INDIRECT INSTRUCTION LESSON PLAN FORMAT

Elementary Science

Big Idea: Students will investigate the affects of slope and flooding on erosion and deposition in the formation of landforms.

Grade Level: 5th grade

Rationale: Landforms can be affected by slope and flooding. The steepness of the slope of the earth's surface affects the amount of erosion and deposition by a river or stream. The quantity of water flowing through a river or stream channel affects the amount of erosion and deposition. Students will use the scientific inquiry process skills of observing, inferring, communicating, comparing, organizing and relating. This lesson will allow students to make connections to their world, specifically noticing how slope might have affected erosion/deposition and the formation of The Grand Canyon. Students will also be able to infer meaning from flooding events they encounter in news media. For example, students will have a better understanding of the causes and effects of the 2011 Philippine flooding on a global level, 2011 flooding of the Mississippi River on the national level and flooding of roads, streams, and low lying areas in their local community.

NC Science Essential Standards AND/OR NCSCOS Objective Reference:

NCSCOS Physical Science

Competency Goal 2:

- 5: The learner will make observations and conduct investigations to build an understanding of landforms.

  2.05 Discuss how the flow of water and the slope of the land affect erosion.

National Science Education Content Standards Reference:

Science as Inquiry

All students should develop abilities to:

- do and understand scientific inquiry. (5-8, p.145)

These activities address these fundamental concepts and principles: (5-8, p, 145,148)

- Identify questions; design and conduct scientific investigations to answer those questions.
- Employ tools to gather, analyze, and interpret data.

• Use data to construct reasonable explanations.

• Develop and communicate investigations and evidence.

• Understand that scientists use different kinds of investigations and tools to develop explanations using evidence and knowledge.

Earth and Space Science Content Standard D:

All students should develop an understanding of:

- Structure of the earth system (5-8, p. 158)

These activities address these fundamental concepts and principles:

- Landforms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion. (5-8, p. 160)

Science in Social and Personal Perspectives Content Standard F:

- Natural Hazards (5-8, p. 166)

These activities address these fundamental concepts and principles:

- Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans. Natural hazards include earthquakes, landslides, wildfires, volcanic eruptions, floods, storms, and even possible impacts of asteroids. (5-8, p. 168)

History of Science Content Standard G:

- Science as a human endeavor (5-8, p.170)

These activities address the fundamental concepts and principles:

- Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill, and creativity—as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (5-8, p.170)

Instructional Objective:

- Use stream-tables and stream-table maps to investigate, depict, and gather data.

- Describe the effect that the slope of the terrain has upon erosion and deposition.

- Describe the effect of a flood condition upon erosion and deposition.

- Use observational evidence and drawings to show the effects of slope and flooding on landforms. Students will observe faster flowing water during sloped conditions. The water has more energy and can carry larger loads of material, increasing the amount of erosion and deposition. Students will also observe an alluvial fan during the slope investigation. An alluvial fan is similar to a delta in that a fan-shaped landform is deposited at the bottom of the slope. Students will use flooding conditions to see how a stream's velocity increases, thereby increasing erosion and deposition.

- Stream-table investigations will be scored using a rubric provided by FOSS for use as a formative assessment. A FOSS rubric will also be used to score the student's work during the Elaboration stage. Students will be given a response sheet with a specific scenario. Students will be expected to advise a fictional character regarding how she might complete a stream-table investigation. Please see Appendix A for details of rubric scoring.

Student Prerequisite knowledge and skills:

- Students should be able to work cooperatively in groups.
- Students should be familiar with landform vocabulary such as: erosion, landforms, deltas, canyon, deposition, sediments, channel, and meander as well as others listed on Landform Vocabulary handout.
- Students should be familiar with stream table usage and stream table maps.

Science background for the teacher:

Students understand that landforms happen gradually over long periods of time. Forces that cause changes in landforms are water, ice, wind and gravity. In particular, the movement of water over and through the landscape can be instrumental in shaping landforms. The wearing away of rock and soil in erosion plays an important role in the formation of canyons, valleys, meanders and tributaries. The deposition of eroded material is an important factor in the establishment of deltas and flood plains.

