GK12: Global Watershed

All About Rivers

Target Grade Level
Biology (7th-8th Grade)

Unit Summary:

This unit is designed to introduce students to the physical structure of rivers, the organisms that are found or associated with rivers, how humans impact rivers, and the services that rivers provide to humans and the environment. Rather than answering predetermined questions one of the goals of this unit is to challenge students to think and write critically by offering the students a chance to take notes and sketch what they observe, and then take that information and write it up into a brief journal regarding how what they observe relates to what they have learned in the lesson.

Rather than dive into one aspect of rivers and focus on that this unit broadly covers a number of topics dealing with geology and hydrology, biology and ecology, and disturbance and restoration of habitat. Students will act as scientists in all of the lesson, making observations and trying to make sense of what they see by fitting it into the larger narrative of the lessons Each lesson in this unit is designed to apply concepts and ideas from previous lessons as a way to offer students a greater understanding of the important role that rivers play for many systems. In addition to acting as critical thinkers, students will gain knowledge about some of the ecological linkages in rivers and the potentially compounding consequences of degrading rivers. A number of the concepts covered in these lessons are related to other topics dealing with terrestrial or other types of aquatic ecosystems.

The first lesson in this unit will expose students with basic concepts how rivers form. The lesson will cover how and why rivers meander and will look at the longer term changes that are difficult to observe through the human eye. As an activity the students will spend time working with a stream simulation table where they will model how a river changes over time. A stream simulation table will change at rate of seconds to minutes compared to a river changing in years to decades (or longer).

In lesson two the students will start to think about the biota that is typically found in rivers. Many of the examples give are for cold-water Midwest rivers, but have applications to other parts of the country. Students will begin to develop an understanding of the connection between organisms in a river through the model of a food web. This lesson will start to engage students in the idea of suitable habitat for organisms through the exercise. In this lesson students will use the stream table again, but in this instance they will divide the table down the center and create two vastly different habitats on either side of the divider. One habitat will consist of a mosaic of pebble and cobbles while the other will be only sand. The students will then experiment by releasing mayfly larvae into each river and observe how the macroinvertebrates behave. This exercise not only allows the students a chance to use their critical observational skills, but also acts as a nice transition into the next lesson.

After students have learned how rivers are shaped and how organisms utilize habitat, they will cover some of the various impacts that humans have on rivers. This lesson will cover impacts both abiotic and biotic, and intentional (such as in dams) and sometimes unintentional, such as in the case for some invasive species. For the exercise in this lesson students will be using the stream simulation table to make observations regarding a number of impacts that have been simulated in the river. Students will need to call on their prior knowledge from the two previous lessons and other prior knowledge to consider the potentially compounding implications of the impacts as well as how they might influence biota.

The final lesson in the unit teaches the students about some of the services that rivers provide to humans as well as the natural environment. The students will be touching on a number of concepts relating back to the three previous lessons and will begin to pull all the concepts together into a more holistic understanding of rivers. The exercise for this lesson has students going out and visiting a local river where they will spend some time walking trails along the banks while taking notes and sketching what they observe. They will be required to use the concepts they have learned dealing with the physical structure of the river, the biological community of the river, any impacts they observe, and the potential services that they river provides. This exercise is designed to take what they have learned by modeling rivers in the classroom or laboratory and applying that knowledge to observing and documenting at a real river. Students will be required to journal about their experience and what they found at the river or come up with a performance (PSA, play, etc.) that they will perform as a way to demonstrate their ability to synthesize the concepts of this unit.

Next Generation Science Standards:

MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

MS-LS2-2: Construct an explanation that predicts patterns of interactions among organism across multiple ecosystems.

MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Lesson Title- Brief Description	**Learning Objectives** Students will be able to:	**NGSS Addressed (codes)**	**Materials**
Physical Structures of Rivers This lesson explores the physical structure of rivers including their shape and how they change over time. Students will spend time working with a stream simulation table and will document how rivers change and explain reasons why they change.	• Identify the various parts to a river and explain their significance • Sketch images of how rivers change over time. • Explain potential reasons why rivers change over time • Predict how a river might look in the future	MS-ESS2-1	• "Meandering Rivers" student sheet • "Physical Structure of Rivers" PowerPoint presentation • Overhead video projector/monitor • Stream simulation table with all required equipment (See below)
Instream Biota In this lesson students will be introduced to a number of biota found in rivers as well as some associated with rivers. They will learn about how each of these organisms connects to each other as well as some of the implications if one or more disappears. For the exercise, students will observe and take notes on how mayfly larvae react to two different habitat types in the stream simulation table as a way to illustrate the importance of habitat to these organisms.	• Identify various biotic members of rivers • Explain how anthropogenic changes to river influence instream biota • Explain how invasive species can influence fluvial habitat • Observe and predict the effects that habitat loss on macroinvertebrates	MS-LS2-2	• "Where do the invertebrates go?" student sheet • "Instream Biota" PowerPoint presentation • Overhead video projector/monitor • Stream simulation table with all required equipment (See below) • Mayfly larvae - available from most fishing bait shops or online (e.g. www.thereelthingbait.com/wigglers.htm)
Human Impacts to Rivers Students will review a number of impacts to rivers that are caused by humans. They will explore not only the impacts, but what effects they can have on instream and river	• Explain the impacts of losing riparian habitat • Identify various ways that humans influence rivers and explain the consequences • Explain how pollution can come in different	MS-LS2-2	• "Human Impacts to Rivers" student sheet • "Human Impacts" PowerPoint presentation • Overhead projector/monitor • Stream simulation table with

associated biota (from lesson two). As an exercise the students will be challenged to observe a simulated stream using the stream table that has a number of impacts. The students will be challenged to find and explain the impacts and the potential consequences of these impacts.	forms and how that can influence the way we manage rivers. • Make connections between impacts to watersheds and the consequences for rivers. • Observe and identify simulated impacts to a river, make predictions the outcome of each impact, and suggest ways to mitigate the impact.		all required equipment (See below)
Why Care About Rivers? In the final lesson of this unit the students will learn about the services that rivers provide to humans as well as the natural environment. They will discuss ways that these services can potentially harm rivers and why it is important to manage them properly. As a way to bring together everything that has been learned up to this point the students will take a field trip to a local river where they will explore while taking notes on what they see. The students will be challenged to apply the knowledge they have gained throughout the four lessons and will explain what they observe, ultimately what rivers mean to them, and why rivers are important to humans and the environment.	• Explain some of the services that rivers offer humans • Articulate some of the reasons why it is important that we take the health of our rivers seriously • Explain some of the services that rivers offer to ecosystems • Synthesize the learning objectives of previous lessons into an understanding of the physical structure and associated biota of rivers, how humans influence both of these, and why it is important we protect rivers.	MS-LS2-5	• "Why Care About River" PowerPoint presentation • Overhead video projector/monitor • "Why Care About River" student sheet

Safety Considerations:

Students will be working around stream tables with water flowing. All equipment should be inspected prior to use for leaks. Additionally, if the students will be in a classroom without carpet, care should be taken when walking around the table, as any water that splashes onto the floor will likely become a slipping hazard. The last lesson has the students going outside to explore a local river therefore proper attire for the weather conditions should be considered.

Evaluation Plan:

Formative Assessment Tools:

- Students will work on their ability to observe the dynamics of a river and how it changes over time.
- Students will observe and experiment with macroinvertebrates in various habitat conditions and how the organisms react to potentially unfavorable habitat.
- Students will work in groups assessing human impacts to a river
- Students will work in groups observing a local river where they will take notes and sketch what they see.

Summative Assessment Tools:

- Students will interpret how rivers change over time based on the observations they make and will answer questions regarding their observations.
- Students will sketch model rivers in multiple lessons that task them with drawing what they observe.
- Students will make predictions about the implications for instream organisms based on local habitat conditions and will answer questions regarding their understanding and observations.
- Students will write a journal and answer questions about how their observations relate to the services provided by rivers as well as the big topics of the first three lesson plans.

