# PROTECTING OUR AQUATIC ECOSYSTEMS

**Upper middle or high school Discussion Guide**

**Teacher: Christina DiLorenzo**

**GRADE LEVEL:** Upper middle or high school

**TIMEFRAME:** 2-3 lessons

**MATERIALS:** Computer access for research and presentation, poster paper, interactive maps linked

**Major waterways in the US**

**Healthy vs Unhealthy ecosystem Graphic**

**KEY WORDS:** Population, Ecosystem, Waterway, Sustainability, Conservation, Wake zone, non-point source pollution, Biodiversity, Foundation/keystone species

**SCIENCE CATEGORIES:** Aquatic & Angling Science

## ACTIVITY SUMMARY

In this lesson, students will explore how boating and water recreation activities have an impact on aquatic ecosystems as well as how they can minimize their negative impact.

The lesson will begin with students exploring the availability of water resources, and evaluating the impact of the movement of water on the geography of an area. This lesson will also help students explore how humans impact aquatic ecosystems and the natural geography of the coast. Then students will model the food web of a marine ecosystem to determine the impacts of the loss of a keystone species. Finally, the students will evaluate the effects of boating on the ecosystem and create an environmental poster highlighting the effects and a solution to the problems.

## LEARNING OBJECTIVES

*Students will be able to:*

• Communicate the cause and effects of water resource problems as well as provide solutions for these problems.

• Describe the relationship between human impact on a water resource and the aquatic organisms.

• Understand the impacts of recreational activities, such as boating, on the marine ecosystems.

# BACKGROUND INFORMATION

The Missouri Department of Conservation controls the management, restoration, conservation, and regulation of the bird, fish, game, forestry and all wildlife resources of the state. Aquatic ecosystems are some of the most sensitive ecosystems because they are the culmination of everything that happens around them, in addition to what happens in them. Boating activities are popular recreational activities but increases the potential impact of boat-related pollutants, water contaminants, noise pollution, sediment disruption, erosion and disturbance of fish habitats. Your own safety, the safety of others, and taking care of the environment, is a boating responsibility and the responsibility of humans.

There are many on land and water activities of daily living that contaminate the waters and disturb aquatic ecosystems. When boating, no wake zones are the areas closest to the shores and docks. These zones are vulnerable parts of the aquatic ecosystem because of the number of aquatic birds, frogs, fish and turtles nesting on the bank and along the shore. A boat wake can destroy the nests or eggs, cause erosion to the shore line. No wake zones are areas where vessels are expected to travel at slow speeds to minimize the wake. These measures are taken to protect the areas from damage from wakes.

Non-point source pollution is also a negative impact of boating on the environment. Non-point source pollution is pollution that does not come from a single source or point. Spilled fuels, chemicals used on boats, oils, paints and cleansers, as well as litter can all contaminate the waters. When oil goes into the water it decreases the dissolved oxygen content in the water which causes oxygen deprivation for the plants and for the fish that are filtering the water through their gills for oxygen.

When boating, it is your responsibility to minimize or eliminate water contamination. Carrying spill kits and reporting spills to be cleaned immediately is a responsible practice. In addition, cleaning and working on boats should be done on land as opposed to water to avoid water contamination from the chemicals being used.

Marine biodiversity is the variety of life in the ocean and seas and is a critical aspect of all three pillars of sustainability – economic, social and environmental. Boating can reduce the abundance of foundation or keystone species which destabilizes the ecosystem. The loss of biodiversity weakens the resilience of the aquatic ecosystem and its ability to adapt and recover from disturbances.

It is important to teach the younger generations how to preserve and protect the environment to ensure that it will be here to enjoy in the future.

## VOCABULARY:

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

**NO WAKE ZONE** –areas where vessels are expected to travel at slow speeds to minimize the wake.

**NON-POINT SOURCE POLLUTION** - pollution that does not come from a single source or point.

**BIODIVERSITY** – a measure of variation at the genetic, species, and ecosystem level.

**FOUNDATION/KEYSTONE SPECIES** – a species that has a large contribution towards creating a habitat/ecosystem that support other species.

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

**CONSERVATION**- prevention of wasteful use of a resource.

## LEARNING PROCEDURE:

*Instructor will say: "What types of things might you find in a healthy marine ecosystem?"*

Write their ideas on the board connected to marine ecosystem. Create a web of marine ecosystems on chart paper. Ask students to brainstorm with you on the board.

Review all student ideas and discuss with students the few key elements of a healthy marine ecosystem:

- • intact habitats that are not degraded or undamaged

- • diversity of species

- • clean, unpolluted water

Display the image of the healthy vs unhealthy marine ecosystems. Have students point out the differences between the two images to create a T-chart of healthy ecosystem vs unhealthy ecosystem, adding to the ideas from their web.

