

Buffered Stream, Healthy Stream

Adapted from: An original Creek Connections activity.
Creek Connections, Box 10, Allegheny College, Meadville, Pennsylvania, 16335

Grade Level: Intermediate to Advanced.

Duration:

- Student Activity Procedure A:
45 min.- water quality data collection.
40 min.- data analysis and discussion
- Student Activity Procedure B:
40 min.- data analysis and discussion

Setting:

- Student Activity Procedure A:
Field Sites and Classroom
- Student Activity Procedure B:
Classroom

Summary: Students compare the chemical characteristics of two small streams, one of which has a healthy riparian forest buffer and the other of which is more exposed or virtually buffer-less.

Objectives: Students will describe how forested riparian zones protect streams and keep them chemically healthy. Students will interpret data and make comparisons between two small streams. Students will identify controls needed when investigating water quality differences resulting from land use practices.

Vocabulary: riparian zones, exotic and invasive species, buffers, aerobic, anaerobic, denitrification, osmosis, algal bloom, eutrophication, nitrification, acid deposition, dissolved oxygen (DO), turbidity, total dissolved solids (TDS), pH, and alkalinity

Related Module Resources:

- Riparian Observations Data Sheets (part of the RCE Activity)
- “Land Use Impacts on Water Quality Parameters” Information Chart

Materials (Included in Module):

- Buffered Stream, Healthy Stream Data Sheets—Student Activity Procedures A and B.

Additional Materials (NOT Included in Module):

- Water Quality Monitoring Test Kits and materials
- HANDBOOK p. 51-119
- Calculators and clipboards

**ACADEMIC STANDARDS:
(ENVIRONMENT & ECOLOGY)**

7th Grade

- 4.1.7.B. Understand the role of the watershed.
 - Explain factors that affect water quality and flow through a watershed.
- 4.1.7.D. Explain and describe characteristics of a wetland.
 - Describe the different functions of a wetland.
- *NOTE: Riparian areas frequently contain wetlands or are considered to be wetlands.
- 4.1.7.E. Describe the impact of watersheds and wetlands on people.
 - Explain the impact of watersheds and wetlands pollution abatement.
- 4.3.7.B. Describe how human actions affect the health of the environment.
 - Identify land use practices and their relation to environmental health.

10th Grade

- 4.1.10.B. Explain the relationship among landforms, vegetation and the amount and speed of water.
 - Explain how vegetation affects storm water runoff.
 - Explain how vegetation cover relates to erosion.
- 4.1.10.D. Describe the multiple functions of wetlands.
 - Explain how a wetland influences water quality, wildlife and water retention.
- 4.1.10.E. Identify and describe natural and human events on watersheds and wetlands.
 - Identify the effects of humans and human events on watersheds.
- 4.3.10.B. Explain how multiple variables determine the effects of pollution on environmental health, natural processes and human practices.
 - Explain how human practices affect the quality of the water and soil.
- 4.8.10.C. Analyze how human activities may cause changes in an ecosystem.
 - Analyze and evaluate changes in the environment that are the result of human activities.

12th Grade

- 4.1.12.C. Analyze the parameters of a watershed.
 - Interpret physical, chemical and biological data as a means of assessing the environmental quality of a watershed.
 - Apply appropriate techniques in the analysis of a watershed (e. g., water quality, biological diversity, erosion, sedimentation).
- 4.1.12.E. Evaluate the trade-offs, costs and benefits of conserving watersheds and wetlands.
 - Evaluate the effects of human activities on watersheds and wetlands.

(SCIENCE & TECHNOLOGY)

7th Grade

- 3.2.7.C. Identify and use the elements of scientific inquiry to solve problems.
 - Generate questions about objects, organisms and/or events that can be answered through scientific investigations.
 - Design an investigation with limited variables to investigate a question.
 - Judge the significance of experimental information in answering the question.
 - Communicate appropriate conclusions from the experiment.

10th Grade

- 3.2.10.C. Apply the elements of scientific inquiry to solve problems.
 - Generate questions about objects, organisms and/or events that can be answered through scientific investigations.
 - Evaluate the appropriateness of questions.
 - Design an investigation with adequate control and limited variables to investigate a question.
 - Organize experimental information using a variety of analytic methods.
 - Judge the significance of experimental information in answering the question.
 - Suggest additional steps that might be done experimentally.

