

Minnehaha Creek Restoration Project

A Place-Based Environmental Water Study

Course: 9th grade Biology

Adapted from Kent Piccott, Minneapolis Public Schools

Background:

This study was designed with the intent to develop individual student relationships with their local ecosystem. By exposing students to environmental fieldwork, it is hoped that the experience will lead them to a greater understanding and appreciation of the role they play in their ecosystem.

Course: Biology (9th grade)

Standards

Human Interactions with Living Systems

Standards: *Human activity has consequences on living organisms and ecosystems. (94412, 94211)*

- I can describe the ecological risks and benefits of changing a natural Minnesota ecosystem as a result of human activity.
- I can describe ways that human activities can change the populations and communities in an ecosystem.

Goal: Student Based

Enduring Understandings:

- I will have an understanding of the role of Minnehaha Creek and the impact humans have had on its ecosystem.
- I will understand the ingredients necessary to provide a healthy ecosystem for Minnehaha Creek.

ESSENTIAL QUESTIONS

1. What are the elements of an ecosystem?
2. How can you describe the environment of Minnehaha Creek?
3. How do humans affect the environment, and how does the environment affect humans?

4. What are the limiting factors that determine healthy populations?

SUMMATIVE ASSESSMENT

Students will design a restoration plan for an assigned specific location, which if implemented, would lead to positive impact for Minnehaha Creek. This project will include:

- A group-designed restoration plan
- Current pictorial view and description of restoration area
- Drawing representing future improvements for site
- Benefits for community and Minnehaha Creek

FORMATIVE ASSESSMENT

- Students will collect and identify macro-invertebrates from Minnehaha Creek and correctly identify them using a dichotomous key.
- Students will perform a variety of field laboratory tests using scientific instruments to collect data necessary to determine the current physical conditions of Minnehaha Creek. This data will be recorded in science journals.
- Students will record and sketch successful restoration ideas determined from analyzing example creek restoration projects in their journals. This information will be implemented in their restoration plan for Minnehaha Creek.

DIFFERENTIATION

- Inquiry Based
- Collaborative learning
- Engaged learning (hands-on)
- Visual, Auditory, and Kinesthetic Field Experiences
- Technology Driven = Powerpoint / photography / Vernier Probes.

ACADEMIC LANGUAGE (vocabulary)

Hydrologic cycle, hydrology, topography, clouds, lakes, wetlands, reservoirs, streams, aquifers, glaciers, ocean, precipitation, stream flow, evaporation, transpiration, watershed runoff, infiltration, percolation, groundwater flow, catch basins, runoff, peak flows, pollution transport, riparian zone, bank slope, suspended solids, bacteria, nutrients, phosphorus, nitrogen, BMPs, sediment basins, impervious surfaces, vegetated buffers, swales, fascines, bio-filters, impaired water, environment, stream reach, stream segment, outfall, macro-invertebrate, water quality, point source, nonpoint source, sediment, toxics, turbidity, dissolved oxygen, impaired biota, hypothesis, reasoning, explanation, inference, engineering, model.

CONCEPTS

- Abiotic and biotic cycles
- Webs, pyramids
- Ecosystems: energy, entropy, populations, carrying capacity, and trophic levels
- Native and invasive species
- Ecology and the environment
- Human intervention and pollution / conservation and management
- Hydrologic cycle / water issues-quality, reuse, recycling

SKILLS

- Science process skills including observing, inferring, measuring, performing experiments.
- Lab equipment skills including using vernier probes, water testing kits, thermometers, dissolved oxygen readers, seining netting and scraping techniques.
- Literacy skills including math computation, writing, reading, scientific literacy.
- Affective skills including communication, cooperation, collaboration, and use of technology.

RESOURCES

- Student supplies = journals, writing utensils, poster board, tri-fold boards, clip boards, markers, colored pencils, etc.
- Teacher supplies = Water quality kits + Vernier probes.
- Hip waders for students. 12 pair / variety of sizes sufficient.
- Kick nets (1 for each group)
- Computer access will be needed. Preferred setting would allow for 1 computer per student when creating restoration design plan on Google docs.