With this background knowledge, students can use stream tables to further their understanding of erosion and landforms through inquiry of land slope and flooding. Students will experiment with slope in an effort to relate slope with an increased rate of erosion and deposition. Students should witness an alluvial fan during the investigation. An alluvial fan is a fan-shaped landform that is deposited at the bottom of a slope and is similar to a delta. Students will also discover how a flood increases the stream's velocity, thereby increasing erosion and deposition. Students will define a flood as a very heavy flow of water, greater than the normal flow of water, going over the stream's normal channel. They will also define flash flood as a flood that rises and falls rapidly with little or no advance warning. Flashfloods are usually the result of very heavy rainfall over a relatively small area. Flashfloods can be caused by heavy rainfall, dam failure, or the thaw of an ice jam.

Materials (for each group – 4 students in each group, for a total of 7 groups):

- 1 Tray with earth material
- 1 Flood water source
- 1 Wood angle
- 1 Ruler, 30-cm
- 1 Container, 1-liter
- 2 Hand lenses
- 1Meter tape
- Stop watch
- 1 Basin
- 8 Stream-Table map sheets to be used for both slope (4) and flood investigations (4)*
- Stream-table setup sheet – 1 per group
- Landform vocabulary sheet – 1 per group

For the Class:

- 28 FOSS "Allyson scenario" worksheets*
- 28 FOSS "Allyson scenario" scoring rubrics*
- 28 FOSS Stream-Table Map scoring rubrics*
- 28 Cloze activity evaluation worksheets*

For the teacher:

- Pictures of the Grand Canyon*
- PowerPoint presentation of flooding on global, national and local levels*
- Duct tape*
- Paper towels*
- Newspaper*
- Water*

Stream-tables should be prepared before teaching lesson. Materials should be displayed for ease of gathering by groups.

FOSS Landform Unit and NCSCOS provide detailed instructions and guidance for teaching this lesson. The fifth grade class at Pitts School Road Elementary uses the FOSS science instructional plan in alignment with the NCSCOS. FOSS science kits provide the majority of the materials needed. The following websites: http://www.fossweb.com/modules3-6/Landforms/index.html and http://www.dpi.state.nc.us/curriculum/science/units/elementary/ provide many teacher resources for use with the unit. Guidance and FOSS literature were provided by Ms. Florance, a 5th grade teacher at Pitts School Road Elementary in Cabarrus County. Items noted with an asterisk (*) will be provided by the teacher or school.

- **Estimated Time**: 90 – 120 minutes; slope investigation will take 30-40 minutes, flood investigation will take 30-40 minutes. Supporting instruction will take 30-40 minutes.

Accommodation for Special Needs: ELL students will benefit from the hands-on nature of the investigations. Working in collaborative groups will also be beneficial, as ELL students will hear vocabulary related to the stream-tables in a relevant context. Students with special needs related to ability will also benefit from the kinesthetic nature of the stream-table investigations.

Content and Strategies (Procedure)

Engage: The Grand Canyon is one place where erosion has taken place on a grand scale. Geologists are still trying to figure out how the Colorado River could have carved such a deep canyon. They have come up with several ideas that might explain what happened. One idea is that the slope of the Colorado Plateau became steeper and caused the canyon to erode faster. Show these slides from the following web address: http://www.lewistonschools.net/staff/ajackson/TESLA/Unit%20Resources/Gr%206%20Landforms/LE%204%20Grand%20Canyon.pdf

Slope is the angle or slant of the stream channel or the land's surface. Ask students: *How could you use the stream tables to find out whether slope of the land makes a difference in how fast the earth material erodes?* If students don't suggest it, recommend using a wood angle to prop up the water-source end of the stream-table. Explain that half of the groups will conduct the investigation with no change in slope and half will change the slope by using a wood angle.

Explore: Assign groups that will conduct a standard investigation and groups that will conduct a slope investigation. There should be four students per group. Group members will have distinct roles of getters, recorder, and speaker to be determined by the teacher. Explain that each student will use a stream-table map to label the investigation as either "slope" or "standard." The getters watch for changes using the hand lenses and communicate to the recorder. Getters will also track elapsed time on the stop watch. The recorder will record events, observations and times during the investigation. Each group will pour one liter of water through their stream-table system. The recorders will record the starting time of the water stream and the ending time of the water stream. After the investigation is complete, all students should complete their individual stream-table maps. They should record two kinds of information: a drawing of the final results of the investigation and a written sequence (first, second, third, etc.) of the important events and the elapsed time at which they occurred. Students will be given stream-table map scoring rubrics for guidance and expectations.

