Rivers

An Interdisciplinary Unit for
Juniors and Seniors in
Rivers and Revolutions
Concord Carlisle High School
500 Walden St.
Concord, MA

North Bridge, circa 1900.
Detroit Publishing Co. "The Old Bridge, Concord." *The Old Bridge*, *Concord*. Library of Congress, Web. 31 July 2012. <http://www.loc.gov/pictures/resource/cph.3g05135/>.

A unit developed for
Approaching Walden
by Matthew Goldberg
Summer 2012

Unit Overview

This is the first unit of a pilot program at Concord Carlisle High School, called, *Rivers and Revolutions*. This is an interdisciplinary program for juniors and seniors, including teachers from Art, English, Math, Science, and Social Studies. The program will operate on a 1:1 classroom to field ratio, though not necessarily on a daily or even weekly basis. Each day of the week will be devoted to a particular discipline, or lens, through which students and teachers will engage the subject matter. Types of field activities include, but are not limited to: attending plays, performances, panel discussions, visiting museums, libraries, natural areas, National and State Parks, Conservation Lands, and other sites of salience.

Presented here is the science portion of the *Rivers* unit, although the assessment represents the work that students will do as they create a unit synthesis assignment, combining all disciplines. The science portion of the unit will consist of six lessons over a two week period, centered around *The River Continuum Concept*. *The River Continuum Concept*, a paper written by Robin Vannote in 1980 is one of the most well known scientific papers on the topic of stream ecology.

Concord Carlisle High School is located adjacent to the Hapgood Wright Town Forest, which contains Fairyland Pond and Brister's Spring and some streams. We are also relatively close to the Sudbury, Assabet, and Concord Rivers. Henry Thoreau wrote extensively about these rivers, and Fairyland was mentioned in the writings of Ralph Waldo Emerson and Thoreau. Fairyland's name is attributed to Emerson's children and their friends, including Louisa May Alcott, who often played here (Maynard, 2004). Our location, with its history and interdisciplinary connections, is the ideal place to study rivers as a way of creating a sense of place.

The six lessons of this unit are:
Lesson 1: Watersheds and Stream Order (45 minutes)
Lesson 2: The River Continuum Concept (60 minutes)
Lesson 3: Streamside Biosurvey at Fairyland, a lower order stream (2-3 hours)
Lesson 4: Streamside Biosurvey on the Concord River, a higher order stream (2-3 hours)
Lesson 5: The effects of dams on the river continuum (60 minutes)
Lesson 6: Streamside Biosurvey upstream and downstream of the Powdermill Dam (2-3 hours)

The following State Standards are supported by this unit.

From the Common Core State Standards

Reading Standards for Literacy in Science, Grades 11-12

1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Writing Standards for Literacy in Science, Grades 11-12

1. Write arguments focused on discipline-specific content.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
7. Conduct short as well as more sustained research projects to answer a question (including a self- generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
9. Draw evidence from informational texts to support analysis, reflection, and research.

From the Massachusetts Science and Technology/Engineering Curriculum Framework

Scientific Inquiry Skills Standards

SIS1. Make observations, raise questions, and formulate hypotheses.
SIS2. Design and conduct scientific investigations.
SIS3. Analyze and interpret results of scientific investigations.
SIS4. Communicate and apply the results of scientific investigations.

Earth and Space Science, High School

3.4 Explain how water flows into and through a watershed. Explain the roles of aquifers, wells, porosity, permeability, water table, and runoff.

3.5 Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.

Biology, High School

5.2 Describe species as reproductively distinct groups of organisms. Recognize that species are further classified into a hierarchical taxonomic system (kingdom, phylum, class, order, family, genus, species) based on morphological, behavioral, and molecular similarities. Describe the role that geographic isolation can play in speciation.

5.3 Explain how evolution through natural selection can result in changes in biodiversity through the increase or decrease of genetic diversity within a population.

6.2 Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.

