

Earth's Changing Surface

Lesson 3: What can change how fast deltas grow?

Grade: 4	Length of lesson: 55 minutes	Placement of lesson: 3 of 6 lessons
Anchoring Phenomenon: The Mississippi delta has grown over thousands of years.		
Unit Learning Goal: At any given point in time, Earth's surface is both building up and wearing down. Some processes build up Earth's surface, while other processes wear down Earth's surface. These processes include weathering, erosion, and deposition and cause Earth's surface to look different in different places.		
<p>Lesson Main Learning Goal: The amount of water, vegetation, and slope of the land can speed up or slow down erosion and deposition.</p> <p>Science and Engineering Practices</p> <p>Planning and Carrying Out Investigations</p> <ul style="list-style-type: none"> • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. <p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. <p>Crosscutting Concepts</p> <p>Cause and Effect</p> <ul style="list-style-type: none"> • Cause and effect relationships are routinely identified, tested, and used to explain change. <p>Stability and Change</p> <ul style="list-style-type: none"> • Change is measured in terms of differences over time and may occur at different rates. 		
Unit Central Question: What can cause Earth's surface to look the way it does?		Lesson Focus Question: What can change how fast deltas grow?
Science content storyline: Rainfall, the amount of water flowing, vegetation, and the type and slope of the land can affect the rates of erosion and deposition, changing where soil and rock flow and deposit. The Mississippi River freely deposited soil and rock that flowed from other places, which created the delta originally.		
Ideal student response to the Lesson Focus Question: Steeper slopes, faster moving water, smaller pieces of rock and soil, more rain, and no vegetation cause more erosion of upstream materials and results in more materials being deposited in the delta. Erosion happens slower with flatter slopes, slower water flow, bigger rocks and soil, less rain, and more vegetation. The more erosion of upstream materials and deposition in the delta, the faster a delta can form and get bigger.		

Preparation


MATERIALS NEEDED	AHEAD OF TIME
<p>Teacher Resources</p> <ul style="list-style-type: none">• TE2.2 <i>Stream Table Setup Instructions</i> (optional)• video made in Lesson 2• computer and projector for video• chart paper and chart markers <p>Student Handout</p> <ul style="list-style-type: none">• HO3.1 <i>Speeding Up or Slowing Down Erosion and Deposition</i> (1 per student) <p>Materials</p> <ul style="list-style-type: none">• 5 stream table setups (1 for each group) from Lesson 2• extra books (for steep slope condition and for writing surface)• 6 cups fine sand (play sand <i>without</i> rocks or pebbles) and gravel and rocks (for different materials condition)• fake moss and plastic trees and shrubs (for vegetation condition)• 2 spray bottles (for precipitation condition)• 1 extra golf tee (for big river condition) <p>Other Materials (per class, optional for easier cleanup)</p> <ul style="list-style-type: none">• large bucket with water (for rinsing hands or to carry water outside)• 1 sponge, paper towels to wipe up any spills• plastic trash bags to cover the work area• aluminum foil to line trays	<ul style="list-style-type: none">• Review the <i>Content Background</i> document.• Use a stream table kit <i>or</i> prepare the stream tables using the teacher reference sheet provided with Lesson 2: TE2.2 <i>Stream Table Setup Instructions</i>.• Arrange a place to show the video you made from Lesson 2. Students will need the video to use as a comparison when they are conducting their investigations in this lesson.• Practice with a stream table investigation so you know what to expect as students try each condition. Steeper slopes, looser material, more precipitation, bigger river, and no vegetation increase erosion of upstream materials and cause deposition in the delta to happen more quickly. Conditions that slow erosion down are flatter slopes, harder material, less precipitation, and more vegetation. Add a second hole and golf tee to a milk jug so that the two holes next to one another allow more water to flow.• Plan where to dispose of the sandy water—not in a sink!!