12th Grade

- 3.2.12.C. Apply the elements of scientific inquiry to solve multi-step problems.
 - Generate questions about objects, organisms and/or events that can be answered through scientific investigations.
 - Design an investigation with adequate control and limited variables to investigate a question.
 - Organize experimental information using analytic and descriptive techniques.
 - Evaluate the significance of experimental information in answering the question.
 - Project additional questions from a research study that could be studied.

BACKGROUND:

Riparian zones, or the land areas next to waterways, play a crucial role in maintaining stream health. Although vegetation of any kind is preferable to cleared, bare streamside areas and banks, riparian *forest buffers* effectively protect stream water quality while also providing other benefits such as habitat, recreation, and streambank stabilization. This activity focuses on riparian forest buffer effects on water quality. When monitoring stream water quality, several major parameters are usually studied. These include temperature, dissolved oxygen (DO), turbidity, nitrogen, phosphorous, total dissolved solids (TDS), pH and alkalinity. Riparian forest buffers have the ability to positively affect all eight of these water quality parameters.

Streams with high water quality usually have relatively cool, and as a result, **dissolved oxygen**-rich waters. Riparian trees and plants that hang over the stream channel produce shade in the waterway. This shade regulates the temperature and light conditions of the stream and results in relatively cool temperatures. Cooler waters can hold more oxygen than warmer waters can, so riparian shaded streams often have higher dissolved oxygen levels. Cool temperatures and high DO are ideal conditions for aquatic life such as caddisfly larvae, stonefly and mayfly nymphs, salmon, and trout. According to the Chesapeake Bay Program, “The relationship between stream shade and trout production is firmly linked. Studies have shown that when stream surface shade is reduced to 35%, trout populations can drop by as much as 85%.”

Another measure of excellent water quality is low **turbidity** levels. Reduced visibility in cloudy, turbid waters inhibits predators’ ability to locate their prey. Suspended particles clog fish gills and filter feeding apparatuses. Furthermore, the sediment that settles out of turbid waters can smother eggs and fill in the spaces between rocks, destroying important macroinvertebrate habitat. Turbid waters also inhibit plant photosynthesis by blocking out sunlight. In addition, the suspended particulate matter that creates turbidity absorbs heat, resulting in higher stream temperatures and lower DO levels. However, even streams adjacent to agricultural or other cleared lands whose soil is easily eroded into waterways can maintain low turbidity levels if their riparian forest buffers are intact. Sediment laden runoff from adjacent lands is slowed down by riparian vegetation, allowing the sediment to settle out. The volume of runoff is significantly reduced as it passes through a riparian buffer and is absorbed by porous streamside forest soils. Therefore, runoff that does reach the waterway is significantly less turbid because it was filtered by the riparian forest buffer. In addition, riparian vegetation reduces the impact of rain hitting the land, decreasing soil erosion that would increase turbidity levels. Overall, riparian forest buffers can remove 50-100% of sediment from runoff!

Low nitrogen and phosphorous levels in waterways are also signs of good water quality. Although minimal amounts of the nutrients nitrogen (N) and phosphorous (P) are needed in streams to serve as the building blocks of aquatic plant life, too much N and P are detrimental to stream health. High nutrient levels result in bursts of plant growth and prolific **algal blooms**. This excess vegetation is a nuisance to boaters and becomes more problematic when it dies. **Eutrophication** occurs when **aerobic** (oxygen-consuming) bacteria decompose the dead vegetation, rapidly reducing DO levels in the waterway and

adversely affecting aquatic life. Fortunately, riparian forest buffers trap, filter out, and store nitrogen and phosphorous in runoff that passes through them and that would otherwise enter stream waters. Because 80-85% of phosphorous in runoff is attached to sediment molecules, streamside forests eliminate vast amounts of phosphorous from runoff by removing sediment as described in the previous paragraph.

