Into the Outdoors

Educational Partner:

TECHNOLOGY & WILDLIFE CONSERVATION

6th-8th Grade Discussion Guide

Developed by: Phyllis McKenzie

SCIENCE CATEGORIES
Technology, Computer Science, Wildlife Conservation, Environmental Science

TIMEFRAME
Four 45-minute sessions

MATERIALS
Internet and computer access, poster materials or presentation software

KEY WORDS
Acoustic monitoring, artificial intelligence, biologger, camera trapping, crowd sourcing, GPS, radio telemetry, remote sensing

LEARNING OBJECTIVES

Students will be able to:

- Explore and describe a variety of technologies and equipment used in conservation work;
- Determine how specific technology resources can be applied to determine the health of animals being protected and restored;
- Identify the pros and cons of using a particular form of technology in a wildlife restoration effort.

ACTIVITY SUMMARY

In May 2021, eBird, a web-based portal for recording bird sightings, announced its one billionth bird observation. That's a LOT of bird observations! One billion bird observations represent the cumulative experience of 77,466,000 birding checklists submitted by 684,300 eBirders from 202 countries.

More and more conservationists are applying technology in their quest for protecting wildlife. Among the technologies used are camera traps, acoustic monitoring, tracking tags, and satellite remote sensing. Additionally, newer technologies that are expected to play a greater role in the future include computer facial recognition, biologger tags, networked sensors, environmental DNA (eDNA), and artificial intelligence.

Protecting and conserving wildlife is one of the greatest challenges facing humanity. In this lesson, students will learn more about these and other technologies and then will devise a plan to apply the use of these technologies to the conservation of two species of wildlife. In the process, learners will also realize what is being done in Wisconsin to ensure healthy elk herds.

VOCABULARY

ACOUSTIC MONITORING – identifying and tracking an animal using sound

ARTIFICAL INTELLIGENCE – artificial intelligence is a field that combines computer science and robust datasets to enable problem-solving

BIOLOGGER – miniaturized animal-attached tags for logging and/or relaying data about an animal's movements, behavior, physiology, and/or environment

CAMERA TRAPPING – using cameras triggered by an animal to document an animal's presence

CROWD SOURCING – the practice of obtaining information or input into a project by enlisting the services of many people, either paid or unpaid, usually via the internet

GPS – Global Positioning System – used to identify the latitude and longitude of an object or place

RADIOTELEMETRY – using radio waves to triangulate the position of an object

REMOTE SENSING – collecting information about terrain or objects from a distance

BACKGROUND INFORMATION

In May 2021, eBird, a web-based portal for recording bird sightings, announced its one billionth bird observation. That's a LOT of bird observations! One billion bird observations represent the cumulative experience of 77,466,000 birding checklists submitted by 684,300 eBirders from 202 countries. eBird began in 2002 with a mission to gather the knowledge and experience of birders and freely share that information to power data-driven approaches to science, conservation, and education.

Wildlife and technology are two things not often considered together. However, more and more conservationists are applying technology in their quest for protecting wildlife. Among the technologies used are camera traps, acoustic monitoring, tracking tags, satellite remote sensing and drones. Additionally, newer technologies that are expected to play a greater role in the future include computer facial recognition, biologger tags, networked sensors, data management tools, environmental DNA (eDNA), and artificial intelligence.

Camera trapping uses compact digital cameras connected to infrared sensors which can measure the body heat of warm-blooded animals to trigger the camera. Any kind of digital camera that is triggered by an animal through movement, trip wire, pressure plate or some other method can be considered a camera trap. Cameras set to record an image at a specified time or that are triggered by a human are considered remote cameras, rather than camera traps.

Acoustic monitoring involves surveying and monitoring wildlife using sound recorders or acoustic sensors. Sensors are placed in the field for hours, days, or weeks to record sound data at specified intervals. After collection, these sound recordings are assessed to retrieve valuable ecological data – about what species are in an area or to track a specific species – these data are then used like other types of survey data.

While remote cameras and sound recordings have been around for a while, Artificial Intelligence (AI) is being used more and more to analyze information collected by conservationists, from camera trap and satellite images to audio recordings. Artificial intelligence is a field that combines computer science and robust datasets to enable problem-solving. AI can learn how to identify which photos out of thousands contain rare species; or pinpoint an animal call out of hours of field recordings – greatly reducing the amount of manual labor required to collect vital conservation data.