Have students turn and talk with a partner to make a list of what can cause an unhealthy marine ecosystem.  Give students 5 minutes to brainstorm a list and then ask pairs to share out.

# ACTIVITY 1:

Show students a globe and ask them to approximate how much of Earth is covered by ocean. Spin the globe and ask them to think about the variety of marine organisms and habitats that exist around the planet, which is over 75% ocean.

Point out the various bodies of water around the globe and have students try to locate the coral reef, arctic, Antarctic, hydrothermal vent, open ocean, etc. This will need guiding and prompts. Ask them to name biotic and abiotic factors of the ecosystems. Now ask students to describe how each of those ecosystems may be different from one another (or similar) and how the marine animals may be different. Describe to your students some of the amazing biodiversity of ocean life. Refer back to the differences among the ecosystems and relate it to the variations among organisms.

Choose a specific aquatic ecosystem and create a list of marine animals. Allow students to pick a marine animal to find out where the animal lives and why that habitat is important to it. Students will do mini research using the internet or other provided sources. Students will compile the information into a poster:

- What type of habitat do they live in?
- What are the biotic and abiotic factors of this ecosystem?
- Is this animal threatened, protected or endangered?
- What are the threats to this animal and its ecosystem?

Students will create a poster with the required information to serve as a mini presentation to share out. They will include a printed or drawn picture of the healthy ecosystem the animal lives in and label the elements needed by their organism to survive.

# ACTIVITY 2:

Write the question on the board. Teacher will ask students, "How do we know if an ecosystem is healthy?" Let students briefly respond to the question and then say "think about how we measure the health of an ecosystem. What might we look for to tell us the ecosystem is healthy?" Give students one minute to think about it on their own, and then pair with a partner to brainstorm. Student pairs will have 2 minutes to brainstorm the health of an ecosystem. After 2 minutes, student pairs will share out.

Once students have shared out, display the picture of the unhealthy ecosystem. Ask "how do we know this ecosystem is not healthy?" Compare the photos of the healthy vs unhealthy ecosystems and tell students "We can measure the health of an ecosystem by looking at what is living there. Healthy ecosystems usually have different kinds of plants and animals living there."
Organize students into small groups and provide students with various images of marine animals from a chosen ecosystem along with paper cups. Students can cut out the pictures and glue them on the cups to create a food web. Alternatively the cups with pictures can be prepared ahead of time. Once groups of students have all cups

ready, instruct groups to build their food web based on prior knowledge. First have students sort their organisms into two groups, the producers of the ecosystem and the consumers. Then have students build their food web by stacking the cups into a pyramid with producers at the bottom, then primary consumers and so on.

After student groups have built their pyramid food webs, ask students – which of the organisms do they think is a keystone/foundation species and why. Have students remove the cup from their pyramid and summarize what happened and why. Ask students, which other organisms were effected when the keystone species was removed? Why are they effected?

"When you remove the keystone species (one of the cups), the food web will collapse. Entire ecosystems or parts of an ecosystem can collapse due to one living thing dying out. This is why it is important to maintain biodiversity in an ecosystem. Each organism has a role to play. Ecosystems are especially important because humans rely on healthy ecosystems for food, medicine, and clean water."

## ACTIVITY 3:

Ask students, "What are some human activities that may affect the health of a marine ecosystem?"  Make a list on the board. Many students will suggest water activities and boating.

Show a video or images of boating along with a map of local marinas. Ask students how does boating impact the aquatic ecosystems?  Look at the maps of the marinas. Ask: Where are marina's located? How does boating activity effect the areas?

Provide students with a copy of a map of the local marinas. Have students draw pictures on the map to illustrate marine animals, biotic and abiotic factors they think may be in the area. Students may use internet sources if they need assistance on this piece.  Once students illustrate the map, have them draw a boat route to a selected location. There route will likely run over or by many of their illustrations. Ask students to think about what impacts the boating activity may have on the ecosystem directly. Make a list. Once you have made a list, discuss the effects with students on the ecosystem and the animals.

Tell students "Boating can contribute to nonpoint source pollution. Chemicals used on boats, such as oils, paints and cleansers, may spill into the water. Spilled fuel or discharged fuels from engines can also contaminate waters around the marina."

Finally, students will create an environmental conservation poster providing a solution to these problems.

# CONCLUSION:

Students will revisit their original lists of ways we interact with the environment and how to minimize the negative impacts on marine ecosystems.

## EXTENDING THE LESSON

- Students will investigate the Clean Water Act and determine if the regulations are beneficial for protecting marine ecosystems.

- Create a PSA video highlighting one method of ecosystem sustainability for boating.

## RELATED LINKS

EPA: Clean Water Act

Florida Keys National Marine Sanctuary Map Library

# 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 ap propriate 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 con ventions 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 con ventions 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 appro priate 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.*