

Water, Sediment, Energy, and Vegetation

Lesson Abstract

Summary:	Students will learn the interrelationships between water, sediment, energy (gradient), and vegetation which work together to determine stream channel stability. Students will focus on the effect of changing one variable at a time and examine the response to each change. In this lesson students will realize that stream channels can be so complex that any change in one component (water, sediment, energy, vegetation) can have dramatic effects on all components, up and down the stream and will change over time as well.
GLE:	4.1.A.6, 5.2.A.6, 5.3.A.6, 8.3.B.6
Subject Areas:	Science, Mathematics, Communication Arts
Show-Me Standards:	Goals – 1.6, 1.8, 2.1, 3.1, 3.4, 3.5 Strands – SC 1, 2, 5, 7, 8; MA 1; CA 6
Skills:	Observation, analysis, synthesis, compare and contrast
Duration:	1 to 2 class periods (50 minutes)
Setting:	Classroom
Key Vocabulary:	Channelization, dredging, stream channel equilibrium, levees, dams, dynamic equilibrium, bedrock

Rationale:

- Stream channel conditions are the function of these four variables: water, sediment, energy, and vegetation (primary components).
- A stream channel is constantly working within the conditions of these four variables to reach a state of dynamic equilibrium.
- A change in the condition of any one or more of these variables due to natural or human events will cause a change within a stream channel.
- The channel system will respond by a series of dynamic processes in order to achieve an eventual state of balance.
- Human activities such as channelization, stream gravel or sand removal, riparian zone clearing, dams, bridges, and other such occurrences in the stream channel disrupt the natural balance of streams and can affect water quality and aquatic habitat.

Student relevance:

- Students are given the opportunity to predict the changes that will occur in a stream channel when water, sediment, or energy is altered.
- Students will discover how vegetation can reduce or buffer changes in these primary components.

Learning Objectives:

Upon completion, students will be able to . . .

- Identify, compare, and contrast the primary components related to stream channel stability (water, sediment, energy, and vegetation).
- Identify, compare, and contrast both natural and human activities that affect the stability of a stream channel.
- Predict the outcome of a stream's stability given an increase or decrease within the primary components and determine what effect vegetation can have on these changes.

Students Need to Know:

- Water cycle process.
- Water runs downhill.
- Water erodes sediments.
- Vegetation decreases soil erosion.
- Sediments are deposited by water.
- Changes in sediment, vegetation, energy, and water in a stream will affect its stability.
- Human activities in a stream channel and riparian corridor directly affect stream stability.
- A disrupted stream affects fish, wildlife, and damage property.
- Gravel and sand are used for many construction and landscape projects.

Teachers Need to Know:

- The interrelationships between water, sediment, energy, and vegetation.
- The causes and effects of channelization.
- The causes and effects of proper and improper stream gravel or sand removal.

Resources:

The following materials are available at no charge from the Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102-0180, (573) 751-4115.

Sand and Gravel Removal and Stream Health: A Landowner's Guide (brochure)

Understanding Streams (brochure)

Stream Sense (video available for free loan from MDC Media Library)

Materials Needed for Lesson:

Figure Background Information (one per group)
Overhead transparencies *Figures 1 – 5*
Copies of *Figures 2, 3, 4, 5* (one per group)
Paper and pencils
Construction paper
Markers
Tape

Procedure:

Part One: Overview

- Review all previous learned knowledge through questioning.
- Have students brainstorm activities that take place within a stream channel or on a stream bank (swimming, boating, gravel or sand dredging, fishing, wildlife feeding, fish laying eggs, sediment settling).
- Have students list their ideas on notebook paper.
- Compile a master list by calling on students to read items from their lists. Separate natural from human activities. For example, human activities within or near a stream channel that will affect its stability area: channelization, gravel removal, bridges, dams, dredging, irrigation, clear cutting, construction, addition or subtraction of vegetation, pavement additions, levees, greenway development. Natural occurring activities that will affect a stream channel's stability are: flooding, earthquakes.
- Tell students that they are going to learn how these activities affect the stability of a stream channel and the aquatic life that lives within the channel.
- Place *Lane's Sediment – Water Scale* transparency on overhead.
- Discuss each variable through questioning and emphasize the point that it is natural for stream channels to alternate through stabilized and unstabilized states (however, human activities often increase the rate of change that normally occurs).
- Ask students to share any examples of erosion and flooding that they have seen along rivers and streams which verify this law.

