Help the Hellbender: A Conservation Quest to Protect and Preserve their Habitat

Lesson Plan:

Understanding wildlife conservation is crucial for fostering a mindset toward valuing the environment, critical thinking, and social responsibility.

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Overview

Estimated Time

Option 1: Two-Day Format (Recommended) – Two 50-minute lessons

Option 2: One-Day Format – One 50-minute lesson

Option 3: Teach over a week span of time in three 15–20-minute lessons

Total Required Learning Time: 50 min in-class lesson(s) where students will apply knowledge and learn from each other through an interactive lecture, discussion, and group problem solving activity.

Course Level

High School, 9-12th Grade

Vocabulary

Must-know Vocabulary

Anthropogenic challenges

Ecosystem

Habitat specialist

Hellbender

Indicator species

Keystone species

Water quality

Wildlife conservation

Exposure Vocabulary

Cutaneous respiration

Landscape conservation

Riparian buffer

Soil health

Watershed

Learning Goals & Objectives

Students will be able to:

Learning Goals:

- Understand ways to give hellbenders a better chance to thrive in their natural environment through landscape conservation efforts.

- Value the complex issues and teamwork needed to solve problems in the field of wildlife conservation.

Learning Objectives:

- Identify hellbender importance to their ecosystem, anthropogenic challenges facing hellbenders in the wild, and conservation efforts that can be implemented to help hellbenders thrive.
- Develop explanations and propose solutions for ways to improve hellbender habitat by making changes to the landscape and explain how practices like limiting sedimentation to river, planting cover crops to keep soil on the farm fields, building fences to exclude livestock from the river, and planting trees to limit sedimentation help protect hellbender habitat.
- Communicate and engage respectively with a team to inspect a photo presenting a challenge for hellbenders, develop explanations for conservation practices to implement to help hellbenders, and construct ideas propose solutions for working with landowners and conservation professionals.
- Apply what they learned through the hellbender case study to the broader field of wildlife conservation through a reflective writing assignment.

Lesson Standards

Next Generation Science Standards (NGSS) - *Connection to Lesson*

Scientific and Engineering Practices Standard

HS-LS2-7: Asking Questions and Defining Problems - *Students identify environmental issues affecting hellbenders.*

HS-ESS3-4: Planning and Carrying Out Investigations - *Students brainstorm and propose conservation practices.*

HS-LS2-1: Analyzing and Interpreting Data - *Students collect qualitative and quantitative data from simulations.*

HS-LS2-5: Developing and Using Models - *Students create posters or diagrams to organize findings.*

HS-LS2-6: Constructing Explanations and Engaging in Argument from Evidence - *Students design, discuss, and defend conservation strategies.*

Disciplinary Core Ideas (DCIs)

HS-LS2-1: Interdependent Relationships in Ecosystems - *Students analyze hellbender ecology and interdependence.*

HS-LS2-2: Interdependent Relationships in Ecosystems - *Students analyze hellbender ecology and interdependence.*

HS-LS2-7: Ecosystem Dynamics and Human Impacts - *Students examine sedimentation, pollution, and land use.*

HS-ESS3-4: Ecosystem Dynamics and Human Impacts - *Students examine sedimentation, pollution, and land use.*

HS-LS2-4: Cycles of Matter and Energy Transfer in Ecosystems - *Students predict changes caused by hellbender decline.*

HS-LS2-6: Engaging in Argument from Evidence - Students evaluate conservation methods using reasoning and evidence.

Crosscutting Concepts

HS-LS2-6: Stability and Change - *Promotes environmental awareness and balance.*

HS-ESS3-1: Cause and Effect / Systems and System Models - *Examines ecosystem health and riparian restoration.*

HS-ETS1-4: Systems and System Models - *Minecraft used as a simulation tool for modeling.*

Texas Essential Knowledge and Skills (TEKS) - *Connection to Lesson*

Course: *Environmental Systems*

Grade Level: *Recommended for Grades 10–12*

Scientific and Engineering Practices

(1)(A): Ask questions and define problems based on observations or information from text, phenomena, models, or investigations - *Students analyze photo scenarios to identify environmental problems affecting hellbenders.*

(1)(B): Apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations - *Students brainstorm and propose conservation practices to solve identified issues.*

(1)(E): Collect quantitative data using SI units and qualitative data as evidence - *Students make qualitative observations from photos and the Minecraft simulation.*

(1)(F): Organize data using models, diagrams, or digital tools - Group posters and class flip charts serve as visual models of findings.