Lesson 3 General Outline

Time	Phase of lesson	How the science content storyline develops
3 min	Link to Previous Lesson: Class recalls ideas from the previous lesson about delta formation and starts to consider what could cause delta formation to happen faster or slower.	
8 min	Lesson Focus Question: Teacher introduces Lesson Focus Question: <i>What can change how fast deltas grow?</i> Students write their initial ideas in their notebook.	
10 min	Setup for Activity: Class brainstorms new conditions to test what might speed up or slow down erosion. Students make predictions.	
12 min	Activity: Students test one condition and record their observations.	Rainfall, the amount of water flowing, vegetation, and the type and slope of the land can affect the rate of erosion and deposition, changing where soil and rock flow and deposit.
12 min	Follow-up to Activity: Each group shares their observations across different conditions, and students record which ones speed up and which ones slow down erosion and deposition.	
5 min	Synthesize and Summarize Today's Lesson: The class discusses the natural processes that can come together to speed up or slow down delta formation.	The Mississippi River freely deposited soil and rock that flowed from other places, which created the delta originally.
5 min	Link to Next Lesson: Teacher tells students about all the changes on the Mississippi to protect towns and transportation traffic. Students suggest ideas for how it could change the natural process.	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
3 min	<p>Link to Previous Lesson</p> <p><u>Synopsis:</u> Class recalls ideas from the previous lesson about delta formation and starts to consider what could cause delta formation to happen faster or slower.</p>	<p>Link science ideas to other science ideas.</p> <p>Ask questions to elicit student ideas and predictions.</p>	<p>NOTE TO TEACHER: Have Lesson 2's focus question written in a place where students can refer to it again throughout today's lesson: What causes deltas to form?</p> <p>What did we figure out last time?</p> <p>Do you think it happened at a steady pace or do you think something could speed it up or slow it down?</p>	<p>We figured out that water washes away dirt and rocks and drops it off at the end of the river.</p> <p>And how does that form a delta?</p> <p>Can you use the new vocabulary from the last lesson in your answer?</p> <p>Erosion happens when water moves sand and rocks from somewhere upriver to the end of the river. This is where deposition happens.</p> <p>Is that the only place deposition happens?</p> <p>No!</p> <p>Can you share what your thinking is about that?</p> <p>Our delta formed pretty quickly in our stream table. Is that how it happens in the Mississippi?</p> <p>No, it takes thousands of years.</p> <p>Maybe a steady pace because the river flows the same all the time.</p> <p>I think maybe the river could have been smaller in the past</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			<p>In today's lesson, we will build on Lesson 2's focus question and explore ways this process happens more quickly or slowly.</p>	<p>and it got bigger and bigger, so maybe the delta grew fast when the river was bigger. Why do you think the river changed sizes?</p> <p>Say more about how you think a bigger river would make a bigger delta?</p>
8 min	<p>Lesson Focus Question</p> <p><u>Synopsis:</u> Teacher introduces Lesson Focus Question: <i>What can change how fast deltas grow?</i> Students write their initial ideas in their notebook.</p>	Set the purpose with a focus question.	<p>Our focus question for today is, <i>What can change how fast deltas grow?</i></p> <p>NOTE TO TEACHER: Write the question on the board for the class to see and then refer to it throughout the lesson.</p> <p>Ask students to write this focus question in their notebook.</p> <p>I want you to take a few minutes and think about our Lesson Focus Question, <i>What can change how fast deltas grow?</i> In your notebook below where you wrote the Lesson Focus Question, make a 2-column chart. Title the columns "Things that speed it up" and "Things that slow it down". List one or more things that will speed it up and one or more things that will slow it down.</p> <p>NOTE TO TEACHER: Give students a few minutes to write down one or more ideas that might speed up or slow down erosion and deposition.</p> <p>Next, conduct a whole-class discussion by asking a few students to share their ideas. Record students' ideas on</p>	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		Ask questions to elicit student ideas and predictions.	<p><i>the Lesson 3 Focus Question chart, underneath the focus question using the 2-column format, so you can refer to them in the follow-up to the activity. Use the same color of marker used for initial ideas on the Lesson 1 and 2 Lesson Focus Question charts.</i></p> <p> <i>Listen to students' ideas. What's visible about student thinking? Do they have ideas related to how big the particles are that can be carried by water? Do they mention the type of materials that are part of the stream table? Do they talk about the amount of water? Do they make connections to the "Energy: Every Day, Everywhere" unit and realize that faster-moving water has more energy to carry particles?</i></p>	<p>I think that if the river is bigger, it would speed it up.</p> <p>And, can you say more about how it would speed it up?</p> <p>The more water you have, the more soil and rock would wash away and deposit at the delta.</p> <p>So, _____ is saying that if the river is bigger, delta formation would happen faster. What other ideas do we have?</p> <p>I think if the land is made of really small rocks and sand, it might happen faster.</p> <p>And why would the size or type of material matter?</p> <p>Because small and lighter stuff can float in the water easier.</p> <p>Does anyone have a similar idea to _____?</p>
10 min	<p>Setup for Activity</p> <p><u>Synopsis:</u> Class brainstorms new conditions to test what might speed up or slow down</p>		<p><i>Distribute HO3.1 Speeding Up or Slowing Down Erosion and Deposition to each student. This handout is a scaffold for students to engage in developing an explanation and engaging in argument. The data they record and the questions they respond to will support</i></p>	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
	<p>erosion. Students make predictions.</p> <p><u>Main Science Idea:</u> Rainfall, the amount of water flowing, vegetation, and the type and slope of the land can affect the rate of erosion and deposition, changing where soil and rock flow and deposit.</p>	<p>Make explicit links between science ideas and activities (before activity).</p>	<p><i>them in part 4 of the handout when they develop their explanation.</i></p> <p><i>Continue by having students <u>think-pair-share</u> with a partner. Ask the pairs to think about and discuss how we can use the stream tables to test some of these ideas. Give students time to brainstorm what they might do with the stream table using part 1 of the handout.</i></p> <p><i>Continue with a <u>whole-class discussion</u>. Ask students to share their investigation ideas. Probe and challenge students to provide a rationale for why they want to investigate a particular condition.</i></p> <p>What could we do to the stream tables to speed up or slow down erosion upstream and deposition in the delta?</p>	<p>We could make the river bigger. What do you mean by “bigger”? We could fill it with part sand and part heavier rocks and see which one erodes faster. What do you predict will happen? We could see if rain matters. And how would rain affect the processes of erosion upstream and deposition in the delta?</p> <p>We could make the water flow faster. How would you do that? We could make the stream table steeper by propping up the top end higher. What do you predict faster water will do to the erosion of upstream materials and deposition in the delta?</p> <p>When it rains, it sometimes causes rivers to flood and they</p>


Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			<p>Alright, we have materials for five conditions we can test today and see what happens. Those conditions are</p> <ul style="list-style-type: none"> ● a bigger river ● rain ● sandy soil versus rocks ● a lot of vegetation, like grass and trees ● faster water flow <p>You will only test one condition, but you will share your results with the whole class. So, it is important for you to make and record all your observations. You will keep track of your condition and what you do and observe in part 2 of your handout.</p> <p>NOTE TO TEACHER: Show each group the new setups with the stream tables. Students will already be familiar with the basic setup, so show them what has changed:</p> <ul style="list-style-type: none"> ● two holes in the jug for more water flow ● spray bottles for precipitation ● a steeper slope for faster water flow ● one side with just play sand; one side with added gravel and rocks ● plastic grass and shrubs to model vegetation. <p>Divide the class into 5 groups and assign the conditions, 1 per group. Each group will write their assigned condition</p>	<p>sweep away a bunch of stuff at once.</p> <p>Are you saying there would be more water in the river when it rains?</p> <p>Are there other things about the river and the water that would change with rain?</p> <p>The speed of the water if there is a lot of rain.</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			<p><i>in part 2 and keep track of their notes there. In part 3, they will keep track of notes from the other 4 groups.</i></p> <p><i><u>Management Tips:</u> Students might suggest ideas outside the scope of what we can test in the classrooms. For example, they might want to test something that takes longer than a class period to try out. Or they might want materials that are not available in this lab setup. If possible, invite students to bring in their own materials and test their ideas during a time convenient in the school schedule.</i></p>	
12 min	<p>Activity</p> <p><u>Synopsis:</u> Students test one condition and record their observations.</p> <p><u>Main Science Idea continued:</u> Rainfall, the amount of water flowing, vegetation, and the type and slope of the land can affect the rate of erosion and deposition, changing where soil and rock flow and deposit.</p>	<p>Make explicit links between science ideas and activities (during activity).</p> <p>Engage students in using content</p>	<p>Now, let’s test each condition and see what happens. I recorded a video of the stream table running from the last lesson so we can compare our results today to the results from the last class.</p> <p>We need to keep some things constant in our setup so we can make a fair comparison. We want to change only one thing—you are changing the condition. Let’s use the marks on the jug like we did last time so that we are running the stream the same. So, everyone, stop the water when it gets down to the first mark and then make your observations. I will project the video of the stream table from the last class so you can compare.</p> <p>Remember to use part 2 of the handout to describe your condition, track your observations, and determine whether the erosion of materials and deposition in the delta happened faster or slower.</p> <p>NOTE TO TEACHER: Give groups 6–8 minutes to test the condition. Encourage students to track detailed observations because they will need to share their results with the class.</p>	

