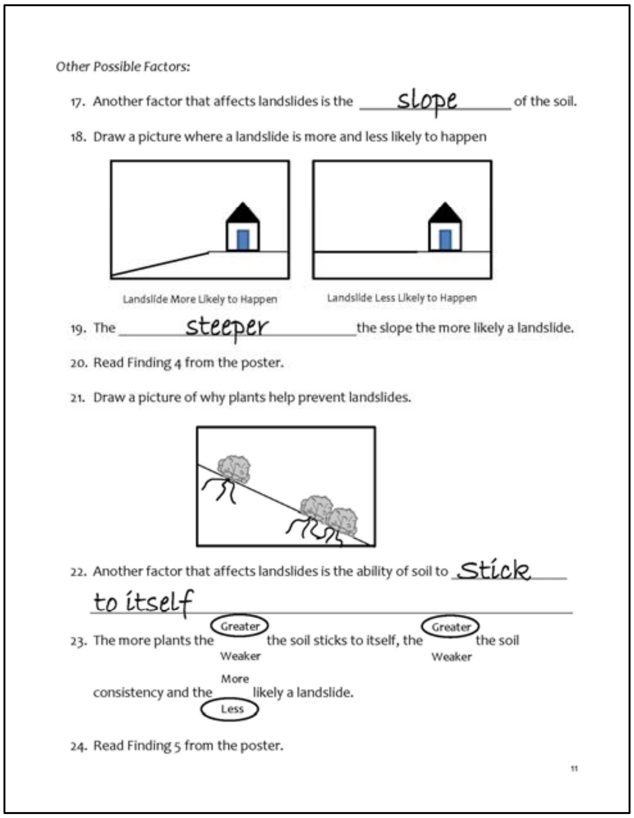
Possible Factor 2: Soil Type

11. Label the following soil types from least to most absorbent. Label the least absorbent soil as 1 and the most absorbent soil as 3.

    2 Small Rocks 1 Large Rocks 3 Sand

12. Piece size affects how much water a soil type can absorb.
13. Sand holds [✓ More] Less water than large rocks making wet sand [✓ Heavier] Lighter than wet large rocks which results in wet sand having [✓ More] Less landslides than wet large rocks.
14. Material absorbency affects how much water a soil type can absorb.
15. Vermiculite holds [✓ More] Less water than sand making wet vermiculite [✓ Heavier] Lighter than wet sand, which results in wet vermiculite having [✓ More] Less landslides than wet sand.
16. Read Finding 3 from the poster.

10



Other Possible Factors:

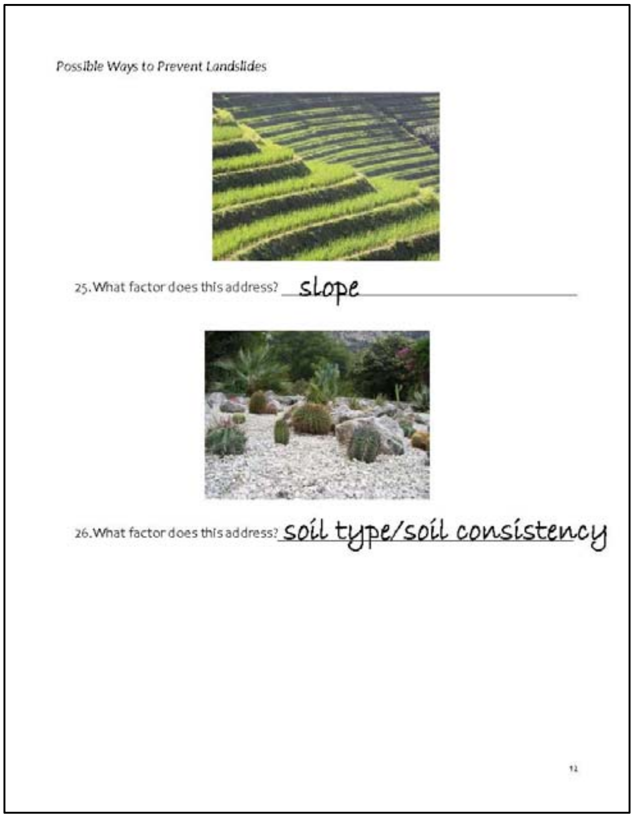
17. Another factor that affects landslides is the slope of the soil.
18. Draw a picture where a landslide is more and less likely to happen

    Landslide More Likely to Happen

    Landslide Less Likely to Happen

19. The steeper the slope the more likely a landslide.
20. Read Finding 4 from the poster.
21. Draw a picture of why plants help prevent landslides.
22. Another factor that affects landslides is the ability of soil to Stick to itself
23. The more plants the [✓ Greater] Weaker the soil sticks to itself, the [✓ Greater] Weaker the soil consistency and the More [✓ Less] likely a landslide.
24. Read Finding 5 from the poster.

