

# LandPKS Lesson 2: Data Collection – Teacher Guide

## ***Program Summary***

---

In this three-lesson module, students become part of the LandPKS knowledge-sharing team.

- In lesson 1, students learn about the effects of climate, soil, topography, and plant characteristics on land potential. They receive an introduction to the indicators and how to assess them in the field.
- In lesson 2, students use the LandPKS apps to collect data on a site.
- In lesson 3, students use the LandPKS-generated Land Capability Classifications (LCCs) to learn how scientists, land managers, and city planners use this information. Students then make inferences about their own sites and how they are being utilized. Students use their new knowledge of LCCs to plan a solution to a land management dilemma.

## ***Lesson 2 Summary***

---

Lesson 2 puts the knowledge students gained in the classroom in Lesson 1 into action as they collect data outside. Students work in groups to collect data on soil properties, land cover, and other characteristics of one or more sites in the schoolyard or local area.

## ***Student Age***

---

10 - 18

Note: this lesson is designed to align with standards for 5th grade and middle school students (generally age 10 – 14) as specified in the Next Generation Science Standards. However, the concepts and activities are relevant for older students and adults.

## ***Objective***

---

- Students will collect the data for their sites in preparation for analysis in Lesson 3.

## ***Time***

---

Approximately 60 minutes

## ***Standards***

---

To ensure conformity to the most current research on pedagogical strategies and education standards, these activities are aligned with the Next Generation Science Standards (NGSS), a peer-reviewed, rigorous set of standards that have been adopted by 19 states (representing more than 36% of the students in the United States). This work is applicable internationally and addresses the needs of international partners for student educational materials.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<ul style="list-style-type: none"><li>• Obtaining, Evaluating, and Communicating Information</li><li>• Constructing Explanations and Designing Solutions</li></ul>	<ul style="list-style-type: none"><li>• ESS3.C Human Impacts on Earth Systems</li></ul>	<ul style="list-style-type: none"><li>• Systems and System Models</li><li>• Cause and Effect</li></ul>

## ***Background***

---

In this lesson, students will go outside to collect data on their site(s) using the LandPKS apps. Students will also be introduced to another soil indicator that was not discussed in lesson 1, land cover. Land cover refers to the physical covering of the land. As we develop and transform our landscapes from one condition to another (i.e. from grassland to shrubland, etc.), we alter soils and local ecosystems, increasing the risk of land degradation. Describing the types of land cover and vegetation can give us an idea of how our landscapes resist and recover from disturbances. It can also give us a baseline from which we can track future changes. Landscapes with higher land cover are less susceptible to soil erosion and are generally more resistant to degradation. Awareness of land cover can help us make appropriate land management decisions to limit risk of land degradation.

## ***Materials***

---

- Phones preloaded with LandPKS application (1 per site minimum)

### **Data Collection Outside (numbers below indicate number needed per site):**

- (5) Data collection worksheets
- (4) Meter sticks with marks at 10 cm, 30 cm, 50 cm, 70 cm, and 90 cm (one meter stick for each cardinal direction)
- (4) Meter sticks to use to measure transect data collection points (one meter stick for each cardinal direction) (optional)
- Ruler
- (3) Small buckets labeled 0-1cm, 1-10cm, and 10-20cm
- Trowel
- (4) Task card labeled “Procedure for Vegetation Measurement” (optional)
- (1) Task card labeled “Procedure for Digging the Hole” (optional)

### **Hand Texturing Inside:**

- Soil collected from sites
- Small bottles or cups of water
- Spoons
- Empty bowls or buckets for used soil
- Towel or paper towels to clean workspace (optional)
- Table cloth (optional)

## ***Tips for entire class participation***

---

- The lesson is designed to accommodate up to 36 students.
- Break class into groups of 10 - 12 students per site.
- For each group of students, assign a separate site where the group will dig the hole and collect data. For example, if you have 32 students you will need 3 sites (two sites with 11 students each and one site with 10 students).