6.3 Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.

6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.

Lesson 1: Watersheds and Stream Order

Lesson Objectives:

Students will...

- be able to define a watershed and map the watershed area for Walden Pond using a topographic map.
- determine the stream order of the Sudbury, Assabet, and Concord Rivers within the SuAsCo Watershed.

Lesson Overview

This lesson will be guided by the presentation shown on the page labeled "Rivers, Lesson 1 Presentation." The concepts presented here are some background that will help students to better understand the Vannote paper, which is the subject of Lesson 2. These concepts include watersheds and how to determine the land area of one, and the concept of stream order.

Lesson Outline

I. Define watershed

- Slide 1 presents a definition for watershed from the EPA website. The quote on this page from John Wesley Powell emphasizes the interconnectedness of things within a watershed.
- Slide 2 is an image representing the topography of a landscape, illustrating why the area within a watershed is connected more intimately than are the areas just outside of the watershed.

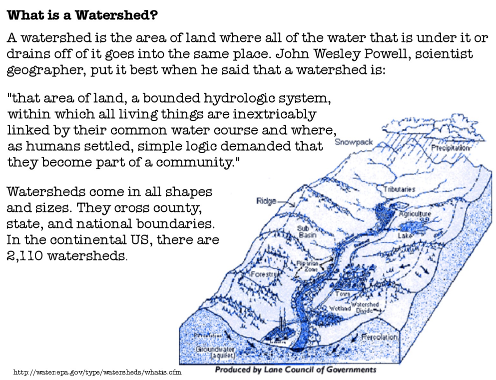
II. Determine the watershed area of Walden Pond

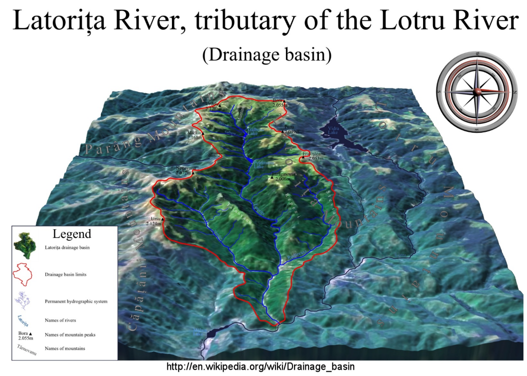
- Walden Pond is a kettle pond, formed as a glacial lake from the last glaciation of the area. Because of this, there is no visible inlet or outlet to the pond. Thoreau makes note of this in *Walden*. It also makes it an ideal place for students to begin to determine a watershed area, as it is a relatively small sub-basin within a large watershed. Slide 3 is an image taken from the topographic map from which students will be working.
- After showing students the features of a topographic map, students will be given the resource, "How to Read a Topographic Map and Delineate a Watershed." With this, students will trace the border of the watershed area for Walden Pond on their map.

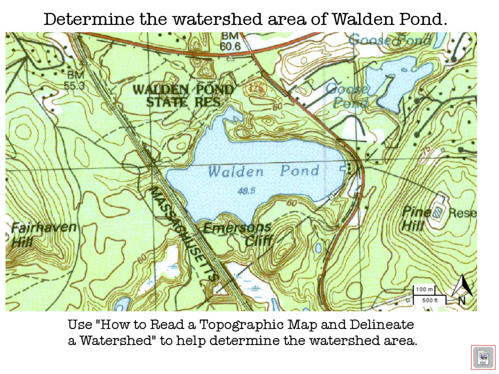
III. Stream order

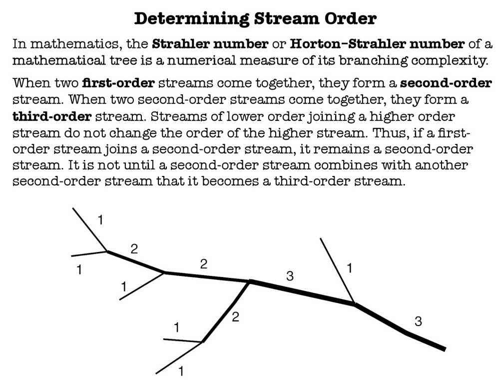
- Stream order is based on Strahler number, and is shown in slide 4. After this explanation, students will be provided with a map of the SuAsCo Watershed (named for the Sudbury, Assabet, and Concord Rivers). Ask the students to identify the stream order for the Sudbury, Assabet and Concord Rivers.

