

## Short Float

### Lesson Abstract

<b>Summary:</b>	This lesson involves a warm-up physical activity where water, Speed, and channel pathways are compared and contrasted. The main component of this lesson is the use of a graphing exercise with dependent and independent variables.
<b>MO GLE:</b>	4.1.D.6,5.1.A.6, 5.3.A.6, 7.1.A.6
<b>Subject Areas:</b>	Science, Mathematics
<b>Show-Me Standards:</b>	Goal – 3.5 Strands – SC 1, 4, 5, 7; MA 2
<b>Skills:</b>	Observe, analyze, predict, compare and contrast, graphing with dependent and independent variables
<b>Duration:</b>	1 to 2 class periods (50 minutes)
<b>Setting:</b>	Classroom
<b>Key Vocabulary:</b>	Channelization, headcutting, meandering, erosion, deposition, sinuosity, Fluvial Geomorphology, equilibrium

The previous lesson; ***Water, Sediment, Energy, and Vegetation*** is a prerequisite to this lesson. It will provide for a better understanding of the relationships discussed.

### Rationale:

- The channel of a stream is a vital component of a stream's physical nature.
- Physical variables such as a stream's gradient (or slope) and velocity can be altered from its natural form, which can cause excessive erosion, deposition, and habitat degradation throughout the stream system.
- Students will have the opportunity to discuss how channelization effects stream power.
- Graphing displays complex information in a format that makes it easier to distinguish cause and effect relationships.

### Student relevance:

- Streams provide opportunities for recreation.
- Improper management practices in the stream channel can harm a stream's aquatic ecosystem, general aesthetics, and dynamic balance.

- Channelization is a management practice that causes headcutting, increases erosion and deposition in streams and is a poor management practice.

## Learning Objectives:

Upon completion, students will be able to . . .

- Compare and contrast characteristics of natural meandering streams versus and channelized streams.
- Graph the miles and elevation changes in a natural meandering stream and the same stream after channelization.

## Students Need to Know:

- Water flows downhill.
- Steeper gradients (or slopes) increase water velocity which increase stream power.
- Water erodes stream banks and bottoms.
- Increased stream power increases erosion.
- The more a stream meanders (greater the distance traveled), the slower its speed or velocity.
- How to graph using dependent and independent variables
- How to determine what increment to use when making a graph

## Teachers Need to Know:

- Characteristics of natural meandering streams that are in equilibrium.
- Interdependent relationships between stream gradient and velocity.
- The effects of channelization on a stream's gradient and velocity and the aquatic ecosystem.
- How to instruct students to set up a graph using dependent and independent variables after formulating a hypothesis.
- The definition of Fluvial Geomorphology. (glossary) **\*Fun Word**

## Key for teacher on instructing the use of dependent and independent variables in graphing.

1. Write a Title: The Effect of the Independent Variable on the Dependent Variable
2. State a Hypothesis: If the (Independent Variable) is (describe how you changed it), then the (Dependent Variable will describe the effect.) ( "If, then" statement)

**Independent Variable** – The variable that is purposely changed. The thing you change or manipulate. The thing I change. (Always the X axis)

**Dependent Variable** – The variable that responds in an experiment. What results from the experiment?

**Constants** – Things that are kept the same in an experiment.

**Levels of the Independent Variable** – The ways that you changed the independent variables.

**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.

*Building and Using the Stream Table*

*Using the Stream Table* (video for free loan from MDC Media Library)

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

*Classic Stream Problems – New Stream Solutions*

*Volunteer Water Quality Monitoring Program* (available with volunteer water quality training workshop)

*Understanding Streams* - A workshop offered by Missouri Department of Conservation every two years. Check with the Stream Unit at: 1-800-781-1989 for date of workshop (recommended)

*River Cutters, Activity Guide* for 6-9 - Available from LHS Gems, Lawrence Hall of Science, University of California, Berkeley, CA 94720, (510)642-7771.

Welch, P.S. *Limnological Methods*. New York: McGraw-Hill, 1948. (p. 377)

*Geologic Wonders and Curiosities of Missouri* - Available from the Missouri Department of Natural Resources, Division of Geology and Land Survey, P.O. Box 250, Rolla, MO 65402, (573)368-2125.