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		<p>representations and models.</p>	<p><i>Circulate around the room and make sure students are stopping to make observations of their stream model at appropriate points. Ask them to show you the examples of erosion and deposition they observe in their stream table model. Remind them to consider if erosion and deposition are happening faster or slower, and why they think that might be.</i></p> <p>What did you notice happening on the stream table for the condition you tested?</p>	<p>The dirt and sand are not really moving as much as last time. Why do you think that is the case? Maybe because the grass and trees are holding it in place.</p> <p>The sand in ours was really moving a lot—more than last time. Can you use the new vocabulary to describe the sand moving a lot? There was more erosion today than there was last time. What did you do differently today? We made the stream table steeper. Why do you think that made a difference in the amount of erosion? Well, when we made the stream table steeper, that made the water flow faster. Can you connect the speed of water flowing and how much erosion is taking place?</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
				The faster the water moves, the more erosion.
12 min	<p>Follow-up to Activity</p> <p><u>Synopsis:</u> Each group shares their observations across different conditions, and students record which ones speed up and which ones slow down erosion and deposition.</p> <p><u>Main Science Idea continued:</u> Rainfall, the amount of water flowing, vegetation, and the type and slope of the land can affect the rate of erosion and deposition, changing where soil and rock flow and deposit.</p>	Make explicit links between science ideas	<p>Let’s share our observations across the groups now that we have tested the five conditions. Who can share information about their condition?</p> <p>NOTE TO TEACHER: Give each group about 1 minute to share their observations and about 1 minute for others to ask clarifying questions. Consider having the class gather around each group’s stream table as they describe their condition so they can show evidence of erosion and deposition. Students should have a book to put their handout on so that they can complete the handout for each condition.</p> <p>As students present their findings, others should be recording notes onto part 3 of the handout. Also, record the results in a public place where all students can see the results across the five test conditions.</p>	<p>We had the condition with plastic trees and grass.</p> <p>Can you tell us more about what your condition represents in the real world?</p> <p>It represents the land with grass, bushes, and trees on it.</p> <p>And what were your observations?</p> <p>We didn’t have much erosion or deposition at all.</p> <p>Why do you think that was the case?</p> <p>It seems like the plants hold the rock and sand into place rather than land that doesn’t have it.</p> <p>So in the real world, what do you think this means?</p> <p>That land that doesn’t have many plants on it might erode faster than land that does.</p> <p>What do others think about that idea?</p> <p>Yeah, in the ditch behind my house where there is no grass, the dirt on the sides are falling down.</p> <p>Let’s look at the next stream table and share our observations.</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		<p>and activities (after activity).</p> <p>Engage students in analyzing and interpreting data and observations.</p>	<p>Alright, so we have seen the results of all five test conditions. What are some things we can say now about what speeds up or slows down erosion and deposition?</p>	<p>More water, like a bigger river or more rain, causes it to happen faster.</p> <p>What do you mean by “it”? The washing away of the rocks and soil.</p> <p>Can someone restate what _____ said using our science vocabulary? More water causes more erosion.</p> <p>Now let’s move to the next stream table.</p> <p>A steeper slope, like mountains and hills, causes erosion to happen faster.</p> <p>How did changing the slope cause erosion to happen faster? A steeper slope made the water flow faster.</p> <p>Now let’s go to our final stream table.</p> <p>If the land is made of small sand or lightweight stuff, erosion happens faster than if the rock is hard or big.</p> <p>What evidence do you have for your claim that erosion happens faster in these conditions? There were more earth materials down at the bottom on the side with smaller pieces of sand.</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
