USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Soil Glue

Soil Quality Fact Sheet

Main Concept

Surface soil particles are held together by various organic substances. For example, glomalin, a protein produced by fungi, acts as a "soil glue" to create stable soil aggregates. The gluing of soil particles together into aggregates helps maintain pores and channels in the soil for air and water to enter and move through it. Soil aggregates are more stable and 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, when soils of the same type are compared.
- Demonstrate why it is important to protect soils from disturbance.
- Provide examples of situations where soils must be disturbed along with further investigation into actions that can be taken to protect soils when they are disturbed.

Background

Soil organisms increase in abundance and in the variety of species represented when soil is not disturbed. Fungi in particular make proteins, such as glomalin, that ooze into the soil and help glue soil particles together.

When soil is heavily cultivated (tilled) or disturbed during construction, the surface layer (topsoil) is often drastically changed, buried, or removed. Change takes place when oxygen gets into the soil and provides energy for decomposers to convert dead organic matter to energy, carbon dioxide, and water. This reduces the amount of organic matter in the soil and the amount of glue that is available to hold soil together as aggregates. Soil habitat is destroyed and live soil creatures are reduced in number and/or variety, or they are eliminated.

When the soil is not disturbed, more animals, plants, fungi, and microorganisms thrive in the soil. The amount of soil glue, such as glomalin, 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 disturbed or tilled for a couple of years will hold together in a wire mesh basket when immersed in water. Often the soil clods will hold together so well that the water will evaporate before the soil falls apart. If any of the soil does fall through the wire mesh basket, it generally will be in the form of small soil aggregates, and the water will remain clear instead of becoming cloudy with loose soil particles.

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 when immersed in water. The loose soil will make the water cloudy, and when it settles it will form a layer of sediment in the bottom of the jar.

In addition to level of soil disturbance, two special cases exist that affect the results of this demonstration. If the soil is held together chemically 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 of the Midwest. The mineral particles of these soils are held together by organic matter that was created decades or centuries ago. This recalcitrant organic matter is resistant to decomposition. If these soils are cultivated, the soil clods will fall apart very fast as sand-sized aggregates. The water will remain clear after the sand-sized aggregates settle to the bottom of the jar.

Examples of situations where soils must be disturbed include production of underground crops, such as potatoes and peanuts, and the construction of roads and houses.

Planting cover crops and covering disturbed soils with mulch provides protection from raindrops and food for soil glue-producing organisms.

How to Set Up the Soil Glue Demonstration *(Instructor Preparation)*

Have the following materials available for the students to prepare the demonstration.

Materials & Preparation

- √ 2 Wide-mouthed glass jars
- √ 2 Pieces of ¼-inch wire mesh about 1½ x 6 inches
- √ 2 Clods of soil, each about the size of an egg, from the top two inches of soil from two different areas.

  Some examples of areas to sample are:
  - – a lawn
  - – a construction site
  - – a farmer's field that has been plowed (disturbed)
  - – a farmer's field that has not been disturbed for several years (no-till)
  - – an orchard
  - – a pasture
  - – a forest
  - – a worn down path

- √ Shape two wire mesh baskets to sit about 1½ inches below the rim of each jar
- √ Fill each jar with water to within ½ inch of the top
- √ Place soil clods from two different sources into the baskets and lower them gently into the jars
- √ Observe the results

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?

Answers to Student Exercise

1 Answers will vary. If one of the samples was taken from an area that was less disturbed than the other, there should be a visual difference in how easily the soil clods 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. Soil will have more pores and channels in it because the particles did not fall apart and fill them.

5 The soil that holds together the best is the soil that can resist erosion the best.

Name:_____

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

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

2. Shape the wire mesh to create a basket that sits below the rim of the jar by about 1½ inches.

3. Fill each wide mouthed bottle with water to within ½ 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

Crumbly soils (left) have more pores and channels than cloddy soils (right). Pores and channels allow air and water to move into the soil.

The slake test demonstrates how soil glues hold soil particles together to resist disintegration into individual particles.

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 held together by soil glues, or glomalin, that are produced by fungi. Soils rich in soil biota hold together, while soils devoid of soil life fall apart and form a layer of sediment in the bottom of the jar. Pictured above, the soil on the left is from a field that has been managed using no-till for several years. The soil on the right is from a conventionally-tilled field.

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Illinois NRCS contributed to this fact sheet.

Helping People Help the Land.

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