(3)(A): Develop explanations and propose solutions supported by data and models - *Groups design conservation solutions for habitat restoration.*

(3)(B): Communicate explanations and solutions individually and collaboratively in a variety of settings - *Students present their posters and discuss findings during the debrief.*

(3)(C): Engage respectfully in scientific argumentation using evidence - *During discussions and presentations, students support conservation ideas with evidence from the game and readings.*

Science Concepts: Ecosystems and Environmental Relationships

(5)(A): Identify native plants and animals within a local ecosystem and compare their roles in other biomes - *Students explore hellbender ecology and keystone species roles.*

(5)(C): Evaluate effects of fluctuations in abiotic factors on local ecosystems - *Students consider how sedimentation and pollution alter water quality and habitat.*

(5)(F): Use models to predict how species extinction may alter the food chain - *Reflection activity connects hellbender decline to larger ecosystem effects.*

Course: *Biology*

Grade Level: *Recommended for Grades 9-10*

(1)(A): Ask questions and define problems based on observations or information from text, phenomena, models, or investigations - *Students observe images depicting environmental issues and identify problems affecting hellbenders and their habitats.*

(1)(B): Apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations; use engineering practices to design solutions - *In groups, students design*

conservation solutions (e.g., limiting sedimentation, fencing livestock) and model these solutions on their posters.

(1)(E): Collect quantitative and qualitative data as evidence - *Students use qualitative data from Minecraft and scenario photos to evaluate ecosystem health and propose conservation actions.*

(1)(F): Organize data using charts, diagrams, and models - *Poster creation allows students to visualize and organize environmental data through models and labeled diagrams.*

(3)(A): Develop explanations and propose solutions supported by data and models consistent with scientific ideas - *Students propose realistic conservation strategies to improve water quality and ecosystem balance for hellbenders.*

(3)(B): Communicate explanations and solutions individually and collaboratively in a variety of settings and formats - *Students share findings through group presentations and written reflections, emphasizing collaboration and scientific communication.*

(3)(C): Engage respectfully in scientific argumentation using empirical evidence - *Class debrief allows discussion of different conservation methods and their potential effectiveness.*

(4)(A): Analyze and critique scientific explanations and solutions using empirical evidence and reasoning - *Students evaluate peer group presentations and reflect on the effectiveness of proposed conservation methods.*

(12)(A): Interpret relationships, including predation, parasitism, commensalism, mutualism, and competition among organisms - *Students discuss ecosystem interdependence and how loss of hellbenders affects food webs.*

(13)(A): Investigate how human activities affect biodiversity and ecosystem equilibrium - *Central theme—students explore how agricultural practices, land use, and pollution impact aquatic ecosystems and biodiversity.*

Principles of Agriculture, Food, and Natural Resources

(1)(B): Identify and demonstrate interpersonal, problem-solving, and critical-thinking skills in agriculture, food, and natural resources - *Students use critical thinking and collaboration to identify environmental issues and propose conservation practices.*

(1)(E): Demonstrate characteristics of good citizenship, including promoting stewardship and agricultural awareness - *Lesson promotes stewardship of natural resources and ecosystem responsibility through habitat protection.*

(5)(F): Describe how emerging technologies (such as online mapping systems, drones, or robotics) impact AFNR industries - *The Minecraft simulation demonstrates the role of technology in modeling conservation systems.*

(5)(G): Compare how environmental issues impact AFNR industries - *Students analyze how ecosystem degradation impacts biodiversity and agricultural sustainability.*

(8)(A): Demonstrate written and oral communication skills appropriate for formal and informal situations - *Students present conservation solutions verbally (group reports) and in writing (reflection assignment).*

(9)(A): Apply scientific processes: identify issues, develop hypotheses, collect and analyze data, and present findings - *Students act as environmental scientists—observing, analyzing photo data, proposing solutions, and reporting findings.*

(9)(B): Apply scientific processes: identify issues, develop hypotheses, collect and analyze data, and present findings - *Students act as environmental scientists—observing, analyzing photo data, proposing solutions, and reporting findings.*

(9)(C): Apply scientific processes: identify issues, develop hypotheses, collect and analyze data, and present findings - *Students act as environmental scientists—observing, analyzing photo data, proposing solutions, and reporting findings.*

(9)(D): Apply scientific processes: identify issues, develop hypotheses, collect and analyze data, and present findings - *Students act as environmental scientists—observing, analyzing photo data, proposing solutions, and reporting findings.*

Wildlife, Fisheries, and Ecology Management

(2)(A): Analyze the importance of wildlife, fisheries, and ecology management - *Students explore the ecological role of hellbenders and the importance of protecting their habitat.*

