HIGH SCHOOL
LESSON GUIDE

Into the Outdoors

THE CONNECTIVITY CONUNDRUM

PEER-DRIVEN HIGH SCHOOL DISCUSSION GUIDE

DEVELOPED BY DAN BERTALAN

In This Activity...

Students will research and debate different stakeholder group perspectives in developing a comprehensive plan for reconnecting a river to its original watershed while also attempting to manage invasive species that could leave or enter the isolated watershed. Their plan will consider the needs of humans, natural resources, the environment, and the future generation of all "citizens" of Planet Earth within the river system.

EDUCATIONAL PARTNERS

Natural Resource Science

GRADE LEVELS
High School - Grades 9-12

CONTENT AREAS
Physical Science, Social Studies, Environmental Science, Natural Resource Science

UNIT THEME
Aquatic ecosystem restoration

TOPICS
Natural resources management, environmental restoration, invasive species, social responsibility

TIME REQUIRED
Four, 45-minute sessions

OVERVIEW

Over the past 200 years Americans have reshaped our terrestrial and aquatic ecosystems both intentionally and accidently through lack of forethought. One example is what happened in the Great Lakes with the invasion of the predatory sea lamprey in the early 1900's that devastated commercial fish populations throughout the Great Lakes ecosystems. Humans wanted to connect shipping passage from the Atlantic Ocean to the Great Lakes, so they constructed the Erie Canal. Cool idea, right? Well, not so much… especially after they discovered they eventually infested the Great Lakes pristine ecosystem with a whole host of invasive species that adversely impacted every level of the food webs in the vast lakes. For a greater understanding, consider reading *The Death and Life of the Great Lakes* by prize-winning author Dan Egan. Though the Great Lakes is a great example of how humans forever mess with ecosystems in the name of "human progress" (which when decoded often means to make money for somebody), the American landscape bears the environmental scars of countless ecosystem disruptions that resulted from not thinking into the future.

In this lesson, students will assume the roles of various and possibly conflicting user groups in researching, presenting, and debating on how to create a plan to possibly reconnect a river to its historic watershed in the **town of Aquaticville**. The various stakeholder groups in Aquaticville will set the stage for peer-driven learning where the entire class will ultimately vote on a plan that they feel best serves their "aquatic environmental community", including all the "environmental citizens" in the present and projected future.

CONCEPT Aquatic Ecosystem Management

ENDURING UNDERSTANDING:

Students will understand the differences between managing outdoor resources for the benefit of humans versus the long-term health of aquatic ecosystems.

CONTENT OBJECTIVES:

Students will be able to evaluate the environmental and social considerations of attempting to restore the dynamics of a river system that connects with lakes or oceans. They will also be able to research, debate and develop a restoration plan that benefits the health of humans and the ecosystems that they are entrusted to manage.

LEARNER OBJECTIVES:

Students will use online research to determine possible solutions and strategies in overcoming the conundrum of reconnecting a river with its historic inflow and outflow. Students will use other online research, group discussions and debate to develop their "re-connectivity plan" that uses a combination of social, environmental, and recreational resource considerations.

PROCESS OBJECTIVES:

Students will work in small and large groups to process new information and use evidence to come to conclusions.

MATERIALS NEEDED (each group, each student):

- Access to computers and the Internet
- Videos and background information at; https://intotheoutdoors.org/topics/reconnecting-rivers-invasive-species/
- Pre-lesson Worksheet with questions to fill in while watching the videos (included in the lesson PDF)
- Four (4) "Connectivity Conundrum" Stakeholder Group Worksheets (included in the lesson PDF)

PROCEDURES

Session 1 - Before watching the three videos, or reading the website background information from the link above, ask students about the fundamental concepts of why humans build dams on rivers, and what might be the impacts on terrestrial and aquatic ecosystems. Also ask students if they have personally seen environmental changes as a result of dams on rivers, or the impacts of aquatic invasive species in lakes or rivers. Lead a short discussion on what students understand about the impacts of building or removing dams. Ecosystem impacts can be: biological, physical, and/or chemical.

Print and distribute the **Pre-Lesson Student Worksheet** (included in this PDF). Instruct students to fill in the worksheet while watching the videos. Go over the questions with the students before viewing so they know what to look and listen for. After viewing the videos, review and discuss the answers to the questions as a class. Encourage discussion and varying perspectives. After viewing the video, review and discuss the answers to the questions as a class. Encourage discussion.

