Educational Partners:

A DELICATE BALANCE

Upper middle or high school Discussion Guide

Teacher: Christina DiLorenzo

ACTIVITY SUMMARY

In this lesson, students will explore how river way structures and aquatic ecosystems have been impacted by waterway navigation. Students will become aware of aquatic ecosystems facing change around the globe and the effects of human activity on aquatic ecosystems.

The lesson will begin with students brainstorming ways in which in which humans help and harm aquatic ecosystems through everyday use. Students will then view segments from the Nautical Navigation video to learn about the need for nautical navigation for early Americans, the developments, and direct impacts navigation had on the environment.

Students will then access the interactive map depicting America's inland waterway system to get a better sense of what travel via waterways is like. They will then work in small groups to answer questions about waterway travel and form a conclusion about the benefits vs negative effects of waterway usage.

Finally, students will work in opposing groups to get varying perspectives on a waterway development projects versus the potentially harmful effects on the aquatic ecosystems due to the project development, proposing more sustainable solutions.
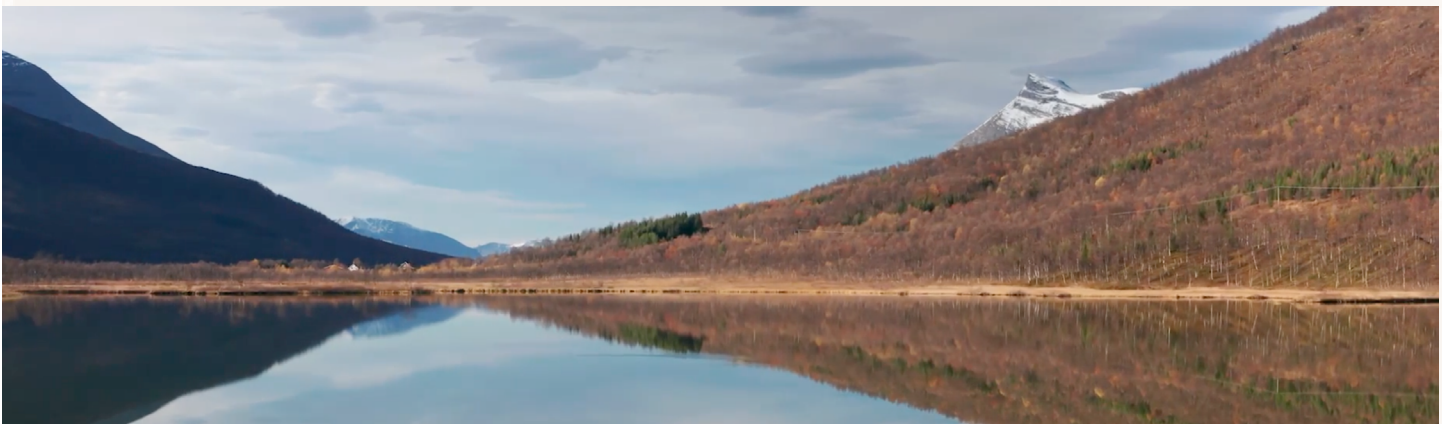
LEARNING OBJECTIVES

Students will be able to:

- Understand the importance of transportation by water in the early history of the United States.

- Identify the harmful effects of waterway navigation on an aquatic ecosystem; Describe ways in which humans positively and negatively impact waterways.

- Explore options for sustainable use of waterways.

BACKGROUND INFORMATION

With a trip to The National Mississippi Museum and Aquarium, this episode explores the history and importance of nautical navigation. Early Americans (Native Americans and Indigenous people of North America) had two options of transportation: walking and use of the rivers. River travel enabled early Americans to expand in exploration, trade, communication and major developments. Because of the ability to travel via riverway, eventually Native Americans were able to, and began trading with Europeans.