The processes by which nitrogen is removed are more complex, but equally as effective, eliminating up to 90% of nitrogen from runoff. Nitrogen in runoff is in a form that is unusable by vegetation. However, aerobic bacteria and fungi living in riparian zones transform that nitrogen into nitrates (NO_3), a form that can be taken up by plants and used to synthesize proteins. Furthermore, in a process called **denitrification**, **anaerobic** (non-oxygen consuming) bacteria convert dissolved nitrogen in runoff into harmless nitrogen gas that escapes into the atmosphere instead of entering streams.

Another measure of water quality is **total dissolved solids (TDS)**, which include nutrients like nitrogen and phosphorous, as well as salts and other ions, minerals, and organic matter. TDS affects **osmosis**, or the water flow in and out of organisms' cells. Thus, relatively stable levels of TDS are crucial for aquatic life. Sudden changes in TDS levels can be detrimental to aquatic organisms. For example, a spike in salt levels can kill fish. Riparian forest buffers can protect waterways from such TDS spikes that are caused by water entering streams from runoff. As described above, porous riparian soils soak up water and the solids dissolved therein. Nitrogen and phosphorous are filtered out, transformed, and taken up by plants. Salts are also absorbed by riparian soils and vegetation. Soil erosion is limited by the anchoring effect of riparian vegetation. Consequently, less runoff and eroded soil reaches the waterway than initially entered the riparian zone, and riparian biological and chemical processes have significantly reduced the TDS levels of runoff that does enter the stream.

Like many of the other water quality parameters, a relatively stable **pH** level (the concentration of H^+ ions, a measure of acidity) is crucial to aquatic life because organisms are adapted to and can tolerate a specific pH range. Even slight changes in pH can be harmful to aquatic life. Low pH levels, in addition to causing developmental and reproductive problems or even death in aquatic organisms, lead to the release of metals locked up in mineral matter. These metals create more problems for aquatic life. Fortunately, forested riparian zones help keep acidic runoff from agricultural fields from entering waterways and detrimentally affecting water quality. Groundwater draining from fields of row crops is often acidic because of two processes that take place there: **nitrification** (the conversion of nitrogen gas to dissolved nitrogen) and **acid deposition** (acid precipitation and/or fallout of dry acid particles). However, as this acidic water passes through forested riparian buffers, uptake of the acidic nitrates and denitrification result in higher pH levels that are less noxious to aquatic life. Thus, some of the processes by which riparian forest buffers effectively increase pH levels are similar to those by which they remove and filter out nitrogen. Keeping excess nitrogen and phosphorous out of waterways also helps maintain balanced aquatic plant growth and avoid eutrophication which produces excess carbon dioxide and reduces the pH of streams. In addition, aquatic life inhabiting the cool waters of riparian shaded areas is

less metabolically active. Reduced respiration produces less carbon dioxide to react with water to produce carbonic acid, which can dissociate producing extra hydrogen ions that lower pH.

Low pH levels and slight changes in pH can be harmful to aquatic life. Thus, a waterway's ability to resist pH change, or **alkalinity**, is also critical to stream health. Streams that have high alkalinity are less adversely affected by acid inputs than waterways with low alkalinity. Once again, riparian forest buffers contribute to raising alkalinity levels and safeguarding water quality. Alkalinity is related to water's contact with soil, rocks, and bedrocks, where it picks up carbonate and bicarbonate ions. (Carbonate and bicarbonate occupy hydrogen ions that would increase pH were they allowed to exist freely in water.) Runoff that enters riparian forest buffers is slowed down and in contact with these substrates longer than runoff that directly enters streams. Thus, streamside forests effectively increase the alkalinity of runoff on its way to the stream, helping the waterway to buffer the effects of acid inputs and to maintain stable pH levels.

Because riparian forests alter the chemical parameters of runoff that eventually enters waterways, they effectively buffer or protect the stream from the adverse effects that runoff could cause. Therefore, we expect portions of waterways buffered by streamside forests to be less negatively affected chemically by adjacent land uses than sections of streams situated next to areas of similar land use but unprotected by riparian forests. That is, given two streams located next to similarly used lands and differing only in the completeness of their riparian forest buffer, we expect the stream with an intact riparian forest buffer to be healthier chemically than the waterway with a disrupted riparian forest buffer.