Next, divide the class into these four (4) Connectivity Conundrum groups:

1. **Economic Revitalization Council**
2. **The River Restoration Coalition**
3. **The Aquatic Ecosystem Scientists Society**
4. **The Lakeside Homeowners Association**

Inform students they will be working together as teams within their stakeholder group to achieve their assigned goals in Sessions 2, 3 and 4.

PROCEDURES *(continued)*

Session 2 - Team Research & Plan Development for "Aquaticville" - Begin by reading aloud (or select some students to read) *The Story of Aquaticville* that's included in your PDF.

Print and distribute the *The Story of Aquaticville* and the four respective Connectivity Conundrum Stakeholder worksheets to the four groups (included in this PDF). Each of the four (4) stakeholder groups have specific and sometimes conflicting subjective goals in developing their river restoration plan. In their separate assigned stakeholder groups, have students perform online research from the links provided, plus other sources they discover, then discuss and develop their group's specific plan. Their worksheets provide instructions and research guidelines for students to gather information. Inform each group that two members of their group will also present their river-connectivity restoration recommendations to the entire class during Session 3. Their presentations should be supported by factual research and/or evidence, and presented with at least one form of art or media prepared by the group (either video, poster, graphs, charts, images, or aquatic ecosystem art).

Session 3 – Stakeholder Group Presentations & Class Debate - Have each group present their River Restoration-Reconnectivity Plan and supporting research and reasons for key points in their plan. Limit each group to five minutes presentation time followed by two minutes of questions by the other groups.

After the four groups present their plans, lead a group discussion on how the various stakeholders might work through their differences in the best interest of humans and the aquatic ecosystems affected by their plans. The Aquatic Ecosystem Scientists Society group may assist the teacher in leading the discussion as they represent "a collective science wisdom" that may offer solutions that balance the interests of various groups and in the best interest of "Mother Earth's" ecosystems.

Conclude Session 3 by assigning all of the groups to consider modifying their respective **River Restoration-Reconnectivity Plan** to now include the goals and interests of at least two other stakeholder groups. Inform students that two students from each group will make a final presentation of their revised plan. Their presentations should include the reasons why they changed their plans and how those changes support other groups while still protecting their key stakeholder goals and beliefs.

Session 4 – Modified Stakeholder Presentations & Class Vote on Winning Plan - Instruct the class that they will participate in a final series of presentations and class debate before voting on which group has developed the winning **River Restoration-Reconnectivity Plan**.

Have each group present their revised **River Restoration-Reconnectivity Plan** and supporting research and reasons. Limit each group to four minutes presentation time and limit questions to a minimum.

After all the final presentations, the teacher and the Aquatic Ecosystem Scientists Society can lead and encourage vigorous debate before the final vote. Limit the debate to ten minutes. Have the students vote on the winning **River Restoration-Reconnectivity Plan.**

Conclude the discussion by challenging students who are seriously interested in restoring aquatic ecosystems to identify potential ecosystems near or within their community that need human intervention and what roles might they play in restoring key parts of the ecosystem.

Over-populated goldfish

SPECIAL CONSIDERATIONS:

This activity is richest when completed in groups with answers shared to a whole class. The student worksheet is not a typical worksheet as it encourages students to construct knowledge as they answer questions. The questions build off of each other.

Imaginary "Tilapicat"

ASSESSMENT

Students will be informally assessed based on their participation within their groups and during class presentations and discussions. Teachers could collect the discussion notes students took during the video to check for completion.

Students can be formally assessed using their Pre-Lesson Student Worksheets. Students can be assessed on meeting the formal learning objectives on how thoroughly students completed their **River Restoration-Reconnectivity Plan worksheets.**

EXTENSION ACTIVITIES

Historic changes in their communities – Students can research and list several historic changes in or near their communities that have negatively impacted terrestrial or aquatic ecosystems. They can either create a written story of what happened, why, and what could be done to restore that part of the ecosystem; or, make a class presentation on their findings and include possible solutions to potential negative historic changes.