Along with benefits, riverway travel also had its challenges for Native Americans and Europeans traveling via the river. As the river changed with the seasons it became more difficult for people to travel into areas that were not easy to recognize. Eventually they implemented various tools to aid in navigation such as bent trees pointing in a direction, or other landmarks to mark the point of travel. These tools, such as maps, further developed as their knowledge of navigation grew.

Well before GPS technology was ever developed, the compass was the primary tool for navigation in combination with early maps. Compasses direct you north and south by using magnets and the magnetic poles of the Earth. The maps that were created by European travelers relied heavily on the knowledge of the Indigenous people. It was, and is important to understand how to navigate properly to work together for safe travel through the rivers.

People walked the rivers with sounding poles to test the depth of the river to ensure at least 9 feet of depth. If the main channels were less than 9 feet, dredging was the only option. Dredging is a technique to remove sediment from the bottom of the river and return it to land. This process causes a degree of environmental disturbance by removing plants, habitats and disturbing animals in the aquatic ecosystem. In the 1920's and 1930's Locks and dams were constructed to speed up the flow of water and change the natural course of river flow.

These developments altered the natural ecosystem by creating barriers for fish migration, and causing the disappearance of seasonal wetlands which are natural resting places in the Spring or Fall. As a result, human dependence on river navigation has caused environmental disturbances that impact humans indirectly and directly impact the world. The museum focuses on educating about human interaction with the environment and the environmental impacts.

LEARNING PROCEDURE:

Instructor will say: "How often do you think about water — and the role it plays in our lives?

Take a few minutes to reflect on water and your everyday life. Then, make a list of all the ways that you and your family use water on a typical day and week.

Afterward, share and compare your list with a partner: What do you notice about your lists? Are you surprised by the many ways you regularly use water and how water is essential to your lives?

Finally, imagine that all of the water in your town or city went away. Discuss with your partner: What would you do without water? How would the loss of water affect your life and well-being?"

Review with students the examples of way we regularly use water. Ask students to think about a specific body of water and to brainstorm ways that humans can make it worse and ways that they can improve it.

Ask students to think of the potential impact of the following on the aquatic ecosystems:

- Family picnics and barbeques. (Throwing food & objects in the water; destroying plants &/other foliage near water)
- Fishing.
- Roads/Cars. (Emissions, increasing traffic to lakes, oceans, etc.)
- Businesses, factories, etc. near water.
- A day at the beach (bottles, sunscreen, items left behind, destroying/ removing sea life & shells).
- Motor boats; sail boats, waterskiing, etc.
- Misusing fertilizers and pesticides.
- Waterway navigation.

Ask students if these examples positively or negatively impact the aquatic ecosystem. Then ask students what may be some barriers to those threats. How can we protect the ecosystem while still using what we need?
Potential Barriers to the threats:
Enforcing clean water regulations. Removing discarded objects from the water.

Explain that sometimes when people try to do something good in the environment, there might be unintended things that happen as a result. For example, inland waterways have a very important role in the global transportation system, but over-use and over-exploitation of waterways for navigational purposes has negatively impacted river ecosystems and inland waterways with modifications to increase their capacity. This affects habitats of aquatic organisms as well as the functioning of the river ecosystem.

VOCABULARY:

WATERWAY- river, canal, or other route for travel by water.

RIVERWAY - the part of a river that boats can travel on, or the route or course of a river.

INLAND NAVIGATION - a transport system allowing ships and barges to use inland waterways (such as canals, rivers and lakes).

SUSTAINABILITY- avoidance of the depletion of natural resources in order to maintain an ecological balance.

CONSERVATION - prevention of wasteful use of a resource.

CANAL - a man-made waterway that allows for the passage of vessels inland.

CANAL LOCKS - devices used for lowering or raising vessels between stretches of water of different levels on canal waterways.