Ask: *How would you describe the way the earth materials are moving down the stream-table? What type of landform is evolving? What interesting features do you notice about this landform? What do you observe about the speed at which the water is moving? What do you notice about the rate at which*

erosion and deposition are taking place? What shape is forming as the water slows near the flatter end of the slope?

Explanation: Speakers will share the results of their stream-table maps from both the standard and slope investigation groups. As the students convey the differences between the two investigations, draw attention to the fact that the earth materials in the sloped stream-tables moved farther and eroded faster. The canyon that was formed was deeper. The events also happened more quickly than those in the standard stream-table. Draw attention to the fan-shaped deposit that occurred as the flowing waters slowed upon reaching the flatter portion of the stream-table floor. Define this fan-shaped landform as an alluvial fan; similar to a delta. Tell students that geologists think that the surface of the Colorado Plateau was slowly tipping while the Grand Canyon formed. Ask students to think about what effect the slope of the Colorado Plateau could have had in the formation of the Grand Canyon. Encourage and support the thought of the idea that the Colorado River would flow faster if the slope of the land increased, thereby increasing the rate of erosion. The following video will be shown to reinforce the ideas learned throughout the investigation in relation to the Grand Canyon.

http://www.youtube.com/watch?v=d2iyFh7jZDo

Students will then use newspaper to absorb water from the stream-tables in preparation for the flood investigation. Students will prepare the earth material within the stream-tables as well. Students can use paper towels for cleanup. Water will be gathered in the 1-liter pitchers. Students will be given a new stream-table map for the flood investigation.

Explore: Groups will now investigate the effects of flood water on their stream-tables. All groups will conduct the investigation using the flood water cup. No slope will be added to the tables. The one liter of water will be poured onto the stream-table through a plastic cup labeled flood. Again, the recorder will draw and record observations and times, while the getters will watch for changes and communicate to the recorder. Getters will also keep track of elapsed time. After the investigation is complete, all students will write "Flood" on their stream-table maps. All students will then record their observations.

Ask: *How does fast-moving water erode the earth material? How would you describe the rate of erosion during flooding conditions? How would you describe the canyons formed due to flooding? What did you notice about the timing of erosion during flooding simulation?*

Explanation: Speakers will share the group findings of the flood investigations.

Ask: *What differences did you observe in the landforms when you used the flood water source? What differences did you notice in how long it took for features to form in the previous **standard** water flow versus **flood** water flow?* As the students explain their findings, lead them to understand that flooding caused wider, straighter canyons with more material eroded. Also, lead them to understand that material started to erode earlier in the flood setup. Tell students that sometimes great thunderstorms near the Grand Canyon send huge amounts of water down the side canyons. These events are called flash floods. Students will view a short PowerPoint presentation of photographs depicting flooding in

the Philippines, along the Mississippi River, and Cabarrus County in an effort to help them make connections between the flooding of the stream-tables and their world.


Flooding.pptx

Students will now view two videos from BrainPop:

http://www.brainpop.com/science/earthsystem/erosion/

http://www.brainpop.com/science/earthsystem/floods/

These videos reinforce the concepts of erosion and flooding from the Landform unit.

Elaborate: As an extension of the stream-table investigations, students will be given the following FOSS scenario:

"Allyson was very interested in the results of the investigations in the stream table. She had read about a flash flood on a river flowing through a steep canyon in Colorado several years ago. The flood caused quite a bit of damage to property and loss of lives. She wondered how she might set up an investigation in the stream table to find out what effect flooding would have on a stream with a steep slope."

