# Hands-On Watershed Education

# With

# The River Table

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*"Working Together for Healthy Watersheds on the Kenai Peninsula"*

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# Introduction

Alaska's rivers and streams are at the heart of local ecosystems, cultures, and economies. Wild salmon, clean drinking water, and healthy landscapes all depend on functioning watersheds. Yet most people rarely get the chance to *see* how rivers form, change, and respond to both natural forces and human actions.

The EM2 Stream Table provides a hands-on way to explore these ideas. By using sand, water, and props, learners can simulate river processes, observe erosion and deposition, and test how different land uses affect water quality and habitat. Whether in a classroom, at a community event, or outdoors, the stream table helps people connect science to real places.

This packet contains lesson plans and supporting materials developed by the Kenai Watershed Forum and partners. The lessons are designed for a range of audiences:

- Grades K–5: engaging, interactive lessons with strong visual and storytelling components.
- Grades 6–12: deeper explorations of processes, data collection, and analysis.
- Adult and Community groups: practical demonstrations that highlight local issues such as riparian buffers, erosion, and culvert design.

Each lesson includes:

- Background for Educators to provide context and confidence.
- A Vocabulary Box highlighting key terms.
- Preparation and Setup steps for the stream table.
- Activities with slide callouts and discussion prompts.
- Assessment or Reflection ideas when appropriate.
- References and Resources to connect lessons to Alaska science standards and real-world policy guidance.

Vocabulary is reinforced in two ways: short definitions in each lesson's vocabulary box, and a comprehensive glossary at the end of this packet. Worksheets are included immediately following the lessons where they are used, along with answer keys for facilitators.

Lessons are intended to align with the Alaska State Science Standards where applicable. Standards are listed at the end of each lesson, and a consolidated bibliography provides sources for all figures, references, and policy notes.

You do not need to use this manual cover-to-cover. Facilitators are encouraged to select the lessons, or parts of lessons, most appropriate to their audience and setting, as well as include their own material and improvisation. Whether working with elementary students, high school classes, or Kenai Peninsula landowners, the stream table offers a powerful way to make the dynamics of water, land, and people visible.

## Support and Development

The EM2 River Table was acquired by Kenai Soil and Water Conservation District (KSWCD) in 2021. Ongoing financial support for Kenai Watershed Forum is provided by KSWCD. Kenai Watershed Forum's Galen Hecht and Megan Morris produced early versions of these educational materials. KWF's Katey Shedden expanded and formalized content in to lesson plans. Benjamin Meyer edited all content into this manual. We made occasional use of ChatGPT at the final stage of drafting this document to help lesson plans maintain consistent style and conform to science education standards.

# Setup Instructions

## Materials Checklist

River Table Kit (provided with EM2 model):

- Aluminum basin
- Sawhorses (2)
- Reservoir tub
- Tubing and spout
- Stopper
- Diffuser
- Four buckets of substrate (sand mix)
- Pump
- Plug/battery adapter
- Straining net
- Box of props and tools (plants, animals, culverts, Lego figures, houses, roads, etc.)

### Additional Materials:

- 20–25 gallons of fresh, cold or room-temperature water (avoid hot water; it promotes bacterial growth). Bring to site with 5-gal buckets if no water is available on-site
- Tarp or protective floor covering (indoors or on grass)
- Extension cord and/or battery hookup (for settings without outlets)
- Blue and green food coloring or dye (to visualize groundwater and surface water)
- Photos or diagrams (for comparison with real rivers)
- Broom, dustpan, or shop-vac (for cleanup)
- Towels or rags
- Wash bucket (water to be used for hand rinsing after session)

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## Safety and Rules of Engagement

- **Hands on / hands off:** Decide when learners may touch the table and when observation is best.
- **Sand hand:** Sand should stay in the table, on a hand, or in a wash bucket—not scattered.
- **Water and wires:** Keep cords, plugs, and pumps dry and secure. Supervise closely with younger students.
- **Respect the props:** Items like culverts, buildings, and trees represent real-world features. Encourage careful use.
- **Cleanup expectations:** Everyone helps return props to the box, empty buckets, and dry surfaces.

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## Setup Steps

1. **Choose the space.** Ensure enough room for learners to gather around. Place tarp if outdoors or on carpet.
2. **Position the sawhorses.** The stream table must slope downstream. Align sawhorses with braces under the table for stability.
3. **Insert the stopper** at the base of the table.
4. **Add substrate.** Pour all buckets of sand into the basin. Spread evenly.
5. **Fill reservoir.** Add at least 20 gallons of water; the pump must always remain fully submerged.
6. **Assemble pump system.** Connect tubing, spout, and diffuser. Plug into outlet or battery pack.
7. **Prepare wash bucket.** Audience members with sand on their hand will need to rinse off afterwards by submerging their hands in a bucket of water.
8. **Check water flow.** Turn on pump briefly to confirm circulation and that water returns smoothly downstream.
9. **Prepare props.** Keep vegetation, buildings, and culverts nearby for quick access during activities.
10. **Review rules with learners.** Go over "sand hand" (use just one hand), safety, and cleanup before starting any activity.