DREDGING - clearing or carving out a path with a dredge by scooping out mud and weeds.
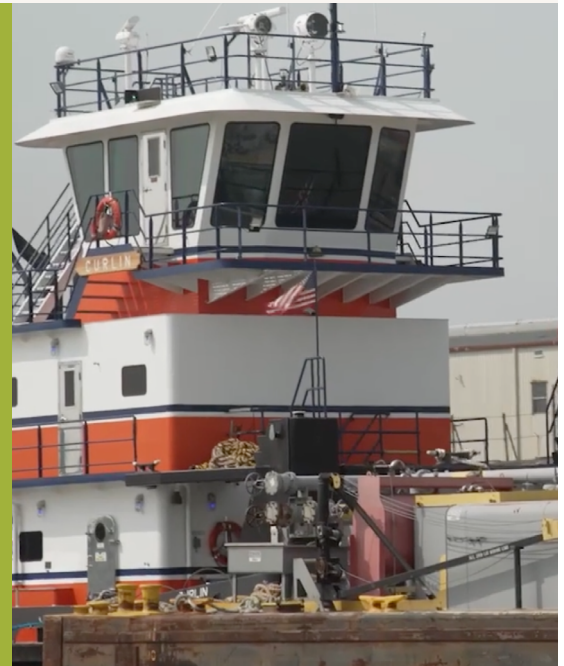
ACTIVITY 1:

Instruct students to access the google map [Map of America's inland waterway system](#) or [Major waterways in the US](#). Students will analyze the map for 1 minute and write down any observations or questions they have about the waterway system. After one minute students will pair with another student and share their observations and questions for 2 minutes. Student pairs will write a collaborative list of observations and questions to share out with the class.

Students will then be organized into small groups of 3-4 students for a station rotation. Questions about inland waterways will be written on chart paper and posted around the room. Student groups will each have 4 minutes to add their ideas and answers to the chart paper before rotating. Students will be asked to place a star next to ideas that are already written that they agree with and write a piggyback question to the ideas they would question. The following questions may be used for the station rotation:

1) Why did early Americans use the river for travel?
2) How did waterway travel benefit early Americans?
3) What were challenges to waterway navigation?
4) Why do you think canals were built along major rivers?
5) What did the rivers provide that the canals needed? Few of the many canals that were built by the middle of the 19th century are still in use today. Why do you think canal travel declined?
6) Who benefitted from canal construction? In what ways were their lives improved?
7) Do you think anyone in the area disliked the changes that resulted from its construction? If so, why do you think they might have felt that way?
8) How do you think the changes impacted the aquatic ecosystems?

Once all students have rotated through the stations activity, students will individually respond in writing to the following prompt: Do you think the benefits of the inland waterways would outweigh the potential negative impacts on aquatic ecosystems?

ACTIVITY 2:

Divide students into 2 groups. Assign one group of students to be inland waterway developers and assign the second group of students to be members of the EPA. Each group will have to design a presentation to share with the opposing group.

Developers will be responsible for designing a waterway project proposal in response to the following situation. It's 1840. A wealthy industrialist owns a fishing and canning business in Cleveland, Ohio. He just recently found out there's a huge demand for trout in Pittsburgh, Pennsylvania. He wants to figure out the best way to transport his trout from Cleveland to Pittsburgh. Based on the evidence you've read and the research you've looked into for your proposal, why is waterway transportation the most effective? In what ways did it improve the way that people or things are transported? What will be the negative impacts, if any?

The EPA group will oppose the development project and will be responsible for researching and citing numerous inherent environmental hazards such as water and air pollution, a loss of habitats, increased coastal erosion, the transfer of invasive species between connected watercourses and lakes, and the transport of pollutants through watercourses to coastal areas. More sustainable solutions will be proposed.