## ***Preparation***

---

1. Locate an appropriate area of your schoolyard (or local area) for the land assessment. This requires digging a small hole (no more than 20 cm in depth) and being able to walk transects up to 25 meters in the four cardinal directions. If more than one hole is to be dug, try to space them far enough apart so the transects do not overlap. Note: students will not be using the phones during this lesson, but the locations can be preset now, so that it does not have to be completed later.

2. Once locations are chosen, take the phones to those locations and pre-set the GPS locations in LandPKS. Label them by class and site number if multiple classes are participating.

A) To pre-set a GPS location, first open the application and select the “+” in the upper right-hand corner of the screen (Figure 1). This will bring you to a “New Site” page (Figure 2).

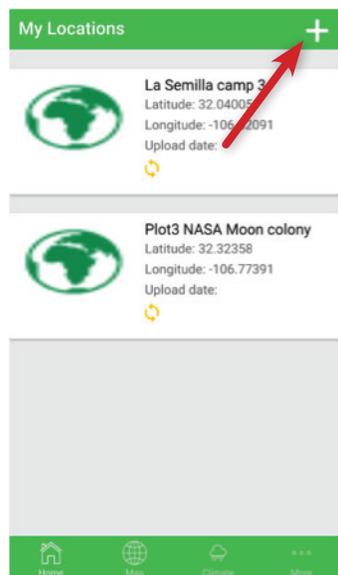


Figure 1. Add a new site by clicking on the “+” in the upper right corner.

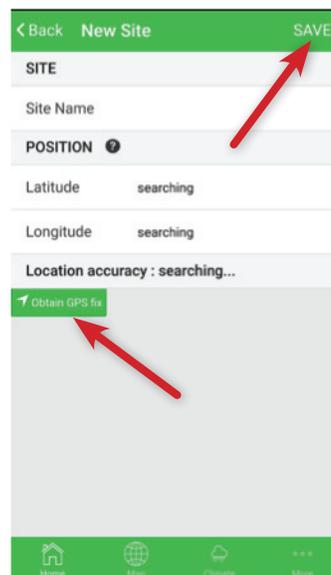


Figure 2. On the “New Site” screen, enter the site name, obtain the GPS coordinates, and save the site.

B) On the New Site page (Figure 2), input a site name in the “Site Name” location and obtain a GPS location. The application will automatically search for latitude and longitude coordinates, but if it is being slow or unresponsive, click on the green, “Obtain GPS Fix” on the lower left side of the screen. If the application is still unable to obtain a GPS coordinate, coordinates can be input later using GoogleMaps or similar apps. Finally, press the save button in the upper right corner to save the site.

## Teaching Guide

### 1. Introduction (10 minutes)

*See notes for optional Data Collection Day PowerPoint Presentation at the end of this section.*

- Students will play the role of land managers for your school. In lesson #1, we learned why soil indicators are important and how to use the apps. Today, we use the LandPKS apps to collect data about our schoolyard. Then, using the data, we will make potential management decisions.
- We will collect data on the soil and the vegetation cover around each site to look at what all of the information above and below ground can tell us about the health of that site for its potential use in the future.
- Inform students that they will be going outside to collect data about their schoolyard.
  - Give the class a brief overview of each group role.
    1. **Sub-group 1 (2 - 4 students) Soil sample takers** – Students will dig a small hole, collecting soil at 3 different depths for soil texturing.
    2. **Sub-groups 2 - 5 (2 students each) Land cover** – Students break into pairs, and each pair walks a transect line in one of the four cardinal directions (north, south, east, west), recording land cover.
    3. **All groups** – While still in their groups, students observe slope, land use, and soil limitations of their location in the schoolyard. Each group records their observations

and then comes to a class consensus.

#### 4. Directions for worksheet

- a) Outside, each of the transect groups will complete their worksheet for their cardinal direction (page 4).
- b) After transect groups and soil sample groups are done, they will work together as a group to collect data on the Land Use, Land Slope, and Soil Limitations of the site (page 3).
- c) Inside, the soil samples from a site are split among the whole group. Students will fill in the worksheet for the layer of soil that they textured (pages 1 or 2) then share their data with the rest of the group. Every worksheet should have the textures for the three soil layers filled in.