11

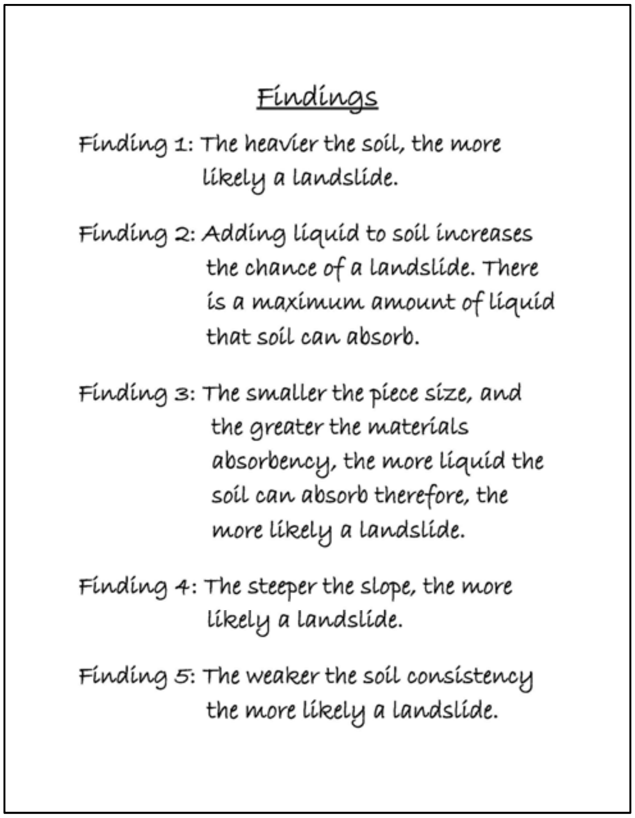


Possible Ways to Prevent Landslides

25. What factor does this address? slope

26. What factor does this address? soil type/soil consistency

12



Findings

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

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

Finding 3: The smaller the piece size, and the greater the materials absorbency, the more liquid the soil can absorb therefore, the more likely a landslide.

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

Finding 5: The weaker the soil consistency the more likely a landslide.

*All findings should be covered so that they can be revealed one by one as the lead goes through the tie to standards activity.

Preparation:

SciTrek Lead:

1. Get the observation assessments and put them in the lead box.
2. If the teacher is not leading the tie to standards activity, do the following:
    a. Give the teacher an extra notebook and have them fill it out with their students, to follow along during the tie to standards activity.
    b. Collect the teacher's lab coat and put it in the lead box.
3. Pass out notebooks to students.
4. Set up the document camera for the tie to standards activity (notebook, pages 8-12; picture packet, pages 6-11).
5. Assemble the tie to standards set-up.
    a. Fill 4 graduated cylinders with 50 mL of water each.
    b. Place a pre-cut coffee filter circle inside each of the four medium (9 oz) cups with holes.
    c. Place the medium cups inside the large (20 oz) cups.
    d. Pour four 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.
6. Tape the *Findings Poster* to the front board. Making sure to cover up the findings.
7. Put your lab coat in the lead box at the end of the day.

Observation Assessment:
(5 minutes – Full Class – Given By Classroom Teacher Prior to SciTrek)

Tell students, "Before we start our activity today, we will determine how your ideas on observations are developing." Pass out the observation assessment and a rubber band to each student. Have students write their name, teacher's name, and date at the top of the assessment. Tell students, "When doing this assessment, you should work individually, so there should be no talking." As you are giving the assessment, walk around the room and verify students have written their names on their assessments.

At the top of the page, have students write in what they think the definition of an observation is. Read the instructions aloud for questions *2-8*. Then, read each of the statements and tell students, “Circle ‘observation’ if the statements is an observation you can make about the object. Circle or ‘not an observation’ if the statement is not an observation you can make about the object.” When they are finished, collect the assessments and the rubber bands and verify students’ names are written on the papers.