(3)(A): Analyze basic ecological concepts of game management - *Students identify limiting factors and design management strategies for species recovery.*

(3)(C): Describe and assess the management of wildlife populations - *Students evaluate conservation practices that improve aquatic habitats and stabilize populations.*

(3)(F): Identify plants impacting aquaculture and wildlife management practices - *Students discuss how riparian vegetation influences erosion, water quality, and habitat.*

(3)(G): Discuss habitat management practices to benefit wildlife species - *Core of the lesson—students recommend practices like planting trees, cover crops, and fencing livestock.*

(5)(A): Explain the hydrologic, nitrogen, carbon, and nutrient cycles - *Students connect conservation actions to ecosystem cycles (sediment control, water filtration).*

(5)(F): Evaluate the effects of pollution sources - *Students analyze pollution and sedimentation as key anthropogenic threats.*

(5)(G): Evaluate riparian zones - *Students identify and propose improvements to riparian buffers in photo analysis.*

Required Materials/Equipment/Technology/Instructor-Developed Resources:

PowerPoint (PPT) slides for hellbender Minecraft review and lesson introduction (or printed photos from scenes Minecraft game if technology or large screen is not available), flip charts to capture group discussion during active learning activities, markers, post it notes, tape, five photos printed on 8.5x11-inch printer paper depicting a problem facing hellbenders (depends on class size – 5 groups of four students if class size is 20), timer, paper for one-minute quick write at beginning of class, 22x28 inch poster boards for the group problem-solving activity, and blank 22x28 inch poster boards for group one-pager.

Prerequisite Student Knowledge:

Prior to class, access Help the Hellbender - A Minecraft Conservation Quest available on Minecraft Education - Get Minecraft for Your Classroom | Minecraft Education and linked to Help the Hellbender with additional supporting resources. This lesson is designed to complement the Help the Hellbender - A Minecraft Conservation Quest game.

For this lesson, students need a basic introduction to ecology and basic understanding of how the environment, habitat quality, conservation efforts, pollution, and water quality impact wildlife. Please share Ecology 101: found in the resources to support student learning. Students need a basic understanding of how to communicate and work in groups.

Teacher Notes

Wildlife conservation is the wise use and management of natural resources, including wildlife and their habitats, to prevent their disappearance and ensure their long-term sustainability. Wildlife conservation lessons are invaluable for shaping informed, engaged, and compassionate citizens who are equipped to face the environmental challenges of the future. Understanding these ecological connections helps students grasp why conservation of one species—like the hellbender—can protect entire ecosystems and benefit humans as well. This is important because the environment, habitat quality, and wildlife health are all connected. When we protect habitats and reduce pollution, we improve water quality and help wildlife survive.

About the Hellbender Salamander

The hellbender (*Cryptobranchus alleganiensis)* is the largest salamander in North America, reaching over two feet in length. They are a fully aquatic amphibian found in clean, cool, well-oxygenated rivers and streams. An **aquatic habitat** is the area where aquatic organisms live and find food, water, shelter, and space to reproduce. Many species—such as fish, amphibians, beavers, and waterfowl—depend on healthy aquatic systems for survival. Hellbender's habitat

includes cobble and coarse gravel streambeds with large flat rocks for shelter, nesting, and protection from predators. Hellbenders are considered **habitat specialists** because they need very specific conditions—clean water, rocky stream bottoms, and steady flow—to survive and reproduce. Hellbenders adaptations for their environment include flattened bodies for hiding under rocks, paddle-like tails for swimming, and wrinkled folds of skin along the sides to absorb oxygen directly from water (**cutaneous respiration**-they "breathe through their skin"). Because of these specific needs, hellbenders are extremely sensitive to environmental change—especially water pollution and sedimentation.

Importance of Clean Water for Amphibians: Indicator and Keystone Species

Like humans, aquatic amphibians depend on clean freshwater to survive. Amphibians have permeable skin that easily absorbs pollutants from the water, which can cause disease, deformities, or death in amphibians. Amphibians' high sensitivity makes them excellent **indicator species**—their presence or absence can reveal the health of the **ecosystem** (all biotic living organisms and abiotic non-living components). Excess nutrients and other pollutants (from fertilizers, sediment, human/animal waste, etc.) can cause algae blooms and smother habitat, which reduce oxygen in the water and make habitats unlivable. Healthy amphibian populations equal healthy rivers and ecosystems.