## 2. Collecting Data Outside (30 minutes)

Take students outside to their assigned site and have them collect data using the instructions below.

- **Sub-Group 1: Soil sample hole digging** – Students dig a small hole (20 cm deep) and collect soil samples from different depths: 0-1 cm, 1-10 cm, and 10-20 cm.
  1. Place buckets next to the area you have been assigned.
  2. Clear away any debris or gravel from the surface of the soil pit and set aside this material in the first bucket.
  3. Use trowel to loosen the top 0-1 cm of soil.
  4. Have one student use a ruler to measure the depth of the hole. This requires the student to look at the ruler at ground level.
  5. Once 1 cm depth is reached, use a trowel to scoop up loose soil and put it into the second bucket. \*Note: be sure to remind students to gather enough soil from each layer so that multiple students can hand texture the soil to improve accuracy.
  6. Next, use the trowel to loosen soil from 1-10 cm below the surface.
  7. Have one student use a ruler to measure the depth of the hole. This requires the student to look at the ruler at ground level.
  8. Use the trowel to scoop up loose soil and put it into the third bucket.
  9. Repeat this process with the soil 10-20 cm below the surface.
- **Sub-Groups 2 - 5: Land cover along transects** – Students walk along four 25-meter transects collecting land cover data. Break students into 4 pairs, with each pair assigned one of the four cardinal directions. Use the sun, a magnetic compass, or the compass in the Photos section of the LandPKS LandInfo app to determine the direction of your first transect. Model the procedure below to all students before they collect data on their sites (this can be done in the classroom before going outside or at the site).

1. Place the meter stick at the edge of the soil sample hole. Lay meter stick perpendicular to the hole, pointing in one of the cardinal directions (see Figure 3).
2. Mark the end of the meter stick on the ground and move the meter stick out from the hole to measure the next meter (see Figure 4).
3. Repeat step 2 until you reach the 5-meter mark.
4. At the 5-meter mark, students lay down the second meter stick perpendicular to the distance meter stick (see Figure 5).

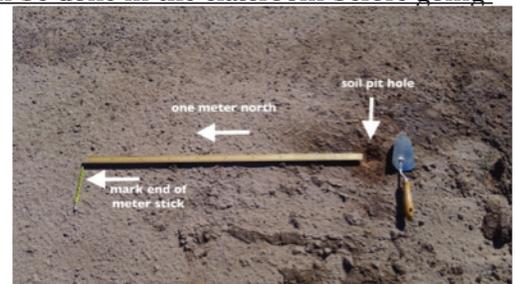


Figure 3. Lay the meter stick perpendicular to the soil pit hole lining up in one of the cardinal directions.

5. Observe the land cover at the 10 cm, 30 cm, 50 cm, 70 cm, and 90 cm markings on the second meter stick with a pin flag (or pencil). Record data on the student worksheet (see Figure 6).
6. Continue this procedure for a total of 25 meters, stopping every 5 meters to record land cover at designated centimeters on the student worksheet.

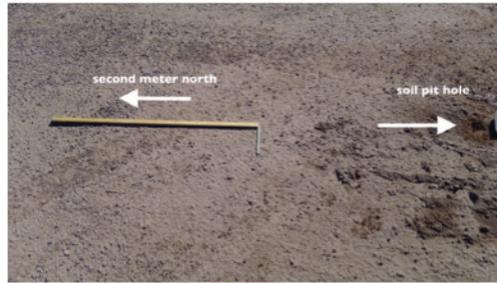


Figure 4. Mark the end of your meter stick and measure meter #2 away from the hole.



Figure 5. Every 5 meters, lay down a second meter stick perpendicular to the distance meter stick.



Figure 6. Using a pin flag (or pencil), observe the land cover at 10cm, 30cm, 50cm, 70cm, and 90cm by placing the pin flag on the ground next to the meter stick and record what is touching the pin flag at that point on the student worksheet.

