

Accompanying Worksheet: Soil Moisture W-S-06

Objective: Students will soil take samples from the field, and compare masses of wet and dry soil. Students will calculate the amount of water in the soil, and use rudimentary statistics to determine if the amount of water is significant.

Considerations:

1. This protocol involves minimal field work in that samples are collected and returned to the lab for further investigation. Thus, we recommend pairing it with another activity (such as Soil Temperature, Soil Bulk Density or Soil Characterization), to give students a broader field experience.
2. The samples taken in the Soil Bulk Density protocol can be used for this activity. Thus, they work well when performed concurrently.
3. This study can be longitudinal in time or all the samples can be collected at once; choose which works best for your situation. A longitudinal approach would allow comparisons across different seasons, but may be inconvenient for your schedule.
4. This protocol outlines two separate sampling methods: transect and depth. Choose which works best for your site and your questions. If there are large amounts of roots or rocks that would make deep digging difficult, you may wish to choose the transect. Also, the transect may be optimal if you would like to study the runoff of a slope, taking samples at measured distances from the bottom of the slope. Conversely, depth studies best illustrate the holding power of soil, especially in marshy or loamy environs.

Materials:

In the Field:

- ___ Worksheet W-S-06
- ___ Trowels
- ___ Meter sticks/rulers/tape measures
- ___ Sealable water-tight containers (one per sample)
- ___ Permanent marker
- ___ (optional: rope, surveyor's flags, spray paint)

In the Lab/Classroom:

- ___ Worksheet W-S-06
- ___ Microwave
- ___ Balance or scale with 0.1 g sensitivity and at least 400 g capacity

Instructions:

- 1. Selecting your site:** if you plan to repeat this process throughout the year, we suggest choosing a site located near to or on your school grounds. Check with school groundskeeper for locations that would cause minimal disturbance and are safe for digging.
- 2. Before leaving the lab:** individually mark and weigh all soil containers and record their weight on the worksheet. Alternatively, if you forget this step in the beginning, you may weigh them at the end after they have been thoroughly washed and dried.
- 3. Taking the samples:**
 - a. Depth:**
 - i.** Use the trowels to scrape off the top layer of debris to expose fresh soil. Also remove any vegetation.
 - ii.** Use the trowel to scoop about 100 g of soil into a container. Be sure to label the container with the site name and depth. Remove all visible organisms and pebbles. Seal the container tightly to prevent water loss. This is your 0-5cm sample.
 - iii.** Use the trowel to dig deeper, removing all soil to an area OUTSIDE the sample hole, to prevent soil from the top reaching samples lower down.
 - iv.** Use the meter stick to measure your hole. When you have reached 10 cm, take another sample and place it in the container.
 - v.** Repeat for 20 cm, 30 cm, 40 cm and 50 cm. Because of the primitive nature of taking samples with trowels (as opposed to an auger, which are cumbersome and not ideal for school projects), you may be unable to dig further due to soil collapse. If, however, you are willing and able, you can take samples in 10 or 20 cm increments up to 1 m.
 - b. Transect:**
 - i.** Using the rope, spray-paint, or surveyors flags to mark the transect of study. It should be about 50 meters long. To add scientific merit, we suggest that the transect begin at an area of some interest that could potentially affect soil moisture, such as the bottom of a slope, the bank of a river, or a marked change in vegetation.
 - ii.** Mark sites every 5 m along the transect. These will be your sample sites. If you are intending to return
 - iii.** At each site, scrape off the top layer of debris and remove any vegetation.
 - iv.** Using the trowel, dig down to 5 cm, and take a 100 g sample (about palm-sized). Remove any organisms and visible pebbles, and place the sample in the container. Seal the container tightly to prevent water loss. Label the container with the sample ID.
 - v.** Repeat with each sample site along the transect. You should end with 11 samples, assuming you included both endpoints.
- 4.** Return the samples to the lab. Weigh the samples (in their containers) and record the result on the worksheet.
- 5. Drying the samples:**
 - a.** Place the samples in the microwave for 3 minutes on the defrost setting. Take the sample out and weigh it.
 - b.** For the best data, you will want to ensure that the soil is as dry as possible. To do this objectively, weigh the sample after the initial drying in the microwave, then microwave it again for 1 minute, and weigh again. Repeat this until you get consistent results for at least 3 iterations.
 - c.** If you do not have a microwave, open the top of the sample and leave it out (preferably on a windowsill) for at least 2 days. Use your best judgment as to when the soil is dry enough to weigh.

6. Use the accompanying worksheet to evaluate your data.
 - a. We have provided resources for students to enter their data into a website and perform and interpret a rudimentary paired t-test of their two groups (dry and wet). You may wish to go into more or less depth concerning the statistics involved.
 - b. Students will also graph their data to form a visual representation.
7. Based on the results, you may want to give your students a larger research project on the implications. You may wish to have them study what sorts of vegetation would flourish in the soil they sampled, or perhaps what sort of use would be optimal for the land (this last one works particularly well when combined with the Soil Characterization protocol—you could conceive a project with geotechnical engineering implications involving the building of structures: How much could the soil support given its water content and properties?)

Adapted from GLOBE Soil Moisture Protocol:
<http://www.globe.gov/documents/352961/353769/grav.pdf>

Visit www.flagstaffscies.org for more information and field worksheets!