If amphibians are declining, it often signals broader ecosystem problems because they reflect the health of their environment. Hellbenders are a long-lived (25+ years) aquatic species that likely play a critical role in the ecosystem. If they disappear from their aquatic ecosystem, this

can cause larger problems for the entire ecosystem. **Keystone species** play a critical role in maintaining ecosystem balance and removing them causes dramatic changes to the food web and habitat conditions. Hellbenders are top predators of aquatic invertebrates like crayfish and help regulate prey populations to maintain ecological stability. Hellbenders are effective indicators of the streams because they need clean water to survive and thrive. Protecting hellbenders benefits the entire freshwater ecosystem, including humans.

What Is Water Quality?

Water quality measures how suitable water is for a specific purpose—such as drinking, recreation, or supporting wildlife. Healthy aquatic ecosystems depend on clean, well-oxygenated water with low levels of sediment and pollutants. Common causes of poor water quality include:

- **Stormwater Runoff:** Rainwater flowing over streets, lawns, and farms picks up pollutants such as fertilizers, pesticides, salt, oil, and sediment before entering storm drains and rivers.
- **Sedimentation:** Sediment is soil and rocks washed from the land into rivers by the process of erosion. Sediment clouds the water, reducing light and making it difficult for animals to find food or breathe, and smothers habitat. It clogs fish gills, fills in the spaces under rocks where hellbenders hide and lay eggs, and reduces oxygen levels. It is one of the most common forms of pollution in rivers, lakes, and streams.
- **Excess Nutrients:** Nutrients such as nitrogen and phosphorus from fertilizers and waste cause algae blooms that deplete oxygen and kill aquatic life.

- **Low Dissolved Oxygen (DO):** Aquatic animals need dissolved oxygen to survive. Sediment, algae blooms, and decaying organic matter (leaves, pet waste, food scraps) use up oxygen, suffocating aquatic organisms.

Human activities that alter or pollute water sources threaten both wildlife and human communities that depend on them. **Anthropogenic challenges** are negative impacts on natural and social systems caused by human activities (pollution from industrial and agricultural practices, deforestation, and urbanization).

Threats to Hellbender Populations

Hellbenders are threatened or endangered across most of their range due to:

- Habitat loss and degradation from erosion, sedimentation, and deforestation
- Pollution from agricultural runoff, chemicals, and waste
- Dam construction that changes water flow and temperature
- Collection or disturbance by humans

Because hellbenders are slow to reproduce and require pristine conditions, even small habitat changes can have lasting impacts on their survival. Protecting hellbenders means protecting entire **watersheds** (area of land that drains all of the streams and rainfall to a common outlet). This approach involves thinking about conservation at the landscape level. **Landscape conservation** is a science-based collaborative approach to address conservation goals aiming to improve environmental health (cleaner water, healthier soil, and enhanced wildlife habitat).

Conservation practices that benefit them also improve water quality for people and other wildlife. Ways to help protect freshwater ecosystems include:

1. **Plant trees near streams and rivers** to reduce erosion and sedimentation. Roots hold soil in place and shade water to keep it cool. This creates a **riparian buffer** (vegetation planted along the river to protect it from pollution and erosion).
2. **Plant cover crops on farm fields** to keep valuable top soil from leaving the farmers' fields and ending up in the river as sediment. The roots of cover crops hold soil in place on the field and help increase **soil health** (capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans).
3. **Building fences to exclude livestock from the river** and keep excess nutrients from entering the watershed. Manure and urine entering the river can deplete oxygen levels and pose a health risk to humans and wildlife.
4. **Remove dams to restore normal water flow** back to the river and improve the ability for wildlife and fish to move freely up and down steam.
5. **Educate humans about the importance of hellbenders** thriving in their native habitat as an indicator and keystone species.
6. **Pick up trash and recycle** to prevent waste from entering waterways where animals might ingest it.
7. **Reduce impervious surfaces** (like pavement) and leave areas unpaved or plant grass buffers so rainwater can soak into the ground instead of running off with pollutants.
8. **Install rain barrels or rain gardens** with native plants to collect and filter runoff before it reaches rivers. Provide habitat for pollinators and other beneficial species.

Understanding how human activities affect aquatic ecosystems helps connect daily choices (like littering or lawn care) to the broader health of rivers, wildlife, and communities. Encouraging these connections promotes environmental stewardship and conservation-minded decision-making. Hellbenders serve as a powerful case study for understanding habitat requirements, biodiversity, and human impact on ecosystems. Their dependence on clean, well-oxygenated water makes them an excellent focal species for connecting local actions to global conservation issues.