References:

"Economics of Riparian Forest Buffers Fact Sheet." Annapolis, MD: Chesapeake Bay Program, 2001.

Connecticut River Joint Commissions "Introduction to Riparian Buffers" Website.

<http://www.crjc.org/riparianbuffers.htm>

Correll, D.L. "Buffer zones and water quality protection: general principles." Buffer Zones: Their Processes and Potential in Water Protection. Eds. N.E. Havcock et al. Edgewater, MD: Quest Environmental, 1997.

OVERVIEW:

Students conduct water quality tests and/or compare the temperature, dissolved oxygen, turbidity, nitrogen, phosphorous, TDS, pH, and alkalinity data of two streams or sections of streams that differ in the completeness of their riparian forest buffer. They evaluate the hypothesis that the stream section buffered by an intact streamside forest is chemically healthier than the more exposed stream with a less complete riparian forest buffer.

PROCEDURE:

Teacher Preparation:

If your school is participating in the Creek Connections Water Monitoring Program OR if your school has water chemistry testing equipment, select two small streams or sections of the same stream. These sites should be as comparable as possible except for the presence, absence or completeness of a riparian forest buffer. Conduct the water quality tests for the eight main parameters on samples from these streams. Prepare test kits, chemicals, distilled water, and other water quality testing materials for the field visits. Arrange for transportation to and from the field sites if necessary. Make photocopies of and record data on the Buffered Stream, Healthy Stream Student Activity Procedure A Data Sheets. Try to conduct the chemical tests at both sites on the same day if at all possible. Commence the procedure with Student Activity Procedure A. You may also elect to do Activity Procedure B in addition to or instead of Activity Procedure A.

*If your school **does not** participate in the Creek Connections Water Monitoring Program, use the data on the Buffered Stream, Healthy Stream Student Activity Procedure B Data Sheets at the end of this activity write-up as grounds for comparison of the chemical health of two small streams, Parker Run and Conneauttee Creek. Make photocopies of these data sheets as needed. Commence the procedure with Student Activity Procedure B. You might also consider taking a field trip to a buffered and an exposed stream to make general observations about temperature, wind, percent shade, etc. Refer to the Extensions/Modifications section for more ideas on how to conduct such an activity.*

Student Activity:

Procedure A

1. Stimulate a discussion about the importance of riparian areas and how riparian forest buffers affect different water quality parameters.
2. Distribute copies of the Buffered Stream, Healthy Stream (Student Activity Procedure A) Data Sheets to students. Have them observe the land use and riparian area at the first field site and complete the Observations section for that particular site on page one of the Data Sheets.
3. Divide the students into eight groups, each of which is responsible for testing one of the following chemical parameters: temperature, dissolved oxygen, turbidity, nitrogen, phosphorous, TDS, pH and alkalinity.
4. Have students think about the background they heard concerning how forested riparian buffers affect their water quality parameter and ask them to hypothesize which site (riparian forest buffer intact=buffered or disrupted=exposed) will have a higher level of their parameter and why. Have them record this prediction on their Buffered Stream, Healthy Stream Data Sheet in the Hypothesis section. For example, “The temperature level will be higher in the exposed stream because there is little or no riparian vegetation to shade the stream from sunlight. This direct exposure to sunlight will result in an

increased water temperature relative to the shaded, cooler waters of a riparian-buffered stream.”

5. Conduct the water quality tests following the Creek Connections Handbook protocols and instructions. The group conducting the temperature test should use the bridge-bailer or shoreline dipper to collect water samples for the rest of the class. Record your data on the Buffered Stream, Healthy Stream Data Sheet.
6. Proceed to the next field site and repeat steps 2 and 5.
7. Have students compare the data for their particular chemical parameter from the buffered and exposed sites, consider the following questions, and be prepared to present their responses to the rest of the class.
 - a. What were the levels of the water quality parameter you obtained at the buffered and exposed sites?
 - b. Were these values comparable or significantly different?
 - c. If they were different, what are the factors that might have caused this discrepancy?
 - d. What was your hypothesis concerning the relative levels of your water quality parameter at the two sites?
 - e. Was your hypothesis rejected or supported? Why?
8. Have students present their findings to the rest of the class.