Biologging is the use of miniaturized animal-attached tags for logging and/or relaying data about an animal's movements, behavior, physiology, and/or environment. Some biologgers are attached externally, on a collar for example, while others are inserted internally to measure an animal's temperature or heart rate. Other biologgers help geolocate an animal – this is often used for tracking the migration of birds.

Remote sensing is the science of obtaining information about objects or areas by measuring its emitted and reflected radiation from a distance, either by planes or satellites. Camera images collected by airplanes or satellites and sonar systems on ships are two forms of remote sensing.

Protecting and conserving wildlife is one of the greatest challenges facing humanity. The technologies described above are just a few of the technology-based possibilities for improving the conservation of wildlife. In this lesson, your students will learn more about these and other technologies and then will devise a plan to apply the use of these technologies to the conservation of two species of wildlife.

LEARNING PROCEDURE

INTRODUCTION:

Begin a discussion with students by asking them what kinds of things need to be measured to know a group of animals is healthy? What do students know about making population counts – of people or wildlife? Students may be familiar with the 2020 or Decennial Census that counts Americans, but how do you take a count of elk or sturgeon or wild birds? Before watching the video, hand out and review the questions on the "Technology and Wildlife Conservation Pre-Video Worksheet". After watching the video, review questions with the students and ask them what other kinds of technology they are aware of that are used in monitoring wildlife.

ACTIVITY 1:

Have students brainstorm some forms of technology that they have heard about in terms of conservation or counting and monitoring wild animals. Form the class into the five groups listed below. Each group will research various technologies within their team category, using the team worksheet as a guide. Two students from each team will present their research to the class in session 2. Presentations should include some form of visual information - maps, drawings, videos, or photographs – and can be in the form of a PowerPoint, talk or demonstration. Allow teams 5-7 minutes to present their technology to the class, followed by 3-5 minutes of questions from the other teams.

Technology Groups:

- Acoustic monitoring Conservation Team
- Artificial Intelligence Conservation Team
- Biologgers Conservation Team
- Camera Trapping Conservation Team
- Remote Sensing Conservation Team

After all teams present their research in Session 2, wrap up with a review of the various technologies and make a list of the pros and cons of using each kind for conservation work. Have students consider what type of animals any of the technologies might be best suited to monitoring.

ACTIVITY 2: Interpretive Panel Review

In Session 3, rekindle a discussion of how the elk in the video are being monitored. What else have students learned about conservation in Wisconsin and strategies and technologies that are already being applied to the elk that have been restored here. In their teams, have students consider what kinds of animals they think their technology is most applicable to. Have teams apply the use of one of the forms of technology their group researched to the monitoring and conservation of Elk and one, or more, of the following groups: Bats, Pollinators, Waterfowl, Fish. Have them use the questions on the "Technology and Wildlife Conservation Plan Worksheet" to guide the development of a conservation and monitoring plan for each species/animal group.

In Session 4, have students share their projects with their classmates, allowing time for questions and answers.

CONCLUSION:

Ask students to consider the elk that have been returned to Wisconsin, which technologies do they foresee will be of use in the future to ensure and monitor the health of these elk? Which technologies are members of the community most likely to assist with, thus providing 'free' research assistance to the professionals charged with caring for the herd?

EXTENDING THE LESSON (Options for extended/additional activities and lessons)

- Encourage students to get involved with Snapshot Wisconsin program or other monitoring programs (eBird, Project Feeder Watch, Bat monitoring, etc.)
- Have students contact a researcher in the area to find out how they can participate in a project using technology for wildlife conservation.

RELATED LINKS

- World Wildlife Fund, "Conservation Technology": wwf.org.uk/project/conservationtechnology
- Snapshot Wisconsin: dnr.wisconsin.gov/topic/research/projects/snapshot/intheclassroom.html
- "What is Conservation Technology?": fauna-flora.org/news/what-is-conservation-technology-how-tech-solutions-can-protect-the-worlds-wildlife/

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TECHNOLOGY AND WILDLIFE CONSERVATION PRE-VIDEO QUESTIONS

Developed by: Phyllis McKenzie

Student Name:_____Class:_____Date:_____

Before watching the video or exploring the website, review these questions, look for and write down your answers while watching the video.