Part Two: Nuts and Bolts of Water, Sediment, Energy, and Vegetation

- Divide students into groups.
- Provide each group with one of the four handouts for *Lane's Sediment – Water Scale* and a copy of the *figure Background Information*. (If possible, divide the class into eight groups so there are two water groups, two sediment groups, two energy groups, and two vegetation groups.)
- Instruct students to read, discuss, and study their handout for they are going to be the class experts on their topic.
- Have each group explain their handout to the rest of the class (student copies or an overhead transparency can be used for other students to follow).

- If short on time, call on just one of the two same topic groups to share their expert knowledge (allow the group not presenting to clarify, add, or correct the presenting group).
- Follow the order on the handouts for expert group presentations (water #2, sediment amount #3, energy (gradient) #4, and sediment size #5).
- As each group presents, emphasize the relationship between all four variables (ask questions which guide students into making these connections). Use the *Figure Background Information* as a guide to direct conclusions.

Part Three: Channel Changes

- Review content so far.
- Place the transparency *Figure 1*, on the overhead. Question students as to the contents. Emphasize the interrelationships (see *Figure Background Information* handout).
- Provide each group copies of the other figures so each group has *Figures 2 – 5*.
- Tell the groups to go over their figures and discuss the processes illustrated.
- Once each group thinks they understand all processes demonstrated in the figures, have them explain it to you for verification. Clarify any misconceptions with the group.
- Encourage students to discuss the interrelationships between the figures and to apply real life examples that they have seen.

Evaluation Strategies:

- Have students summarize the effects of channelization and gravel dredging on each stream channel component: water, sediment, energy, and vegetation.
- Performance Task: You have bought a farm bordering a stream. It has rich bottom land. Your goal is to preserve topsoil for soybean crops. Design a landscape plan and vegetative planting that will prevent erosion (floods and wind). Draw a diagram of your plans.

Extension Activities:

- Have students read the Missouri Department of Conservation brochure *Sand and Gravel Removal and Stream Health* and share their findings with the rest of the class.
- Demonstrate channelization and gravel removal on a Stream Table.
- Show the Missouri Department of Conservation film *Stream Sense*.
- Have students keep a record of all examples that they see of human or natural channel changes and include their observations.

Suggested Scoring Guide:

Water, Sediment, Energy, and Vegetation

Teacher Name: _____

Student Name: _____

CATEGORY	4	3	2	1
Contributions	Routinely provides useful ideas when participating in the group and in classroom discussion. A definite leader who contributes a lot of effort.	Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard!	Sometimes provides useful ideas when participating in the group and in classroom discussion. A satisfactory group member who does what is required.	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Quality of Work	Provides work of the highest quality.	Provides high quality work.	Provides work that occasionally needs to be checked/redone by other group members to ensure quality.	Provides work that usually needs to be checked/redone by others to ensure quality.
Problem Solving	Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems. Lets others do the work.
Focus on the task	Consistently stays focused on the task and what needs to be done. Very self-directed.	Focuses on the task and what needs to be done most of the time. Other group members can count on this person.	Focuses on the task and what needs to be done some of the time. Other group members must sometimes nag, prod, and remind to keep this person on-task.	Rarely focuses on the task and what needs to be done. Lets others do the work.
Working with Others	Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.	Usually listens to, shares with, and supports the efforts of others. Does not cause "waves" in the group.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.

