**Riparian Zone Runoff**

**Alignment to Ohio Content Standards:**

[**Ohio Learning Standards for Science**](http://education.ohio.gov/Topics/Learning-in-Ohio/Science)**:**

**Environmental Science:** Pg. 107 ENV.ES.1: Biosphere-Biodiversity, Ecosystems (equilibrium, species interactions, stability)

**Environmental Science:** Pg. 107 ENV.ES.5: Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere. Biogeochemical cycles, Ecosystems, Climate

**Environmental Science:** Pg. 108 ENV.ER.3 Water and Water Pollution. Hypoxia, eutrophication

**Environmental Science:** Pg. 108 ENV.GP.2: Potable water quality, use and availability

**Physical Geology:** Pg. 110 PG.IMS.4: Ocean. Streams (channels, streambeds, floodplains, cross-bedding, alluvial fans, deltas)

**Physical Geology:** Pg. 111 PG.ER.3: Water. Water quality, Hypoxia, eutrophication.

**Science Inquiry and Application**

* Identify questions and concepts that guide scientific investigations
* Design and conduct scientific investigations
* Formulate and revise explanations and models using logic and evidence (critical thinking)
* Recognize and analyze explanations and models
* Communicate and support a scientific argument

**Lesson Length:**

50 to 60 minutes

**Lesson Overview:**

Students will explore how Riparian Zones can help prevent water pollution, runoff and flooding by trapping water and filtering it into the underground water table. They will experiment with different Riparian Zone compositions to determine which is the best for preventing runoff. Then students will develop their own water filters to explore how riparian zones help protect rivers from runoff.

**Lesson Objectives:**

The student will:

* Compare different riparian zone structures
* Create a filtration system
* Communicate experiment results
* Explain how different riparian zone can affect water quality
* Demonstrate how riparian zones filter water

**Materials needed:**

Materials needed for Lesson Prep:

* Bottle Riparian Corridor Activity Instruction Sheet (Lesson Prep)
	+ 2-Liter Bottle (1 per setup)
	+ Boxcutter
	+ Marker
	+ Nail, Candle, Matches or Power Drill
	+ Rubbers bands (at least 2 per setup)
	+ Cheesecloth
	+ Scissors

Materials needed for the Runoff Race (Engagement):

* Runoff Race Instructions
* Stopwatches (1 per group/3 per class)

Materials needed for Riparian Zone Experiment (Explore):

* Riparian Zone Experiment Instructions
* Riparian Zone Data Worksheet
* Bottle Riparian Corridors (1 per group)
* Ring stand (to hold Bottle Riparian Corridor) or Larger Beaker (with mouth large enough to hold Bottle Riparian Corridor)
* 500mL Beaker (1 per group)
* Cup/Container large enough to hold 500mL (1 per group)
* Stopwatch (1 per group)
* Ruler (1 per group)

Materials needed for Notes (Explain):

* Riparian PowerPoint

Materials needed for Water Filtration Activity (Extend):

* Water Filtration Worksheet
* Bottle Corridor Body (1 per group)
* Large Collection Beaker (500mL)
* Soil/Dirt (Potting mix is fine)
* Activated Charcoal
* Sand
* Small Gravel
* Medium to Large Gravel
* Leaves
* Dirty/Unfiltered Water
* Coffee Filter
* Cheesecloth
* Cotton Balls
* Water Filter Instructions
	+ <https://sciencing.com/make-water-filter-science-experiment-5507017.html> (Very simple instructions)
	+ <https://www.wikihow.com/Make-a-Water-Filter> (This has a traditional DYI water filter and an additionally, more alternative one using banana peels)
	+ <https://science.lovetoknow.com/science-fair-projects/homemade-water-filter-science-project>

**Technology Needed:**

* PowerPoint

1. Engage the Learner

(5 to 15 minutes)

To engage students in learning, have them participate in a Runoff Race! The Runoff Race allows students to simulate rain runoff by taking on the role of raindrops. The raindrops race to the river but trees can slow their time. Students will have an opportunity to get up, move, and burn some energy while getting their minds ready for the day’s topic.

**Teacher (T):** Conduct Runoff Race *(see attachment for Runoff Race Instructions)*

**Student (S):** Participate in Runoff Race

2. Explore the Concept

(15 to 30 minutes)

**T:** Separate students in groups of 3 to 4. Define riparian zone as the area of land bordering a river. Ask the students what the land may look like in a riparian zone.