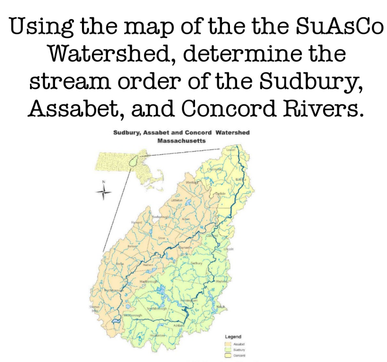
Rivers, Lesson 1 Presentation

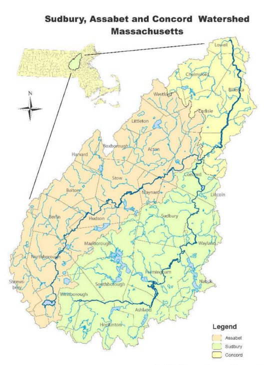












Lesson 2: The River Continuum Concept

Lesson Objectives

Students will...

- Read and analyze a scientific paper.
- Interpret scientific data.
- Understand the river continuum concept.
- Describe how the physical, chemical, and biological features of a river influence each other.

Lesson Overview

The River Continuum Concept (Vannote, 1980) is one of the most well known papers on stream ecology. While many scientific papers are extremely challenging to read for a high school student, this one is quite accessible. This provides an opportunity for students to dive into and analyze a scientific paper. This paper can be found at: *fishlab.nres.uiuc.edu/NRES_409/Documents/**vannote_1980**.pdf*

Prior to this lesson, students will read the paper for homework. They will also be given the page called "The River Continuum - Reading Guide." During this lesson, the class will jigsaw while sharing their ideas on the paper.

Lesson Outline

I. Identifying c\Characteristics of Rivers.

- To warm up, ask the class to identify the physical, chemical, and biological characteristics of rivers. Record student answers on slides 2, 3, and 4.

II. The River Continuum Jigsaw - Part 1

- Break the class into 3 (or 6) groups, groups A, B, and C
- Provide the following instructions to the corresponding groups:
    - **Group A:** Review the article "The River Continuum Concept," and describe the physical changes that occur in a river as you travel from the headwaters to the mouth of the river. Each member of the group should keep their own notes on the conversation, as you will be sharing these ideas with other students later.
    - **Group B:** Review the article "The River Continuum Concept," and describe the chemical changes that occur in a river as you travel from the headwaters to the mouth of the river. Each member of the group should keep their own notes on the conversation, as you will be sharing these ideas with other students later.
    - **Group C**: Review the article "The River Continuum Concept," and describe the biological changes that occur in a river as you travel from the

headwaters to the mouth of the river. Each member of the group should keep their own notes on the conversation, as you will be sharing these ideas with other students later.

•Allow the groups 10 - 15 minutes to review the article and address the question.

III. The River Continuum Jigsaw - Part 2

•Jigsaw the students in the class into groups of 3, so that each new group has a representative from groups A, B, and C.

•Provide these new groups with the following prompt:

‣Each group member will first present the physical, chemical or biological changes that were described in their first group. Then, look for the relationships between these changes. As a group, answer the following questions:

-How do the changes in the chemistry of a river as it flows down stream affect the biology of the river?

-How do the changes in the biology of a river as it flows down stream affect the chemistry of the river?

-How do the changes in the physical aspects of the river affect both the biology and the chemistry of the river?