Rubric Made Using: **RubiStar** (<http://rubistar.4teachers.org>)

Figure Background Information

Please note that this model only represents changes that can happen in a theoretical alluvial system without bedrock controls or human influences such as bridges. It is only useful to teach the fundamental reactions that stream channels can have from primary component changes, not the more complicated (and often real life) situations.

FIGURE 1:

This is a disgrammatic representation of E.W. Lane's (1955) water and sediment scale. This model shows relationships between water, sediment, energy (gradient), and channel responses from changing one component at a time.

FIGURE 2:

Water . . . Decrease the amount of water in a system and the channel responds by filling in.

Examples of how this can happen: Drought, irrigation, dams, water withdrawals.

How can vegetation affect this change? This change can encourage more vegetation growth in the channel and on stream banks.

Water . . . Increase the amount of water in a system and the channel responds by downcutting.

Examples of how this can happen: Heavier rainfall than normal, more pavement, clear cutting, etc.

How can vegetation help buffer this change? Vegetation can help slow the velocity of the water which will help slow the erosive force of the water.

FIGURE 3:

Sediment Amount . . . Increase the amount of sediment in the system and the channel responds by filling in.

Examples of how this can happen: Accelerated erosion, channelization and improper gravel mining.

How can vegetation help buffer this change? Vegetation holds soil in place, slowing erosion.

Sediment Amount . . . Decrease the amount of sediment in the system and the channel responds by downcutting.

Examples of how this can happen: Below a dam, reduced erosion. Downcutting from reduced erosion is a gradual thing and generally a positive response. Downcutting from reduced sediment below a dam can be dramatic and damaging.

How can vegetation affect this change? Vegetation helps reduce erosion, decreasing the amount of sediment to the channel.

FIGURE 4:

Gradient (or energy) . . . Increase the gradient in a stream system and the channel responds by downcutting.

Examples of how this can happen: Channelization, improper gravel mining, downstream of a poorly constructed low water bridge.

How can vegetation help buffer this change? Vegetation can slow water velocities which help reduce the erosive force of an increase in energy.

Gradient . . . Decrease the gradient in a stream system and the channel responds by filling in.

Examples of how this can happen: Gradient can be reduced upstream of a dam, upstream (for a short way) of a poorly constructed low water bridge, and from excessive sediment deposits.

How can vegetation affect this change? Vegetation helps hold soil in place and reduces excessive sediment deposits.

FIGURE 5:

Sediment Size . . . Increase the sediment size in a stream system and the channel responds by filling in. These larger particles cannot be as easily moved by water.

Examples of how this can happen: Improper gravel mining often leaves the largest sediment in the stream and only takes the smaller ones out.

How can vegetation help buffer this change? Since the water in the system cannot move these larger particles as easily, the water force tries harder to erode the smaller sediment particles from the stream banks. Vegetation will help slow this erosive force on the stream banks.

Sediment Size . . . Decrease the sediment size of the particles in a stream system and the channel responds by downcutting.

Examples of how this can happen: Increased stream bank erosion, gully or field erosion.

How can vegetation affect this change? Once again, vegetation helps hold soil in place, which reduces the potential of erosion.