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

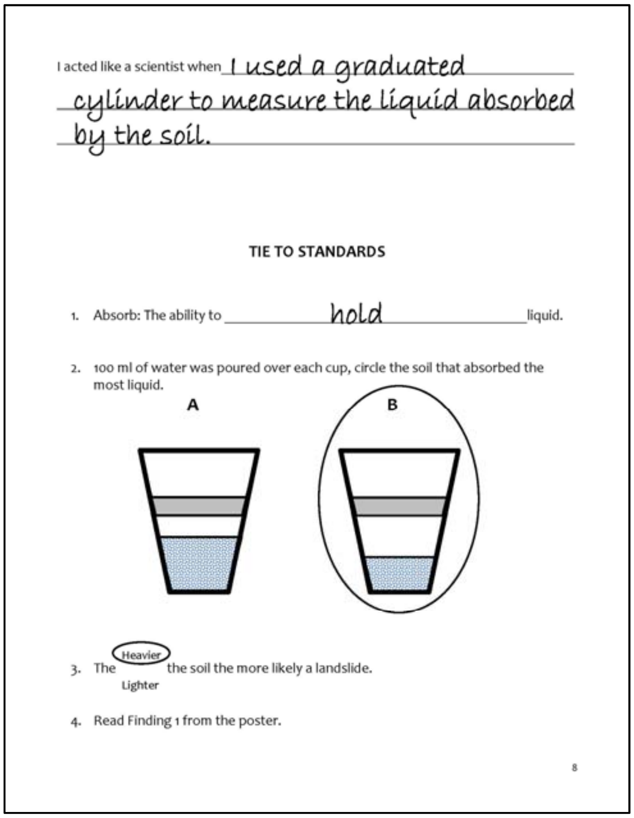
Review: (7 minutes)

Tell the class, “I enjoyed your poster presentations last time. Today, we are going to revisit some of the variables you have been investigating and look at a few other variables to determine how they affect how much liquid soil can absorb. But before we do, 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 the class 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 students look at the cups and identify which cup absorbed the most liquid. Make sure students understand the more liquid in the large cup, the less liquid that the soil absorbed.

Ask students, “What causes landslides to happen?” Help them realize the heavier the soil, the more likely a landslide, and have them circle the correct word in 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.



I acted like a scientist when I used a graduated cylinder to measure the liquid absorbed by the soil.

TIE TO STANDARDS

1. Absorb: The ability to hold liquid.
2. 100 ml of water was poured over each cup, circle the soil that absorbed the most liquid.

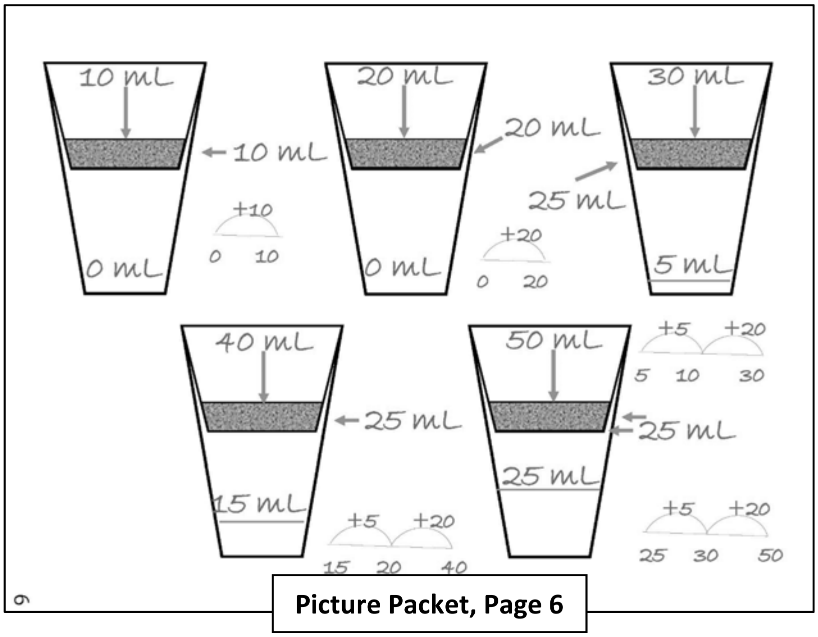
3. The [✓ Heavier] Lighter the soil the more likely a landslide.
4. Read Finding 1 from the poster.

8

Note: Finding 1 is not completely correct. More accurately, it should be, the greater the change in mass, the more likely a landslide.