1) Twenty-five elk were initially released. How many elk are there now in that group? _____

2) How do you track the elk that live in WI? _____

_____

_____

3) What is triangulation? _____

_____

_____

4) What are two reasons to check or track elk? _____

_____

_____

5) What are some ways elk use different habitat types? _____

_____

_____

6) What are the three kinds of habitat management being used for elk? _____

_____

7) What are the three types of tracking collars being used? _____

_____

8) Besides the collar, what other components do you need to be able to track an elk? _____

_____

_____

9) How do you know if you're getting close to a collared elk? _____

_____

_____

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Educational Partner:

ACOUSTIC MONITORING CONSERVATION TEAM WORKSHEET

Developed by: Phyllis McKenzie

Student Name:_____Class:_____Date:_____

Congratulations! Because of your joy for music, you have been selected to be part of the **Acoustic Monitoring Conservation Team**. Your challenge is to learn all about Acoustic Monitoring and how it is being applied to conservation work around the world.

In Session 2, two members of your team will be presenting your information to the rest of your class. Presentations should include some form of visual information - maps, drawings, videos, or photographs – and can be in the form of a PowerPoint, talk or demonstration. You need to be able to define and describe Acoustic Monitoring, explain what kind of equipment is needed, how much it costs, what kind of training is required, and tell whether this kind of technology is best used in the field to collect data or is more useful for analyzing data. Be prepared to share at least two examples of how Acoustic Monitoring is currently being used in conservation. Use the questions below as well as links on the website and other resources you find to prepare your presentation.

1) What is Acoustic Monitoring? _____
_____
_____
_____

2) How might recordings or the use of echolocation contribute to Acoustic Monitoring?
_____
_____
_____

3) What kind of investment (money, equipment) is required for using Acoustic Monitoring?
_____
_____
_____

4) Where can Acoustic Monitoring be used – in the field, in an office? What kinds of places can Acoustic Monitoring be used in or adapted for?_____
_____
_____
_____

5) What kind of operator training or experience is required? _____

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_____

6) Can Acoustic Monitoring be combined with Crowd Sourcing?_____

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_____

7) How can Acoustic Monitoring be used in citizen- or community-science approaches to conservation?

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_____

8) What are some of the advantages and limitations of using Acoustic Monitoring?

_____

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9) Share two examples of how Remote Sensing is currently being used in conservation.

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_____

10) How might you adapt Acoustic Monitoring in the future for conservation purposes?

_____

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Into the Outdoors

Educational Partner:

ARTIFICIAL INTELLIGENCE (AI) CONSERVATION TEAM WORKSHEET

Developed by: Phyllis McKenzie

Student Name:_____Class:_____Date:_____

Congratulations! Based on your creative, out-of-the box thinking skills, you have been selected to be part of the **Artificial Intelligence Conservation Team**. Your challenge is to learn all about Artificial Intelligence (AI) and how it is being applied to conservation work around the world.

In Session 2, two members of your team will be presenting your information to the rest of your class. Presentations should include some form of visual information - maps, drawings, videos, or photographs – and can be in the form of a PowerPoint, talk or demonstration. You need to be able to define and describe Artificial Intelligence, explain what kind of equipment is needed, how much it costs, what kind of training is required, and tell whether this kind of technology is best used in the field to collect data or is more useful for analyzing data. Be prepared to share at least two examples of how AI is currently being used in conservation. Use the questions below as well as links on the website and other resources you find to prepare your presentation.

1) What is Artificial Intelligence (AI)? _____
_____
_____
_____

2) What kind of investment (money, equipment) is required for using AI?
_____
_____
_____

3) Where can AI be used – in the field, in an office? What kinds of places can AI be used in or adapted for?
_____
_____
_____

4) What kind of operator training or experience is required? _____
_____
_____
_____

5) Can Artificial Intelligence be combined with Crowd Sourcing? _____

_____

_____

_____

6) How can AI be used in citizen- or community-science approaches to conservation?

_____

_____

_____

7) What are some of the advantages of using AI? _____

_____

_____

_____

8) What are some of the limitations of using AI? _____

_____

_____

_____

9) Share two examples of how Remote Sensing is currently being used in conservation.

_____

_____

_____

10) How might you adapt AI in the future for conservation purposes? _____

_____

_____

_____

Into the Outdoors

Educational Partner:

BIOLOGGERS CONSERVATION TEAM WORKSHEET

Developed by: Phyllis McKenzie

Student Name:_____Class:_____Date:_____

Congratulations! Because you always seem to keep track of where everybody is, you have been selected to be part of the **Biologgers Conservation Team**. Your challenge is to learn all about Biologgers and how they are being applied in conservation work around the world.

