



Lesson Plan: Soil Aggregate Stability Water Test

Course: Plant Science / Agriscience / Environmental Science	Grade Level: 9-12
Lesson Length: 50-60 minutes, including observation time	Topic: Soil aggregate stability, structure, and soil-health indicators

Agronomists at GROWMARK look at soil in many different ways to better understand its health. An aggregate stability test provides clues about soil structure by showing how well a soil clump holds together when exposed to water.

Essential Question

What can the way a soil aggregate behaves in water tell us about soil structure and overall soil health?

National AFNR Standards Alignment

Applicable AFNR Connections

- Plant Systems: PS.01.02. Prepare and adjust growing media for use in plant systems.
- Environmental Sustainability Systems: ESS.03.02. Apply soil science and hydrology principles to environmental sustainability systems.
- Career Ready Practices CRP.04. 02. Produce clear, reasoned, and coherent written and visual communication in formal and informal settings.

Learning Intention

We are learning to observe and evaluate soil samples and will use the evidence collected to determine overall soil health.

Success Criteria- I can:

- Select soil samples of similar sizes and appropriately submerge in water for observation.
- Observe reactions over multiple time periods and record observations.
- Analyze the record of observations and make determinations of soil health.
- Explain how this quick test might be helpful in deciding next steps for a particular location.
- Communicate my findings and recommendations clearly.

Materials Needed

- Air-dried soil aggregates or clumps from two or more contrasting sites
- Clear jars, cups, or bowls with enough water to submerge each sample
- Small plastic baskets, wire mesh, tea strainers, or comparable holders that allow water to contact the soil
- Timer or stopwatch
- Labels or masking tape and marker
- Student observation sheet and pencils



Vocabulary

Soil Aggregate	Aggregate Stability	Slaking
Soil Structure	Organic Matter	Pore Space
Infiltration	Erosion	Soil Texture
Biological “Glues”	Cloudiness	Soil Health

Lesson Sequence at a Glance

Time and Lesson Component	Purpose / Facilitator Focus
5 min Bell Ringer	Predict how contrasting soil clumps may behave in water.
10 min Direct Instruction	Introduce aggregates, stability, and the commonly used slake test
5 min Setup	Label samples and establish consistent observation criteria.
20 min Water Test	Submerge aggregates, observe changes, and record water clarity.
10 min Compare and Analyze	Rank relative stability and connect evidence to soil function.
5 min Closure / Exit Ticket	Explain what the test suggests and what it cannot prove.

Bell Ringer / Opening Prompt (5 Minutes)

Place two different dry soil clumps where students can observe them. Ask:

“Which soil clump do you predict will stay together longer in water, and what evidence supports your prediction?”

Students record a prediction before seeing the water-test results. Emphasize that appearance alone may not accurately predict aggregate stability.

Direct Instruction (10 Minutes)

What Are Soil Aggregates?

What Does the Water Test Show?

Guided Setup (5 Minutes)

1. Label each container with the soil sample location or treatment.
2. Fill each clear container with the same approximate amount of clean water.
3. Select air-dried aggregates of similar size when possible.
4. Place each aggregate in a mesh holder so it can be submerged without resting on the bottom.
5. Agree on consistent observation points: immediately after submerging, about 30 seconds, and about 5 minutes.

Consistency matters: Use approximately similar aggregate sizes, water volumes, container types, drying conditions, and observation times. This makes comparisons more meaningful.



Interactive Activity / Laboratory (20 Minutes)

Soil Aggregate Water Test

- Before submerging, describe each dry aggregate: size, shape, visible roots, pores, residue, hardness, and color.
- Slowly and gently lower the aggregate into the water until it is fully submerged. Start the timer.
- Observe without stirring. Record whether air bubbles appear and whether the aggregate stays intact, cracks, slumps, breaks into pieces, or disperses.
- At approximately 30 seconds, record the aggregate condition and water clarity.
- Continue observing for about 5 minutes. Record the final aggregate condition and whether the water is clear, slightly cloudy, cloudy, or very cloudy.
- If using a mesh holder, the facilitator may optionally demonstrate gentle dipping after the observation period to compare resistance to additional disturbance. Use the same treatment for every sample.
- Optional: Photograph the samples side by side and compare the amount of soil that remains aggregated.