Procedure B

1. Stimulate a discussion about the importance of riparian areas and how riparian forest buffers affect different water quality parameters.
2. Distribute copies of the Buffered Stream, Healthy Stream Data Sheets (Student Activity Procedure B, two pages). Have students read over Table 1, particularly the Land Use and Vegetation Characteristics sections, and study Figures 1 and 2. Which site has a more complete riparian forest buffer? *Parker Run!* How might we describe the riparian area of the other site? *Meadow.*
3. Divide the students into eight groups, each of which is responsible for analyzing the data of one of the following chemical parameters: temperature, dissolved oxygen, turbidity, nitrogen, phosphorous, TDS, pH and turbidity.
4. Have students think about the background they heard concerning how forested riparian buffers affect their water quality parameter and ask them to hypothesize which site (Parker Run or Conneauttee Creek) will have a higher level of that parameter and why. Have them record this prediction on their Buffered Stream, Healthy Stream Data Sheet in the Hypothesis section below Table 1. For example, “The temperature level will be higher in Conneauttee Creek because there is less overhanging riparian trees and vegetation to shade the stream from sunlight. This direct exposure to sunlight will result in an increased water temperature relative to the shaded, cooler waters of Parker Run, a riparian forest-buffered stream.”

5. Now have students refer to Table 2 on the second page of the Buffered Stream, Healthy Stream Data Sheet. Have the students in each group calculate the average value of their chemical parameter for Parker Run and Conneauttee Creek and record those values at the bottom of Table 2. Here are the average values for each of the chemical parameters:

Date	Site	Temp. (°C)	DO (mg/L)	Turbidity (JTU)	N/NO ₃ ⁻ (mg/L)	P (mg/L)	TDS (mg/L)	pH	Alkalinity (mg/L)
Average	Parker Run	7.73	12.61	4.72	0.15	0.014	101.7	8.82	153.3
Average	Conneauttee Creek	11.13	11.13	8.33	0.22	0.0001	135.0	7.73	148.8

6. Have students compare the data for their particular chemical parameter from Parker Run and Conneauttee Creek, consider the following questions, and be prepared to present their responses to the rest of the class. They should also read the site description for their stream to help them interpret the data.

- What were the average levels of the water quality parameter you analyzed for Parker Run and Conneauttee Creek?
- Were these values comparable or significantly different?
- If they were different, what are the factors that might have caused this discrepancy?
- What was your hypothesis concerning the relative levels of your water quality parameter at the two sites?
- Was your hypothesis rejected or supported? Why?
- What information in the site description was useful when interpreting the data? What did that information reveal?

7. Have students present their findings to the rest of the class.

DISCUSSION:

- Were most of the hypotheses supported or rejected? Why?
- Evaluate the hypothesis that the stream section buffered by an intact streamside forest is chemically healthier than the more exposed stream with a less complete riparian forest buffer.
- Were there differences between the field sites other than the presence/absence of a riparian forest buffer that might have affected our results? If so, how?
- How might we alter the experimental design to obtain results that are more indicative of the affect of riparian forest buffers on water quality? *For example, in Activity Procedure B, chemical parameter data from two different waterways are compared. It would be better to compare different sections of the same waterway. One might also try to normalize factors such as the distance from shore at which the samples are taken, whether they are taken from a riffle, run, or pool, etc.*
- Which water quality parameter levels differed the most? Why?
- How are the alkalinity and pH values for the different sites consistent with what we might expect? *The pH at Conneauttee Creek is lower than the pH at Parker Run so the H⁺ ions are using up the alkalinity in the water, decreasing the alkalinity value at Conneauttee.*
- Are the phosphorous reading consistent with what we might expect based on the turbidity and TDS values for the two sites? *No. Turbidity and TDS were both significantly greater in Conneauttee Creek. Phosphorous molecules are most often attached to sediment that enters the waterway. Since more runoff and sediment*

appears to be entering Conneauttee Creek, we would expect the phosphorous levels to be higher there than in Parker Run. However, the phosphorous values at both sites are low. It appears that both the riparian forest at Parker Run and meadow riparian area at Conneauttee Creek are successfully filtering phosphorous out of runoff.