•Allow these groups to work on this for approximately 10 minutes, then ask them to pause to review some of the data from the Vannote paper.

•Display Fig. 2 from Vannote (slide 7) and present the class with the following questions:

‣Why does the diversity of organic compounds dissolved within the river first increase, then decrease in lower order streams?

‣Why is ΔT_{max} greatest in medium sized (3rd to 5th order) streams?

‣Why is biotic diversity also greatest in medium sized (3rd to 5th order) streams?

‣Why does the P/R ratio increase as you move from lower order to mid order streams?

‣Why does the CPOM/FPOM ratio decrease over the same segments of these streams?

•After this discussion, present slide 8 and allow groups to return to the analysis questions that they were working on.

IV. Conclusion

•After all groups have had sufficient time to answer the questions, choose students to relay their groups responses and record them on slides 9-11.

•Wrap up with slide 12, and ask students to describe what is meant by “dynamic equilibrium” in the Vannote paper.

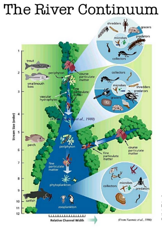
The River Continuum - Reading Guide

The River Continuum (Vannote, 1980) is one of the most well known scientific papers on stream ecology. While many scientific papers are extremely challenging to read for a lay person, this one is a bit more accessible. Please read this paper tonight, as it will be the foundation of our discussion on our first science day before we go into the field. You may find that these questions help guide you through some of the most important parts of the paper.

1. What is meant by "dynamic equilibrium?"
2. What is stream order?
3. What is meant by P/R < 1? When might this happen?
4. How are CPOM, FPOM, and UPOM distinguished?
5. What are macroinvertebrates?
6. What are the characteristics of each of the following macroinvertebrate functional feeding groups: shredders, collectors, scrapers (or grazers), and predators?
7. Why are shredders and collectors dominant in lower order streams?
8. Why are grazers found more commonly in mid order streams as opposed to lower or higher order streams?
9. Why are collectors so dominant in higher order streams?
10. How do fish communities change as stream order increases?
11. On page 133, the authors state, "As a consequence of physical and biological processes, the particle size of organic material in transport should become progressively smaller down the continuum and the stream community response reflect progressively more efficient processing of smaller particles." Why should we expect this to be true?
12. Why is ΔTmax greatest in medium sized (3rd to 5th order) streams?
13. What is the relationship between ΔTmax and organism diversity?
14. Why does the quantity and type of food availability change seasonally in New England rivers?

Rivers, Lesson 2 Presentation

The River Continuum



"Riparian: River Continuum Concept." *Stream Ecology*. Oxbow River and Stream Inc., July 2008. Web. 30 July 2012. <http://www.oxbowriver.com/Web_Pages/Stream_Ecology_Pages/Ecology_Riparian/Ecology_RCC.html>.

What are the *physical* characteristics of a river?

What are the *chemical* characteristics of a river?

What are the *biological* characteristics of a river?

Group A

Review the article "The River Continuum Concept," and describe the *physical* changes that occur in a river as you travel from the headwaters to the mouth of the river.

Group B

Review the article "The River Continuum Concept," and describe the *chemical* changes that occur in a river as you travel from the headwaters to the mouth of the river.

Group C

Review the article "The River Continuum Concept," and describe the *biological* changes that occur in a river as you travel from the headwaters to the mouth of the river.

Each group member will first present the physical, chemical or biological changes that were described in their first group. Then, look for the relationships between these changes. As a group, answer the following questions:

- How do the changes in the *chemistry* of a river as it flows down stream affect the *biology* of the river?
- How do the changes in the *biology* of a river as it flows down stream affect the *chemistry* of the river?
- How do the changes in the *physical* aspects of the river affect both the *biology* and the *chemistry* of the river?