- **All Groups: Land slope/land use/limitations/salt on surface/surface stoniness** – After each group has completed their soil collecting or land cover data collection, they will work together to survey their assigned location and complete page 3 the student worksheet. Back in the classroom, students will share their group information to come to a class consensus.
  - Procedure - Students stand with their group at the southern end of the southward transect and face north. As they look across their assigned location, they decide on the best description of the site for the five indicators that were covered in Lesson 1 (surface stoniness, salt on surface, land use, slope, slope shape, and land cover), recording data on their worksheets. Back in the classroom, this data will be discussed and agreed upon as a class before entering into the LandPKS app. If time is an issue, have students take a picture of their site with their phone from the end of their southward transect and fill in their worksheet back in the classroom or at the beginning of lesson 3.

### 3. In-Class Hand Texturing Data (20 minutes)

- Back in the classroom, students hand texture the soil that was collected from the site(s) outside. The procedure for soil texturing is the same as it was in Lesson 1:
  1. Place two teaspoons of soil from the appropriate depth in your palm.
  2. Slowly add water until the soil is moldable. Roll the soil into a ball with your hands, and answer question 1 on your worksheet.
  3. Place the ball of soil between your thumb and forefinger. Gently push the soil with your thumb, squeezing it upward into a ribbon.
  4. Allow the ribbon to extend over your forefinger until it breaks from its own weight. Answer question 2 on your worksheet.
  5. If it forms a ribbon, measure the length of the ribbon and answer question 3.
  6. Pinch some soil between your thumb and forefinger and answer question 4, 5, or 6 about how the soil feels.
  7. Finally, your answer to 7 is your soil type.
  8. Repeat process above for soil from 1 - 10 and soil from 10 - 20 cm.

- Each group will sit together near the other groups from their designated sample hole. The soil samples can be split among group members. Each layer of soil must have someone recording the texture data.
- Students need to fill in the section of their worksheet for the layer of soil they are testing and then share their texture data with others in the group until all five worksheets for the site have the texture data answered for the three soil layers.
- Have students fill in page 3 of their worksheets if it was not done outside.
- Give a brief description of lesson 3.

## Day 2 – Data Collection Day PowerPoint Presentation (optional)

*This PowerPoint presentation begins where the Day 1 presentation left off.*

### Introduction

- (Slide 19) In lesson #1, we learned why soil indicators are important and how to use the apps. Today, we use the LandPKS apps to collect data about our schoolyard. On Day 3, using the data, we will make potential management decisions.
  - We will collect data on the soil and the vegetation cover around each site to look at what all of the information above and below ground can tell us about the health of that site for its potential use in the future.
  - (Slide 20) Remind students that soil is made up of small particles that vary in size (draw the figure at right on the board if projector is unavailable). The largest particles are called sand, the medium sized particles are called silt, and the smallest sized particles are called clay. The combination of these different-sized particles helps us determine the soil texture. Soil texture tells us important information about the soil such as how fast water will move through the soil and how much water the soil holds for plants.
- 
- Model of how water moves through different soil particles.
- (Slide 21) We are collecting data on the soil texture at multiple depths because plant roots can penetrate deep into the soil. Figure A shows how roots can spread through multiple soil layers.
  - The soil texture often changes as you move deeper underground due to variations in the soil particle weathering and historical use of a landscape. Figure B shows examples of soil from two different ecosystems. The redder soil on the left is older and from a coastal upland region that has been used for agriculture for the last few centuries. The browner soil on the right is younger and from a forested area in a mountainous region, so the rocky substratum is closer to the surface of the soil. Have students describe some visual differences they can see within the two soil profiles.
  - (Slide 22) We will also be measuring the percent of land cover because if we can describe the types of land cover and vegetation, it can give us an idea of how our landscapes resist and recover from disturbances. Landscapes with higher land cover are less susceptible to soil erosion and are generally more resistant to degradation. Awareness of land cover can help us make appropriate land management decisions to limit risk of land degradation. It can also give us a baseline from which we can track future changes.
  - (Slide 23) Give a brief description of how Day 3 will use the data collected on Data Collection Day.
  - Inform students that they will be going outside to collect data about their schoolyard.
    - Give the class a brief overview of each group role.
    - Continue the rest of the lesson using the outline above starting with the description of the group roles in the top introduction.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Site Number: \_\_\_\_\_

## Soil Sample Hole & Soil Texture

### **Depth of 1 cm**

1. Does the soil form a ball?

- Yes (proceed to #2)       No - This is sand.