FIGURE 1

LANE'S SEDIMENT – WATER SCALE

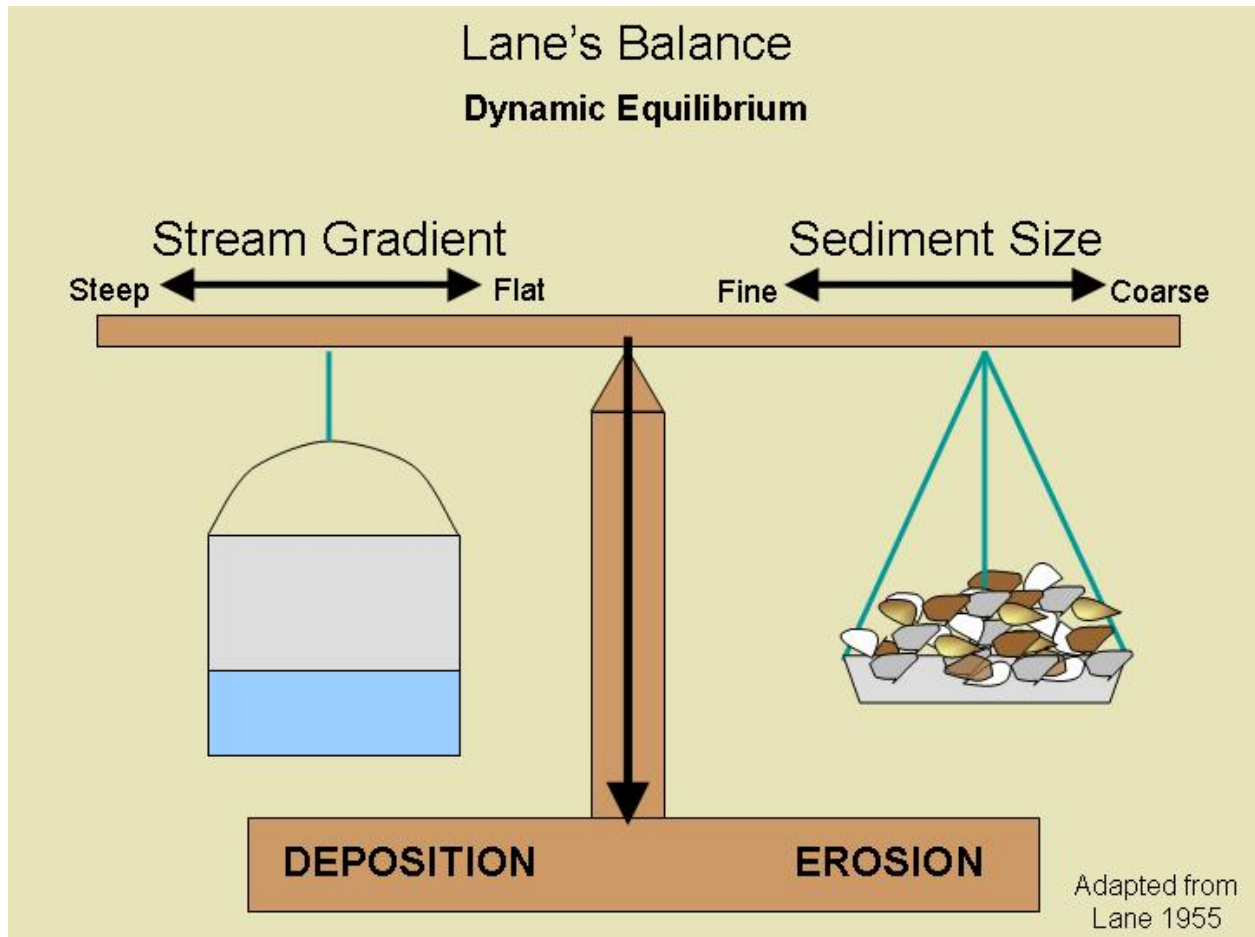
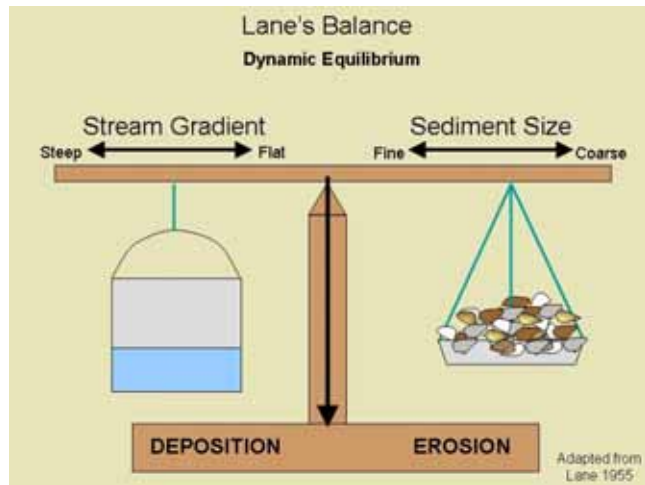
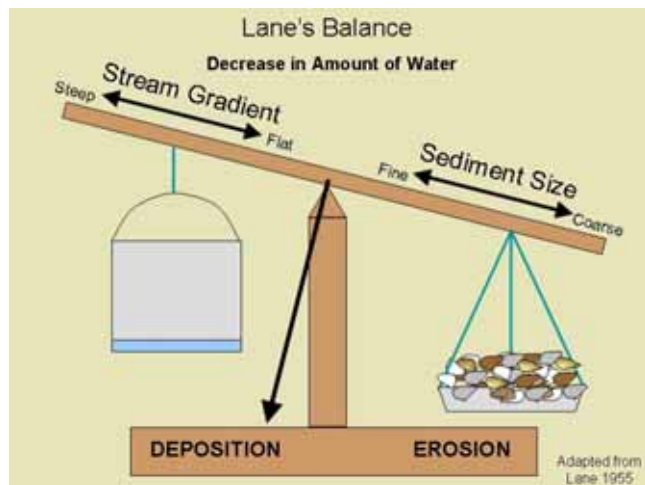


