Lesson 1: RIVERS NEVER RUN STRAIGHT

Three flip chart pictures introduce this subject.

Very little meander - Why?
First flip chart: "If we spent a lot of time flying we would recognize that rivers and creeks never run straight. Notice the little bit of "wiggle" in this river?"

Typical meandering
Next flip chart *"Here is more typical meandering pattern."*

Lots of meanders–A Braided Stream
Third flip chart shows extreme meandering to a degraded condition.

Trailer Set Up

Drop rear jack legs, reinsert pins, and crank down until jacks touch the ground. Adjust side-to-side level with rear jack legs. Adjust front to back slope using front crank and small level. Crank hitch jack up about 5 turns from level.

Use screed board to smooth and level grit, making it a constant depth throughout the upper ¾ of the pan. Leave the lower end of pan empty (approximately ¼ of pan). Excavate a "reservoir" at the upper end of the pan, from the vicinity of the inlet to the middle of the pan. Use screed to create a shallow, 1-inch groove through the center of the grit, approximately 1 inch deep, on the midline of the grit bed. Make slot deeper at the outlet end.

"The shortest distance between two points is a straight line. So this river should cut a straight path, right?"

Screed board is used to smooth and level grit.

Dig out a reservoir at top of slope connecting inlet to starting point of channel. Cut a shallow, straight groove down center.

Start flow -- one pump set at full flow.

"Look at what's happening in the stream channel."
"Where does the water flow the fastest: on the outside of the bend or the inside?"

Water spreads out then cuts unevenly to one side or the other.

A clear meander is soon established.

Sprinkle dry grit into the flow to show where the fastest flow on outside of bend.

"The outside of the bend is where water flows fastest and cutting occurs. The inside is where water is slow and sediment is deposited forming a point bar."

Next flip chart

"Why do streams form bends instead of running straight?"
"It's because the faster water flows, the more cutting power it has. When it flows a little faster on one side than the other, it erodes the bank on that side. In slower areas it deposits sediment. If you watch the model you will see one side cut while the other builds up, forming a curve. The process of erosion and deposition may change from one side to the other as banks collapse into the stream. In the real world, there may also be bedrock, boulders, or differences in the soil that start this process.

"The outside of the bend is the cutting zone and the inside is where sediment is deposited."

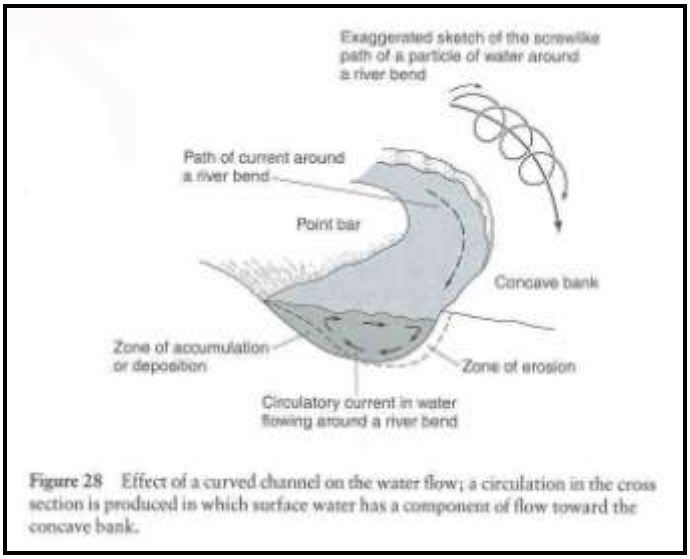


Figure 28 Effect of a curved channel on the water flow; a circulation in the cross section is produced in which surface water has a component of flow toward the concave bank.

Why do streams meander?

"The faster water flows, the more cutting power. Watch what happens when I increase the speed of the water by increasing the slope.

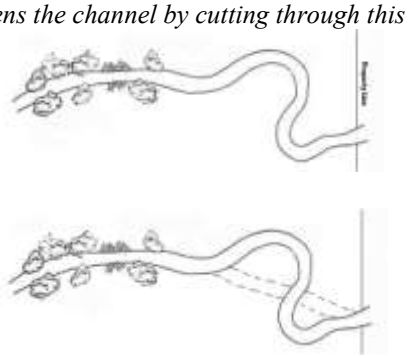
Crank up the front of the trailer, one turn, to speed up the flow. Point out faster cutting of either the outside curves or the streambed.