Resources

Bodinof Jachowski, C. M., J. J. Millspaugh, and W. A. Hopkins. 2016. Current land use is a poor predictor of hellbender occurrence: why assumptions matter when predicting distributions of data-deficient species. Diversity and Distributions, 22, 865–880. https://doi.org/10.1111/ddi.12446

Burgmeier, N. G., S. D. Unger, B. Osinski, and R. N. Williams. 2016. Help The Hellbender: North America's Giant Salamander. Purdue Extension, FNR-536-W. https://www.extension.purdue.edu/extmedia/FNR/FNR-536-W.pdf

"Landscape Conservation Initiatives." Natural Resources Conservation Service. U.S. Department of Agriculture. Accessed October 29, 2025. https://www.nrcs.usda.gov/programs-initiatives/landscape-conservation-initiatives

MacGowan, B. J. 2015. Wildlife Habitat Education Program – Teaching and Learning Wildlife Management Practices. Purdue Extension, FNR-494-W. https://extension.purdue.edu/extmedia/FNR/FNR-494-W.pdf

Mills, L. S., Soulé, M. E., & Doak, D. F. (1993). The Keystone-Species Concept in Ecology and Conservation. BioScience, 43(4), 219–224. https://doi.org/10.2307/1312122

Mullendore, N., Mase, A. S., Mulvaney, K., Perry-Hill, R., Reimer, A., Behbehani, L., Williams, R. N., and Prokopy, L. S. 2014. Conserving the Eastern Hellbender Salamander. Human Dimensions of Wildlife, 19(2), 166–178. https://doi.org/10.1080/10871209.2014.853221

Nickerson, M. A. and C. E. Mays. 1973. The Hellbenders: North American "giant salamanders." Milwaukee Public Museum. Milwaukee, WI.

Siddig, A. A. H., A. M. Ellison, A. Ochs, C. Villar-Leeman, and M, K. Lau. 2016. How do ecologists select and use indicator species to monitor ecological change? Insights from 14 years of publication in Ecological Indicators, Ecological Indicators, Volume 60, 223-230, ISSN 1470-160X, https://doi.org/10.1016/j.ecolind.2015.06.036.

Tazerji, S. S., Nardini, R., Safdar, M., Shehata, A. A., and Duarte, P. M. (2022). An Overview of Anthropogenic Actions as Drivers for Emerging and Re-Emerging Zoonotic Diseases. Pathogens (Basel, Switzerland), 11(11), 1376. https://doi.org/10.3390/pathogens11111376

"Watersheds." United States Geological Survey. Accessed October 29, 2025. https://www.usgs.gov/centers/california-water-science-center/science/science-topics/watersheds

Wheeler, B. A., E. Prosen, A. Mathis, and R. F Wilkinson. 2003. Population declines of a long-lived salamander: a 20+-year study of hellbenders, *Cryptobranchus alleganiensis*, Biological Conservation, 109(1), 51-156. ISSN 0006-3207, https://doi.org/10.1016/S0006-3207(02)00136-2.

Additional Related Educational Materials

1. Help The Hellbender, Purdue Agriculture website https://ag.purdue.edu/department/extension/hellbender/index.html
2. The Nature of Teaching, Purdue Agriculture website https://ag.purdue.edu/department/extension/nature/index.html
3. Adaptations for Aquatic Amphibians, The Nature of Teaching https://www.extension.purdue.edu/extmedia/fnr/FNR-573-w.PDF
4. Healthy Water, Happy Home Lesson Plan, The Nature of Teaching https://www.extension.purdue.edu/extmedia/FNR/FNR-527-W.pdf

5. Hellbenders Rock! Lesson Plan, The Nature of Teaching https://extension.purdue.edu/4-H/_docs/volunteer/resources-and-development/stem/activity-guide-for-hellbender-havoc-game.pdf

Procedure

This lesson uses the hellbender salamander (*Cryptobranchus alleganiensis*) as a focal species to teach high school students about the importance of engaging in wildlife conservation efforts.

1. Prior to the in-class lesson, students will play Help the Hellbender - A Minecraft Conservation Quest to learn about hellbender life-history and importance, anthropogenic challenges, and conservation efforts with conservationists and landowners.
2. In-class, students will apply the knowledge they learned individually and work collaboratively with class members. The lesson begins with a **one-minute quick write** and review of the hellbender Minecraft lesson learning objectives. Students will write about what they learned during the hellbender Minecraft game at the beginning of class prior to the learning objective review of the game.
3. **Active learning think-pair-share activity**: Students think about and discuss challenges facing hellbenders with a partner. Each pair will be asked to share a challenge they discussed with the whole class before moving onto the group problem solving activity.
4. **Group problem solving and brainstorming:** Groups of four students receive a photo depicting a problem that might negatively impact the hellbender for them to identify.