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## Cleanup and Storage

- Drain and rinse sand after extended use to prevent odor. Allow substrate 4 – 8 days' time to fully dry prior to long term storage, turning over the substrate daily
- Dry the pump, tubing, and basin thoroughly before storage.
- Store props and laminated vocabulary labels in labeled bins.
- Allow at least 20 minutes for full breakdown and cleanup after each session.

# Lesson Plan: How Does a Watershed Work?

## Lesson Overview

| | |
|---|---|
| Audience | Grades K-5 and 6-12 |
| Timeframe | TBD |
| Objectives | Understand what a watershed is and learn vocabulary to describe river systems.<br>K-5: Recognize the Kenai River as a watershed and identify basic features.<br>6-12: Explore the role of development and intact ecosystems in watershed function. |
| Materials | EM2 River Table with included supplies; Props (astro-turf, roads, vegetation, vehicles, large rock for mountain); Rain pitcher; 'On the River' books; Watershed worksheet; Laminated vocabulary labels; Projector with 'Anatomy of a River' slideshow. |
| Standards Alignment | Alaska State Science Standards:<br>- 4-ESS2-1 (p. 94): Make observations to provide evidence of weathering/erosion by water.<br>- MS-ESS2-2 (p. 192): Construct explanations of how geoscience processes change Earth's surface.<br>- HS-ESS2-5 (p. 304): Plan and conduct an investigation of water's effects on Earth materials. |

## Background for Educators

An understanding of how sediment, vegetation, and flowing water interact to form stream channels is essential for local restoration, management, and education. Streams form as raindrops fall on high ground, join into brooks, and combine into tributaries that flow toward a mainstem river. Eventually these rivers reach the ocean, completing the water cycle as evaporation returns water to the atmosphere.

A basin of land that drains into a river system is called a watershed. The Kenai River watershed is a prime example: snowmelt and mountain streams form headwaters, joining into tributaries that feed the Kenai River before it empties into Cook Inlet. As water flows downslope, it interacts with soils, vegetation, and land use.

Water carries energy. This energy carves meanders, which lengthen streams and reduce slope. During floods, water spills onto floodplains if accessible; if not, the stream cuts into its banks, causing erosion.

Riparian vegetation stabilizes banks, filters pollutants, and shades streams. When vegetation is removed for roads or buildings, erosion increases. Human stabilization projects such as riprap may protect one site but transfer energy downstream.

Stream crossings (culverts, arches, bridges) allow travel across water but can harm fish passage if poorly designed. A perched culvert, where the outlet is higher than the streambed, creates a small waterfall that salmon cannot pass. Protecting stream connectivity is critical for fish survival on the Kenai Peninsula.

