

Soil Glue

Main Concept

Surface soil particles are held together by organic proteins (glomalin/soil glue) into larger pieces called soil aggregates. The gluing of soil particles together into aggregates helps maintain holes in the soil for air and water to enter and move through the soil. In addition, the soil aggregates are harder to wash away than individual soil particles during rain storms.

EDUCATIONAL GOALS

- Demonstrate that less-disturbed soils contain more “soil glue” and are held together better than more disturbed soils.
- Demonstrate why it is important to protect soils from disturbance.
- Provide examples of cases where soils must be disturbed and further investigations regarding actions that can be taken to protect soils when they are disturbed.

This demonstration is suitable for kindergarten through college. The student activity is suitable for 5th - 8th grade.

Materials & Preparation

2 Wide-mouthed glass jars

2 Pieces of 1/4-inch wire mesh about 1 1/2 x 6 inches

2 Lumps of soil, each about the size of an egg, from the top two inches of two different areas. Some examples of areas are:

- a lawn
- a construction site
- a farmers field that has been plowed (disturbed)
- a farmers field that has not been disturbed for several years (No-Till)
- an orchard
- a pasture
- a forest
- a worn down path

Background Information

Certain fungi create “glomalin”. Glomalin is a form of natural glue that binds soil particles together. When soil is not disturbed, the soil biology increases both in the amount of life in the soil as well as the variety of species. Fungi in particular make proteins that ooze into the soil and help glue soil particles together. When the soil is heavily cultivated (tilled) or disturbed during construction, the surface layer called topsoil is often buried, drastically changed, or removed. Live creatures are killed. Oxygen gets into the soil and provides energy for decomposers to convert the dead organic matter to energy, carbon dioxide, and water. This reduces the amount of organic matter in the soil and the amount of glue available to hold soil together. When the soil is not disturbed, more animals, plants, fungi, and microorganisms thrive in the soil. The amount of glomalin (soil glue) increases and the soil holds together better.

Explanation

Soil from the surface layer of a lawn, an orchard, or a field that has not been tilled for a couple of years will hold together and stay in the basket. Often the soil will hold together so well that the water will evaporate before the soil falls apart. If any of the soil does fall through the screen, it generally will be in the form of soil aggregates and the water will remain clear instead of becoming cloudy.

Soil from a continuously tilled field, a construction site, or from several inches below the surface will generally fall apart (disperse) into individual soil particles. The soil will make the water cloudy and when it settles it will form a layer of mud on the bottom of the jar.

Two additional special cases exist. If the soil is chemically held together it may not fall apart during

this test. Sometimes soils with a high clay content are bound together chemically.

A second exception is exhibited by the thick, dark soils from Illinois. The mineral particles of these soils are held together by organic matter that was created decades or centuries ago. That organic matter is called recalcitrant (resistant to decomposition) organic matter. If these soils are cultivated, the soil clods will fall apart very fast as sand sized aggregates settle to the bottom of the jar. The water will remain clear after the sand sized aggregates settle to the bottom of the jar. Examples of cases where soils must be disturbed include cultivation of root and tuber crops like potatoes and peanuts and the building of roads and houses. Planting cover crops and covering disturbed soils with mulch provides protection from raindrops and food for glomalin producing organisms.



Healthy soils are held together by soil glue (glomalin)

Answers to Student Handout

1. Answers will vary. If the samples were taken from an area that was less disturbed than another, there should be a visual difference in how easily the lumps of soil fall apart.
2. Answers will vary. A soil sample from a less disturbed site should stick together better.
3. Answers will vary. A soil that is both disturbed and contains more silt and clay will generally result in cloudy water that will take a while to clear.
4. The less disturbed the soil, the clearer the water, and the more stable the soil will be. That soil will have more pores in it because the particles did not fall apart and fill all of the holes.
5. The soil that holds together the best is the soil that can resist erosion the best.

Further Investigations

Compare samples from the same soil at different depths.

Compare samples from the same general area at the same depth to see how similarly they act.

Compare samples from the same area before and after disturbance (before and after tilling).

Compare moist samples to samples that have been dried. Does drying affect the results?



Crumbly soils have more holes than cloddy ones

Name: _____

Student Procedures:

1. Ask your teacher about the source of the soil samples and record the information here.

What type of soil is in the wire basket?	
Jar 1	Jar 2

2. Shape the screen rack so that it creates a basket that sits below the rim of the wide mouthed jar by about 1 1/2 inches.
3. Fill each wide mouthed bottle with water to within 1/2 inch of the rim.
4. Place a clod of soil onto the wire rack and lower it gently into the water.
5. Watch the results and record your observations.

Observations after the soil was placed in water	
Jar 1	Jar 2

Questions:

1. Did both soil samples react the same way? (Did the soil stay together or fall apart?)

2. Was the water clearer in one jar than the other?

3. If the water became cloudy, did it become clear again? How long did it take to become clear again?

4. Which soil would have more pores in it after a rain storm?

5. Which soil is more apt to resist erosion during a rain storm?



Healthy soils are glued together by glomalin. Soil with less life fall apart and form a layer of mud in the jar.