Unit	Hydrology
Lesson	2.3 Measuring sediment transport
Essential question	How does water move sediment?
Objective	Students will be able to predict the effect of different water discharge rates on sediment transport.
Key words	weathering, sediment, erosion, deposition, delta, flood plain, meander
Related Standards	
NGSS standard	HS-ESS2-5
AP Env Sci topic	8.2
IB Biology topic	
IB ESS topic	4.4
Suggested sequence of learning activities	1. Starter quiz/prior knowledge check 2. Direct instruction (if traditional) or classroom discussion (if flipped). Slides here. 3. Sediment transport investigation (group work). Teacher instructions here. Student sheet here. 4. Individual exit ticket/comprehension check
Assessment	Exit ticket/comprehension check
Possible modifications	• Give a keyword list (with or without definitions already included) to students before or during class • Be intentional about student groupings (eg. heterogeneous skill levels)
Resources required	For each group: chart paper, straw, ruler, sand, rice, sugar, pebbles/gravel, meter stick, copies of sediment transport activity student sheet for each student
Starter questions	1. Which do you think will move farther in a stream– sand or pebbles? Why? 2. How do you think a river can shape the land around it?
Concepts covered in lesson	**Weathering** is when rocks are broken down into **sediments** (smaller rock pieces) by either physical processes like abrasion or by chemical processes like acid rain. Sediments can be classified according

	to their average grain size (diameter of pieces) according to the following categories: ● Boulders: greater than 258 mm (greater than 10 inches) ● Cobbles: between 64 and 258 mm (about 2.5 to 10 inches) ● Pebbles: between 2 and 64 mm (about a tenth to 2.5 inches) ● Sand: between 0.0625 – 2 mm ● Silt: between 0.004 – 0.0625 mm ● Clay: less than 0.004 mm Note that individual silt and clay particles are too small to be seen by the human eye. Grain size is important because it determines which agent of erosion can move the sediment and what velocity of water is required. **Erosion** is when sediments are moved by agents such as water, wind, ice or gravity from one place to another. The faster the water flows, the heavier the sediments it can carry. Erosion can be fast and dramatic (like landslides that occur in a matter of seconds), slow and dramatic (like the formation of the Grand Canyon over millions of years), or slow and not-so-dramatic (like the wearing away of the Appalachian Mountains). **Deposition** is the build-up of sediments caused when the forces of erosion are no longer strong enough to carry their sediment load. Common depositional environments occur where flowing water slows down rapidly upon entering a body of still or much slower moving water such as the side of a big pool in a stream, a marsh, lake, estuary or the ocean. Although large amounts of sediments can be deposited rapidly (like landslide debris and flood deposits), most stream sediments are deposited slowly and steadily in specific areas, such as a **delta**. Deltas are areas of deposition (often roughly triangular in shape) located near the mouths of rivers. Because of their importance for trade, many deltas, such as those formed by the Mississippi and Nile Rivers, have been developed into urban areas. Deposition of stream sediments also occurs in and around river beds. Within a river bed there are areas of faster and slower moving water, often associated with a bend or change in slope or width of the river bed. Erosion tends to occur along those parts of the river bed where the water moves the fastest while deposition occurs along those parts of the river bed where the water moves the slowest. Deposition also occurs on the relatively flat areas called **flood plains** located on either side of many rivers. This is where rivers begin to **meander**, or curve.

Slide presentation	Link here
Activity	Student groups investigation sediment transport by blowing air through a straw against sediment of various sizes. Teacher instructions here. Student sheet here.
Exit ticket questions	1. What part of a stream cross-section will have the most erosion and why? What part of a stream cross-section will have the most deposition and why? 2. What causes a stream to meander? Answers: *1. The deepest part of the stream will have the fastest water velocity and the most erosion. The shallowest part of the stream will have the slowest water velocity and the most deposition.* *2. The outside of a stream bend will have the fastest velocity and erode the stream bank on that side. The inside of the stream bend will have the slowest velocity and will deposit and fill in the inside of the stream. These two processes will cause the stream bend to widen and the stream to meander.*
Extension questions/activities/ resources	Interesting videos of sediment transport modelling experiments here. If budget allows, a stream table is very useful for modelling sediment transport. They range in size and can cost as little as $75 and as much as $800. You can also build your own stream table with a recirculating stream table with a pump (instructional video here) or even as simple as pouring sand into a tilted tray and then showering water at the top with a garden watering can. Have students research the effect of levees and channelization on reducing sediment deposition in and around New Orleans causing land subsidence.