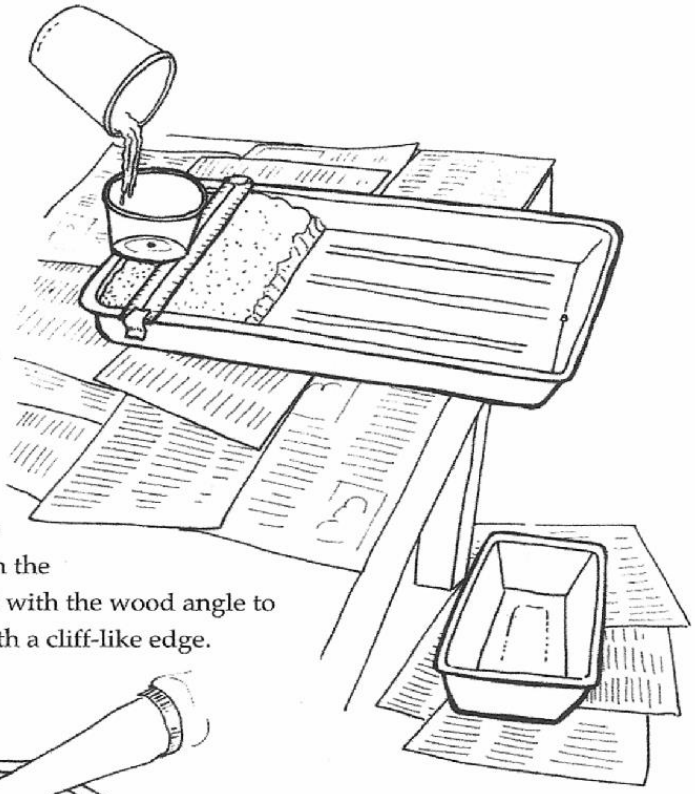
What advice can you give her about setting up her investigation? How will she know what changes were caused by flooding?

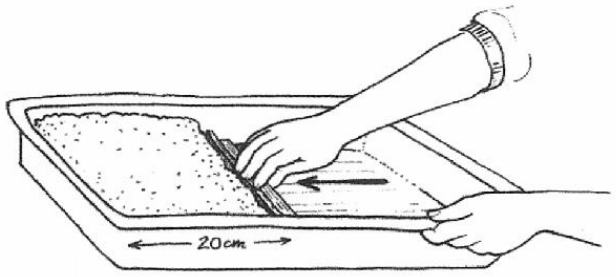
Students will be encouraged to use vocabulary from the landform unit along with the slope and flood investigations. Encourage students to compare and relate their findings as they advise Allyson. Students will also receive scoring rubrics indicating information needed for respective scores.

Evaluate: Informal evaluation will take place by way of teacher observation as students perform the investigations. A FOSS rubric scoring the stream-table map findings and drawings will be used. Also, a FOSS rubric will be used for scoring the students' "Allyson scenario" response sheet. These rubrics provide formative assessment. Students will post stream-table maps and findings along with the response sheets in their science journals. A cloze worksheet will be completed by each student in order to assess vocabulary knowledge related to the investigations and the effects of slope and flooding. The cloze activity is summative in nature for this particular portion of the unit, but not for the entire Landform Unit. Please find these assessment rubrics and worksheets in Appendix A.

STANDARD STREAM-TABLE SETUP

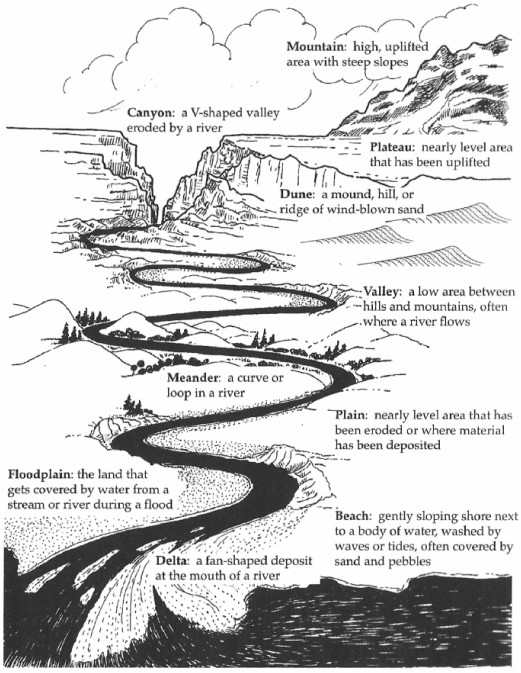
1. Cover the table with newspapers.
2. Position the plastic tray so that the end with the drain hole extends over the edge of the table.
3. Place the catch basin on newspaper on the floor under the drain hole.
4. Use the wood angle to push (bulldoze) the earth material to the end of the plastic tray away from the drain hole. Make sure it is all behind an imaginary line 20 cm from the end. Smooth the surface of the earth material with the wood angle to make a flat, even surface with a cliff-like edge.