Student Observation Table

Sample	Dry Aggregate	~30 Seconds	~5 Minutes	Water Clarity
Sample 1				
Sample 2				
Sample 3				
Sample 4				

Suggested Classroom Rating Scale

Observation	Relative Stability	What Students Should Record
Aggregate stays largely intact; little visible material leaves it.	Higher	Describe intact shape, small edge changes, and water clarity.
Aggregate breaks into several pieces but some structure remains.	Moderate	Describe cracking, size of pieces, and amount of cloudiness.
Aggregate rapidly slumps, crumbles, or disperses.	Lower	Describe speed of breakdown, dispersed material, and water cloudiness.

Analysis and Discussion (10 Minutes)

- Which sample stayed together the longest? What observations support that conclusion?
- Which sample created the cloudiest water? What does that suggest about particle dispersion?
- Were the samples similar in soil texture, collection depth, and dryness? How could differences affect the comparison?
- How might stable aggregates help soil maintain pore space during rainfall?
- Why might organic matter and biological activity help support aggregate formation?
- What additional information or tests would you want before making a broader soil-health conclusion?
- Describe what happened to your most stable soil aggregate in water.



- What did water clarity tell you about the movement or dispersion of soil particles?
- Explain one way organic matter or biological activity can contribute to aggregate stability.
- Name one reason this water test cannot be used alone to determine overall soil health or exact organic-matter content.

Enrichment

- Compare samples from two management histories while controlling for soil type and sampling depth as closely as possible.
- Create a photo sequence showing aggregate change over the observation period.
- Connect the demonstration to infiltration, erosion, crusting, and pore-space concepts.
- Research a laboratory or field soil-health assessment that could complement aggregate-stability observations.

Closure (5 Minutes)

Revisit the essential question:

What can the way a soil aggregate behaves in water tell us about soil structure and overall soil health?

Students complete the sentence: “My evidence suggests this sample had higher/lower aggregate stability because...”. Require the explanation to include both aggregate behavior and water clarity.

Extension Activity

- Career Exploration: Investigate how agronomists, soil conservationists, and crop advisers assess soil structure and soil-health trends.
- Communication Practice: Prepare a one-minute explanation for a landowner describing what the demonstration shows and what additional testing would be needed before making management conclusions.

Facilitator Preparation Notes

- Collect contrasting soil samples in advance and air-dry the aggregates. Do not oven-dry soil intended for the demonstration.
- Choose aggregates of similar size and use equal water volumes and comparable containers.
- If comparing management systems, try to collect the same soil type and similar sampling depth so management is not confused with texture differences.
- Prepare one extra aggregate for modeling the setup before students begin.
- Keep the focus on observation and relative stability rather than assigning exact organic-matter values from visual appearance.
- Dispose of soil and water according to school procedures, and wash hands after handling soil.

Teacher Background Notes

- Aggregate stability tests evaluate how well soil aggregates hold together when disturbed or rewetted.
- Rapid aggregate breakdown is associated with poorer structure and can contribute to surface sealing, slower infiltration, runoff, and erosion.
- More stable aggregates are associated with stronger soil structure and improved water capture, infiltration, and storage.
- Organic matter, microbial products, roots, fungal networks, soil texture, and chemical bonding all influence aggregation.



References & Supporting Resources

- **University of Massachusetts Amherst, Center for Agriculture, Food, and the Environment.** *Soil Aggregate Stability Test.* Provides background information and a field-friendly large aggregate slake test for evaluating how soil aggregates respond to water. UMass Amherst Soil Aggregate Stability Test [umass.edu]
- **USDA Natural Resources Conservation Service (NRCS).** *Soil Health Assessment: Water Stable Aggregates.* Demonstrates a simple method for observing water-stable soil aggregates as an indicator of soil health. USDA NRCS Water Stable Aggregates Video

This GROWMARK lesson plan incorporates established soil-health concepts and aggregate-stability assessment methods. The instructional sequence, student activities, questions, and classroom application have been developed for the GROWMARK lesson plan library.