GLOBE
Soil Bulk Density
Data Sheets

Print the Bulk Density Data Sheet:

- Bulk Density Data Sheet (2 pages)
  - The data sheet has space to record bulk density for one soil horizon. Print out a copy for each horizon you are sampling.
  - **Data Entry Note:** You will need to add information about each horizon you are sampling before entering your bulk density data, from the "Create/Edit My Sites" button. For complete site definition, see the Soil Characterization protocol.

Or print the Bulk Density Data Sheet with the field guide incorporated:

- Bulk Density with field guide (3 pages)
  - This option has space to record data for one sample. Print out multiple copies of the "In the Lab" procedure or print out the Bulk Density Data Sheet (linked above) to record data for other samples.

GLOBE Bulk Density Data Sheet (page 1)

Name: _____ Site Name: _____

Date: _____ Time (local): _____

Date of soil collection: _____

Bulk Density Measurements

Horizon #: _____ Top depth : _____ cm Bottom depth: _____ cm	**Sample Number**		
	1	**2**	**3**
Container #			
A. Wet mass of soil and container (g)			
B. Dry mass of soil and container (g)			
C. Container mass (g)			
D. Mass of dry soil (g) = B - C			
E. Mass of rocks (g)			
F. Container volume* (mL)			
G. Volume of water without rocks (mL)			
H. Volume of water with rocks (mL)			
I. Volume of rocks (mL) = H - G			
Bulk Density (g/mL) = $\frac{\textbf{D - E}}{\textbf{F - I}}$			

*Container volume equations are on page 2.

GLOBE Bulk Density Data Sheet (page 2)

Horizon #: _____

Container Volume Measurements: Can

Sample	Initial Volume (mL, V_i)	Final Volume (mL, V_f)	Container Volume* (mL, V_i-V_f)
1			
2			
3			

Container Volume Measurements: Pipe

Sample	h = height of pipe (cm)	r = radius of pipe (cm)	Container Volume* (mL)
1			
2			
3			

* **Pipe Container Volume** = $Pi \times r^2 \times h \times (1mL/1cm^3)$

Comments:

GLOBE Bulk Density Data Sheet and Field Guide (page 1)

Name: _____ Site Name: _____

Date: _____ Time (local): _____

Date of soil collection: _____

Bulk Density Measurements: In the Field

1. Record the soil horizon from which the sample came from. **Horizon # : _____**
2. Record the horizon depths. **Top: _____ cm Bottom: _____ cm**
3. For each horizon in your soil profile, push a can or pipe into the side of the horizon. Stop when soil pokes through the small hole in the bottom of the can or has reached the edge of the pipe.
   - If necessary, wet the soil first to ease the can into the soil.
   - If it is difficult to push the can into the soil, place a piece of wood over the can and hit the wood with a hammer. If the sides of a can bend beyond perpendicular, discard that can and use another.
4. Using a trowel or shovel, dig around the can or pipe to remove it and the surrounding soil. Trim the soil from the top and edges of the can (and bottom for a pipe) so that the volume of the soil is the same as the volume of the can or pipe.
5. Cover the can with its lid and label with a container number. If using a pipe, label it with a container number and place the pipe in a plastic bag.
6. Repeat this procedure so that you have three bulk density samples for each horizon in your profile.

If you do not have a soil pit or exposed soil profile:

1. Choose three locations close to the site where you performed the Soil Characterization Protocol. Remove vegetation and other material from the soil surface.
2. At each of the three locations, push a can or pipe into the surface of the soil. If necessary, wet the soil first to ease the can into the soil.
3. Stop when soil pokes through the small hole in the bottom of the can or has reached the edge of the pipe, so that the pipe is full of soil.

GLOBE Bulk Density Data Sheet and Field Guide (page 2)

Bulk Density Measurements: In the Lab

1. Calibrate the balance to 0.1 g.

2. Remove the lid off the sample can and measure the mass of the sample in its can (wet mass). If you used a pipe, remove the pipe from the plastic bag; measure the mass of the sample and the pipe.

Wet mass of soil and container: _____ g

1. Dry the samples using one of the following options: a 250-watt heating lamp (dries in about 2–3 days), a drying oven (dries overnight), or air drying (dries in 2–5 days)
2. Determine when the sample is dry by weighing it, drying for a few more hours or another day, and then weighing it again. When the mass of the sample does not change, it can be considered dry.

3. After the soil has dried, determine the mass of the soil and its container again (dry mass).

Dry mass of soil and container: _____ g

6. Place a sieve on a paper plate or large piece of paper and pour the sample onto the sieve.

7. Wipe the inside of the can or pipe. Measure the mass of the can or pipe without the lid.

Container mass : _____ g

8. Calculate the mass of the dry soil.

Mass of dry soil = _____ g - _____ g = _____ g
Dry mass *Container mass*

9. Measure the volume of the clean, dry **can**:
    1. Fill a graduated cylinder with water and record the initial volume below. Be sure to record the volume from the bottom of the meniscus.
    2. Pour the water into the can until it fills the can to the brim.
    3. Record the volume of water left in the graduated cylinder as the final volume.

Can Container Volume = _____ mL - _____ mL= _____ mL
Initial volume *final volume*

10. Calculate the volume of the clean, dry **pipe** using the equation below where r = radius of the pipe and h = height of the pipe.

Pipe Container Volume = Pi x r^2 x h x (1mL/1cm^3) = _____ mL

GLOBE Bulk Density Data Sheet and Field Guide (page 3)

Bulk Density Measurements: In the Lab, continued

11. Put on gloves to avoid contaminating your sample and pick up the sieve full of soil.

12. Carefully push the dried soil material through the mesh onto the paper plate. Be careful not to bend the wire mesh by forcing the soil through. Rocks will stay on top of the sieve. If no sieve is available, carefully remove the rocks by hand. Save the sieved soil for other analyses.

13. If rocks are present, use the following procedure to determine the mass and volume of the rocks.

    1. Measure the mass of the rocks.

    Mass of rocks: _____ g

    2. Place 30 mL of water in a 100 mL graduated cylinder. This is the Volume of Water without Rocks (mL).

    3. Gently place the rocks in the water. Read the level of the water after all the rocks have been added and record this volume.

    Volume of water with rocks: _____ mL

    ➢ As you add the rocks, if the volume of water and rocks in the cylinder comes close to 100 mL, record the increase in volume, empty the cylinder and repeat the procedure for the remaining rocks. In this case, you must record the sum of the water volumes with the rocks and the sum of the water volumes without the rocks. If you have sticks or other organic debris, substitute alcohol for water, and follow the same procedure.

    4. Find the volume of the rocks.

Volume of rocks = _____ mL - 30 mL = _____ mL
Volume water with rocks *Volume water without rocks*

14. Transfer the rock-free soil from the paper plate to a clean dry plastic bag or container. Seal the container, and label with horizon number, top and bottom depth, date, site name, and site location. Store in a safe, dry place to be used for other analysis.

15. Calculate Bulk Density.

$$\textbf{Bulk Density} = \frac{\textit{Mass of dry soil (g)} - \textit{Mass of rocks (g)}}{\textit{Container volume (mL)} - \textit{Volume of rocks (mL)}} = \_\_\_\_\_ \text{ g/mL}$$

16. Repeat steps 1–14 for all other samples and record on the data table.