**Photo Gallery**

*Provided by Missouri Department of Conservation Stream Technical Unit*



**Channelized river**



**Bank erosion**



**Headcutting**



**Headcut moving up tributaries**



**Deposition of sediments downstream from a highly channelized river section**

### **Materials Needed for Lesson:**

- Two tennis balls

Lesson One: Down Stream Relay (Fun Warm up for Lesson Two)

- Divide the class into two teams.
- Designate identical start and finish lines for each team.
- Line up one team in a straight “channel” line and line up the other team (which will require more members) in a meandering line. Both lines begin and end at the start and finish lines.
- Give each team an object, such as a ball, and ask the students to pass the object from start to finish at the same rate.
- Repeat this process until the students realize that it takes longer for the object to travel down the meandering line.
- If time permits, have the meandering line slowly straighten so the students can see the relationship clearer.
- Discuss the relationship between stream length and distance (the meandering stream takes longer for the water to travel and the slower the water travels the less power the stream has to erode.)

### **Materials Needed for Lesson:**

- Graphing paper or Mylar for overlay
- Calculator

Lesson Two: Graphing using dependent and independent variables, formulating a hypothesis, and determining the decrease in distance and the increase in gradient of a channelized stream.

## Procedure:

Write pre-graphing questions on the board to discuss with the class. Have them write the questions and the answers discussed in class.

1. The independent variable in this experiment is the \_\_\_\_\_.
2. The dependent variable in this experiment is the \_\_\_\_\_.
3. The independent variable is always plotted on the \_\_\_\_\_ axis.
4. The dependent variable is always plotted on the \_\_\_\_\_ axis.
5. The title of the graph always includes: The effect of the \_\_\_\_\_ variable on the \_\_\_\_\_ variable.

Using Figure 1 set the stage for the students by describing a canoe float trip on a favorite river or stream.

Have the students note the elevations at each end of the river reach shown. (620, 590 ft) Note: Also the distance between the beginning and end of the float. (10 miles) Have the students divide the elevation difference ( $620-590=30$ ) by the distance in miles [ $(10) 30-10=3$ ] this gives you the feet per mile gradient (3 ft per mile gradient)

Figure 2 scenario shows the channelizing of a stream to eliminate a “S” curve meander in the river. Have the students calculate the new feet per mile gradient. Have the students discuss what this means to their float trip. Will they arrive at the end of the float at the same time? Or will their float trip be shortened? Discuss what effect this will have on the stream over time. Will the stream try to reach equilibrium once again? If so how will it achieve equilibrium? What will this mean to landowners upstream from the channelized reach? How might this effect aquatic life in the stream? Have students form a hypothesis.

**Have the students construct a graph showing the gradient (ft per mile) in Figure 1 and Figure 2.** If clear Mylar sheets are available, have them graph each on a separate sheet and then overlay them to see the changes. If the students use paper, have them use a different color for each plot. Multiple data sets are provided for elevation and river miles for the entire route on both figures. Have students write a summary of their conclusion.

## Evaluation Strategies:

- Students will graph using independent and dependent variables to demonstrate the difference in distance and slope (gradient) of a natural meandering unchannelized stream and the same stream after channelization.
- Students will demonstrate their understanding of independent and dependent variables by graphing the slope of a meandering and channelized stream
- Students will make a connection between the results of their graphing (gradient) and stream power by writing a short summary.
- Students will create the graph correctly with proper labeling

## **Extension Activities:**

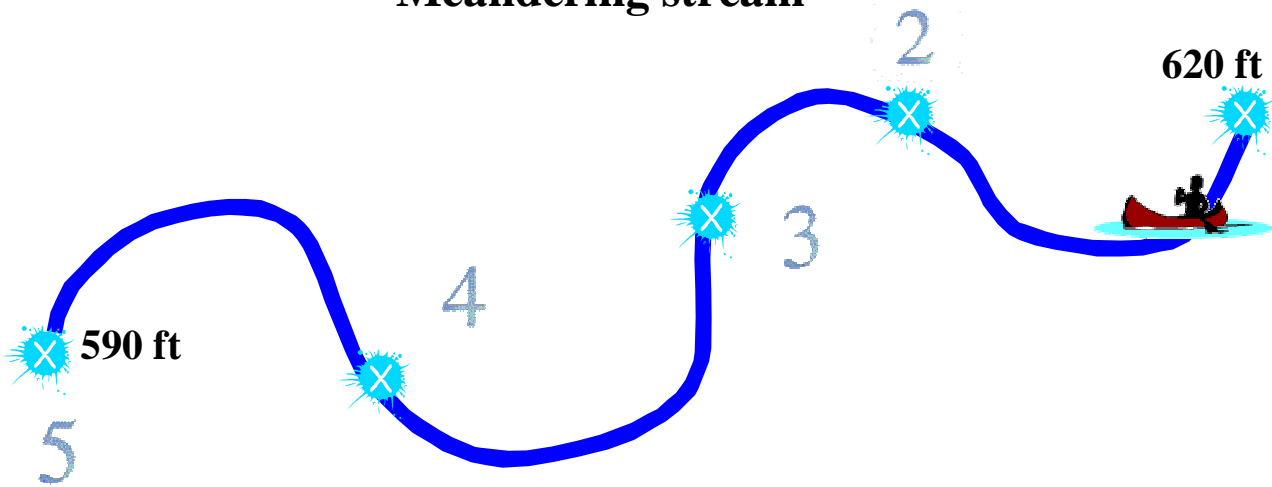
- Invite an employee of the Missouri Department of Conservation to bring a stream table to your school to demonstrate: Channel Stability – Channelization – Headcutting – Erosion