5 min	<p>Synthesize and Summarize Today's Lesson</p> <p><u>Synopsis</u>: The class discusses the natural processes that can come together to speed up or slow down delta formation.</p> <p><u>Main Science Idea</u>: The Mississippi River freely deposited soil and rock that flowed from other places, which created the delta originally.</p>	<p>Highlight key science ideas and <u>focus question</u> throughout.</p> <p>Engage students in constructing explanations and arguments.</p> <p>Engage students in making connections by synthesizing and summarizing key science ideas.</p>	<p>Remember, our focus question today is, <i>What can change how fast deltas grow?</i> Use part 4 of your handout to create an explanation that answers this question. Be sure to talk about the evidence you collected today and what you learned from your classmates and why each condition made the delta form faster or slower.</p> <p> <i>Embedded assessment task</i></p> <p>NOTE TO TEACHER: Allow students 4 minutes for individual thinking and writing time as they answer the questions in part 4 on their observations sheet. Ask for volunteers to share their responses and record ideas on the Lesson 3 Focus Question chart using the same color used for revised ideas on the other Lesson Focus Question charts.</p>	<p>I think that a delta would form faster at the end of a big river, with lots of water. And especially if they get a lot of rain and there is loose sand. But grass, trees, and a flat slope would slow it down.</p> <p>Do you think that the rate of erosion and deposition can change in a river? In other words, do you think erosion and deposition can do both—speed up and slow down?</p> <p>Yes!</p> <p>Can you share what you are thinking about that?</p> <p>Well, it could be steep in some places and erosion could happen really fast because the water is moving fast. Then farther down the river it could get flatter or have a bunch of grass and trees. That would make the materials slow down increasing deposition.</p> <p>What do erosion and deposition have to do with delta formation?</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
				Erosion moves the earth materials downstream towards the delta and deposition lets it collect in the delta.
5 min	<p align="center">Link to Next Lesson</p> <p><u>Synopsis:</u> Teacher tells students about all the changes on the Mississippi to protect towns and transportation traffic. Students suggest ideas for how it could change the natural process.</p>	Link science ideas to other science ideas (links to next lesson).	<p>Many of you have mentioned that getting a lot of rain or having a lot of water can cause erosion to happen faster which increases the amount of material deposited in the delta.</p> <p>But what else happens on a river when there is a bunch of rain or a lot of water?</p> <p>NOTE TO TEACHER: Remind students of the reading the class did in Lesson 1 that talked about the wetland ecosystem of the Mississippi delta. Add on some new ideas, such as the following:</p> <ul style="list-style-type: none"> • The Mississippi River has been known to flood a lot, but there are so many towns and neighborhoods along the Mississippi. • There are also a lot of ships going up and down the river carrying goods to different ports. • To protect homes along the river, people, and boats, they have built dams and levees along the river to control the water. <p>NOTE TO TEACHER: The term levee may not come up in this discussion, and that is OK. Students will learn about levees in Lesson 4.</p> <p>How might building a dam on the river change erosion and deposition? How would it impact the delta ecosystem we read about in Lesson 1?</p>	<p>The water gets high!</p> <p>It floods!</p> <p>Maybe it would stop the water from flowing and impact the animals and plants there?</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			<p>In our next lesson, we will test some things that people have done on the Mississippi River to see if that caused any changes in the delta.</p>	<p>Maybe the delta would stop getting bigger because the water can't get there?</p>