2. Does the soil form ribbon?

- Yes (proceed to #3)       No - This is loamy sand.

3. What is the length of the ribbon?

- <2.5 cm (proceed to #4)  
 2.5 - 5 cm (proceed to #5)  
 >5 cm (proceed to #6)

4. How does the soil feel?

- Gritty - This is sandy loam  
 Not gritty or smooth - This is loam  
 Smooth - This is silt loam



5. How does the soil feel?

- Gritty - This is sandy clay loam  
 Not gritty or smooth - This is clay loam  
 Smooth - This is silty clay loam

6. How does the soil feel?

- Gritty - This is sandy clay  
 Not gritty or smooth - This is clay  
 Smooth - This is silty clay

7. What is the texture of your soil? (for example, sand, clay loam, etc.) \_\_\_\_\_

Soil texture affects how much water the soil holds. Sand holds the least water and clay holds the most.

## Soil Sample Hole & Soil Texture

### Depth of 2-10 cm

1. Does the soil form a ball?

Yes (proceed to #2)

No - This is sand.

2. Does the soil form ribbon?

Yes (proceed to #3)

No - This is loamy sand.

3. What is the length of the ribbon?

<2.5 cm (proceed to #4)

2.5 - 5 cm (proceed to #5)

>5 cm (proceed to #6)

4. How does the soil feel?

Gritty - This is sandy loam

Not gritty or smooth - This is loam

Smooth - This is silt loam

5. How does the soil feel?

Gritty - This is sandy clay loam

Not gritty or smooth - This is clay loam

Smooth - This is silty clay loam

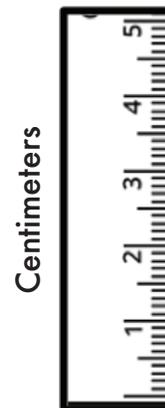
6. How does the soil feel?

Gritty - This is sandy clay

Not gritty or smooth - This is clay

Smooth - This is silty clay

7. What is the texture of your soil? (for example, sand, clay loam, etc.) \_\_\_\_\_



Soil texture affects how much water the soil holds. Sand holds the least water and clay holds the most.

## Soil Sample Hole & Soil Texture

### Depth of 10-20 cm

1. Does the soil form a ball?

Yes (proceed to #2)

No - This is sand.

2. Does the soil form ribbon?

Yes (proceed to #3)

No - This is loamy sand.

3. What is the length of the ribbon?

<2.5 cm (proceed to #4)

2.5 - 5 cm (proceed to #5)

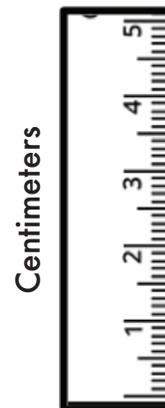
> 5 cm (proceed to #6)