Possible Factor 1: Liquid Amount (20 minutes)

Tell students, “We will now look at different variables and see how they would affect landslides. The first variable we will discuss is a variable that no one tested. We will look at how changing the water amount affects how much 1 small cup of potting soil can absorb.” Have students look at the graph (notebook, page 9). Show them the x-axis shows the amount of water that was poured over the potting soil. Ask students, “How much water was poured over the potting soil for trial 1?” Students should reply, “10 mL.” On the first cup, (picture packet, page 6) draw 10 mL of water going into the soil. Show students the y-axis shows the amount of water that was absorbed by the soil. Ask students, “How much water was absorbed by the soil for the first trial?” Students should reply, “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 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 medium cup?” (0 mL)



Picture Packet, Page 6

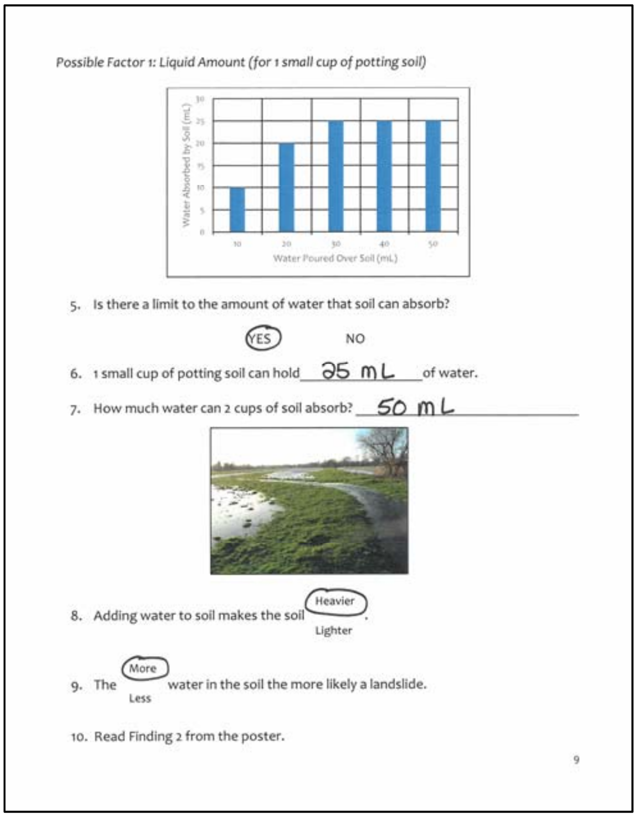
Repeat this process for the other 4 trials. An example of what page 6 of the picture packet will look like, when it is filled out, is shown above.

Ask students, “Why did the first two cups absorb all the water and the last three cups did not?” Possible student response: the soil was not fully wet in the first two cups, but now is fully wet.

Ask the class question 5, “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 6 (1 small cup of potting soil can hold **25 mL** of water). Ask students question 7, “How much water can 2 cups of soil absorb?” Make sure by the end of the conversation they realize two cups of soil could hold 50 mL, because we have doubled the amount of soil that we used to make the graph.

Have students look at the picture on page 9 and put the full-size colored picture under the document camera (picture packet, page 7, shown below). Ask students, “Can someone explain what they think happened?” By the end of the conversation, make sure students understand 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.

Picture Packet, Page 7



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

5. Is there a limit to the amount of water that soil can absorb?

[✓ YES] NO

6. 1 small cup of potting soil can hold 25 mL of water.

7. How much water can 2 cups of soil absorb? 50 mL

8. Adding water to soil makes the soil [✓ Heavier] Lighter.

9. The [✓ More] Less water in the soil the more likely a landslide.

10. Read Finding 2 from the poster.

9

Tell students, "We are now going to apply what we know to landslides. Pretend 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 mass when it is wet or dry?" Possible student response: it will have a greater mass when the soil is wet. Have students circle the correct word in question *8* (Adding water to soil makes the soil **heavier.**) Ask students, "How does this apply to landslides?" Possible student response: the heavier the soil, the more likely a landslide. Have them circle the correct word in question *9* (The **more** water in the soil, the more likely a landslide.) "Pretend it continues to rain for the next 20 hours. During this time you keep taking soil samples. Does the mass of the soil samples keep going up?" Students should realize 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 no longer increase. 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 a landslide will happen and why?" Possible student response: as it rains, the chances of a landslide happening go up, because the mass of the soil goes up.