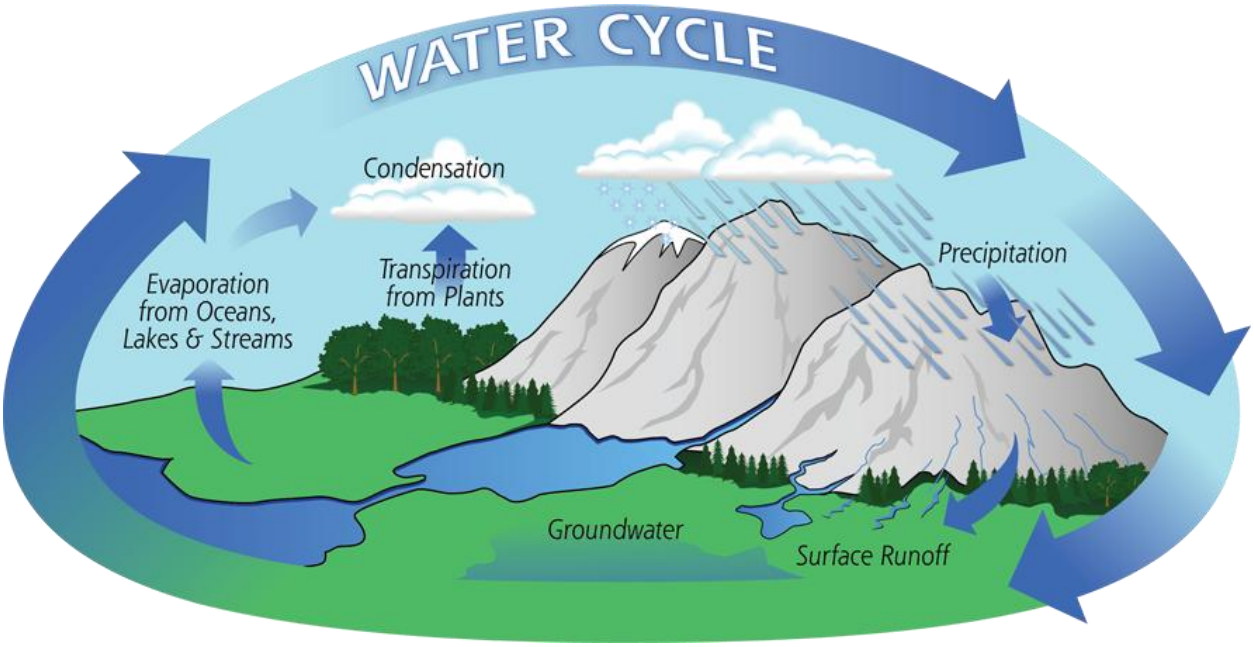



Figure 1. The Water (Hydrologic) Cycle. Source: NASA Precipitation Education Program

## Key Vocabulary

| | |
|---|---|
| **Watershed** | A basin of land in which all water flows to a common body, such as the Kenai River. |
| **Meander** | A winding curve or bend in a stream. |
| **Riparian Area** | Vegetated area along a stream that stabilizes banks and provides habitat. |
| **Floodplain** | Low-lying area that floods during high water events. |
| **Culvert** | Buried pipe that allows water to pass under a road; can block fish passage if perched. |
| **Erosion** | Process where earth materials are worn away and transported by water or wind. |

## Preparation/Setup

1. Set up EM2 River Table with 4 buckets of sand and about 20 gallons of water.
2. Ensure pump is fully submerged; connect to power or battery.
3. Prepare laminated vocabulary labels.
4. Ready the 'Anatomy of a River' slideshow.
5. Review safety rules ('sand hand,' water and wires, cleanup expectations).

## Activities

**Activity 1.1: Connection**
- Run a quick demo of the stream table.
- Each student introduces themselves and shares a favorite memory on the water.
- Show Slide 7: 'What is a Watershed?'
- Option: use laminated cutouts (Appendix A) to label parts of a watershed

**Activity 1.2: Watershed 101**
- Demonstrate groundwater, water table, and springs using props.
- Start with a straight channel, then show meandering and erosion.
- Show Slide 6: 'Groundwater' and Slides 13–15, 17–20, 22–25 (stream anatomy features).

**Activity 1.3: Student-Led Scenarios**
- Learners add props to simulate a lake, a delta, or development.
- Discuss impacts on water flow, sediment, and fish habitat.
- Show Slide 11: 'Lakes'; Slide 27: 'River Delta'; Slides 32–33: 'Impervious Surfaces' and 'Nonpoint Source Pollution'.

**Activity 1.4: Apply to the Real Kenai River**
- Guide students to observe the Kenai River (or use photos if offsite).
- Show Slide 12: 'Kenai River'.
- Students sketch the river channel and label features on the worksheet.

## Assessment/Closing

- Collect worksheets for review.
- Ask: 'How does the Kenai River watershed affect the land, water, and people who live here?'
- Summarize key points: water cycle, watershed, riparian role, human impacts.

## Extension/Reflection

- Homework: Visit a local stream with family; note erosion, vegetation, or human impacts.
- Reflection Prompt: 'What does riparian vegetation look like near your home or school?'

## References

- NASA Precipitation Education Program. Water Cycle Diagram. http://pmm.nasa.gov/education/water-cycle
- Kenai Watershed Forum. https://www.kenaiwatershed.org

- EmRiver EM2 Stream Table. https://emriver.com/models/em2/
- Slide references: 'Anatomy of a River' (Kenai Watershed Forum) slideshow