- What might one do to the riparian area of the stream with a disrupted riparian forest buffer to improve water quality? *For example, plant native wetland and flood tolerant trees and shrubs or fence off the riparian area to keep out livestock.*
- Why was the forested riparian buffer at the disrupted site cleared, i.e., what is/was the cleared land used for? How might the resultant decrease in water quality of the stream affect the success of that particular land use? What are the water quality costs, benefits, and trade-offs associated with maintaining a riparian forest buffer versus clearing it for agriculture, industry, or construction?
- In addition to positively affecting water quality, how else do riparian forest buffers improve overall stream health?

Vegetation that falls into streams from riparian forest buffers provides habitat and food for aquatic life. Some riparian vegetation also has the ability to take up pollutants and toxins in runoff and transform them into less harmful forms and keeping them out of waterways.

- Clearly, riparian forest buffers positively affect water quality. After having destroyed areas of riparian forest buffers, what must humans do to artificially replicate the natural water treatment processes carried out by these buffers? *We have to construct and maintain water treatment facilities, build dikes to decrease flooding, install other flood-reduction devices, restore riparian zones, etc.* What are the economic costs of destroying riparian zones and or constructing man-made water treatment facilities? *It is extremely costly, both economically and environmentally to destroy riparian buffers. Constructing man-made water treatment facilities is also highly exorbitant. It costs much less to maintain existing riparian forest buffers and to restore streamside forests than to artificially treat water.*

EVALUATION:

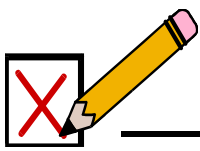
- Discussion questions above
- How does the presence of a riparian forest buffer affect stream temperature, dissolved oxygen, turbidity, nitrogen, phosphorous, TDS, pH and turbidity levels?
- What affects does low water quality have on aquatic life? Terrestrial life? Humans?
- How does experimental design affect the comparability of data and our ability to link differences between two data sets to one specific factor?

EXTENSIONS AND MODIFICATIONS:

- Involve students in the experimental design aspect of this activity by discussing the controls needed when making comparisons between two sites, i.e., the buffered and exposed streams should be virtually identical in all other characteristics: season, land use, stream order, depth, width, etc. Have them help you, the teacher, come up with the criteria needed to select two good sites at which they will collect data that will demonstrate how riparian forest buffers affect water quality parameters.
- Students could compare the chemical data of streams with a forested riparian buffer versus meadow/grass buffer versus no buffer.

- Students could compare the chemical data of streams with different widths of riparian buffers, e.g., no buffer, 5 m, 20 m, 50 m, and 100 m.
- Students could compare the soil, sunlight intensity on the stream, the percent of stream shaded, wind, and/or biodiversity at streams with streamside forests, meadows, and no riparian buffers. The Riparian Observations Data Sheet at the end of the Riparian, Channel, and Environmental Inventory (RCE) activity includes many of these topics.
- Students could make comparisons between the number and diversity of streamside salamanders and/or terrestrial insects in forested riparian buffers and severely disrupted/cleared riparian zones.
 - For streamside salamander comparisons, students might turn over all rocks in 5 meters by 5 meters areas directly adjacent to waterways and count and record the number and types of different salamanders uncovered. Although this could be an opportunity for students to learn the common names of the salamanders they discover, it is not necessary to identify the species. Instead, operational taxonomic units could be used, i.e., have students assign an imaginary name to each different type of salamander uncovered and subsequently use that name to refer to the particular salamander species each time it is found thereafter. Have students predict what they will find in the form of a hypothesis before commencing the activity.
 - For terrestrial insect comparisons, students might turn over all rocks and examine all vegetation in one square meter areas adjacent to waterways and count and record the number and types of different insects uncovered. Although this too could be an opportunity for students to learn the common names of the insects they discover, it is not necessary to identify the species. Instead, operational taxonomic units could be used, i.e., have students assign an imaginary name to each different type of insect uncovered and subsequently use that name to refer to the particular insect species each time it is found thereafter. Have students predict what they will find in the form of a hypothesis before commencing the activity.
 - Another potential experimental design for terrestrial insect comparisons would be to collect leaf litter in four-inch squares from a streamside area with a riparian forest and a riparian area with little or no streamside vegetation. Be sure to label the leaf litter samples and bring them back to the classroom. You'll need several large funnels for this activity. Secure a piece of screen with relatively large openings in the bottom of all funnels. Put the leaf litter in the funnels, label the funnels with the origin of the leaf litter, and cover the leaf litter with a piece of window screen to keep critters from escaping. Position the funnels over jars with alcohol in the bottom of them. Shine incandescent light into the funnels. The critters in the soil will move away from the light, towards the bottom of the funnels, and into the alcohol jars. Compare the diversity and abundance of terrestrial insects from the riparian forest versus those from the more exposed site. Use operational taxonomic units to classify insects. Have students predict what they will find in the form of a hypothesis before commencing the activity.