RESOURCES

Research the resources offered on this topic's web page...
https://intotheoutdoors.org/topics/reconnecting-rivers-invasive-species/

Connectivity Conundrum Standards

Assembled by Phyllis McKenzie – June 26, 2021

Next Generation Science Standards:

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.]

HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* [Clarification Statement: Emphasis is on testing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problembased on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Common Core Standards (Grades 9-12):

Grades 9-10:

CCSS.ELA-LITERACY.RI.9-10.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

CCSS.ELA-LITERACY.RI.9-10.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper).

CCSS.ELA-LITERACY.RI.9-10.7 Analyze various accounts of a subject told in different mediums (e.g., a person's life story in both print and multimedia), determining which details are emphasized in each account.

CCSS.ELA-LITERACY.RI.9-10.8 Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.

CCSS.ELA-LITERACY.W.9-10.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

CCSS.ELA-LITERACY.W.9-10.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

CCSS.ELA-LITERACY.W.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-LITERACY.W.9-10.5 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.

CCSS.ELA-LITERACY.W.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

CCSS.ELA-LITERACY.W.9-10.7 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.

CCSS.ELA-LITERACY.W.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

CCSS.ELA-LITERACY.W.9-10.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

CCSS.ELA-LITERACY.SL.9-10.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

CCSS.ELA-LITERACY.SL.9-10.2 Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.

CCSS.ELA-LITERACY.SL.9-10.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.

CCSS.ELA-LITERACY.SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

CCSS.ELA-LITERACY.SL.9-10.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

CCSS.ELA-LITERACY.SL.9-10.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.

CCSS.ELA-LITERACY.L.9-10.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

CCSS.ELA-LITERACY.L.9-10.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

CCSS.ELA-LITERACY.L.9-10.3 Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

CCSS.ELA-LITERACY.L.9-10.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9-10 reading and content, choosing flexibly from a range of strategies.

CCSS.ELA-LITERACY.L.9-10.5 Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.

CCSS.ELA-LITERACY.L.9-10.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

CCSS.ELA-LITERACY.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

CCSS.ELA-LITERACY.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

CCSS.ELA-LITERACY.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-LITERACY.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

CCSS.ELA-LITERACY.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

CCSS.ELA-LITERACY.WHST.9-10.1 Write arguments focused on discipline-specific content.

CCSS.ELA-LITERACY.WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

CCSS.ELA-LITERACY.WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-LITERACY.WHST.9-10.5 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.

CCSS.ELA-LITERACY.WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

CCSS.ELA-LITERACY.WHST.9-10.7 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.

CCSS.ELA-LITERACY.WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

CCSS.ELA-LITERACY.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

Grades 11-12:

CCSS.ELA-LITERACY.RI.11-12.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

CCSS.ELA-LITERACY.RI.11-12.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).

CCSS.ELA-LITERACY.RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

CCSS.ELA-LITERACY.W.11-12.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

CCSS.ELA-LITERACY.W.11-12.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

CCSS.ELA-LITERACY.W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-LITERACY.W.11-12.5 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.

CCSS.ELA-LITERACY.W.11-12.6 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.

CCSS.ELA-LITERACY.W.11-12.7 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.

CCSS.ELA-LITERACY.W.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

CCSS.ELA-LITERACY.W.11-12.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

CCSS.ELA-LITERACY.SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

CCSS.ELA-LITERACY.SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

CCSS.ELA-LITERACY.SL.11-12.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

CCSS.ELA-LITERACY.SL.11-12.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

CCSS.ELA-LITERACY.SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

CCSS.ELA-LITERACY.SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

CCSS.ELA-LITERACY.L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

CCSS.ELA-LITERACY.L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

CCSS.ELA-LITERACY.L.11-12.3 Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

CCSS.ELA-LITERACY.L.11-12.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11-12 reading and content, choosing flexibly from a range of strategies.

CCSS.ELA-LITERACY.L.11-12.5 Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.

CCSS.ELA-LITERACY.L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

CCSS.ELA-LITERACY.RST.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.

CCSS.ELA-LITERACY.RST.11-12.2 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.

CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.6 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.

CCSS.ELA-LITERACY.RST.11-12.7 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.

CCSS.ELA-LITERACY.RST.11-12.8 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.

CCSS.ELA-LITERACY.RST.11-12.9 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.