Groups brainstorm conservation practices to help solve the problem and benefit the hellbender.

5. **Group activity:** Students determine who they might work with to make these changes on the landscape, identify what challenges they might face putting the conservation practice on the landscape, and create a **one-pager** to report their problem and is solution to the class.

Key Scientific Process Skills: Making observations, Communicating results

Pedagogical Approaches: Think-pair-share, Brainstorming, Collaborative work, One-minute quick write, Reflective writing, Interactive lecture, One-pager

Bloom's Cognitive Level: Application and analysis

Assessment:

Student groups will create a group one-pager during class on a poster board based off their group problem solving photo scenario to present their challenge impacting hellbenders and answers to the questions during the group reports. Students will be assessed based on their level of participation within the group by discussing the questions, writing responses, notes, and annotations; and explaining their solution and potential challenges when implementing a conservation practice: 15 points – Active participation, 10 points – limited participation, 5

points – needs improvement, 0 points – absent. Students will be assessed on a 15-point scale outlined in the rubric.

Criteria	0 points	5 points	10 points	15 points	Criterion Score
Group one-pager participation and presentation	Absent.	Needs improvement. Engages in group discussion to find a solution, contributes no ideas on the one-pager by including a written response, note or annotation. Does not help explain any solutions verbally during the group presentation.	Limited participation. Engages in group discussion to find a solution, contributes at least one idea on the one-pager by including a written response, note or annotation. Does not help explain any solutions verbally during the group presentation.	Active participation. Engages in group discussion to find a solution, contributes at least two ideas on the one-pager by including a written response, note or annotation. Helps explain one solution verbally during the group presentation.	Score of Criterion Group one-pager and presentation ___/15

Students will be assessed with a 1-page reflective writing assignment allowing students to reflect individually on what they learned about the importance of wildlife conservation using the hellbender as a case study species and apply what they learned to the broader field of wildlife conservation. Students will be assessed on a 3-point scale outlined in the rubric.

Criteria	1 point	2 points	3 points	Criterion Score
Criterion 1 – Completely answers questions 1 and 2	Response demonstrates a lack of reflection on, or personalization of why it is important to work with others in the field of wildlife conservation and	Response demonstrates a minimal reflection on, and personalization of why it is important to work with others in the field of wildlife conservation and	Response demonstrates a general reflection on, and personalization of why it is important to work with others in the field of wildlife conservation and examines the role education plays buy	Score of Criterion 1 - Depth of reflection, ___/3

	examines the role education plays buy including 1 example and/or reason.	examines the role education plays buy including at least 2 examples and/or reasons.	including at least 3 examples and/or reasons.	
Criterion 2 - Completely answers question 3 and lists two examples	Response explains ways they can inform others about the importance of wildlife conservation but lists no examples.	Response explains ways they can inform others about the importance of wildlife conservation but only lists one example.	Response explains ways they can inform others about the importance of wildlife conservation and lists two examples.	Score of Criterion 2 -Required components, ___/3

Inclusive Teaching:

The lesson plan is inclusive by design to engage all participants by using active learning techniques, like think-pair-share and group problem solving, giving all students a chance to be engaged and build a sense of belonging in the class. Working collaboratively in groups will allow students to experience how different views and opinions add value to diversity in science. This lesson can be translated to accommodate ESL students and assessments can be scaled down for SPED students.

Lesson Plan

Prior to the in-class lesson, students will play Help the Hellbender - A Minecraft Conservation Quest individually to learn about hellbender life-history and importance, anthropogenic challenges, and conservation efforts. Students will work through the three activities in the hellbender Minecraft world simulating real issues and people working to conserve hellbenders through landscape conservation efforts. The hellbender Minecraft lesson objectives include

identifying hellbender's role in their environment as a keystone species, distinguishing challenges facing hellbenders like pollution, sedimentation, and habitat destruction, and discovering conservation practices to put on the landscape like planting cover crops and trees, fencing livestock from rivers, and building watering structures. Students will also discover the importance of conservationists working with landowners through farm visits and consultations with agricultural producers.