4. How does the soil feel?

Gritty - This is sandy loam

Not gritty or smooth - This is loam

Smooth - This is silt loam



5. How does the soil feel?

Gritty - This is sandy clay loam

Not gritty or smooth - This is clay loam

Smooth - This is silty clay loam

6. How does the soil feel?

Gritty - This is sandy clay

Not gritty or smooth - This is clay

Smooth - This is silty clay

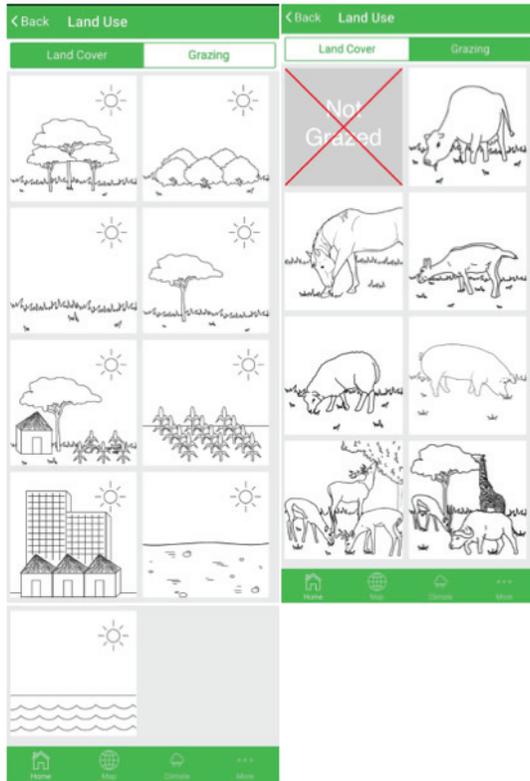
7. What is the texture of your soil? (for example, sand, clay loam, etc.) \_\_\_\_\_

Soil texture affects how much water the soil holds. Sand holds the least water and clay holds the most.

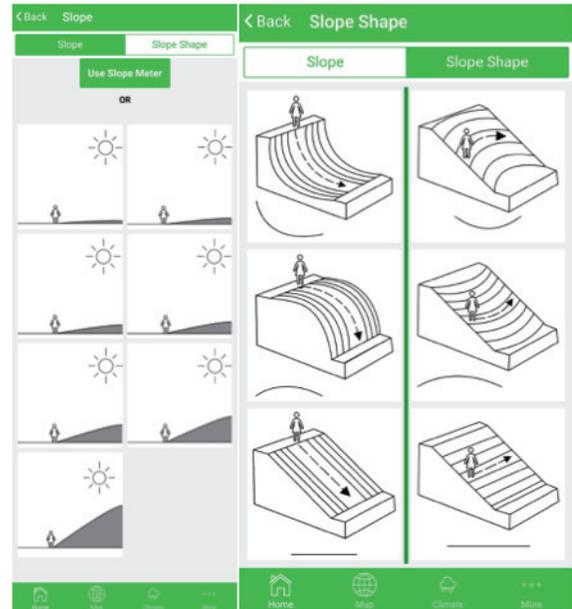
# LandPKS Lesson 2: Data Collection | Student Worksheet, Pg. 4

**Directions:** Stand with your group at the southern end of the southward transect and face north. As a group, look across your assigned site and decide on and record land use, land slope, and soil limitations below. Circle the icon on each app screen that best describes your plot.

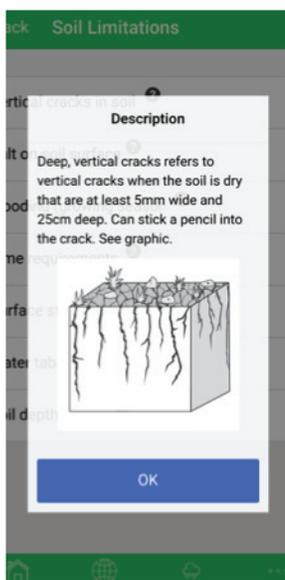
## Land Use



## Land Slope

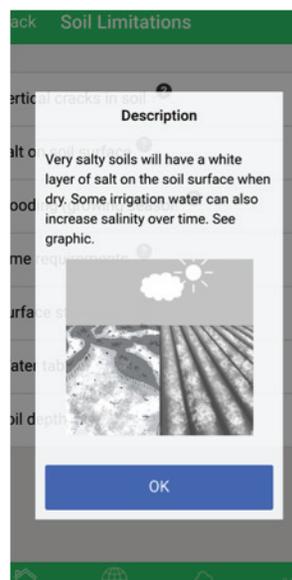


### Soil Limitations – Vertical Cracks



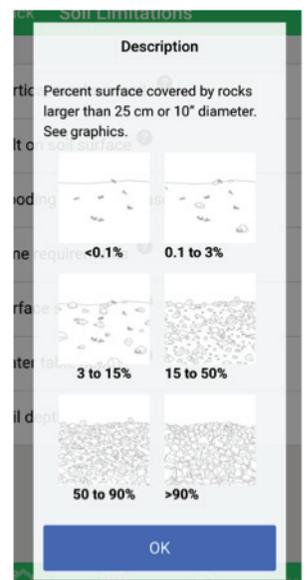
- No cracking
- Surface cracking only
- Deep, vertical cracks