CCSS.ELA-LITERACY.RST.11-12.10 By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS.ELA-LITERACY.WHST.11-12.1 Write arguments focused on discipline-specific content.

CCSS.ELA-LITERACY.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

CCSS.ELA-LITERACY.WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-LITERACY.WHST.11-12.5 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.

CCSS.ELA-LITERACY.WHST.11-12.6 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.

CCSS.ELA-LITERACY.WHST.11-12.7 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.

CCSS.ELA-LITERACY.WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

CCSS.ELA-LITERACY.WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

CCSS.ELA-LITERACY.WHST.11-12.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

The Story of Aquaticville

Welcome to your new community in the lakeside town of Aquaticville. Your town is located at the south end of the lake that is fed by the Clear River and its watersheds upstream to the north. Your 200-acre lake was created in 1890 when a farmer's co-op constructed a mill dam to grind their grains… which in turn backed up the river's flow and flooded a small valley. Ta-da, your fake lake was born.

The farmers were so delighted with their two-for creation, they officially named the fledgling community "Aquaticville". Years passed, the town grew, people loved their new lake and life there was good. Though the mill that was driven by the dammed waterflow stopped working long ago, overflow from the old dam still drains downstream into the historic riverbed and eventually leads to the ocean some ten miles to the southeast.

Things took a dark turn in your lakeside town about 30 years ago when residents around the lake began dumping their unwanted pet goldfish (originally from China) into the lake. Without larger fish predators, the goldies soon overpopulated the lake and became a nuisance. The goldfish being bottom feeders, churned up the silt that had accumulated in the sediment and the lake became un-swimmable. They also died in mass sometimes, further fouling the shorelines as stinking flotsam. To "solve" the invasive goldfish problem, some other enterprising lakeside owners dumped in a new predator fish that was a crossbreed between a tilapia (native to Africa) and a sailfin catfish (native to South America). This new fish, called a "tilapicat", was supposed to gobble up the goldfish, make great table fare, and once and for all solve the town's problem.

Despite being sold as a "sterile" hybrid that would taste great, the tilapicats not only thrived by eating the millions of goldfish, but somehow began reproducing (not uncommon in some hybrids) and they, too, soon overpopulated the lake. To make matters worse, as the water became less muddy, people tried swimming again, only to be stung by the nasty barbs on the aggressive tilapicats' fins. Plus, the old saying, "you are what you eat" proved true as they tasted like greasy mud from eating the fat little mud-eating goldfish. To top it all off, the EPA banned even trying to eat the tilapicats when it was discovered that they were "bio-accumulators" full to DDT and other pesticides that had once been used by farmers upstream, that had washed off their fields into the Clear River, been carried downstream, had settled in the silt, that was sucked up by the goldies, which were eaten by the tilapicats. Ta-da, poison fish, with stinging barbs, thank you very much.

Clearly, this was all intolerable. The townsfolk were understandably in an uproar and now voted to turn back the clock of Mother Nature and restore their once pristine valley into a naturally flowing Clear River by removing the old mill dam that was starting to leak through several cracks in the eroded concrete. A town meeting has been called where several special-interest groups who have been researching solutions, will make presentations on how to solve the cascade of problems that now plague their once idyllic community.

Let's wish them luck…

Ta-da, poison fish, with stinging barbs, thank you very much.

Connectivity Conundrum Pre-Lesson Student Worksheet

Student Name: Class: Date:

Before watching the video(s) or exploring the website, review these questions and look for answers during the video(s).

1. How can aquatic ecosystems be impacted by humans?

2. How can invasive species affect the food web in a lake or river, and how might that in turn affect native species that live there?

3. What kinds of historic reshaping of lands and waters were done for the benefit of "society" at the cost of other "environmental citizens"?

4. What's factors might create a "connectivity conundrum" for natural resource managers attempting to remove a 100 year old dam?

5. What are some of the most significant ecosystem changes in the Great Lakes during the past 200 years?

The River Restoration Coalition
River Restoration-Reconnectivity Plan

Student Name: **Class:** **Date:**

Welcome to **The River Restoration Coalition** in the lakeside town of Aquaticville. You're a driving force in removing the decrepit dam and restoring the Clear River to its historic flow through the once pristine valley. Your water-rich town has experienced a variety of environmental and community "challenges" in recent decades. To get a better sense of your lake, community, and your various challenges, please re-read the story of Aquaticville within your group.