In-class, students apply the knowledge they learned individually and work collaboratively with class members. The teacher will welcome students and ask them to write a one-minute quick write recalling what they learned during the hellbender Minecraft game. Next, the teacher will recap of the hellbender Minecraft lesson objectives and outcomes using a PowerPoint presentation (or printed photos from the Minecraft game). Next, students move into an active learning think-pair-share activity where they will think about and discuss challenges facing hellbenders with a partner. Students will be asked to find a partner they do not usually work with for the activity. Each pair will be asked to share a challenge they discussed with the whole class before moving onto the group problem solving activity. During the sharing, the teacher will capture student ideas on a flip chart or whiteboard. Next, students will be broken into groups of four (depending on class size) for the group problem solving activity. Students will count off by four, join students with the same number, and each group will receive a photo depicting a problem that might negatively impact the hellbender for them to identify. Each group will receive a poster board to write their answers to the question prompts on for the group report. Groups brainstorm conservation practices to help solve the problem and benefit

the hellbender. Then students determine who they might work with to make these changes on the landscape, identify what challenges they might face putting the conservation practice on the landscape, and report their problem and its solution to the class via a one-pager. Questions given with the photo include the following:

1) What do you see in the photo that might negatively impact the hellbender?
2) What conservations practices would benefit the hellbender?
3) Who would they have to work with to make these changes on the landscape? What challenges might they face?

Next, student groups will report their identified problem to the class and explain how they would try to solve the conservation issue from their one-pager. In closing the lesson, the teacher will debrief the group and ask students what they found most interesting, challenging, or helpful about this lesson. The teacher will also describe the individual reflection writing assignment due next week with the following questions:

1) Why is it important to work with others in the field of wildlife conservation?
2) What role does education play in wildlife conservation?
3) How can you inform others about the importance of wildlife conservation?

Option 1: Suggested Adjustments to Fit Two-Day Format (Recommended)

Day 1 (50-mins)

Timeline	**Time allotted**	**Flow**	**Materials & Reminders**
Introduction	10 minutes	One-minute quick write – What did you learn during the Help the Hellbender - A Minecraft Conservation Quest game?	PowerPoint slides (or printed Minecraft photos) ready to review hellbender Minecraft

		Recap Minecraft lesson objectives and outcomes "*During the Help the Hellbender: A Minecraft Conservation Quest you identified the hellbender's role in their environment as a keystone species, learned about challenges facing hellbenders like pollution, sedimentation, and habitat destruction, and discovered conservation practices to put on the landscape like planting cover crops and trees, fencing livestock from rivers, and building watering structures. You also discovered the importance of conservationists working with landowners through farm visits and consultations with agricultural producers.*" Transition: Describe the next think-pair-share activity "*Next, we are going to move into an activity that will require you to think about the challenges hellbenders are facing and share your thoughts with a partner.*"	learning objectives and intended outcomes Flip chart ready to capture feedback about what students learned
Think-Pair-Share	15 minutes (Think - 2 minutes Share - 6 minutes Discussion - 7 minutes)	Question: What challenges are hellbenders facing? "*Now, I want you to take 3 minutes and think about this question: What challenges are hellbenders facing? Think back to what you learned during the Minecraft game and what we discussed at the beginning of class.*" Time 2 minutes. "*Find a partner next to you to share your ideas.*"	Timer for each section. Flip chart ready to capture student feedback from discussion. If students have similar ideas, you can star, check or underline to show that multiple groups agree with a single response.

		During the share, tell students when they have reached 3 minutes and it is time to switch if they have not done so already. "*Now we are going to go around the room and have each group share their ideas and I am going to write them on this flip chart."* Capture group feedback. Transition: Describe the next group problem solving activity. "*Thank you for sharing your thoughts on the challenges hellbenders are facing. This leads us to our next activity where we are going to look at photos of real-life examples. We are going to try and identify the problems in these photos for the hellbender and you are going to work with a team come up with solutions."*	
Group Problem Solving	20 minutes	Activity instructions - 5 mins Describe group in-class poster project based on problem-solving activity with example ready to show students. "*We are going to break up into groups and I want you to count off by 4s and hold up your number… Now, find your other group members with the same number."* *"Your group is going to be given a photo for you to analyze and some questions to answer over the next 15 minutes."* Activity – 15 mins	Break students into groups of 4 (Class size 20) - have students count off by four and get into groups with their number Each student will be given a poster board to put their picture on and point out issues by drawing arrows and making circles on the photo. Students will write their answers to the questions on the poster board to reference during the group reports. Teacher will float around room during discussion

		1) Give student groups a photo with a problem for them to identify: What do you see in the photo that might negatively impact the hellbender? 4 mins 2) Brainstorm conservation practice to help solve the problem: What conservation practices would benefit the hellbender? 6 mins 3) Who would they have to work with to make these changes on the landscape? What challenges might they face? 5 mins *"I am sure your groups discussed great solutions to help the hellbender."*	
Whole-Class Debrief and Reflection	5 minutes	Ask students what they found most interesting, challenging, or helpful about this activity. Ask students if they have any additional questions. *"Thank you for participating in today's activities. We are going to pick back up on this discussion in our next class period and create a one-pager to share with the class."*	Lesson objectives • Problem-solving • Communication
Total Time	**50 minutes**		

Day 2 (50-mins)

Timeline	**Time allotted**	**Flow**	**Materials & Reminders**
Complete Group Poster	15 minutes	Activity instructions - 3 mins Students share ideas from their individual posters to create a single group one-pager to report to the class	New blank poster board for group one-pager.