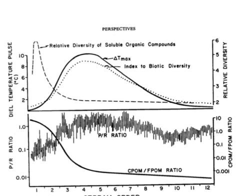


FIG. 2. Hypothetical distribution of selected parameters through the river continuum from headwater seeps to a twelfth order river. Parameters include heterogeneity of soluble organic matter, maximum diel temperature pulse, total biotic diversity within the river channel, coarse to fine particulate organic matter ratio, and the gross photosynthesis/respiration ratio.

Vannote R.L. , G.W. Minshall, K.W. Cummins, J.R. Sedell, C.E. Cushing: "The River Continuum Concept". Canadian Journal of Fisheries and Aquatic Sciences. 37.1980,1 Ottawa, 130-137.

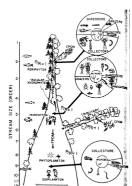


FIG. 1. A proposed relationship between stream size and the progressive shift in structural and functional attributes of lotic communities. See text for fuller explanation.

How do the changes in the *chemistry* of a river as it flows down stream affect the *biology* of the river?

How do the changes in the *biology* of a river as it flows down stream affect the *chemistry* of the river?

How do the changes in the *physical* aspects of the river affect both the *biology* and the *chemistry* of the river?

Vannote R.L. , G.W. Minshall, K.W. Cummins, J.R. Sedell, C.E. Cushing: "The River Continuum Concept". Canadian Journal of Fisheries and Aquatic Sciences. 37.1980,1 Ottawa, 130-137.

How do the changes in the *chemistry* of a river as it flows down stream affect the *biology* of the river?

How do the changes in the *biology* of a river as it flows down stream affect the *chemistry* of the river?

How do the changes in the *physical* aspects of the river affect both the *biology* and the *chemistry* of the river?

What is meant by "dynamic equilibrium?"

Lesson 3: Streamside Biosurvey at Fairyland, a lower order stream

Lesson Objectives

Students will...

•observe the characteristics of a lower order stream.

•conduct a streamside biosurvey.

•compare the characteristics of a lower order stream and a higher order stream.

Lesson Overview

This is the first of four streamside biosurveys that will be conducted. In lesson 4, students will conduct a second survey at the Old North Bridge on the Concord River. After these two surveys, students will be able to compare the characteristics of lower and higher order streams, and evaluate these results in light of the Vannote paper. In lesson 6, students will conduct two more streamside surveys, to compare the areas upstream and downstream of a dam.

Lesson Outline

I. Preparation for survey

•Before leaving the classroom, each student will receive "Stream Biosurvey: Habitat Walk" and "Streamside Biosurvey: Macroinvertebrates" data sheets. These can be found at: http://water.epa.gov/type/rsl/monitoring/stream_index.cfm

•Divide class into groups of 4 or 5 students. Each group will receive the supporting instructions for the data sheets including "4.1 Stream Habitat Walk," found at http://water.epa.gov/type/rsl/monitoring/vms41.cfm, and "4.2 Streamside Biosurvey," found at http://water.epa.gov/type/rsl/monitoring/vms42.cfm.

II. Survey at Fairyland

•Assign each group to a region of the stream at Fairyland, with some working in the stream between Brister's Spring and Fairyland Pond, and other groups working downstream of Fairyland Pond.

•Groups will conduct their streamside biosurvey.

•Groups will collect macroinvertebrates to identify back in the classroom.

III. Identification of macroinvertebrates and data analysis

•Back in the classroom, students will use a key to identify their collected macroinvertebrates and complete their analysis. One identification key can be found in the "Volunteer Stream Monitoring Training Manual - State of Indiana" at *www.in.gov/dnr/nrec/files/nc-**Riverwatch_Manual.pdf***

•Students will then share their results with the class.

Lesson 4: Streamside Biosurvey on the Concord River, a higher order stream

<u>Lesson Objectives</u>

Students will...

•observe the characteristics of a lower order stream.

•conduct a streamside biosurvey.

•compare the characteristics of a lower order stream and a higher order stream.