You know better than most that your once beautiful Clear River flowing pure with trout and lined with lush riverbanks has become an ecological cesspool full of invasive species and toxic silt. It all began with building that darned dam to make a handful of farmers a few more cents per bushel of grain. Now you've got a leaking dam forming a stinking lake because of the goldifsh-tilapicat-DDT-defunct-dam mess. So your group needs to come up with an innovative plan to remove the dam and restore the river to its historic beauty and environmental health. So how can you restore Clear River to Aquaticville that involves:

1. removing the old mill dam,
2. reconnecting the river with the ocean, and
3. restoring the once pristine valley that now holds the lake.

On separate sheets of paper or on your computer, work as a team to research and develop your own **River Restoration-Reconnectivity Plan** that should include:

- How to "remove or renovate" the old dam to prevent the unnatural tilapicats, goldfish and DDT from washing into downstream communities and into the ocean. (consider how you might use the river's "gradient change" caused by the dam to your advantage)

- How might your plan prevent invasive species like sea lamprey from using the Clear River as new spawning grounds… and does it matter… while also preventing those darn tilapicats from infecting downstream ecosystems? (maybe kill off everything in the lake before draining it, or designing a selective fish passage for regulating both up and downstream passage of certain fish?)

- If the layer of silt-mud that now fills the valley under the lake is exposed when it's drained, what are the environmental implications of the trapped pesticides and what could you do about it? (what have other similar projects done with contaminated silt?)

- Some groups may not want to pay for your idea with "their money" or change the lake that they have grown accustomed to. Consider how their interests might be shared with yours.

- You're not the first group who wanted to remove a dam and restore a river. How might you get money or help from state (DNR) and federal agencies (USFS) or the Great Lakes Fishery Commission who have extensive experience in removing dams, invasive species

and reconnecting rivers? (and in getting grant funding… because your ideas may cost millions)

In class Session 3, all of the stakeholder groups will present their **River Restoration-Reconnectivity Plans.** Then you'll participate in a class debate on solutions to developing an overall plan that best serves the combined goals of the various groups.

Develop your potentially realistic and achievable plan using the following methods:

- Begin your research by watching the classroom videos again, and decoding some key points on the webpage: *https://intotheoutdoors.org/topics/reconnecting-rivers-invasive-species/*
- Do online research to support the key parts of your plan. Cite references.
- Because you understand the aspects of dam removal and river restoration better than the other groups, debate with real facts to show all the groups how a synergistic, yet sophisticated river restoration plan can in fact, work in everyone's best interest, while protecting citizens and the environment.

Now go create an awesome **River Restoration-Reconnectivity Plan** to present in Session 3.

The Lakeside Homeowners Association
Lake Restoration Plan

Student Name: **Class:** **Date:**

Welcome to **The Lakeside Homeowners Association** in the lakeside town of Aquaticville. You've enjoyed your lakeside homes for decades both in their exceptional recreational, scenic and property values. You know better than most the value of all the things the lake has and can still offer to not only your members but the entire community. Yes, it's true that your water-rich community has experienced a variety of environmental "challenges" in recent decades, partly because some of your neighbors unwittingly dumped invasive fish into your lake. To get a better sense of your lake, community, and your various challenges as owners of valuable homes surrounding the lakeshore, please re-read the story of Aquaticville within your group.

It's a fact that your home's recreational and property values are now jeopardized by the ecological cesspool of a lake full of invasive species and toxic silt. Plus, you know that the old leaking dam needs some repair or renovation. The problem is that the rest of the community who don't live on the lake are not only jealous of your lifestyle on the lake, but they now have the crazy idea of removing the dam completely and draining the entire lake to leave you with a stinking toxic front yard of 200 yards of mud. To top it off, your home's lot line legally only goes to the lakes' shoreline, and when that gets drained, you have no control on what others may do near your front yard. You do know that your property value will plunge and your home and your future plans for life there will be devastated. So how can you serve your interests and the interests of the other stakeholder groups in Aquaticville in a way that might involve:

1. keeping or modifying the dam to prevent invasive species from going upstream or downstream,
2. fixing the old dam, removing all the invasive species in the lake, and safely getting rid of all the toxic silt that now fills much of the lake bottom, and
3. Having the community share more in the lakeside lifestyle your members enjoy.