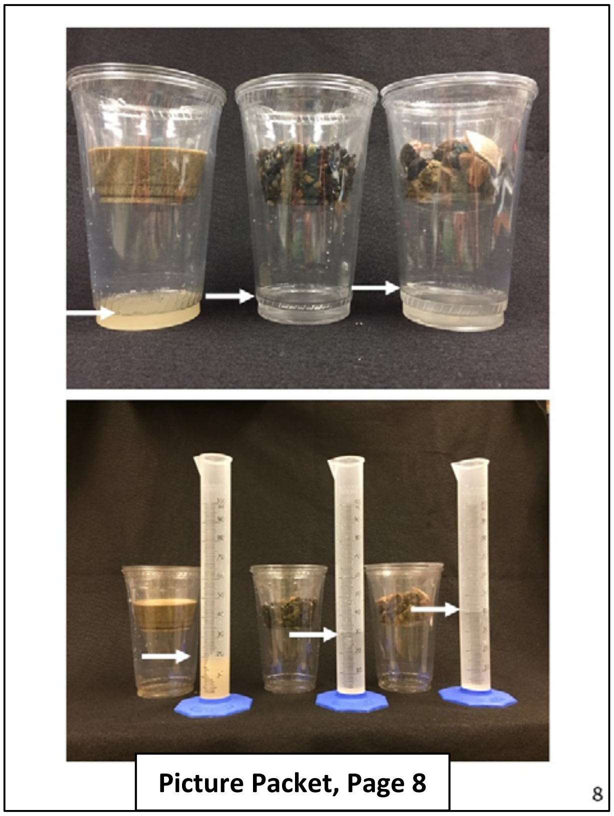
Tell students, "Now we know adding a liquid to soil increases the chance of a landslide. But, there is a limit to the amount of liquid that a soil can absorb." Remove the clips showing finding 2 on the *Findings Poster*.

> *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 notebook can be seen above.

Possible Factor 2: Soil Type (13 minutes)

If a group tested soil type, ask students, “Can someone predict which of the soil types (small rock, large rocks, or 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 SciTrek volunteer help you pour 50 mL of water through each of the three soil types. Make sure 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 liquid have the most or the least water in the large cup?” Students should reply, “The least water.” Then, have students put the soil types in order from least absorbent (1) to most absorbent (3) for question *11* (large rocks (least absorbent - 1), small rocks, and sand (most absorbent - 3)). If needed, show students picture packet page 8 (shown 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.



Picture Packet, Page 8

Picture Packet, Page 9

Ask students, “Do different soil types absorb different amounts of water?” Students should reply, “Yes.” Ask students, “What pattern do you notice about the amount of water the soil can absorb?” Possible student response: the larger the piece size of the soil, the less the soil absorbs. Record piece size for question *12.* Ask students, “If you add the maximum amount of water each soil type can absorb, which of the three soil types would have the largest weight change and why?” Possible student response: the sand because it has the smallest pieces and therefore can absorb the most water. Then ask students, “Which soil type would be the most likely to have a landslide?” Student should reply, “Sand.” Have students circle the correct answers for question *13*.

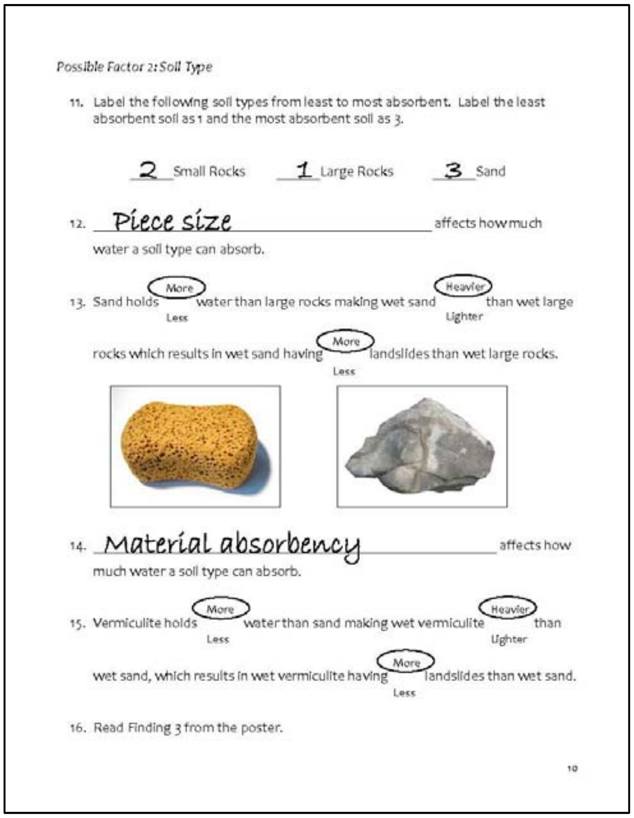
Have students look at the two pictures on page 10 and show students the corresponding colored pictures (picture packet, page 9, shown above, right). Ask students, “Can someone describe the objects to me?” They should describe the first object as a sponge and the second object as a rock. Ask students, “Are the objects approximately the same size?” Students should reply, “Yes.” Ask students, “If you poured water over each of the objects, what would happen?” Possible student response: water will be absorbed by the sponge but would just run off of the rock. Tell students, “This shows us another factor that affects the amount of water a soil can absorb and is known as **material absorbency**.” Record this answer for question *14*. Ask students, “Do small rocks, large rocks, and sand have the same material absorbency and do they have a low or high absorbency?” Possible student response: all of those soil types have similar material absorbency and the materials’ absorbency is low. If a group tested soil type and used vermiculite, ask students, “Do you know any soils that have a very large material absorbency?” (Vermiculite). If no group worked with this substance, show students the vermiculite and tell them it has a high material absorbency. Tell students, “I want to confirm material absorbency affects the amount of liquid a soil can absorb.” Ask the class, “Which soil, sand, small rocks, or large rocks, has about the same piece size as vermiculite?” Students should reply, “Sand.” Tell the class, “I will now pour 50 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 students, “If you add the maximum amount of water sand and vermiculite can absorb, which of the soils would have the largest weight change and why?” Possible student response: the vermiculite, because it has the largest material absorbency. Then ask students, “Which soil type would be the most likely to have a landslide?” Students should reply, “Vermiculite.” Have students circle the correct answers for question *15*.