## Suggested Scoring Guide:

	<b>Points Possible</b>	<b>Points Earned</b>
1. Statement of hypothesis	10	
2. Graph:		
a. Proper Title	10	
b. Axes drawn and labeled	10	
c. Dependent variable and units labeled	10	
d. Independent variable and units labeled	10	
e. Appropriate scale	10	
3. Summary of Results	10	
4. Participation in discussions	10	
5. Pre-graphing questions	<u>20</u>	
Total Points Possible	100	

Figure 1

### Meandering stream



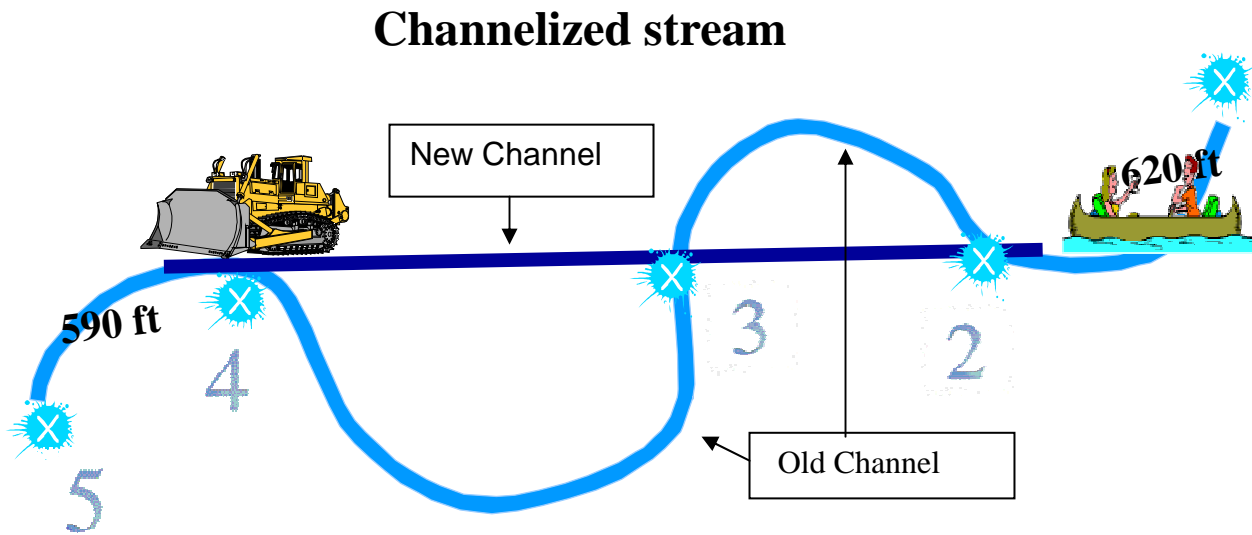
Length of Stream = 10 Miles

$$620 \text{ ft} - 590 \text{ ft} = 30 \text{ ft}$$

$$30 \text{ ft} / 10 \text{ Miles} = 3 \text{ ft per mile gradient}$$

<b>POINT</b>	<b>DISTANCE (Miles)</b>	<b>ELEVATION (FEET)</b>
1	0 Miles	620 feet
2	2.2 Miles	615 feet
3	3.8 Miles	610 feet
4	7.0 miles	600 feet
5	10.0 Miles	590 feet

Figure 2



**Length of Stream = 5 Miles**

$$620 \text{ ft} - 590 \text{ ft} = 30 \text{ ft}$$

$$30 \text{ ft} / 5 \text{ Miles} = 6 \text{ ft per mile gradient}$$

<b>POINT</b>	<b>DISTANCE (MILES)</b>	<b>ELEVATION (FEET)</b>
<b>1</b>	<b>0 Miles</b>	<b>620 feet</b>
<b>2</b>	<b>1.2 Miles</b>	<b>615 feet</b>
<b>3</b>	<b>2.8 Miles</b>	<b>610 feet</b>
<b>4</b>	<b>4.2 Miles</b>	<b>600 feet</b>
<b>5</b>	<b>5.0 Miles</b>	<b>590 feet</b>