Resources (websites):

Stream Table Resources:

Little River Research	http://www.emriver.com/?page_id=834
MO Stream Team	http://www.mostreamteam.org/documents/how_to/streamtable.pdf
Bureau Land Mgmt	http://www.blm.gov/or/programs/nrst/files/stream_table.pdf
Mr. Hollister	http://www.mrhollisterphoto.com/stream-table.html

Water Related Information:

U.S. Geological Survey	http://www.usgs.gov/water/
Nat Wild Scenic River	http://www.rivers.gov

Additional Information for Stream Simulation Table:

There are a number of options for building or purchasing a stream simulation table. No matter the option that is chosen for your class there are a few components that would be required for lessons in this unit. Check websites (listed above) for plans to build or purchase stream simulation tables. For this unit the following are required for a stream simulation table:

- **Stream table** - Many sizes are available/optional but larger and deeper (e.g. 2-3' wide, 4-6' long, 3-5" deep) are better. Blocks or the like should be used to add a slope to the table.
- **Sediment** - Real sand (silica) or plastic sand (see www.emriver.com) are appropriate. The amount needed will depend on the size of the stream table. For a 2'Wx4'Lx3"D table approximately $2ft^3$ of sand will be used (approx. 200lbs). Additional larger rocks (10-100mm diameter) will be needed for lesson 2 – Instream Biota to test how invertebrates respond to fine verses coarser substrates.
- **Water Pump or Bucket –** Many pumps are available to feed the table, See resources for examples. If a water pump is used it may be helpful to use a flow controller in order to control how fast water is pumped into the stream table. Additionally, a large bucket with a feed tube can be used to drain into the stream table.
- **Reservoir or Bucket with Filter**– This will drain the table and will be used to recirculate the water. This can be part of the table (if the table has a false bottom) or can be below the table if there is a drain in the table. It is important to have a filter to catch any sand that drains out of the table.
- **Additional Material** – Small model buildings can be used to line the banks of simulated rivers as a way to demonstrate what can happen when building too close to a river.

Brief description of how this unit relates to your graduate research:

The topics in this unit dealing with abiotic factors and biotic members of rivers closely aligns with my research dealing with the dynamics of wood in rivers, how that relates to fine sediment, and the potential restoration of critical habitat for aquatic organisms. In my research I am looking at ways to predict the stability of instream sediment through the quantity of naturally occurring wood in a channel. Additionally we are considering the long term changes in the volume of wood in the Otter River watershed.

Another facet of my research is working on a project dealing with the potential restoration of critical spawning habitat for brook trout through the use of wood additions to the channel. In the target river a large volume of sand has been covering critical habitat for instream residents for almost ten years, and many of the spawning sites for brook trout have been lost or greatly reduced. Our hope is that by strategically adding wood to the channel we will be able to use the river's flow to scour out the fine sediment, thus exposing the coarse sediment that appears to be required for spawning.

One of the key components of the work I have been part of is understanding and identifying degradation of instream habitat. In the case of the brook trout work I am a part of, that degradation is the inundation of fine sediment into spawning habitat. One of my goals with the unit is that students will begin to understand that impacts such as pollution do not always

come in the form of waste or trash being tossed into waterways, but can come in the form of naturally occurring things in the environment.

In addition to modeling rivers using the stream simulation table the student will have an opportunity to observe a real stream and apply what they have learned about the ecology of rivers. I hope that by doing this students will have an opportunity to act as scientists and possibly spark a further interest in understanding how organisms interact with the environment.

The lessons in this unit use my understanding of stream ecology as a way to introduce students to the many factors that should be considered when thinking about rivers. I hope that students will think critically about what they observe and apply the knowledge from the lessons while they make predictions and draw conclusions from the exercises.