"Meanders are nature's way of overcoming this problem. When a channel meanders not only is there more stream bank to absorb the energy of the water, but the slope is reduced so the water flows slower."

Reduce trailer slope and observe reduced bank and bed cutting

Next flip chart.

"Mr. Jones is worried about flooding on his land. He wants to get the floodwaters off his land quicker. What do you think will happen if he straightens the channel by cutting through this meander?"



What happens if you straighten a stream?

"Let's setup the model to see." "I'm going to cut through this meander."
" I want you folks to watch closely to see what happens to the stream velocity. Where is sediment deposited? Where does bank cutting occur? How long before the new channel begins to meander?"

Cutting through a bend to straighten the creek.

Conclusion:

"Cutting through a stream meander usually means disaster. Meanders are nature's way of slowing the flow to protect the flood plain from serious erosion."

Optional Exercises

Basic exercise for students
Turn off flow. Set stream channel board with one edge on the lip of trailer and other on the grit. Place a scoop or other object under the upper end of the board to increase the slope. At the lower end of the board build a small, hill of grit for the ball bearings to impact.

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Use the board with three grooves to compare straight and curvy channels.

"Which bead will travel fastest and reach the bottom first?" The bead in the straight groove, the curved groove, or the very curved groove."

"Which will have the most energy when it hits the grit at the bottom?"
Use one of the signs as a starting gate to release ball bearings at same time.

"OK kids, give me a one-two-three"

"Many landowners think a good creek should drain floodwaters as quickly as possible. Actually this is not good. The fastest one is really the loser because fast (high energy) water causes severe bank erosion. The more the stream meanders, the less energy they have for bank cutting.

"What is the slope of the channel?"

"We calculate slope as rise divided by run. Using a ruler, measure the height from top of the board to the bed of grit. This is called Rise. Measure the length of the channel using the flexible tape measure. This is called Run.

"Divide Rise by Run to get slope.

"Water flows slower in the meandering channel. Why?

"Just like driving in the mountains - the roads switches back and forth to keep your car's brakes from burning up. Meanders in the creek slow the flowing water so there is less cutting and less bank erosion."

One theme of the different stream trailer lessons is, *"With water, slow is good. We like slow rains and slow flowing creeks and even slow floods because they all let more water soak into the ground and cause less soil erosion."*

Optional exercise for students in higher grades

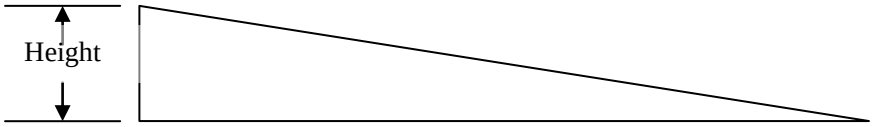
Use Stream Channel Slope, Velocity, and Erosion Potential Worksheet to record times, distances, and elevations to calculate slopes and velocities. (See last pocket in the flip chart book for copies of worksheet.) The worksheet explores the effect of sinuosity on slope and provides a comparison of the erosion power of flowing water. Use measuring tape in box for Lesson 1.

Stream Channel Slope, Velocity, and Erosion Potential Worksheet

Channel	Height (inches)	Length (inches)	Slope (percent)	Time (seconds)	Velocity (inches/ second)	Relative Erosion Potential (velocity^2)
Channel 1 Gentle curves						
Channel 2 Straight						
Channel 3 Tight curves						

Procedure:

1. Measure the vertical height of the upper end of the board .



2. Measure length of each channel using flexible tape, string, or a map wheel.
3. Calculate the percent slope. Slope = (height/length) x 100.
4. With a stopwatch, measure the time it takes for the ball to go from top of each channel to the bottom.
5. Calculate velocity. Velocity = length/time.
6. Relative erosion potential = Velocity x Velocity (erosion potential is related to the square of velocity).

Questions:

1. Which slope is the steepest? _____
2. Which slope is the shallowest? _____
3. What 3 factors determine the velocity in each channel? _____ _____ _____
4. If you straighten a channel what will happen down stream? Why?

_____

_____

Extra Credit: Sinuosity is the ratio of the actual channel length to the straight-line length from one end of the channel to the other. Calculate sinuosity for each channel.

Channel 1 _____ Channel 2 _____ Channel 3 _____

On a topographic map you can calculate sinuosity as the ratio of average valley slope to average channel slope. Why is this the same and why?