Each group will share out their presentations in an informal style. All students must participate in the presentation.
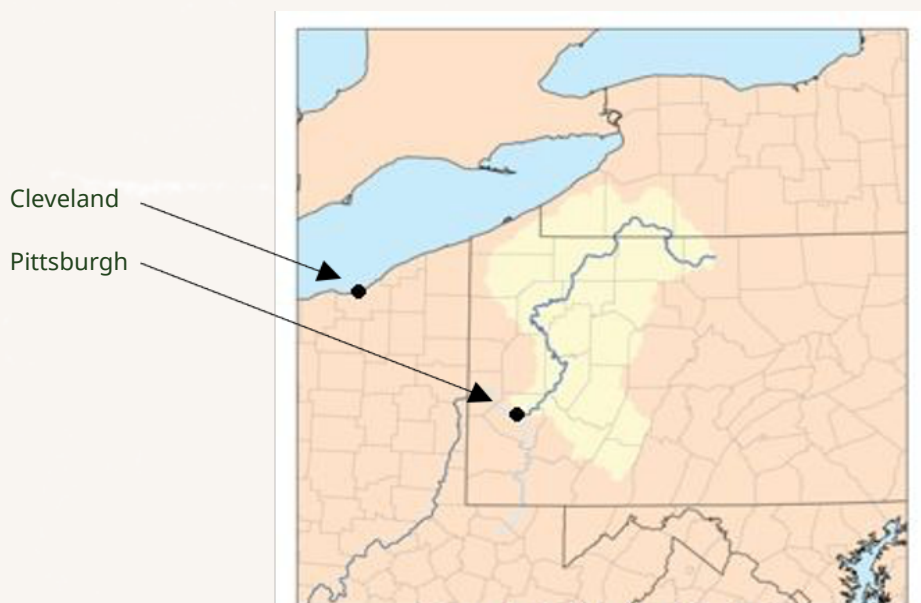
CONCLUSION:

Students will revisit their original lists of ways regularly use water every day. They will now make a second column to that list and brainstorm ways to sustainably use the source for the water need.

EXTENDING THE LESSON

Students will investigate the early transportation systems of their own community. When was the first canal or railroad serving the community built? With which market cities were they connected? How did the improved transportation change the local economy? Have the students present the results of their research to the entire class.
Create a PSA video highlighting one method of sustainability for waterway travel.

RELATED LINKS

https://www.itf-oecd.org/sites/default/files/docs/06waterenv.pdf

https://repositorio.cepal.org/bitstream/handle/11362/41042/1/S1601324_en.pdf

EDUCATIONAL STANDARDS

CCSS.ELA-LITERACY.RI.7.1	Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.W.7.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-LITERACY.W.7.1	Write arguments to support claims with clear reasons and relevant evidence.
CCSS.ELA-LITERACY.W.7.1.A	Introduce claim(s), acknowledge alternate or opposing claims, and organize the reasons and evidence logically.
CCSS.ELA-LITERACY.W.7.1.B	Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.
CCSS.ELA-LITERACY.W.7.1.C	Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), reasons, and evidence.
CCSS.ELA-LITERACY.W.7.1.D	Establish and maintain a formal style.
CCSS.ELA-LITERACY.W.7.1.E	Provide a concluding statement or section that follows from and supports the argument presented.
CCSS.ELA-LITERACY.W.7.2.A	Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
CCSS.ELA-LITERACY.W.7.2.B	Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.
CCSS.ELA-LITERACY.W.7.2.C	Use appropriate transitions to create cohesion and clarify the relationships among ideas and concepts.
CCSS.ELA-LITERACY.W.7.2.D	Use precise language and domain-specific vocabulary to inform about or explain the topic.
CCSS.ELA-LITERACY.W.7.2.E	Establish and maintain a formal style.
CCSS.ELA-LITERACY.W.7.2.F	Provide a concluding statement or section that follows from and supports the information or explanation presented.
CCSS.ELA-LITERACY.W.7.3	Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.
CCSS.ELA-LITERACY.W.7.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.SL.7.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

CCSS.ELA-LITERACY.SL.7.1.C	Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
CCSS.ELA-LITERACY.SL.7.1.D	Acknowledge new information expressed by others and, when warranted, modify their own views.