Tell students, “We now know 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 *Findings 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.*

An example of this section in the notebook can be seen below.



Possible Factor 2: Soil Type

11. Label the following soil types from least to most absorbent. Label the least absorbent soil as 1 and the most absorbent soil as 3.

2 Small Rocks 1 Large Rocks 3 Sand

12. Piece size affects how much water a soil type can absorb.

13. Sand holds [✓ More] Less water than large rocks making wet sand [✓ Heavier] Lighter than wet large rocks which results in wet sand having [✓ More] Less landslides than wet large rocks.

14. Material absorbency affects how much water a soil type can absorb.

15. Vermiculite holds [✓ More] Less water than sand making wet vermiculite [✓ Heavier] Lighter than wet sand, which results in wet vermiculite having [✓ More] Less landslides than wet sand.

16. Read Finding 3 from the poster.

10

Note: Question *15* is not completely correct. If you put the wet vermiculite and the wet sand on a scale, the wet vermiculite will weigh less than the wet sand. However, the change in mass for the vermiculite will be greater than the change in mass for the sand, because it absorbed more water making it more likely for a landslide.

Other Possible Factors (14 minutes)

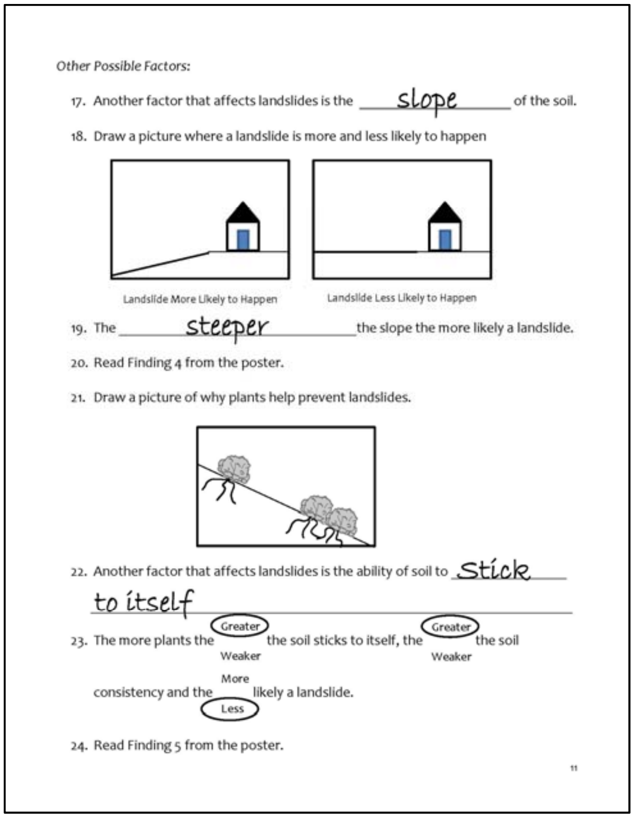
Have the students turn to page 11 of their notebook. Turn the class notebook to page 11. Ask students, "If you were standing on the field at your school, would you be worried about a landslide, why or why not?" Possible student response: I would not be worried because the field is flat and landslides are more likely to occur on sloped surfaces. Have students fill in **slope** for question *17*. 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. Then, have them fill in the blank in question *19* (The **steeper** the slope, the more likely a landslide).

Tell students, "We now know another important variable that affect landslides, the slope. The steeper the slope, the more likely it is to have a landslide." Remove the clips showing finding 4 on the *Findings Poster*.