On separate sheets of paper or on your computer, work as a team to research and develop your own **Lake Restoration Plan** that details:

- How to "renovate" the old dam to prevent the unnatural tilapicats, goldfish and DDT, or future unwanted species from washing into downstream communities and into the ocean.

- How other communities with dammed lakes have occasionally killed off unwanted species, temporarily drained their lakes, removed the silt, and refilled their lakes like new. (If the lake was idyllic 50 years ago, why not make it that way again?)

- If the layer of silt-mud that now fills the valley under the lake is exposed when it's temporarily drained, what are the environmental implications of the trapped pesticides and what could you do about it? (what have other similar projects done with contaminated silt?)

- Some of the other groups want to bankrupt the community with their crazy plan to remove the dam and restore the river that will cost millions. Consider how their interests might be shared with your ideas to "restore" the lake instead at a fraction of the cost, time and work.

- You're not the first lakeside owners who have faced this kind of challenge. Research what others have done successfully, or with modifications to protect their lakeside values and interests.

In class Session 3, all of the stakeholder groups will present their **River Restoration-Reconnectivity Plans.** However, you'll present your own **Lake Restoration Plan** where you'll participate in a class debate on solutions to developing an overall plan that best serves the combined goals of the various groups.

Develop your potentially realistic and achievable plan using the following methods:

- Begin your research by watching the classroom videos again, and decoding some key points on the webpage: *https://intotheoutdoors.org/topics/reconnecting-rivers-invasive-species/*

- Do online research to support the key parts of your plan. Cite references.

- Because you understand the value and economics of "restoring the lake" instead of trying to restore an entire valley and river system, debate with real facts to show how keeping and improving the lake can be in everyone's best interest, while protecting lakeside values, helping the community and considering the environment.

Now go create an awesome **Lake Restoration Plan** to present in Session 3.

Economic Revitalization Council
River Restoration-Reconnectivity Plan

Student Name: **Class:** **Date:**

Welcome to the **Economic Revitalization Council** in the lakeside town of Aquaticville. You're a driving force in revitalizing the economy of your water-rich community that has experienced some "challenges" in recent decades. To get a better sense of your lake, community, and your challenges, please re-read the story of Aquaticville within your group.

Once known as a desirable lakeside resort town, the economics have plunged since the goldfish-tilapicat-DDT-defunct dam mess. Now more people want to leave your town instead of visiting or moving there. So your group needs to come up with an innovative plan to bring back economic life to your community. But you're smart enough about the history of "economic gain" to know that it's usually the environment that suffers the most when humans come up with new ways to make money. So how can you bring both environmental and economic prosperity back to Aquaticville that involves;

1. removing the old mill dam,
2. reconnecting the river with the ocean, and
3. restoring the once pristine valley that now holds the lake.

On separate sheets of paper or on your computer, work as a team to research and develop your own **River Restoration-Reconnectivity Plan** that should include:

- How to "remove or renovate" the old dam to prevent the unnatural tilapicats, goldfish and DDT from washing into downstream communities and into the ocean? (maybe an engineered whitewater kayak park where the old dam was?)

- How to prevent invasive species like sea lamprey from using the Clear River as new spawning grounds… and does it matter? (maybe a selective fish passage for both up and downstream?)

- If the layer of silt-mud that now fills the valley under the lake is exposed when it's drained, what are the environmental implications of the pesticides and what could you do about it? (what have other similar projects done with contaminated silt?)

- What can the rest of the stakeholder groups do to help revitalize the economy of the community? Consider how their interests might be shared with yours.

- How might you convert your list of challenges into possible ways to boost the economy? Think into the future and what's becoming more important to communities.

- Whatever your plan, somebody is going to have to pay millions for this project. How might you work with state (DNR) and federal agencies (USFS) or the Great Lakes Fishery

Commission who have extensive experience in removing dams, invasive species and reconnecting rivers? (and getting grant funding)

In class Session 3, all of the stakeholder groups will present their **River Restoration-Reconnectivity Plans.** Then you'll participate in a class debate on solutions to developing an overall plan that best serves the combined goals of the various groups.