5. Set a 30-cm ruler across the top of the tray about 6 or 7 cm from the end. Secure it in place with a couple of small pieces of duct tape.
6. Support the standard water source on the edge of the plastic tray and the ruler. Center it.
7. Use the 1-liter container to add water to the water source, as your teacher directs.

LANDFORM VOCABULARY



RESPONSE SHEET—GO WITH THE FLOW

Allyson was very interested in the results of the investigations in the stream table. She had read about a flash flood on a river flowing through a steep canyon in Colorado several years ago. The flood caused quite a bit of damage to property and loss of lives. She wondered how she might set up an investigation in the stream table to find out what effect flooding would have on a stream with a steep slope.

What advice can you give her about setting up her investigation? How will she know what changes were caused by flooding?

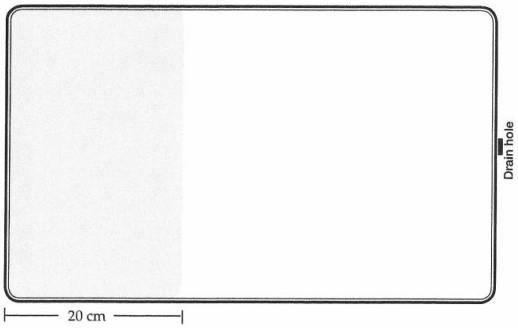
Flood Guided Notes

Sediment	**Larger**	**Decreases**	**Delta**
Alluvial Fan	**Steepness**	**Deposition**	**Erosion**
Deposited	**Increases**	**Amount**	**Deposition**

After investigating a flood within our stream table model, we learned that the _____ of the slope of the Earth's surface affects the amount of _____ and _____ by a stream. We also learned that the _____ of water flowing through a stream channel affects the rate of erosion. Steeper slopes result in faster-flowing water which has more energy and can carry _____ sizes and loads of materials; therefore faster-flowing water _____ the amount of erosion. However, as water travels over a less steep slope, its speed _____. When this happens, the water cannot carry as much earth material, also called _____, so _____ occurs. The largest pieces of Earth material are _____ first. First the boulders drop out, then the cobbles, pebbles and sand, then silt and clay particles. We also noticed a new landform today, called a (n) _____ which is the fan-shaped landform that is deposited at the bottom of a slope and is similar to a _____.

STREAM-TABLE MAP

This is an investigation of _____



KEY	Elapsed time (minutes after start)	Important events
Sand/clay earth mixture		
Sand		
Clay		

FOSS Scoring Rubrics

Student Sheet—Stream-Table Map	
Score	**If the student...**
+	draws an accurate map of the stream table after running water through it; records important events of erosion and deposition on the stream-table log.
√	draws a map of the stream table with minor flaws; records some of the important events of erosion and deposition.
–	cannot draw a reasonable representation of the stream table in the map space; does not record important events.

Response Sheet—Go with the Flow	
Score	**If the student...**
4	clearly defines the variables for which Allyson will be testing (slope and flood); describes a procedure: (1) runs a standard stream table or uses the record of the standard used in class, (2) runs a stream table with a slope and records data, (3) runs a stream table with a flood and records data, [redacted]; states that Allyson can determine the changes by comparing the records of her stream-table runs.
3	clearly defines the variables for which Allyson will be testing (slope and flood); describes a procedure that uses a standard, and compares it to other conditions tested (but not as detailed as above); suggests some way to make comparisons.
2	defines at least one variable (slope or flood); describes a procedure that compares stream-table runs; does not tell how to determine the changes.
1	suggests setting up a stream table in which the tray is supported to model a slope and the flood water source is used; does not include a standard run or a way to determine changes.
0	does not complete the task, or gives information that has nothing to do with what was asked.