Minnehaha Creek Study (2-3 week unit)

Implementation: (Students placed in groups of 8)

Day #1: Students were introduced to a reach location (52nd Ave S. and Minnehaha parkway). Ecology vocabulary was introduced in a Creek Walk assignment asking students to make observations of Minnehaha Creek's ecosystem.

Day #2: Students were introduced to the basic concepts of hydrology including the water cycle, watersheds, runoff, water quality components (physical/chemical) etc.

Day #3 & 4: Students went to Creek and performed water quality analysis comparing the gathered data with the state standards for turbidity, dissolved oxygen, nitrogen, phosphorus, pH, and temperature. Data was recorded in journal to be used in summative assessment.

Day #5: Macro-invertebrate introduction. Focus on 4 groups of stream macro-invertebrates, their necessary creek habitats, and pollution tolerance levels. Class lecture.

Day #6: Macro-invertebrate collection. Here the students collected samples using kick nets and used insect guides to identify individual collections. Worksheet was given so students could use the sample collection to calculate the water quality index (based on macro-invertebrates pollution tolerance level). Date recorded in journal.

Day #7: Creek restoration lecture showing examples of creek restoration projects and focusing on the design plan and necessary components to promote a healthy creek ecosystem.

Day #8: Last creek visit. Students assigned a section of Minnehaha Creek focusing on sketching physical features in need of improvements.

Day #9 - #11: Students groups create design plan and complete summative assessment project. Students create Google doc and tri-fold poster board presentation. (Student Creek project rubric and guiding questions supplied)

Day #12 & #13: Student class presentations. All members are required to have active role in presentation. Instructor / Peer / Self -assessment constitutes the overall score earned.

Anecdotal Report from piloted lesson

Students showed both excitement and enjoyment during the varied activities of the Minnehaha Creek study. During the Creek data collection days there was a high level of engagement by students who are less motivated when in the classroom setting. Students showed strong cooperative and collaborative skills when at the creek and during the creating of their design plan. A student survey was given which showed 96% of students found the Creek study to be a positive experience and would recommend the instructor to repeat it next year with 9th grade Biology students.

Opportunities for Improvement and Expansion

To improve data collection method, student groups could have been better organized to have specific tasks and to rotate these tasks. This ensures there is an even load share by each member when testing and gathering data.

There was also lost time due to off-task behaviors by students who naturally allow the leaders of the group to “take the ball and run with it.” This could be addressed by assigning specific tasks verses individual team members deciding their role during the restoration design plan.

Minnehaha Creek Study could include a political/historical component. This would allow for interdisciplinary content yielding a greater understanding of the local value of Minnehaha Creek’s ecosystem.

Involving some outside professional partners would also increase student understanding of the importance of Minnehaha Creek. Having professional sources as references would bolster their explanation of the importance of their Minnehaha Creek Restoration Plan

Minnehaha Creek Restoration Project Science Rubric----Minnehaha Creek students,
Below are the point values by which you will be assessed while working in this project.

Point Value	3 Points	2 Points	1 Point	0 Points
#1. Restoration design plan for Minnehaha Creek.	Your design is thorough including abiotic and biotic benefits and a cost analysis	Your design is thorough including abiotic and biotic benefits.	Your design is incomplete only partially showing abiotic and biotic benefits.	Your design does not show abiotic and biotic benefits.
#2. Sketches/pics showing current stream condition and restoration design	Your sketches/pics are complete and show detailed current stream condition and restoration plan with a legend or key	Your sketches/pics are complete and contain current stream condition and restoration plan	Your sketches/pics are incomplete or unclear.	Sketches/pics are missing.
#3. Use scientific tools to gather relevant information on Minnehaha Creek's water quality and aquatic life	You have demonstrated the ability to independently use several scientific instruments to gather research data used for restoration plan	You have demonstrated the ability to use several scientific instruments with minimal assistance to gather research data used for restoration plan	You have demonstrated the ability to use several scientific instruments with assistance to gather research data used for restoration plan	You have not demonstrated the ability to use several scientific instruments to gather research data used for restoration plan
#4. Use of information from expert sources Expanded	You have demonstrated the ability to incorporate information gathered from several visiting outside sources in your restoration plan	You have demonstrated the ability to incorporate information gathered from 2 visiting outside sources in your restoration plan	You have demonstrated the ability to incorporate information gathered from 1 visiting outside sources in your restoration plan	You have not demonstrated the ability to incorporate information gathered from visiting outside sources in your restoration plan
#5. Record of tests and observations	You have demonstrated the ability to maintain a thorough and complete journal documenting data collected.	With minimal assistance, you have demonstrated the ability to maintain a thorough and complete journal documenting data collected.	Journal entries are incomplete, unclear, or missing.	You have not kept a journal documenting the data collected.
#6. Description of how you will be assessed while working in cooperative groups	You have demonstrated the ability to work cooperatively in class and at stream sites with your peers.	You have demonstrated the ability to work cooperatively with your peers in class and at stream sites most of the time.	You find it difficult to work cooperatively with your peers in class and at stream sites most of the time.	You have not demonstrated the ability to work cooperatively with your peers either in class or at stream sites.
#7. Explanation of the importance of the Minnehaha Creek Restoration Plan	You have demonstrated the ability to clearly articulate your Restoration Plan.	With minimal assistance, you have demonstrated the ability to clearly articulate your Restoration Plan.	You have failed to communicate clearly the importance of your Restoration Plan.	Your explanation of the importance of your Restoration Plan is missing.