## Attachment 1: Watershed Worksheet

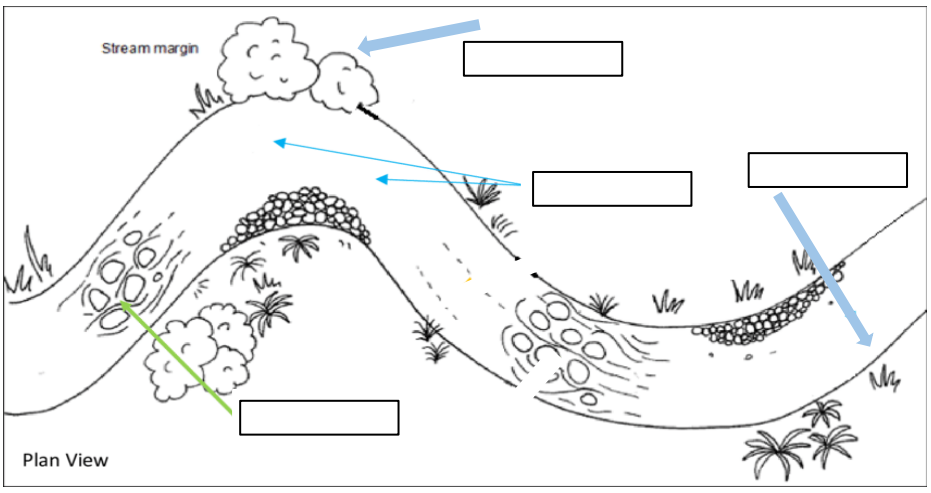
Name: _____ Date: _____

1. Vocab Matching (draw a line to the matching vocabulary definition)

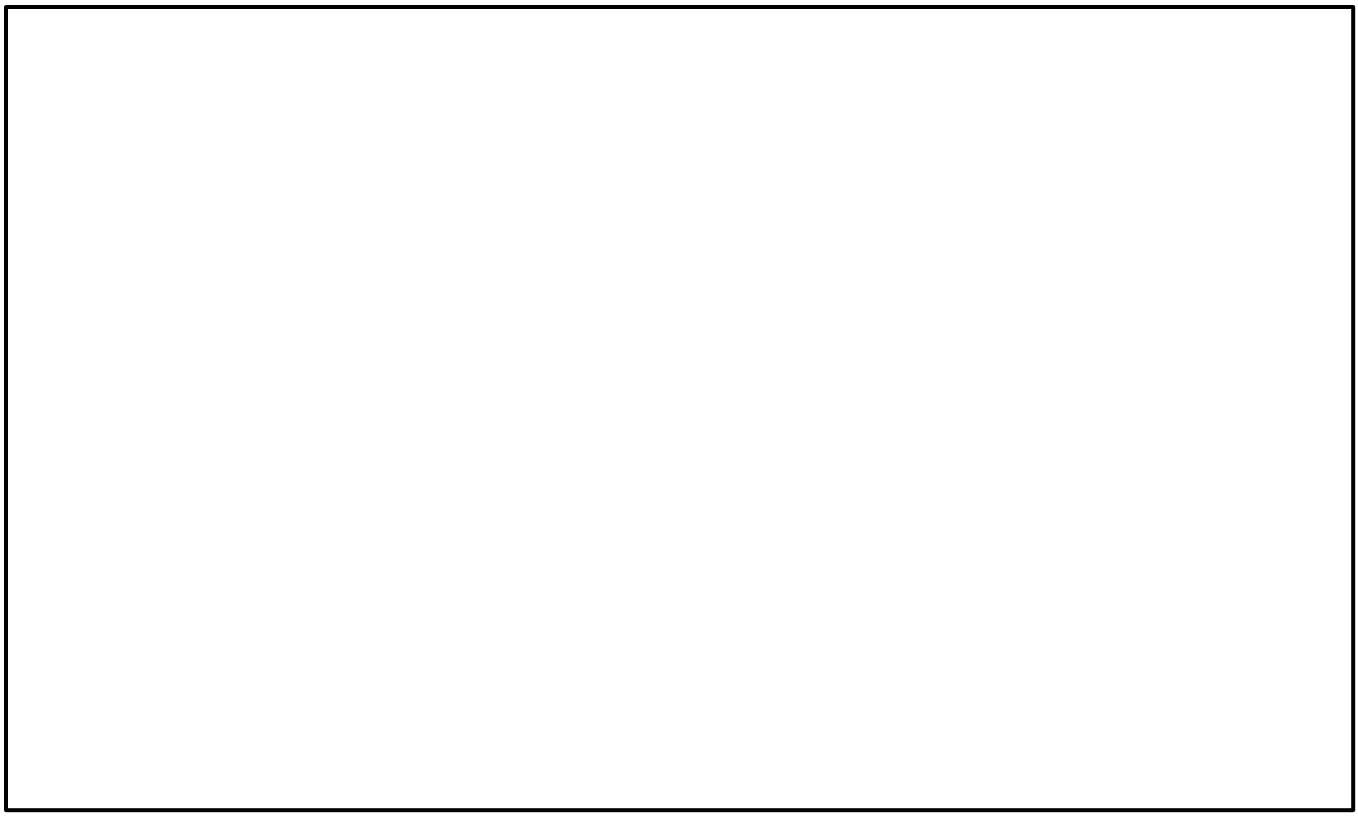
| | |
|---|---|
| Watershed | The natural home or environment of an animal, plant, or other organism |
| Habitat | A stream that flows into another stream or river; usually smaller than mainstem |
| Groundwater | Area where freshwater means the ocean |
| Tributary | A basin of land where all water flows to a common water body |
| Estuary | Subsurface water and underground streams |