NOTES (PLEASE WRITE ANY SUGGESTIONS YOU HAVE FOR TEACHERS USING THIS ACTIVITY IN THE FUTURE):



DATA SHEET: BUFFERED STREAM, HEALTHY STREAM

STUDENT ACTIVITY PROCEDURE A

Name _____

Observations: Buffered Stream Site (riparian forest buffer intact)

*Date: _____ *Time: _____
 *Stream Name: _____ *Watershed: _____
 *Exact Location: _____
 *Approximate Stream Width: _____ *Depth: _____
 *Estimated width of woody or marshy riparian zone from stream edge to cleared area: _____ m
 *Land-use pattern beyond the immediate riparian zone: _____

 *Creek Appearance (velocity, color, frozen, etc.) _____
 *Weather in past 48 hrs (rain, snow, cats & dogs, etc.) _____
 *Other observations: _____

Observations: Exposed Stream Site (riparian forest buffer absent or disrupted)

*Date: _____ *Time: _____
 *Stream Name: _____ *Watershed: _____
 *Exact Location: _____
 *Approximate Stream Width: _____ *Depth: _____
 *Estimated width of woody or marshy riparian zone from stream edge to cleared area: _____ m
 *Land-use pattern beyond the immediate riparian zone: _____

 *Creek Appearance (velocity, color, frozen, etc.) _____
 *Weather in past 48 hrs (rain, snow, cats & dogs, etc.) _____
 *Other observations: _____

HYPOTHESIS: The _____ level will be higher in the _____ stream because _____
 (water quality parameter) (buffered or exposed)

FIELD TESTS (Ideally, all testing should be completed on site, but the following tests MUST be done on site because they are temperature and/or time dependent.)

Average

Temperature: Normal Creek Range: 0.0-33.0°

____ °C **Buffered Stream** Sample A: ____ °C Sample B: ____ °C
 ____ °C **Exposed Stream** Sample A: ____ °C Sample B: ____ °C

pH: Normal Creek Range: 6.16-8.80 Possible Range: 0.0 – 14.0

____ **Buffered Stream** Sample A: ____ Sample B: ____
 ____ **Exposed Stream** Sample A: ____ Sample B: ____

Total Dissolved Solids (TDS): Normal Creek Range: 60-460 mg/L; Possible Range: 10-2000mg/L, rarely over 1500mg/L

____ mg/L **Buffered Stream**
 Value on Blue Meter for A: ____ x10 = ____ mg/L **OR** Value on Beige TDS Tester for A: ____ mg/L
 Value on Blue Meter for B: ____ x10 = ____ mg/L Value on Beige TDS Tester for B: ____ mg/L
 ____ mg/L **Exposed Stream**
 Value on Blue Meter for A: ____ x10 = ____ mg/L **OR** Value on Beige TDS Tester for A: ____ mg/L
 Value on Blue Meter for B: ____ x10 = ____ mg/L Value on Beige TDS Tester for B: ____ mg/L

Dissolved Oxygen (DO): *Normal Creek Range: 6-14 mg/L Possible Range: Rarely exceeds 16mg/L High Range:(1-20 mg/L)*
 _____ mg/L Buffered Stream # of drops for A: _____ mg/L # of drops for B: _____ mg/L
 _____ mg/L Exposed Stream # of drops for A: _____ mg/L # of drops for B: _____ mg/L

LABORATORY TESTS (Ideally, these tests should be completed no longer than 24 hours after samples are obtained.)