FIGURE 2



With a decrease in the amount of water, the channel responds by filling in.



With an increase in the amount of water, the channel responds by eroding.

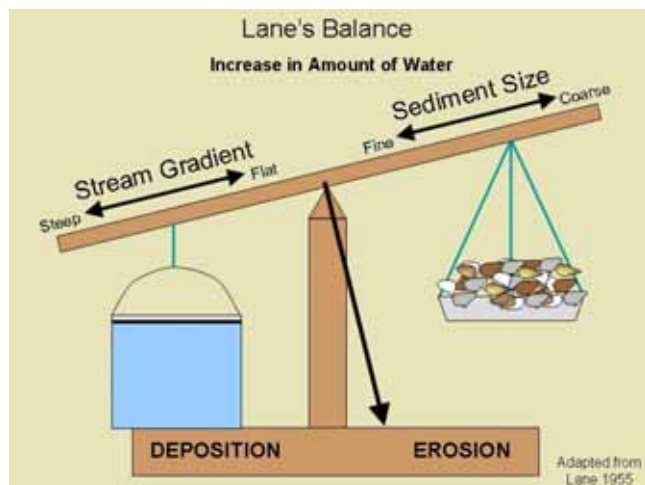
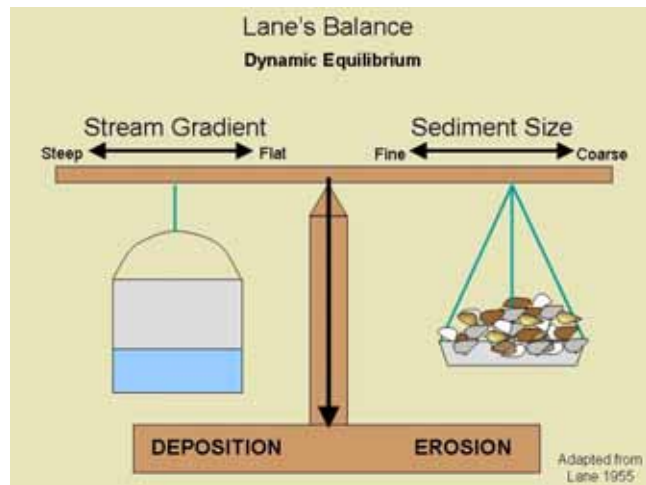
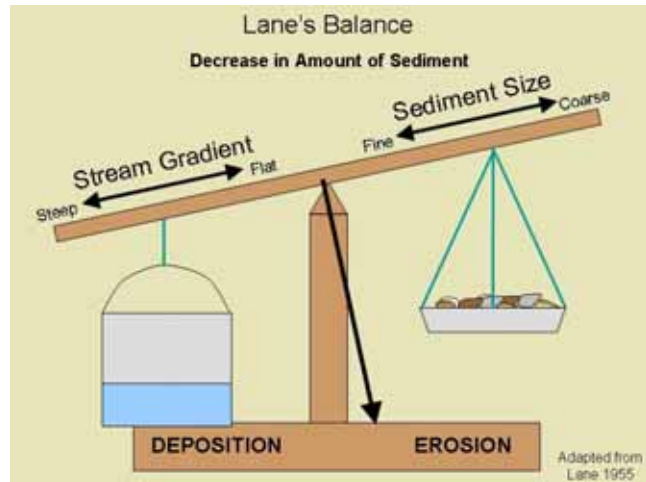