**S:** Describe possible riparian conditions (e.g. parking lot, trees, grass, dirt, gravel…etc…)

**T:** Explain to students that they will be modeling different riparian zone conditions. Specifically, they will be looking at pavement, gravel, bare soil, and vegetated riparian zones. Pass out Riparian Zone Experiment Instructions, Riparian Zone Data Worksheet, Bottle Riparian Corridors (premade), Rulers, Stopwatches and Beakers to each group. Have a communal area to retrieve gravel, soil, and leaves. *(See attachments for Riparian Zone Experiment Instructions, Riparian Zone Data Worksheet, and for Bottle Riparian Corridor Instructions.)*

**S:** Follow Riparian Zone Experiment Instructions to measure the speed of water moving through different Riparian Zone conditions. Record their results in the Riparian Zone Data Worksheet. Fill out the Riparian Zone Data Worksheet completely and answer the questions at the end.

**T:** Supervise class and offer guidance and clarify when needed.

**S:** Clean up experiment when done, complete Riparian Zone Data Worksheet and wait for further instructions.

3. Explain the Concept and Define Terms.

(10 minutes)

**T/S:** Discuss the data, and have students compare data with other people in the class. Consider these questions:

* Were all the measurements the same or at least similar?
* What scenario did the water move the quickest and which was the slowest? Why?
* Was there ever a time when the initial and final volumes were very different? Why?
* Did the quality of the water ever change? (i.e. Did it become cloudy, dirty, or any other noticeable change). Why and when did this occur?
* Which scenario might prevent or slow flooding?
* How would roots affect the flow of water?

**T:** Present Riparian Zone PowerPoint *(See attachments for Riparian Zone PowerPoint)*.

**S:** Follow along with the PowerPoint (may take notes if teacher prefers)

4. Elaboration/Expansion of the Concept (remediation if needed)

(15 to 30 minutes)

This water filtration activity is set up to allow for maximum exploration for students. It has minimal instructions for the construction of water filters. If your class would work better with instructions suggestions for water filters is listed under the Water Filtration Materials list.

Safety Note: Do not allow students to drink water, even after being passed through the filter. Even if the water appears clean, some things may not be completely filtered out.

**T:** To prepare for the activity, have a bucket of dirty/unfiltered water that is a mixture of soil, organic matter, and possibly food coloring, oil and vinegar. Be sure to mix the water before giving any portion to be filtered.

**T/S:** Discuss with the students that one of the main benefits of a heathy, natural riparian zone is the removal of pollutants by way of water filtration through natural substrate.

**T:** Instruct the students to work in groups of 2 to 4 to create water filters using the Body of the Bottle Riparian Corridor as the base of the filter (have them put the rainfall lid aside and do not use it). Allow students to experiment with different materials and ratios as they see fit. Tell the students that they will need to share the effectiveness of their design with the class and describe why they did what they did. Pass out the Water Filtration Worksheet *(See attachment for Water Filtration Worksheet)*

**S:** Create water filters to try and filter the dirty water provided by the teacher. Fill out the Water Filtration Worksheet after completing the activity.

**T/S:** Have a group discussion about the activity and have students share what seemed to work and what did not seem to work when filtering. Discuss what issues may exist when riparian zones are skewed towards different materials such as too much gravel, or very thin layers.

5. Evaluate Students’ Understanding of the Concept

* Teacher should make observations of student understanding during their exploration of the material (Explore/Extend) and during class discussion (Explain/Extend).
* Teacher should collect worksheets (Explore/Extend) for additional proof of learning.

Additional Extension Ideas:

* Have students research causes of unhealthy rivers from point and non-point source pollution (farm runoff from row crop and/or animal feedlots, lack of vegetated riparian zones/soil erosion, industry, illegal dumping, acid mine drainage…) and have them create a PSA (can be video, poster, radio announcement…etc…) about how those activities harm local waterways.
* Have them write letters to the local farms, community members, or government about ways they could help protect the waterways and why it is important to protect them.
* Have students research different wildlife that are reliant on vegetated riparian zones.
* Have students test water quality of two different streams, one with impaired riparian zones (parking lot, roads, farmland, etc…) and one with a healthy, natural vegetated riparian zone. Then compare the data from the two streams and see which is healthier.
* Have students research a major flood and have them map flood heights along the river. Have students overlap a current map over the flood map and make comparisons of flood data of cities vs. countryside vs. forested lands. See if there seems to be any correlations.

Additional Resources:

**Contact Jen Bowman (****bowmanj2@ohio.edu****) to borrow water quality meters.**

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