2. Label the stream below with the following vocabulary:

Meander, Riparian Area, Riffle




3. Draw the river channel (Kenai River) and label the different parts:



# Lesson Plan: Fast Water, Slow Water

## Lesson Overview

| | |
|---|---|
| Audience | Grades 6-12 |
| Timeframe | TBD |
| Objectives | Students will explore how water speed and channel shape affect erosion and deposition. Students will recognize differences between fast and slow water, riffles and pools, and implications for salmon habitat. |
| Materials | EM2 River Table with included supplies; Pitchers of water; Stopwatch or phone timer; Laminated vocabulary labels; Optional: blue food coloring for visibility; Props to simulate vegetation and barriers; Projector with 'Anatomy of a River' slideshow. |
| Standards Alignment | Alaska State Science Standards:<br>- MS-ESS2-2 (p. 192): Geoscience processes changing Earth's surface.<br>- MS-ESS2-4 (p. 295): Develop models to describe cycling of water through Earth systems.<br>- HS-ESS2-5 (p. 304): Water's effects on Earth materials and surface processes. |

## Background for Educators

Rivers constantly change as water speed, slope, and sediment interact. Fast-moving water has more energy to erode banks and transport sediment. When water slows, energy is lost and sediment is deposited. This balance between erosion and deposition shapes riffles, pools, and meanders. In Alaska rivers, these features provide critical habitat for salmon: riffles oxygenate water, pools provide resting places, and gravel bars serve as spawning grounds.

On the Kenai River and its tributaries, high spring flows caused by snowmelt and glacial runoff create powerful erosion, while slower backwaters and sloughs deposit fine sediments. Human alterations such as bank hardening, channelization, or removal of riparian vegetation can accelerate erosion and reduce habitat diversity.

This lesson helps students connect the concepts of velocity, slope, and channel shape to real-world salmon habitat concerns. It encourages observation, measurement, and discussion of how water behaves under different conditions.

## Key Vocabulary

| | |
|---|---|
| Velocity | The speed at which water flows in a channel. |
| Erosion | The wearing away of earth materials by moving water. |
| Deposition | The process of sediments being laid down as water loses energy. |
| Riffle | A shallow, fast-flowing section of a stream with coarse substrate. |
| Pool | A deeper, slower-moving section of a stream, often with finer sediments. |

## Preparation/Setup

1. Set up EM2 River Table with water circulating steadily.
2. Prepare laminated vocabulary labels (Velocity, Erosion, Deposition, Riffle, Pool) (Appendix A).
3. Mark a section of the table for measuring flow (use tape or props to designate start/end).
4. Ready the 'Anatomy of a River' slideshow.
5. Have stopwatches or timers available for measuring water speed.

## Activities

**Activity 2.1: Observe Fast vs. Slow Water**
- Pour water quickly down the straight channel; observe erosion and transport of sand.
- Pour water slowly and observe deposition.
- Show Slide 14: 'River Channel' and Slide 19: 'Riffle'.

**Activity 2.2: Measure Velocity**
- Drop a floating object (e.g., small piece of vegetation or cork) at the upstream marker.
- Time how long it takes to reach the downstream marker.
- Repeat in different parts of the channel (riffle vs. pool).
- Calculate and compare velocities.

**Activity 2.3: Connect to Salmon Habitat**
- Discuss how salmon use riffles, pools, and gravel bars.
- Show Slide 20: 'Point Bar' and Slide 25: 'Floodplain'.
- Ask: How would bank hardening or channel straightening affect these habitats?

## Narrative Notes

Presenters may use these bullet points in conversation/presentation

KEY POINTS:

- Rivers can change shape and size over time due to the speed of the water.
- Faster-moving water can erode land more quickly than slower-moving water.
- Erosion and deposition are important processes that shape rivers.
- The landscape around rivers can be affected by these changes.

- Vocabulary: erosion, deposition, riverbed, flow.

OPENING:

- Begin with a question: "What do you think happens to a river when it rains a lot?" (snow melts, ice dam bursts?)
- Show a short video or image of a river during a flood.
- Engage students by asking them to share any experiences they have with rivers.

INTRODUCTION TO NEW MATERIAL:

- Use the sand and water river table to demonstrate how water flows and shapes land.
- Explain the concepts of erosion and deposition using simple language.
- Show examples of how faster water can move sand and rocks more effectively.
- Common misconception: Students may think that rivers do not change unless there is a flood, so clarify that rivers change gradually over time too.

GUIDED PRACTICE:

- Ask guiding questions: "What happens when we add more water? What if we slow down the water?"
- Monitor students as they play, providing support and prompting deeper thinking about their observations.