### Soil Limitations – Salt on Soil Surface



- No salt
- Small, temporary patches
- Yes, most of the surface

### Soil Limitations – Surface Stoniness



My transect direction  
(circle one):

**North**

**South**

**East**

**West**

5 meters

10 meters

15 meters

20 meters

25 meters

## Task Card

# Procedure for Digging the Hole



1. Place buckets next to the area you have been assigned.
2. Clear away any debris or gravel from the surface of the soil pit and set aside this material in the first bucket.
3. Use the trowel to loosen the top 0-1 cm of soil.
4. Have one student use a ruler to measure the depth of the hole. This will require the student to look at the ruler at ground level.
5. Once 1 cm depth is reached, use the trowel to scoop up the loose soil and put it the second bucket.
6. Next, use the trowel to loosen soil from 1-10 cm below the surface.
7. Have one student use a ruler to measure the depth of the hole. This will require the student to look at the ruler at ground level.
8. Use the trowel to scoop up the loose soil and put it into the third bucket.
9. Repeat this process with the soil 10-20 cm below the surface.



## Task Card

# Procedure for Vegetation Measurement



1. Place the meter stick at the edge of the soil sample hole. Lay meter stick perpendicular to the hole pointing in one of the cardinal directions (Figure 1).
2. Mark the end of the meter stick on the ground and move the meter stick away from the hole to measure the next meter (Figure 2).
3. Repeat #2 until you reach the 5-meter mark.
4. After the 5-meter mark, students lay down the second meter stick perpendicular to the distance meter stick (Figure 3).
5. Observe the land cover at the 10 cm, 30 cm, 50 cm, 70 cm, and 90 cm markings on the second meter stick with a pin flag (or pencil) and record data on the student worksheet (Figure 4).
6. Continue this procedure for a total of 25 meters, stopping every 5 meters to record land cover at designated centimeters on the student worksheet.

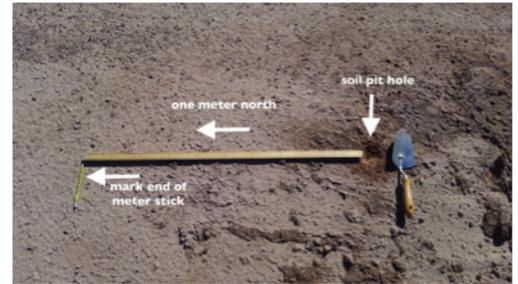


Figure 1. Lay your meter stick next to the soil pit hole and have it point away from the hole in your assigned cardinal direction.

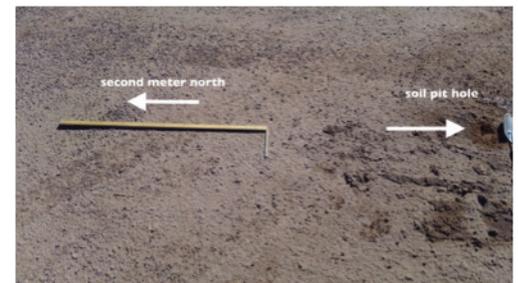


Figure 2. Mark the end of your meter stick and measure meter #2 away from the hole. Repeat until you reach 5 meters.



Figure 3. (Left) Lay the second meter stick perpendicular to the meter stick measuring distance.

Figure 4. (Right) Using a pin flag (or pencil), observe the land cover at 10cm, 30cm, 50cm, 70cm, and 90cm by placing the pin flag on the ground next to the meter stick and record what is touching the pin flag at that point on the student worksheet.