FIGURE 3



With a decrease in the amount of sediment, the channel responds by eroding.



With an increase in the amount of sediment, the channel responds by filling in.

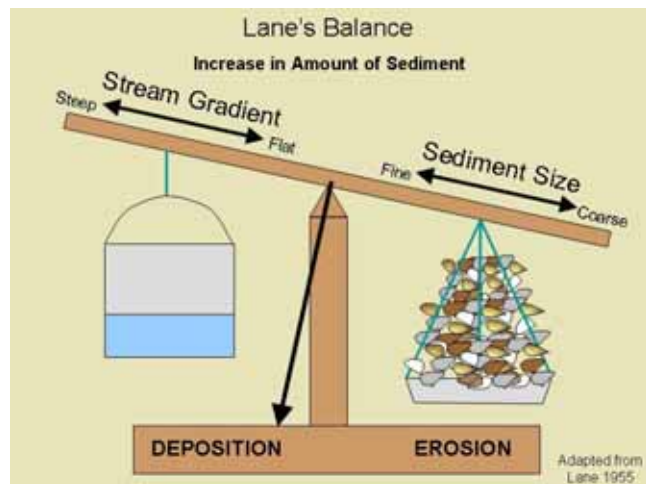
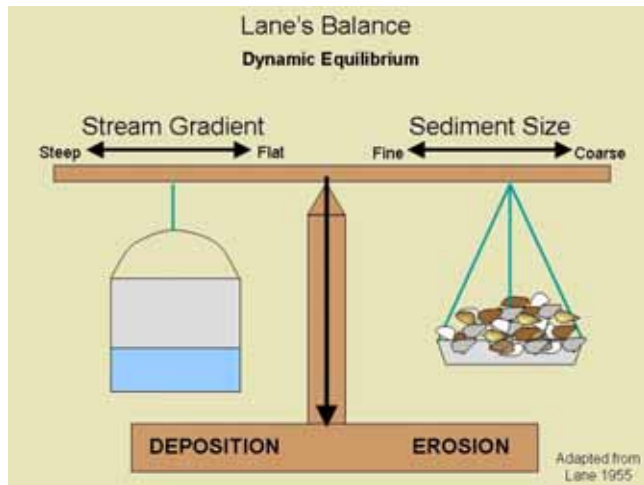
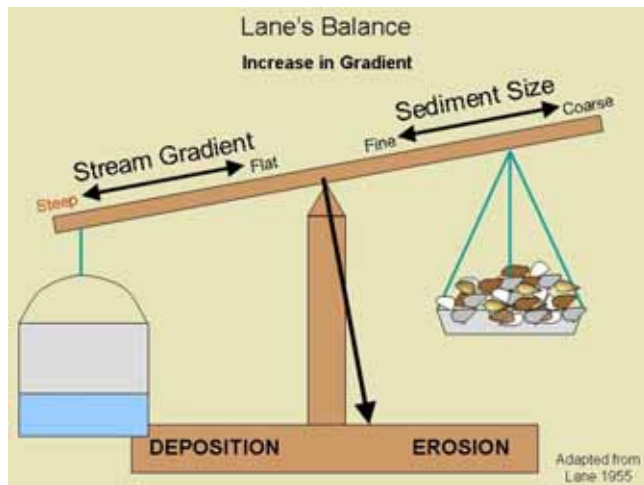


FIGURE 4



With an increase in gradient, the channel responds by eroding.