<u>Lesson Overview</u>

This is the second of our streamside biosurveys. The Concord River at the Old North Bridge is a higher order stream, and will be a great site to compare our results from the stream at Fairyland. The lesson task is very similar to Lesson 3. But, because of the different location, our sampling method for macroinvertebrates will need to be different.

<u>Lesson Outline</u>

I. Preparation for survey

- •Students will work in the same groups as they did in Lesson 3, and bring with them the same materials.
- •Once at the Concord River, ask the students to spend a few moments observing the river in this area, then identifying parts of the procedure that will need to differ from that in Lesson 3. Because of the rivers width and depth, and lack of a riffle area, they will need to choose an alternative method for sampling for macroinvertebrates.

II. Survey at the Concord River

- •Assign each group to a region of the Concord River.
- •Groups will conduct their streamside biosurvey.
- •Groups will collect macroinvertebrates to identify back in the classroom.

III. Identification of macroinvertebrates and data analysis

- •Back in the classroom, students will use a key to identify their collected macroinvertebrates and complete their analysis.
- •Students will then share their results with the class.
- •Groups will then work on comparing how the observed physical, chemical, and biological characteristics of the Concord River differ from the stream observed in Lesson 3.
- •Groups will then share their findings with the class, and discuss if these findings support the ideas in Vannote's *River Continuum Concept*.

Lesson 5: The effects of dams on the river continuum

Lesson Objectives

Students will...

- Understand the reasons why dams have been built and are such a common part of the New England landscape.
- Predict the effects that a dam will have on the physical characteristics of a river.
- Compare the effects that dams have on anadromous and non-anadromous fish.

Lesson Overview

Before coming to class, students will read *Calamity on the Colorado* (Powell, 2010) and *Dams on the Assabet: a guided tour* (Field-Juma, 2008). They will compare local dams to the large dams on the Colorado River, and analyze the effect that dams have on anadromous and non-anadromous fish populations.

Lesson Outline

I. Opening exercise

- Students will work in small groups to address the following question: *In what ways do dams affect rivers?*
- Each group will then share ideas with the class.
- Students will then read *10 Ways Dams Damage Rivers*

II. Comparing local dams to dams on the Colorado.

- Students groups will then use their homework reading to address the following questions:
  1. *Why have dams been built on the Colorado River?*
  2. *Why have dams been built on the Assabet River?*
  3. *In what ways are the issues raised by the dams on the Assabet and the Colorado similar? In what ways are they different?*

III. The effect of dams on fish

- Students will be placed into two types of groups. The "Shad" groups will focus on anadromous fish. The "Guppy" groups will focus on non-anadromous fish.
  - The "shad" groups will then read either *State and Federal Wildlife Officials Work With Local Partners to Restore Shad in Charles River* and *What is a fish ladder?*
  - The "guppy" groups will use the online activity *Sex and the Single Guppy* and read *Evolution Can Occur In Less Than 10 Years, Guppy Study Finds* (University of California - Riverside).
- Brief presentations
  - "Shad" groups will work together to present a brief presentation on the effect of dams on anadromous fish, and what how those effects might be mitigated.
  - "Guppy" groups will work together to present a brief presentation on the potential effects of dams on non-anadromous fish.

Lesson 6: Streamside Biosurvey upstream and downstream of the Powdermill Dam

Lesson Objectives

Students will...

- Predict the effects that a dam will have on the physical characteristics of a river.
- Analyze the implications of removing an existing dam.

Lesson Overview

Students will conduct a streamside survey at the Powdermill Dam on the Assabet River. Some groups will be assigned areas above the dam, while others will be assigned areas below the dam. The compiled results can then be compared to see what effects of the dam can be observed. On our return trip, we will visit the site of the breached Damon Mill Dam.