INDEPENDENT PRACTICE:

- Provide each student with a piece of paper and art supplies to draw their own river.
- Ask them to label parts of their river and write a few sentences about how water speed can change their river.
- Encourage creativity while ensuring they incorporate key vocabulary.

CLOSING:

- Gather students to share their drawings.
- Ask a few students to explain how their river might change over time and why that happens.
- Summarize the key points discussed in the lesson.

## Assessment/Closing

- Students share observations of where erosion and deposition occurred.
- Quick reflection: 'Which parts of the channel had the fastest and slowest water, and why?'

## Extension/Reflection

- Optional homework: Visit a local stream. Identify a riffle and a pool, describe differences in depth, speed, and substrate.
- Reflection Question: 'Why is a variety of fast and slow water important for salmon?'

## References

- Kenai Watershed Forum resources: https://www.kenaiwatershed.org
- EmRiver EM2 Stream Table: https://emriver.com/models/em2/
- Slide references: 'Anatomy of a River' (Kenai Watershed Forum) slideshow

# Lesson Plan: This Land is My Land

## Lesson Overview

| | |
|---|---|
| Audience | Adult and Community Groups (landowners, residents, community leaders) |
| Timeframe | TBD |
| Objectives | Participants will explore how land use decisions affect river systems and salmon habitat.<br>They will identify the importance of riparian buffers, recognize erosion risks, and evaluate stream crossing designs. |
| Materials | EM2 River Table with included supplies; Props (culverts, bridges, buildings, vegetation, vehicles); Handouts on riparian buffers and culverts; Projector with 'Anatomy of a River' slideshow. |
| Standards Alignment | Not applicable for adult/community lessons; focus is on practical land management and policy relevance. |

## Background for Educators

On the Kenai Peninsula, private landowners and community members play a major role in protecting salmon habitat. Healthy riparian buffers provide bank stability, filter pollutants, and keep streams cool for fish. When vegetation is cleared for lawns, driveways, or buildings, erosion increases and sediment enters the water, degrading habitat.

Stream crossings are another critical factor. Poorly designed culverts may block fish passage, increase erosion, or alter stream flow. Perched culverts create drops that salmon cannot cross, while undersized culverts may clog during high flows. Bridges or properly sized culverts that align with natural streambeds are far more effective for maintaining fish passage.

Kenai Peninsula Borough ordinances, Alaska Department of Fish and Game guidelines, and Alaska DEC resources all provide best practices for landowners. These include maintaining at least a 50-foot (or more) riparian buffer in sensitive areas, using vegetated stabilization methods instead of riprap, and ensuring culverts meet fish passage standards.

## Key Vocabulary

| | |
|---|---|
| Riparian Buffer | A strip of vegetation along a river or stream that stabilizes banks and filters runoff. |
| Perched Culvert | A culvert with an outlet above the downstream water level, creating a barrier to fish passage. |
| Nonpoint Source Pollution | Pollution that comes from diffuse sources such as runoff from land surfaces. |
| Bank Stabilization | Methods to prevent erosion, such as planting vegetation or using engineered structures. |

## Preparation/Setup

1. Set up EM2 River Table with water and substrate.
2. Prepare props for demonstrating riparian buffers, culverts, and bank development.
3. Have local policy/ordinance handouts available for older audiences (KPB, ADF&G, DEC).
4. Ready the 'Anatomy of a River' slideshow.
5. Invite participants to share examples from their own land or community.

For mature or well-behaved audiences, use their input and hands-on assistance to carry out the following activities. For example, all audience members get to choose where they want to place “their” house.

## Activities

**Activity 3.1: Riparian Buffers**
- Demonstrate a stream with intact vegetation versus one with cleared banks.
- Observe erosion differences and water clarity.
- Highlight Slide 29: 'Riparian Area'.

**Activity 3.2: Stream Crossings**
- Place a perched culvert prop and show how water and sediment back up.
- Replace with a properly sized culvert or bridge; observe smoother flow and fish passage.
- Show Slide 35: 'Perched Culvert' and Slide 36: 'Culvert With Fish Passage'.

**Activity 3.3: Landowner Scenarios**
- Pose scenarios:

    - building a home on an eroding bluff of an outside river bend
    - clearing vegetation for a lawn
    - installing a driveway culvert,
    - stabilizing banks with rocks vs. vegetation
        - Discuss impacts and better alternatives
        - Encourage participants to connect with their own experiences.

## Assessment/Closing

- Group discussion: 'What changes can you make on your property or in your community to protect salmon habitat?'
- Summarize key points: riparian buffers, fish-friendly crossings, and minimizing erosion.

## Extension/Reflection

- Reflection Question: 'What does your riparian area look like today, and what improvements could you make?'
- Encourage participants to walk their property and identify erosion risks or buffer opportunities.