In Session 2, two members of your team will be presenting your information to the rest of your class. Presentations should include some form of visual information - maps, drawings, videos, or photographs – and can be in the form of a PowerPoint, talk or demonstration. You need to be able to define and describe Biologgers, explain what kind of equipment is needed, how much it costs, what kind of training is required, and tell whether this kind of technology is best used in the field to collect data or is more useful for analyzing data. Be prepared to share at least two examples of how Biologgers are currently being used in conservation. Use the questions below as well as links on the website and other resources you find to prepare your presentation.

1) What are Biologgers? _____

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_____

_____

2) What role do GPS, Radiotelemetry, MOTUS, tags, pit tags, and nanotags play in the use of Biologgers?

_____

_____

_____

3) What kind of investment (money, equipment) is required for using Biologgers?

_____

_____

_____

4) Where can Biologgers be used – in the field, in an office? _____

_____

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_____

5) What kind of operator training or experience is required? _____

_____

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_____

6) How can Biologgers be combined with Crowd Sourcing? _____

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_____

7) How can Biologgers be used in citizen- or community-science approaches to conservation?

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8) What are some of the advantages and limitations of using Biologgers?

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_____

9) Share two examples of how Remote Sensing is currently being used in conservation.

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10) How might you adapt Biologgers in the future for conservation purposes?

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Into the Outdoors

Educational Partner:

CAMERA TRAPPING CONSERVATION TEAM WORKSHEET

Developed by: Phyllis McKenzie

Student Name:_____Class:_____Date:_____

Congratulations! Because you love to take pictures, you have been selected to be part of the **Camera Trapping Conservation Team**. Your challenge is to learn all about Camera Trapping and how it is being applied to conservation work around the world.

In Session 2, two members of your team will be presenting your information to the rest of your class. Presentations should include some form of visual information - maps, drawings, videos, or photographs – and can be in the form of a PowerPoint, talk or demonstration. You need to be able to define and describe Camera Trapping, explain what kind of equipment is needed, how much it costs, what kind of training is required, and tell whether this kind of technology is best used in the field to collect data or is more useful for analyzing data. Be prepared to share at least two examples of how Camera Trapping is currently being used in conservation. Use the questions below as well as links on the website and other resources you find to prepare your presentation.

1) What is Camera Trapping? _____

_____

_____

_____

2) What are the differences between Camera Trapping and remote camera use?

_____

_____

_____

3) What kind of investment (money, equipment) is required for using Camera Trapping?

_____

_____

_____

4) Where can Camera Trapping be used – in the field, in an office? What kinds of places can Camera Trapping and remote cameras be adapted for? _____

_____

_____

_____

5) What kind of operator training or experience is required?

_____
_____
_____

6) How can Camera Trapping be combined with Crowd Sourcing?

_____
_____
_____

7) How can Camera Trapping be used in citizen- or community-science approaches to conservation?

_____
_____
_____

8) What are some of the advantages and limitations of using Camera Trapping?

_____
_____
_____

9) Share two examples of how Remote Sensing is currently being used in conservation.

_____
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10) How might you adapt Camera Trapping in the future for conservation purposes?

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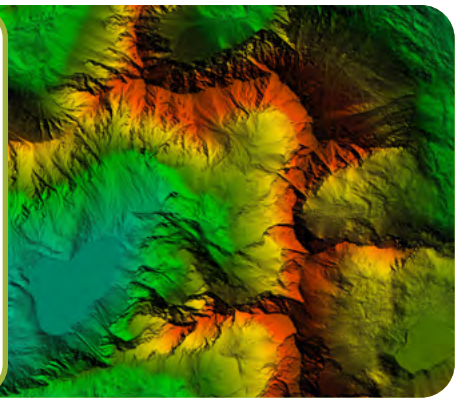
Into the Outdoors

Educational Partner:

REMOTE SENSING CONSERVATION TEAM WORKSHEET



Developed by: Phyllis McKenzie

Student Name:_____Class:_____Date:_____

Congratulations! Because you always know what's going on before anyone else, you have been selected to be part of the **Remote Sensing Conservation Team**. Your challenge is to learn all about Remote Sensing and how it is being applied to conservation work around the world.