MINNEHAHA CREEK SUMMATIVE ASSESSMENT PROJECT

PART #1

You are to address the questions below by creating a slide for each question.

1. What are the elements of an ecosystem?
2. How can you describe the ecosystem/environment of Minnehaha Creek?
3. How do humans affect the environment, and how does the environment affect humans?
4. What are the limiting factors that determine healthy populations?
5. What components are necessary to promote and sustain a healthy creek ecosystem?

PART #2---RESTORATION PLAN ----- SEE RUBRIC

1,2,3,4,5.

PART #3---CONCLUSION

6. How can your implementation plan benefit your community?
7. What steps must we take to ensure the preservation of the Minnehaha Creek?
8. How is taking responsibility for the local environment a part of your civic duty?

WATER QUALITY CREEK RESTORATION PROJECT

Parameter	Sample 1	Sample 2	Average	State Standard
Water Temperature	17C	17C	17C	None
Turbidity (NTU)	No Data	No Data	No Data	25 NTU
Phosphate (ppm)	0 ppm	0 ppm	0 ppm	40 ppm (no standard)
Dissolved Oxygen	6.8 ppm	7 ppm	6.9 ppm	5 ppm (no standard)
pH	8.0	8.5	8.25 ppm	6.5-8.5 (no standard)
Nitrate (ppm)	0 ppm	2.0 ppm	1.0 ppm	45 ppm (no standard)

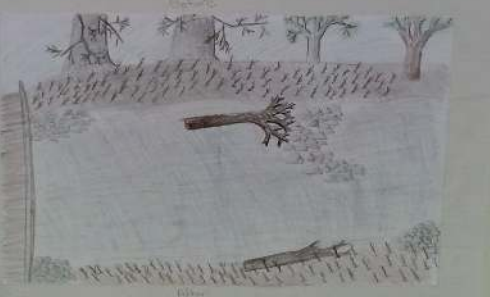
We can conclude that the creek's water quality is healthy.

MACROINVERTEBRATE TALLY

Group #	# of animals	Substratum
Group 1 - sensitive to pollutants	0	N/A
Group 2 - semi-sensitive to pollutants	3	2 clogs, 1 muddy bank
Group 3 - some tolerant of pollutants	0	N/A
Group 4 - tolerant of pollutants	4	4 rocks, 1 muddy bank

Group 1: 0/200
Group 2: 3/100
Group 3: 0/100
Group 4: 4/100

Since the creek's water is very turbid, the animals that live there are mostly tolerant of pollutants.



PLAN

- cut down trees with exposed roots and lay the biggest one along the side of one creek bank
- cut down overhanging tree so that doesn't fall and lay along other creek bank
- put in algae and other prairie grasses in 25 live stakes to help with erosion
- remove stump threatening to fall
- put in a J-shaped rock formation to create more ripples farther away from the bridge and a home for more animals

BENEFITS

- less erosion
- more ripples
- more dissolved oxygen
- increase in aquatic life
 - more shredders means there are more plants to chew up
 - more beetwaters
 - more collectors
 - more to eat
 - scrapers
- more places to live (logs/rocks)
- more ripples
- increase in food supply