Develop your potentially realistic and achievable plan using the following methods:

- Begin your research by watching the classroom videos again, and decoding some key points on the webpage: *https://intotheoutdoors.org/topics/reconnecting-rivers-invasive-species/*
- Do online research to support the key parts of your plan. Cite references.
- Because you understand the economic aspects better than the other groups, debate with economic facts to show all the groups how a synergistic, yet sophisticated plan can in fact, work in everyone's best interest, while boosting the economy plus protecting citizens and the environment.

Now go create an awesome **River Restoration-Reconnectivity Plan** to present in Session 3.

The Aquatic Ecosystem Scientists Society
River Restoration-Reconnectivity Plan

Student Name: **Class:** **Date:**

Welcome to **The Aquatic Ecosystem Scientists Society** in the lakeside town of Aquaticville. You're all real scientists who deal in the real world of scientific facts and realistic solutions to challenges that blend the needs of humans and ecosystems. You also serve the critical function of scientifically debunking the crazy ideas of other various special interest groups. You also know better than most how your water-rich community has experienced a variety of environmental "challenges" in recent decades. To get a better sense of your lake, community, and your various challenges as scientists, please re-read the story of Aquaticville within your group.

Unfortunately, you can't turn back the hands of time or locate, then tar-and-feather the idiot who dumped the tilapicats into the dammed lake. Nonetheless, you're now faced with an ecological cesspool of a lake full of invasive species and toxic silt. It all began with building that darned dam to make a handful of farmers a few more cents per bushel of grain. Now you've got a leaking dam forming a stinking lake because of the goldifsh-tilapicat-DDT-defunct-dam mess. So your group needs to come up with an innovative yet scientifically reasonable plan to either remove the dam and restore the river to its historic beauty… or possibly, restore the lake to its dammed condition of 100 years ago. So, how can you serve the interest of the other stakeholder groups in Aquaticville by creating a plan that might involve:

1. removing the old mill dam and reconnecting the river with the ocean;
2. keeping or modifying the dam to prevent invasive species from going upstream or downstream; and/or
3. fixing the old dam, removing all the invasive species in the lake, and safely getting rid of all the toxic silt that now fills much of the lake bottom.

On separate sheets of paper or on your computer, work as a team to research and develop your own **River Restoration-Reconnectivity Plan** that should include:

- How to "remove or renovate" the old dam to prevent the unnatural tilapicats, goldfish and DDT from washing into downstream communities and into the ocean? (consider how you might use the river's "gradient change" caused by the dam to your advantage)

- How might you use science and engineering to prevent invasive species like sea lamprey from using the Clear River as new spawning grounds… and does it matter… while also preventing those darn tilapicats from infecting downstream ecosystems? (maybe kill off everything in the lake before draining it, or designing a selective fish passage for regulating both up and downstream passage of certain fish?)

- If the layer of silt-mud that now fills the valley under the lake is exposed when it's drained, what are the environmental implications of the trapped pesticides and what could you do about it? (what have other similar projects done with contaminated silt?)

- Some groups may not want to pay for your science solutions with “their money” or change the artificial lake that they have grown accustomed to love (and hate). Consider how their interests might be shared with your science savvy.

- You’re not the first scientists challenged to remove a dam and restore a river. How might you get money or scientific-engineering help from state (DNR) and federal agencies (USFS) or the Great Lakes Fishery Commission who have extensive experience in removing dams, invasive species and reconnecting rivers? (and in getting grant funding… because your ideas may cost millions)

In class Session 3, all of the stakeholder groups will present their **River Restoration-Reconnectivity Plans.** Then you’ll participate in a class debate on solutions to developing an overall plan that best serves the combined goals of the various groups.

Develop your potentially realistic and achievable plan using the following methods:

- Begin your research by watching the classroom videos again, and decoding some key points on the webpage: *https://intotheoutdoors.org/topics/reconnecting-rivers-invasive-species/*

- Do online research to support the key parts of your plan. Cite references.

- Because you understand the science of invasive species, dam removal and river restoration better than the other groups, debate with real facts to show all the groups how a synergistic, yet scientific river restoration plan can in fact, work in everyone’s best interest, while protecting citizens and the environment.

Now go create an awesome **River Restoration-Reconnectivity Plan** to present in Session 3.