4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.			
PE Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]	DCI • Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. • Living things affect the physical characteristics of their regions.	CCC • Cause and Effect – Cause and effect relationships are routinely identified, tested, and used to explain change.	Practices Planning and Carrying Out Investigations – *Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.* Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
Activity Small Groups: Using the bottle and chalk provided, first simulate weathering by wind (swirl the bottle with chalk inside). Observe how the chalk has changed. Simulate weathering by water (add water to the bottle and swirl it again). Perform chemical weathering by dropping chalk into a bottle of clear vinegar.	Question How do rocks and soil break down (weather)?	Objectives / *Next Steps* • Weathering is the process of material breaking down into sediment. (Weathering is not to be confused with erosion, which is the movement of the resulting sediment.) *How do our experiments compare to the real world?*	Notes The chemical reaction you see will depend on the chemical content of the chalk you are using. Sidewalk chalk does not generally have a strong reaction, and this is also true of many classroom chalk brands. To ensure a reaction, you can apply acid directly to a piece of classroom chalk. Prang's Hygieia brand works well – it is 95% pure calcium carbonate.
Whole Class: Discuss how the simulations reflect the real world.	How do rocks and soil break down (weather)? [Continued]	• Earth materials can break down through abrasion, chemical reactions / dissolution, and due to water's expansion and contraction as temperature changes.	Be sure to address abrasion (sand blowing or flowing and the actions of animals and plants).

Whole Class: Show students the shoebox-sized sandboxes they will be working with and ask them how we can measure the amount of soil that runs off.	How can we measure soil run-off (erosion)?	• There are several methods which we could use to measure soil run-off, including two based on volume. *Now that we can measure run-off, what changes can we make to the land or the way water is applied?*	The two methods include the volume of sand accumulating in the run-off cup and the ratio of sand to water in the run-off cup. Ultimately, it may be easiest to use relative measurements where experiments are rated "more sand," "less sand," or "the same amount."
Small Groups: Brainstorm variables that could be tested. Examples include slope angle, sand coverage versus gravel coverage, the amount of vegetation, cloud height, relative flow rate, and terrain changes like ditches.	What factors related to land or water affect soil run-off (erosion)?	• Choose one factor to test.	
Whole Class: Discuss the importance of changing only one variable while controlling the rest.	How would scientists approach this experiment?	• Experiments must be carefully controlled in order to ensure accurate results.	Encourage multiple trials. If possible, assign two or more teams to investigate each method.
Small Groups: Perform an experiment to determine how your variable affects the amount of erosion.	What land factors affect soil run-off (erosion)? [Continued]	• The greater the angle, the smaller the particle, the less the vegetation, the higher the cloud, the greater the flow rate, and the more the directed the flow, the more erosion there will be. *How do you know if land has been shaped by wind, water, or ice?*	An optional Next Step question would be *What types of natural and artificial structures can we use to reduce erosion?* Students can conduct experiments from the second grade unit to answer this question if desired.
Whole Class: View photos of various landforms and determine if they are weathered by wind, water, or ice. (Descriptions and answers / causes are listed in the notes section of the slide show presentation.)	How do you know if land has been shaped by wind, water, or ice?	• Looking at the surrounding area is a good start – if there is water nearby, there is a good chance weathering was a result of water flow. • Weathering as a result of glaciation (ice) often results in lakes rather than rivers.	This activity works well when begun in small groups – students can look at an individual photo and present their findings to the class in order to stimulate discussion.