Transforming Science Education Through Research-Driven Innovation

Earth's Changing Surface

Lesson 3

What can change how fast deltas grow?



1

What did we figure out?

Lesson 2 Focus Question

What causes deltas to form?

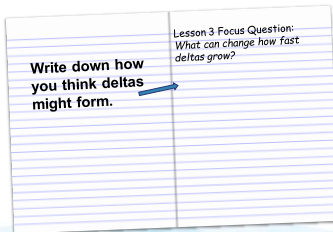
How did we answer this question in our last class?



2

Lesson 3 Focus Question

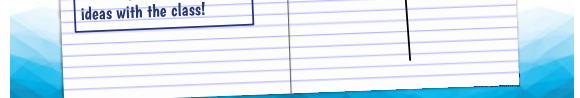
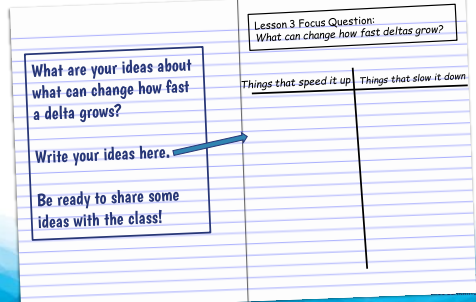
What can change how fast deltas grow?



3

Lesson 3 Focus Question

What can change how fast deltas grow?



4

How can we use our stream table to investigate our ideas?

Think-Pair-Share

- Talk about your ideas with a partner.
- Record your ideas on part 1 of the handout.

Speeding Up or Slowing Down Erosion and Deposition

Part 1: List ideas for what might speed up or slow down erosion and deposition.

Idea for the class to test using stream tables:	Why this idea is important to test:



5

Designing an Investigation



How will we use these materials to test our conditions?

Conditions to test

- a bigger river
- precipitation
- sandy soil versus rocks
- a lot of vegetation, like grass and trees
- faster water flow



6



7

Stream Table from Lesson 2 (comparison)

NOTE TO TEACHER: Insert video from Lesson 2 stream table for students to use as a comparison.

8

Investigation Follow-up

What can we say about what changes how fast a delta can grow?

What is our evidence?

What did we figure out?

What can you say about erosion and deposition?



Record data from other teams in part 3 of your handout.

Part 3: Record notes across all the other 3 conditions.

Condition	Describe the conditions. What about is important for the next round?	Record observed observations	Does it speed up erosion or deposition or does it slow? Why do you think so?

9

Putting It All Together

What can change how fast deltas grow?

Answer our focus question by completing part 4 of your handout.

Part 4: Construct an explanation for how water can speed up or slow down erosion and deposition. Include additional factors that can speed up or slow it down as well.

How does speeding up or slowing down erosion and deposition change the delta?

10

What's next?

What we know from earlier reading

- The Mississippi River has been known to flood a lot, but there are so many towns and neighborhoods along the Mississippi.
- There are also a lot of ships going up and down the river carrying goods to different ports.
- To protect homes along the river, people, and boats, they have built dams and levees along the river to control the water.

Do you think building dams would affect erosion and deposition?

Do you think it would affect delta formation?



11



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12

Speeding Up or Slowing Down Erosion and Deposition

Part 1: List ideas for what might speed up or slow down erosion and deposition.

Idea for the class to test using stream tables	Why this idea is important to test

Part 2: Test one condition and record observations to share with the class.

What condition are you testing? _____

Describe the condition. What does it represent in the real world? How did you model the condition with the stream table?	Record your observations	Does it speed up erosion of upstream materials and increase deposition in the delta or slow it down? Why do you think so?

Part 3: Record notes across all the other 4 conditions.

Conditions	_____	_____	_____	_____
Describe the condition. What does it represent in the real world?				
Record detailed observations.				
Does it speed up erosion and deposition or slow it down? Why do you think so?				

Part 4: Construct an explanation for how water can speed up or slow down erosion and deposition. Include additional factors that can speed up or slow it down as well.

How does speeding up or slowing down erosion and deposition change the delta?