Average

Nitrate-Nitrogen: *Normal Creek Range: 0-2.60mg/L Possible Range: 0 – 20 mg/L*
 _____ mg/L Buffered Stream
 Low Range (0-1 mg/L) **OR** High Range (0-10 mg/L)
 Color wheel value for A: _____ mg/L Color wheel value for A: _____ x 10 = _____ mg/L
 Color wheel value for B: _____ mg/L Color wheel value for B: _____ x 10 = _____ mg/L
 _____ mg/L Exposed Stream
 Low Range (0-1 mg/L) **OR** High Range (0-10 mg/L)
 Color wheel value for A: _____ mg/L Color wheel value for A: _____ x 10 = _____ mg/L
 Color wheel value for B: _____ mg/L Color wheel value for B: _____ x 10 = _____ mg/L

Total Phosphorus: *Normal Creek Range: 0.010-0.430mg/L Possible Range: 0-50mg/L*
 _____ mg/L Buffered Stream
 Low Range (0-1 mg/L) **OR** Mid Range (0-5 mg/L)
 Color wheel value for A: (____ / 150) = _____ mg/L Color wheel value for A: (____/30)= _____ mg/L
 Color wheel value for B: (____ / 150) = _____ mg/L Color wheel value for B: (____/30)= _____ mg/L
 OR High Range (0-50 mg/L)
 Color wheel value for A: (____/3) = _____ mg/L
 Color wheel value for B: (____/3) = _____ mg/L
 _____ mg/L Exposed Stream
 Low Range (0-1 mg/L) **OR** Mid Range (0-5 mg/L)
 Color wheel value for A: (____ / 150) = _____ mg/L Color wheel value for A: (____/30)= _____ mg/L
 Color wheel value for B: (____ / 150) = _____ mg/L Color wheel value for B: (____/30)= _____ mg/L
 OR High Range (0-50 mg/L)
 Color wheel value for A: (____/3) = _____ mg/L
 Color wheel value for B: (____/3) = _____ mg/L

Total Alkalinity: *Normal Creek Range: 20-200 mg/L Possible Range: 0- 400mg/L*
 _____ mg/L Buffered Stream
 High Range **OR** Low Range
 # of Drops Sulfuric Acid in A: _____ x17= _____ mg/L # of Drops Sulfuric Acid in A: _____ x6.8= _____ mg/L
 # of Drops Sulfuric Acid in B: _____ x17= _____ mg/L # of Drops Sulfuric Acid in B: _____ x6.8= _____ mg/L
 _____ mg/L Exposed Stream
 High Range **OR** Low Range
 # of Drops Sulfuric Acid in A: _____ x17= _____ mg/L # of Drops Sulfuric Acid in A: _____ x6.8= _____ mg/L
 # of Drops Sulfuric Acid in B: _____ x17= _____ mg/L # of Drops Sulfuric Acid in B: _____ x6.8= _____ mg/L

Turbidity: *Normal Creek Range: 0-42 JTU Possible Range: 0-100 JTU (rarely exceeds 100 JTU)*
 _____ JTU Buffered Stream
 Low Range (50mL sample) **OR** High Range (25mL sample)
 # of 0.5 mL reagent additions to A: _____ x5= _____ JTU # of 0.5 mL reagent additions to A: _____ x10= _____ JTU
 # of 0.5 mL reagent additions to B: _____ x5= _____ JTU # of 0.5 mL reagent additions to B: _____ x10= _____ JTU
 _____ JTU Exposed Stream
 Low Range (50mL sample) **OR** High Range (25mL sample)
 # of 0.5 mL reagent additions to A: _____ x5= _____ JTU # of 0.5 mL reagent additions to A: _____ x10= _____ JTU
 # of 0.5 mL reagent additions to B: _____ x5= _____ JTU # of 0.5 mL reagent additions to B: _____ x10= _____ JTU