With a decrease in gradient, the channel responds by filling in.

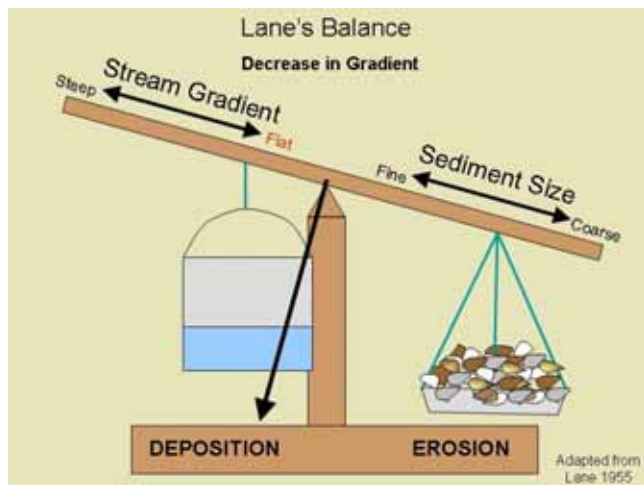
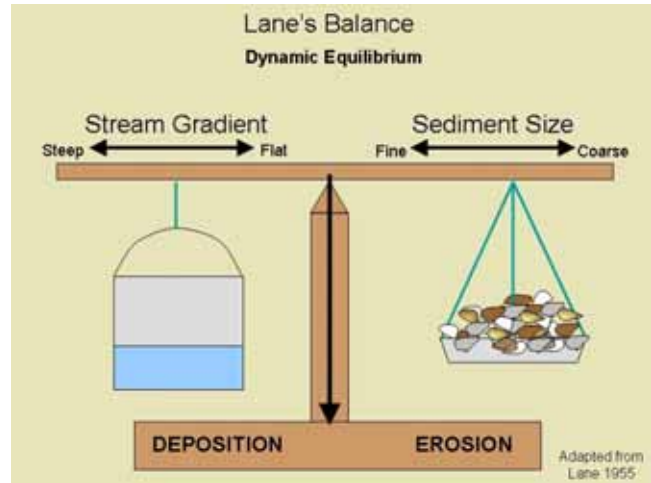
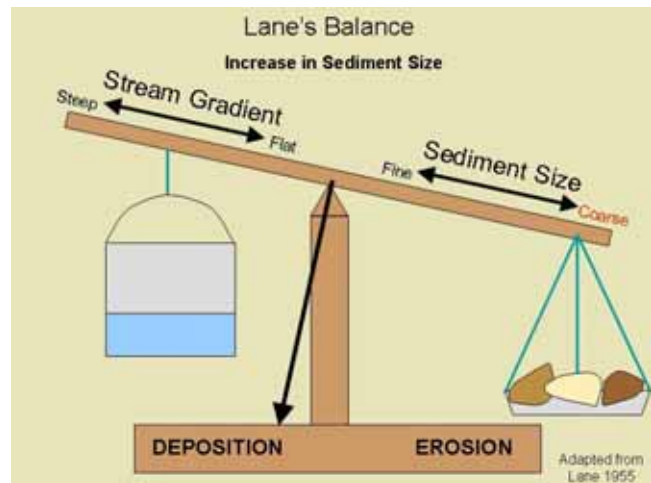


FIGURE 5



With an increase in sediment size, the channel responds by filling in.



With a decrease in sediment size, the channel responds by eroding.