## References


- Kenai Peninsula Borough (KPB) Ordinance 21.18: Anadromous Streams Habitat Protection.
- Alaska Department of Fish and Game. Fish Passage Inventory and Assessment Program. https://www.adfg.alaska.gov
- Slide references: 'Anatomy of a River' (Kenai Watershed Forum) slideshow

# Lesson Plan: Outdoor Youth Event

## Lesson Overview

| | |
|---|---|
| Audience | Grades K-5 (outdoor activity, adaptable to community events) |
| Timeframe | TBD |
| Objectives | Students will explore the basics of watersheds, culverts, and salmon habitat using the stream table. They will practice observation, follow safety rules, and discuss how human structures affect rivers. |
| Materials | EM2 River Table with included supplies; Culvert and bridge props; Laminated vocabulary labels; Photos of salmon and culverts; Projector with 'Anatomy of a River' slideshow (optional if indoors). |
| Standards Alignment | Alaska State Science Standards:<br>- 2-LS4-1 (p. 46): Make observations of plants/animals to compare habitats.<br>- 3-LS4-3 (p. 65): Construct arguments that animals have traits aiding survival.<br>- 5-ESS3-1 (p. 110): Communities protect Earth's resources. |

## Background for Educators

This lesson was adapted from Trout Unlimited Alaska and Kenai Watershed Forum's outdoor river table events with elementary students in Seward, AK. It introduces watershed concepts in a simple, engaging way, using storytelling and rules of participation. Children are guided to connect salmon survival with healthy streams and culverts that allow migration.

On the Kenai Peninsula, culverts are a major focus of habitat restoration. Replacing perched or undersized culverts improves access to miles of spawning and rearing habitat. Young learners can understand this through simple demonstrations of 'good' and 'bad' culverts.

## Key Vocabulary

| | |
|---|---|
| Watershed | All the land area that drains water into a river or stream. |
| Salmon | A migratory fish that depends on streams for spawning and rearing. |
| Culvert | A pipe or channel carrying water under a road; may block fish passage if poorly designed. |
| Riparian | The vegetated area along a stream or riverbank. |

## Preparation/Setup

1. Place EM2 River Table outdoors or in a well-ventilated indoor space.
2. Review and post ground rules: 'sand hand,' water stays in table, respect props.
3. Prepare culvert and bridge props for demonstration.
4. Have salmon photos or figures ready for storytelling.
5. If possible, use projector or printed slides (Slides 7: Watershed; 35–36: Culverts).

## Activities

**Activity 4.1: Sand Hand and Safety**
- Begin with clear boundaries and rules (e.g., only one hand in the sand at a time).
- Reinforce respect for equipment and safety with water and cords.
- Use call-and-response for engagement ('oooo, ahhh').

**Activity 4.2: What is a Watershed?**
- Demonstrate how rain runs off mountains and collects in streams.
- Invite students to move water through the table to form rivers.
- Show Slide 7: 'What is a Watershed?'.

**Activity 4.3: Salmon and Culverts**
- Place a perched culvert and show how salmon figures cannot move upstream.
- Replace with a bridge or fish-friendly culvert; show improved passage.
- Show Slides 35–36: 'Perched Culvert' vs. 'Fish Passage Culvert'.

**Activity 4.4: Student Participation**
- Let students take turns pouring water, placing culverts, and moving salmon figures.
- Use storytelling: imagine a salmon migrating upstream to spawn.

## Assessment/Closing

- Group reflection: 'What makes it easier or harder for salmon to survive?'
- Quick recap of key ideas: watersheds, riparian zones, culverts.
- Encourage students to look for culverts in their own neighborhoods.

## Extension/Reflection

- Drawing activity: Students sketch a salmon swimming through a stream with riparian plants and a safe culvert.
- Reflection Question: 'Why do salmon need healthy streams to survive?'

### Narrative Notes

Presenters may use these points in presentation/conversation

How does the table work? (Most students like knowing how things work. You can save yourself a headache by going through this list. It will lead you into creating the river pretty well.)

- Table made of aluminum
- Sand is chopped up Credit Cards
- This table weighs about 30 pounds
- See the white bin? What's in it? *Water, a net, and a pump*
- A pump is like a powerful electric straw – Pump is powered by battery or plugged into the wall – pay attention to wires – don't pull or step on them
- The pump pulls water from the basin through a plastic tube and to the top of the table. This water will then flow down the table thanks to? *Gravity*. Then all the water will be recycled and reused by the pump.

This is where the narrative begins. If you are short on time, it's good to have a plan. This is a narrative that I've found to work well for ages K-6. Practice. Use the table. Know how it works. With young students, you need to know what is going to happen.