In Session 2, two members of your team will be presenting your information to the rest of your class. Presentations should include some form of visual information - maps, drawings, videos, or photographs – and can be in the form of a PowerPoint, talk or demonstration. You need to be able to define and describe Remote Sensing, explain what kind of equipment is needed, how much it costs, what kind of training is required, and tell whether this kind of technology is best used in the field to collect data or is more useful for analyzing data. Be prepared to share at least two examples of how Remote Sensing is currently being used in conservation. Use the questions below as well as links on the website and other resources you find to prepare your presentation.

1) What is Remote Sensing?_____

_____

_____

_____

2) What do LIDAR, drones, and remotely operated vehicles (ROVs) have to do with Remote Sensing?

_____

_____

_____

3) What kind of investment (money, equipment) is required for using Remote Sensing?

_____

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_____

4) What kinds of places can Remote Sensing be used in or adapted for?

_____

_____

_____

5) What kind of operator training or experience is required?

_____
_____
_____

6) Can Remote Sensing be combined with Crowd Sourcing?

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_____
_____

7) How can Remote Sensing be used in citizen- or community-science approaches to conservation?

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_____
_____

8) What are some of the advantages and limitations of using Remote Sensing?

_____
_____
_____

9) Share two examples of how Remote Sensing is currently being used in conservation.

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_____

10) How might you adapt Remote Sensing in the future for conservation purposes?

_____
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Into the Outdoors

Educational Partner:

TECHNOLOGY AND WILDLIFE CONSERVATION PLAN WORKSHEET

Developed by: Phyllis McKenzie

Student Name:_____Class:_____Date:_____

Apply the use of one of the forms of technology your group researched to the monitoring and conservation of Elk and one, or more, of the following groups: Bats, Pollinators, Waterfowl, Fish. Use the following questions to guide the development of your conservation and monitoring plans. Be prepared to present your plans to the class in session 4 and be ready to answer any questions they may have.

Develop a plan for each species or group of animals using these questions:

1) Our plans are for elk and _____

2) The technology we are using is _____

3) How will your technology be used overall to monitor the health of your chosen animals?

_____

_____

_____

4) Will the technology directly measure the animal population, an individual's condition, its location, or something else?

_____

_____

_____

5) What equipment will be needed for this effort? _____

_____

_____

_____

6) How much or what kind of training will be needed?_____

_____

_____

_____

7) How many people will be involved in this effort? One operator? Many observers?

_____

_____

_____

8) What kinds of costs are involved?_____

_____

_____

_____

9) How will you deploy your technology-based solution to monitoring wildlife?

_____

_____

_____

10) What similarities and differences are there in applying this technology to monitoring these two different kinds of animals?

_____

_____

_____

11) What role would you like to play in this plan and why? _____

_____

_____

_____

The following National Common Core Standards can be met teaching;

TECHNOLOGY & WILDLIFE CONSERVATION

6TH GRADE:

CCSS.ELA-LITERACY.RI.6.1	Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.6.2	Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
CCSS.ELA-LITERACY.RI.6.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.
CCSS.ELA-LITERACY.RI.6.6	Determine an author's point of view or purpose in a text and explain how it is conveyed in the text.
CCSS.ELA-LITERACY.RI.6.7	Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
CCSS.ELA-LITERACY.W.6.1	Write arguments to support claims with clear reasons and relevant evidence.
CCSS.ELA-LITERACY.W.6.2	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.6.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.W.6.5	With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
CCSS.ELA-LITERACY.W.6.6	Use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of three pages in a single sitting.
CCSS.ELA-LITERACY.W.6.7	Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.
CCSS.ELA-LITERACY.W.6.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.
CCSS.ELA-LITERACY.W.6.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCSS.ELA-LITERACY.W.6.10	Write routinely over extended time frames (time for research, 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.
CCSS.ELA-LITERACY.SL.6.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.6.2	Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
CCSS.ELA-LITERACY.SL.6.3	Delineate a speaker's argument and specific claims, distinguishing claims that are supported by reasons and evidence from claims that are not.