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

Show students page 10 of the picture packet (below, left). Ask students, "Do the two hills have approximately the same slope?" Students should reply, "Yes." Then, ask students, "Which of the hills is more likely to have a landslide and why?" By the end of the conversation, make sure they understand 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. If students are struggling to understand this, ask students, "When you pull a plant out of the ground do you only get the plant?" Make sure by the end of the conversation students know dirt is usually stuck to the roots when a plant is pulled from the ground, therefore, the roots help hold the soil together.

Picture Packet, Page 10



Other Possible Factors:

17. Another factor that affects landslides is the slope of the soil.
18. Draw a picture where a landslide is more and less likely to happen

19. The steeper the slope the more likely a landslide.
20. Read Finding 4 from the poster.
21. Draw a picture of why plants help prevent landslides.
22. Another factor that affects landslides is the ability of soil to stick to itself
23. The more plants the [✓ Greater] Weaker the soil sticks to itself, the [✓ Greater] Weaker the soil consistency and the More [✓ Less] likely a landslide.
24. Read Finding 5 from the poster.

11

Have students draw in the roots of the plants in question *21*. Tell students, “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 *22*. Ask students, “Do plants affect the soil consistency and why?” Possible student response: plants increase the soil consistency because they hold the soil together. Have students circle the correct answers in question *23*. An example of this section in the notebook is shown above on the right.

Tell students, “We now know another important variable about landslides, the weaker the soil consistency, the more likely a landslide.” Remove the clips showing finding 4 on the *Findings Poster*.

Finding 4: The weaker the soil consistency, the more likely a landslide.

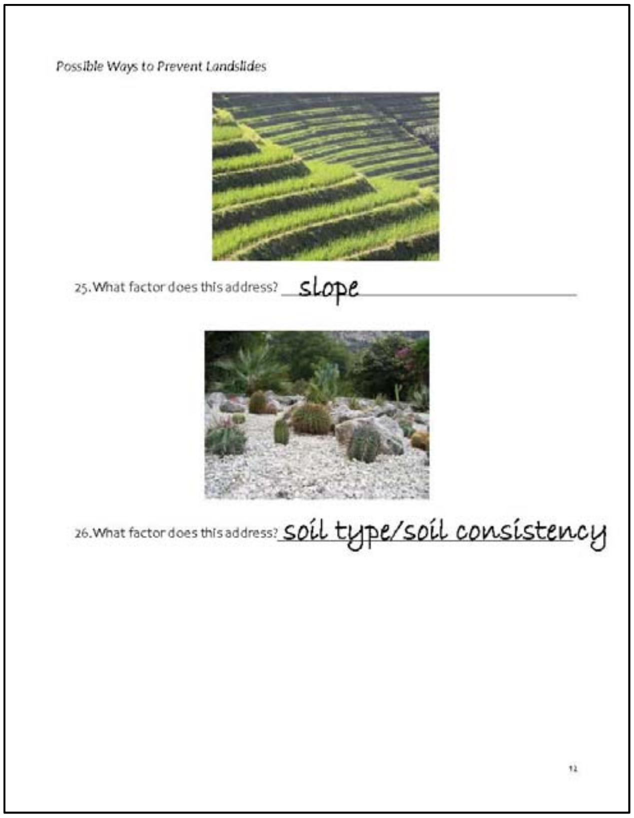
Note: In this section you can relate fires to landslides. If you are in the Santa Barbara area you can talk about the Thomas Fire and the Montecito landslide that happened after. The fire killed all of the plants which was one of the factors that led to the Montecito landslides.

Possible Ways to Prevent Landslides (6 minutes)

Tell students, “I now know water amount, particle size, material absorbency, slope, and soil consistency all affect if a landslide will happen. But are there ways to prevent landsides? One field of science is called engineering, and these types of scientists try to solve problems. One of the problems engineers have tried to solve is how to stop landslides. We are now going to look at two solutions engineers have come up with.”

Have students turn to page 12 of their notebook and put page 11 of the picture packet (below, left) under 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 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, “This idea is called terracing. This means the ground is graded so it is sloped and then flat, making stair like structures in the ground.” Ask students, “Which factor is this method trying to solve?” Students should reply, “Slope.” Have them fill this in for question *25*.


Picture Packet, Page 11


Possible Ways to Prevent Landslides

25. What factor does this address? slope

26. What factor does this address? soil type/soil consistency

Have students look at the bottom picture on page 11 of the picture packet (above, left). Tell students, “This picture shows another idea that engineers came up with. This picture was taken in Santa Barbara.” Ask students, “Does Santa Barbara usually look like this?” Students should reply, “No.” Have them describe the picture, and tell you how this might stop a landslide. By the end of the conversation, make sure students have talked about how replacing potting soil with rocks increases 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 factor is this method trying to solve?” (soil type/soil consistency). Have them fill this in for question *26*.