As this water flows, it will create what? *A River, stream, canyon?* Where is this river flowing? *Into the Ocean.*

While your river is forming: Point out our river, then the ocean, so that means the whole table is a ***Watershed***. Watershed: An area of land (and water) where all precipitation flows into a common body of water. We can zoom in to individual creeks or lakes, or zoom out to look at water flowing into one ocean. Key point: Watersheds include land and all things within that land area. Including people! (you might need to continue to remind them that humans live in a watershed… like 10 times per class sometimes)

Once the river has reached the ocean, stop the water flow, and continue. You will restart the water after all items have been placed in the table.

What else lives in our watershed? *Plants, animals, salmon, bears, any living thing that lives in Alaska is an acceptable answer. (*No need to say "no" if they say something incorrect. A good response is always "does that live in Alaska?")

Plants live in our watershed, lets add some plants. Ask Students: DO trees grow in the ocean? Do trees grow in the middle of a raging river? Nope – then let's keep plants to the land, or stream

bank. All students place their plants, if there are not many students, you can have them place 2-3, or instructor can place a few as well. If time allows, you can add animals as well.

Do we live in a watershed? Yes! Then let's add some of our stuff! *Depending on number of students, you can add houses, cars, or lego people. Make sure buildings go on both sides of the already created river channel. If it's a school group, I like to take the 2 largest buildings and make them the school & grocery store. In an ideal world, the school and grocery store will be on different sides of the river channel.*

Now we have people living on both sides of our river, we need a way for them to make it to the grocery store, or to school. What do we need to build? *A bridge*

When we build a river crossing, we have two considerations: It needs to serve humans by allowing us to drive over it, and it needs to serve salmon and other creek critters by allowing easy upstream access. So, as we work together to build our bridge, we need to keep in mind human use and salmon use.

Now, its time for us to go culvert shopping. (*Depending on how engaged the students are, you can make this really fun. I'm a big fan of showing culverts and showing the culvert off like a QFC kind of vibe. "*Everyone say oooooo, everyone say ahhhhhh*" as you show it off and talk about it the features. It worked for all the students, and the teachers and parents thought it was funny.*

Set the stage: Students are part of a community group tasked with choosing a culvert. *I'm going to show you all of your options, and you'll vote at the end for which ones you want to try.*
Box Culvert: (ooo, aaa) explaining the features. This is a good one to demo how it will lay in the creek and how the road will go over it.
Then offer the other culvert options - Students think it's funny to call the other culvert types "tubes" ie, *Big tube, little tube, double tube.*

Have students vote on which of the first few options they think will work. I usually keep the large arch culvert hidden and present it as another option once they've chosen one of the lesser options. Depending on time, you can have them pick a few options to try before the arch, but beware: blown out culverts will drastically change the landscape and make it more difficult to demonstrate the successful culvert at the end. It's good to show failure before success.

Select a few students (3-4) to be your construction crew. These students will install our new culvert, without major instruction.

Place the selected culverts into the stream, let them complete construction, then flood the river. It might take a few seconds to fill the table, but eventually the culvert will perch, and the road will fail.

After each simulation remind the students: *What are the two purposes of this structure? Human road and fish passage. Are they fulfilling these purposes?*

Once all simulations are complete, and you have found a culvert option to fulfill both purposes, remove everything from the table.

If there is time, and students seem responsible enough, you can let them play in the sand. If there are more than 10 students, I restrict them to playing in the sand with one finger. They tend to get rowdy, so I'll start pulling students that use more than one finger and have them rinse their hands in the bucket and be done. This whole last bit should only last about 2-3 minutes. The longer you let them play, the more destructive it tends to be.

# Master Glossary

### Bank Stabilization
Methods to prevent erosion, such as planting vegetation or using engineered structures.

### Culvert
A pipe or channel carrying water under a road; may block fish passage if poorly designed.

### Deposition
The process of sediments being laid down as water loses energy.

### Erosion
The wearing away of earth materials by moving water.

### Floodplain
A low-lying area that floods during high water events.

### Meander
A winding curve or bend in a stream.

### Nonpoint Source Pollution
Pollution that comes from many sources, like rain washing off roads and yards.

### Perched Culvert
A culvert with an outlet above the downstream water level, potentially creating a barrier to fish passage.

### Pool
A deeper, slower-moving section of a stream, often with finer sediments.

### Riffle
A shallow, fast-flowing section of a stream with coarse gravel or rocks.

### Riparian
The vegetated area along a stream or riverbank.

### Riparian Buffer
A strip of vegetation along a river or stream that stabilizes banks and filters runoff.

### Salmon
A migratory fish that depends on streams for spawning and rearing.

### Velocity
The speed at which water flows in a channel.

### Watershed
All the land area where water drains into a river or stream.

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