8th Grade

Key Ideas and Details:

CCSS.ELA-LITERACY.RI.8.1	Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.8.2	Determine a central idea of a text and analyze its development over the course of the text, including its relationship to supporting ideas; provide an objective summary of the text.
CCSS.ELA-LITERACY.W.8.1	Write arguments to support claims with clear reasons and relevant evidence
CCSS.ELA-LITERACY.W.8.1.A	Introduce claim(s), acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
CCSS.ELA-LITERACY.W.8.1.B	Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.
CCSS.ELA-LITERACY.W.8.1.C	Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
CCSS.ELA-LITERACY.W.8.1.D	Establish and maintain a formal style.
CCSS.ELA-LITERACY.W.8.1.E	Provide a concluding statement or section that follows from and supports the argument presented.
CCSS.ELA-LITERACY.W.8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
CCSS.ELA-LITERACY.W.8.2.A	Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
CCSS.ELA-LITERACY.W.8.2.B	Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
CCSS.ELA-LITERACY.W.8.2.C	Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
CCSS.ELA-LITERACY.W.8.2.D	Use precise language and domain-specific vocabulary to inform about or explain the topic.
CCSS.ELA-LITERACY.W.8.2.E	Establish and maintain a formal style.
CCSS.ELA-LITERACY.W.8.2.F	Provide a concluding statement or section that follows from and supports the information or explanation presented.

CCSS.ELA-LITERACY.W.8.3	Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.
CCSS.ELA-LITERACY.W.8.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.W.8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
CCSS.ELA-LITERACY.SL.8.1.A	Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
CCSS.ELA-LITERACY.SL.8.1.C	Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
CCSS.ELA-LITERACY.SL.8.1.D	Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.

9-10th Grades

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.9-10.2	Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.
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.9-10.1.A	Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.
CCSS.ELA-LITERACY.W.9-10.1.B	Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.
CCSS.ELA-LITERACY.W.9-10.1.C	Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
CCSS.ELA-LITERACY.W.9-10.1.D	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

CCSS.ELA-LITERACY.W.9-10.1.E	Provide a concluding statement or section that follows from and supports the argument presented.
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.9-10.2.A	Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
CCSS.ELA-LITERACY.W.9-10.2.B	Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
CCSS.ELA-LITERACY.W.9-10.2.C	Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
CCSS.ELA-LITERACY.W.9-10.2.D	Use precise language and domain-specific vocabulary to manage the complexity of the topic.
CCSS.ELA-LITERACY.W.9-10.2.E	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
CCSS.ELA-LITERACY.W.9-10.2.F	Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
CCSS.ELA-LITERACY.W.9-10.3	Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
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.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.9-10.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
CCSS.ELA-LITERACY.SL.9-10.1.C	Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
CCSS.ELA-LITERACY.SL.9-10.1.D	Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.

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.

11-12th Grades

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.11-12.2   Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.

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.11-12.1.A   Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.

CCSS.ELA-LITERACY.W.11-12.1.B   Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.

CCSS.ELA-LITERACY.W.11-12.1.C   Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

CCSS.ELA-LITERACY.W.11-12.1.D   Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

CCSS.ELA-LITERACY.W.11-12.1.E   Provide a concluding statement or section that follows from and supports the argument presented.

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.11-12.2.A   Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

CCSS.ELA-LITERACY.W.11-12.2.B   Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

CCSS.ELA-LITERACY.W.11-12.2.C	Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
CCSS.ELA-LITERACY.W.11-12.2.D	Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy to manage the complexity of the topic.
CCSS.ELA-LITERACY.W.11-12.2.E	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
CCSS.ELA-LITERACY.W.11-12.2.F	Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
CCSS.ELA-LITERACY.W.11-12.3	Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
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.11-12.7	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.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.11-12.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
CCSS.ELA-LITERACY.SL.11-12.1.C	Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
CCSS.ELA-LITERACY.SL.11-12.1.D	Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.

4-ESS3-2 Earth and Human Activity

Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*

MS-ESS3-3 Earth and Human Activity

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*