Lesson Outline

I. Preparation for survey

- Students will work in the same groups as they did in Lessons 3 and 4, and bring with them the same materials.
- Once at the Powdermill Dam, ask the students to spend a few moments observing the river in this area, above and below the dam. Then, identify parts of the procedure that will need to differ from that in Lesson 3. Because the physical characteristics of the river differ above and below the dam, they may need to choose an alternative method for sampling for macroinvertebrates.

II. Survey at the Powdermill Dam on the Assabet River

- Assign each group to a region of the Assabet River, some above the dam, others below.
- Groups will conduct their streamside biosurvey.
- Groups will collect macroinvertebrates to identify back in the classroom.

III. Identification of macroinvertebrates and data analysis

- Back in the classroom, students will use a key to identify their collected macroinvertebrates and complete their analysis.
- Students will then share their results with the class.
- Groups will then work on comparing how the observed physical, chemical, and biological characteristics of the Assabet River differ above and below the Powdermill Dam.
- Groups will then share their findings with the class, and discuss how the dam impacts the river continuum, based on Vannote's *River Continuum Concept*.

Unit Synthesis Assignment

While only the science portion of the unit has been presented, the main goal of the program is to have students synthesize their learning across disciplines. This scoring rubric reflects this goal. At the conclusion of the unit, students will submit a project that reflects their understanding of the material. Students will reference content from across all disciplines in creating a singular artifact that chronicles and synthesizes their learning in the unit. This project may take one of the following forms: text-based (e.g. prose, poetry, essay), visual or auditory representation (e.g. painting, photograph, original music, dance, theater), a mathematical model (e.g. theorem, proof), or a framework for a scientific experiment. The Rivers and Revolutions faculty will also take into consideration other forms of synthesis assignments suggested by students that do not fall within these broad categories.

DRAFT Customized Developmental Rubric for Unit Synthesis Assignments
Prepared by Rivers and Revolutions Program Coordinator Michael Goodwin
August 1, 2012

Note: This version of the rubric is very much a work in progress and will be revised throughout the month of August by the Rivers and Revolutions Faculty with assistance from colleagues at the Harvard Graduate School of Education.

DOMAIN/LEVEL	***NEEDS IMPROVEMENT**** ***C to C+ to B- to B***	***MEETS STANDARD*** ***B+ to A-***	***EXCEEDS STANDARD***** ***A***
Relate disciplines to one another, and to the essential questions, topics and themes offered in the unit	Work shows little overlap between disciplines, or only between 1-2 disciplines Work does not clearly articulate a nor discuss a primary question, topic or theme expressed by the different disciplines	Work shows strong connections between the disciplines and discusses how they are being used to explore a common question/topic/theme	Work shows an understanding of how all disciplines overlap, and also how they provide similar yet distinct ways of understanding the material and exploring essential questions, topics and themes Work makes specific and relevant references to class content across units

Incorporation of nightly preparation	Work includes only a few references to work completed outside of class	Work references each of the assignments completed outside of class	Work weaves together assignments completed outside of class in order to support the central idea or argument
Expression	Work sample requires substantial additional explanation in order to be understood Many grammatical and/or technical errors Lacks clarity and coherence: work is incoherent – more a collection of fragments than a single work. Work is submitted late or incomplete	Few grammatical and/ or technical errors Clear organization and coherence: work exhibits coherence and stands together as a unified work	No grammatical or technical errors Exceptional clarity Structure and organization strengthens argument/idea Work may be used as an exemplar for the class
Customized Student Goal One	TBD	TBD	TBD
Customized Student Goal Two	TBD	TBD	TBD

* If the work presented does not even meet the criteria listed in the "needs improvement" column, the work will be considered incomplete and will be resubmitted by the student.
**Work falling in this level also contains the characteristics listed in "meets standard"

References

"10 Ways Dams Damage Rivers." *American Rivers*. American Rivers. Web. 11 Aug. 2012. <http://www.americanrivers.org/our-work/restoring-rivers/dams/background/10-ways.html>.

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