CCSS.ELA-LITERACY.SL.6.4	Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
CCSS.ELA-LITERACY.SL.6.5	Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.
CCSS.ELA-LITERACY.SL.6.6	Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.
CCSS.ELA-LITERACY.L.6.1	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
CCSS.ELA-LITERACY.L.6.2	Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
CCSS.ELA-LITERACY.L.6.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
CCSS.ELA-LITERACY.L.6.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 6 reading and content, choosing flexibly from a range of strategies.
CCSS.ELA-LITERACY.L.6.5	Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
CCSS.ELA-LITERACY.L.6.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

7TH GRADE:

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.RI.7.3	Analyze the interactions between individuals, events, and ideas in a text e.g., how ideas influence individuals or events, or how individuals influence ideas or events).
CCSS.ELA-LITERACY.RI.7.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.
CCSS.ELA-LITERACY.RI.7.6	Determine an author's point of view or purpose in a text and analyze how the author distinguishes his or her position from that of others.
CCSS.ELA-LITERACY.W.7.1	Write arguments to support claims with clear reasons and relevant evidence.
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.7.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.W.7.5	With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
CCSS.ELA-LITERACY.W.7.6	Use technology, including the Internet, to produce and publish writing and link to and cite sources as well as to interact and collaborate with others, including linking to and citing sources.
CCSS.ELA-LITERACY.W.7.7	Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

CCSS.ELA-LITERACY.W.7.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
CCSS.ELA-LITERACY.W.7.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCSS.ELA-LITERACY.W.7.10	Write routinely over extended time frames (time for research, 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.
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.7.2	Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.
CCSS.ELA-LITERACY.SL.7.3	Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence.
CCSS.ELA-LITERACY.SL.7.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
CCSS.ELA-LITERACY.SL.7.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.
CCSS.ELA-LITERACY.SL.7.6	Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.
CCSS.ELA-LITERACY.L.7.1	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
CCSS.ELA-LITERACY.L.7.2	Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
CCSS.ELA-LITERACY.L.7.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
CCSS.ELA-LITERACY.L.7.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 7 reading and content, choosing flexibly from a range of strategies.
CCSS.ELA-LITERACY.L.7.5	Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
CCSS.ELA-LITERACY.L.7.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

8TH GRADE:

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.8.3	Analyze how a text makes connections among and distinctions between individuals, ideas, or events.
CCSS.ELA-LITERACY.RI.8.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.
CCSS.ELA-LITERACY.RI.8.6	Determine an author's point of view or purpose in a text and analyze how the author distinguishes acknowledges and responds to conflicting evidence or viewpoints.

CCSS.ELA-LITERACY.RI.8.7	Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multi-media) to present a particular topic or idea.
CCSS.ELA-LITERACY.W.8.1	Write arguments to support claims with clear reasons and relevant evidence.
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.8.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.W.8.5	With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
CCSS.ELA-LITERACY.W.8.6	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas efficiently as well as to interact and collaborate with others.
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.W.8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
CCSS.ELA-LITERACY.W.8.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCSS.ELA-LITERACY.W.8.10	Write routinely over extended time frames (time for research, 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.
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.SL.8.2	Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
CCSS.ELA-LITERACY.SL.8.3	Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.
CCSS.ELA-LITERACY.SL.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
CCSS.ELA-LITERACY.SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
CCSS.ELA-LITERACY.SL.8.6	Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.
CCSS.ELA-LITERACY.L.8.1	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
CCSS.ELA-LITERACY.L.8.2	Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
CCSS.ELA-LITERACY.L.8.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.

CCSS.ELA-LITERACY.L.8.4	Determine or clarify the meaning of unknown and multiple-meaning words or phrases based on grade 8 reading and content, choosing flexibly from a range of strategies.
CCSS.ELA-LITERACY.L.8.5	Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
CCSS.ELA-LITERACY.L.8.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

6TH-8TH GRADE:

CCSS.ELA-LITERACY.RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts.
CCSS.ELA-LITERACY.RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
CCSS.ELA-LITERACY.RST.6-8.4	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 6-8 texts and topics.
CCSS.ELA-LITERACY.RST.6-8.6	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
CCSS.ELA-LITERACY.RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-LITERACY.RST.6-8.8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
CCSS.ELA-LITERACY.RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
CCSS.ELA-LITERACY.WHST.6-8.1	Write arguments focused on discipline-specific content.
CSS.ELA-LITERACY.WHST.6-8.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
CCSS.ELA-LITERACY.WHST.6-8.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.WHST.6-8.5	With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
CCSS.ELA-LITERACY.WHST.6-8.6	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.
CCSS.ELA-LITERACY.WHST.6-8.7	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.WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation
CCSS.ELA-LITERACY.WHST.6-8.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCSS.ELA-LITERACY.WHST.6-8.10	Write routinely over extended time frames (time for research, 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.

NEXT GENERATION SCIENCE STANDARDS:

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services. [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.