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Soils Calendar Activity

Learning Activity: Measuring Aggregate Stability using the Slakes App

Summary/ Background: An aggregate is a naturally occurring group of sand, silt and clay particles that cohere (stick) to each other more strongly than to other surrounding particles to form a unit. To the rest of the world, these units are just clods, but to soil scientists, there is a difference: aggregates are naturally occurring while clods are the result of human activities such as digging, plowing, driving through mud and construction. The ability of aggregates to hold together is called aggregate stability.

The health of soils is crucial in the efforts to reduce soil degradation and support the systems of the underground life cycle. In healthy soils, sand, silt and clay particles are held together by a host of organic compounds, "soil glues", such as exudates that leak out of plant roots, microbial decomposition products, slime from worms and glomalin, a protein produced by fungi. These compounds stick to soil particles and hold them together, much like glue or double-sided tape, to form stable aggregates.

When a soil is heavily disturbed during construction or cultivation (tillage) during agricultural practices, the uppermost layer of the soil, known as topsoil, is drastically changed or even removed. These changes decrease soil biological and microbial activity which decreases the amount of these organic compounds produced and released into the soil. Soil aggregates from the surface of lawns or fields that have not been disturbed for many years will have larger amounts of these glues, resulting in more stable aggregates that stay together better because the organic compounds hold the soil particles together. Slaking is a term that describes the degree to which soil aggregates fall apart when saturated with water. In this activity, air-dried aggregates will be put into water and tested to see how well they can remain together. This activity will use Slakes, a smartphone app created to determine the aggregate stability index on a scale of 0 (aggregate falls completely apart) to 1 (no particles fall off the aggregate).

Grade level: High school

Learning Objectives

1. Observe the effect of disturbance on stability of soil aggregates; aggregates in less disturbed soils hold together better due to the "soil glue" than those in undisturbed soils
2. Demonstrate the importance of protecting soils from disturbance
3. 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

Materials

- Smartphone: Android or iOS
- Download the Slakes App, created by the Soil Health Institute, from the Google Play or Apple Store.
- 2 90-mm Petri dishes or similar-sized circular dishes with white background (unlined paper works well)
- Tap water
- Stand for phone (10 and 15 oz soup and vegetable cans and tape also work); camera should be 10 to 13 cm above the container
- Dry soil aggregates about the size of a pea (4 to 8 mm) for each test
- Soils from different places/conditions/management for comparison,
    - Undisturbed: lawn, pasture, forest, prairie, orchard, vineyard, farm field that has not been plowed for several years (no-till)
    - Disturbed: construction site, dirt path or road with no growing plants, roadsides, farm field that has been plowed

Procedure

1. Collect the supplies, start the Slakes app.
2. Read all the instructions for Camera Setup, Procedures Steps 1 to 6 and the Helpful Hints.
3. Set up the camera as shown in the instructions in the app. If backlighting is not an option, mount something above the camera to completely shade the dish to avoid shadows. Shadows can lead to false results.
4. Once the dry aggregates are in the dish, answer these exploratory questions:
    a. Make a simple outline sketch of the aggregates.

    b. Describe the appearance of each - shape, smoothness, roughness?
    c. How are they the same?
    d. How are they different?
5. Once set, tap Start Aggregate Stability Test, select a name, grant permission for the app to use the camera, and follow the onscreen instructions.
6. The test takes 10 minutes to complete.
7. Once complete, tap My Results at the bottom of the screen to view the Aggregate Stability Index and before/after photos of the aggregates.
8. Record the results given for the aggregate stability index and revisit the exploratory questions.
    a. Make another simple sketch outline of the aggregates.
    b. Describe the appearance of each - shape, smoothness, roughness, intact or dispersed?
    c. Compare your before/after observations. What happened to the aggregates?
9. Ideally, do three replications - do the experiment on aggregates from the same sample two more times.

DISCUSS

1. What happens to soil particles that slake off the aggregate?

2. Which soil do you think will be able to maintain the surface condition (aggregate size and unclogged pores) during a hard rain?

3. How is infiltration - water movement into the soil - affected by clogged pores? Where does water go when it cannot infiltrate the soil?

4. Which soil is better able to resist erosion (soil particles lost from the surface with runoff) during a rain?

NGSS CONNECTIONS

- Science and Engineering Practices: Obtaining, Evaluating, and Communicating Information; Asking Questions and Defining Problems
- Disciplinary Core Ideas: Earth's Materials and Systems
- Crosscutting Concepts: Systems and Systems Models; Influence of Science, Engineering, and Technology on Society and the Natural World