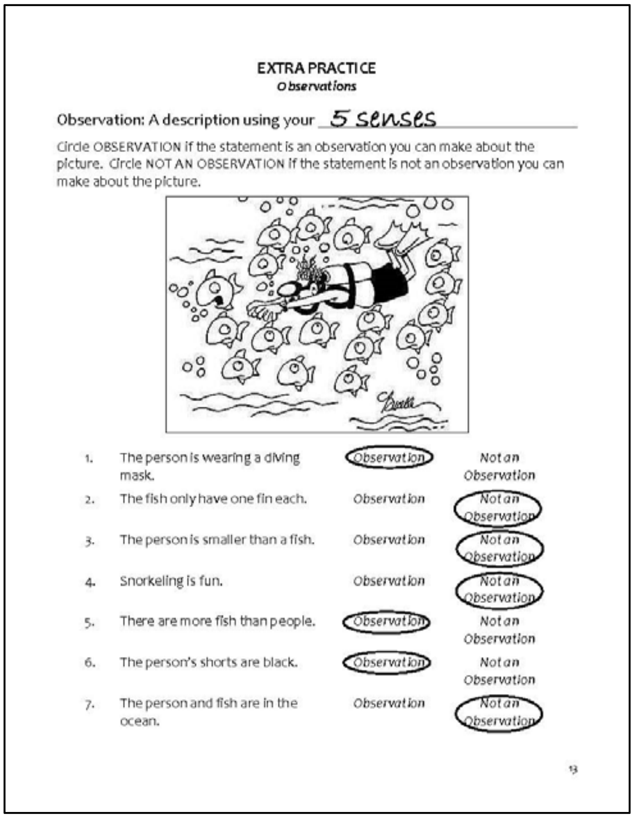
An example of this section in the notebook can be seen above on the right.

Tell students, “You have taught me a lot about landslides and I now know when they are more likely to happen, as well as some ways to try to prevent them. You can keep your SciTrek notebooks, and I have enjoyed working, and learning science with you. I hope you will continue to see yourselves as scientists, and explore the world around you. You will get another opportunity for SciTrek to come to your class and run another long-term investigation with you later in the year, so it is important that you remember what you have learned for your next module.”

Clean-Up:

1. Leave notebooks with students.
2. Place materials into the lead box and bring them back to UCSB.
3. Remove all materials from your lab coat pockets, remove your nametag, unroll your lab coat sleeves, and put your lab coat into the dirty clothes bag at UCSB.

Extra Practice Solutions:



EXTRA PRACTICE

Observations

Observation: A description using your 5 senses

Circle OBSERVATION if the statement is an observation you can make about the picture. Circle NOT AN OBSERVATION if the statement is not an observation you can make about the picture.

1. The person is wearing a diving mask. [✓ *Observation*] *Not an Observation*
2. The fish only have one fin each. *Observation* [✓ *Not an Observation*]
3. The person is smaller than a fish. *Observation* [✓ *Not an Observation*]
4. Snorkeling is fun. *Observation* [✓ *Not an Observation*]
5. There are more fish than people. [✓ *Observation*] *Not an Observation*
6. The person's shorts are black. [✓ *Observation*] *Not an Observation*
7. The person and fish are in the ocean. *Observation* [✓ *Not an Observation*]

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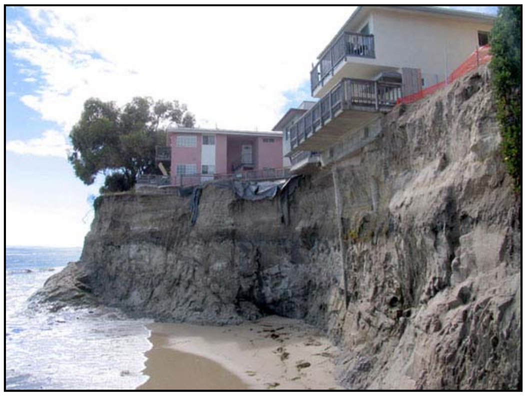
Module Extension

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 shown below, e-mail scitrekelementary@chem.ucsb.edu and these pictures will be sent to you.

Tell students, "We have been focusing on landslides and one of the variables that affects landslides is water. However, landslides are only one of the ways water can change the shape of the land." Ask students, "Can anyone tell me 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 occurs through building levees, walls, or dams to keep water from going in certain areas. Many times, these levees are built so 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 occurs when sea walls are built so 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 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.