		Finalize one-pager – 12 mins Students use their creativity to write/draw/incorporate answers from previous days questions into their one-pager report.	
Group Reports	10 minutes	Each of the 5 groups have 2 mins to report their problem and how they would solve it from their one-pager.	Flip chart ready to capture student feedback from reports
Whole-Class Debrief and Takeaways	10 minutes	Ask students what they found most interesting, challenging, or helpful about this activity Describe reflection assignment due next week. 1) Why is it important to work with others in the field of wildlife conservation? 2) What role does education play in wildlife conservation? 3) How can you inform others about the importance of wildlife conservation? List two examples.	Lesson objectives • Problem-solving • Communication
Reflection Writing Prompt Overview	15 minutes	Explain instruction for the writing reflection assignment to students and start in class if time allows.	Paper and pencil or laptop for writing reflection
Total Time	**50 minutes**		

Option 2: Suggested Adjustments to Fit One 50-Minute Lessons

Timeline	**Time allotted**	**Flow**	**Materials & Reminders**
Introduction	10 minutes	One-minute write – What did you learn during the Help the Hellbender - A Minecraft Conservation Quest game?	PPT slides ready to review hellbender Minecraft learning objectives and intended outcomes

		Recap Minecraft lesson objectives and outcomes Describe the next pair and share activity	
Pair and Share	10 minutes	Pair and Share - 4 mins Students share what you learned during the hellbender game with another student from their one-minute quick write. Discussion - 6 mins Ask students to share insights on what they learned from the pairs.	Flip chart ready to capture student feedback from discussion
Group Activity	15 minutes	Activity instructions - 2 mins Describe group in-class poster project based on problem-solving activity with example ready to show students. Activity – 13 mins 4) Give student groups a photo with a problem for them to identify: What do you see in the photo that might negatively impact the hellbender? 5) Brainstorm conservation practice to help solve the problem: What conservation practices would benefit the hellbender? 6) Who would they have to work with to make these changes on the landscape? What challenges might they face?	Break students into groups of 4 (Class size 20) - have students count off by four and get into groups with their number Each student will be given a poster board to put their picture on and point out issues by drawing arrows and making circles on the photo. Students will write their answers to the questions on the poster board to reference during the group reports. Teacher will float around room during discussion
Group Reports	10 minutes	Each of the 5 groups have 2 mins to report their problem and how they	Flip chart ready to capture student feedback from reports

		would solve it from their poster board	
Group Activity Debrief and Takeaways	5 minutes	Ask students what they found most interesting, challenging, or helpful about this activity Describe reflection assignment due next week. 1) Why is it important to work with others in the field of wildlife conservation? 2) What role does education play in wildlife conservation? 3) How can you inform others about the importance of wildlife conservation? List two examples.	Lesson objectives • Problem-solving • Communication
Total Time	**50 minutes**		

Option 3: Suggested Adjustments to teach lesson over a week span of time

Break down the lesson into three 15–20-minute sections to cover each day of class and teach the content in conjunction with other related content to support the subject even more.

Supporting Materials

Glossary of Activities:

One-minute quick write is a fast-paced, low-stakes, and often ungraded writing activity where a person writes continuously for 60 seconds (or sometimes up to 3 minutes) about a specific topic, question, or prompt.

> **Question prompt:** What did you learn during the Help the Hellbender - A Minecraft Conservation Quest game?

Example answer: I learned the hellbenders are an endangered salamander species that need our help to survive. People can help them by keeping the river clean and working to protect the area around the river where they live.

One-pager is a creative, single-page, visual response to a text, topic, or unit, designed to demonstrate understanding through a mix of images, key quotes, notes, and analysis. It serves as a concise, high-level summary, allowing students to synthesize information, analyze themes, and show their learning in a visually appealing way.

PPT Slides Resources: Screenshots from Help the Hellbender - A Minecraft Conservation Quest for teacher to present in class.

Link to Help the Hellbender - A Minecraft Conservation Quest: Minecraft Education Resources - Get Minecraft for Your Classroom | Minecraft Education

The inspiration for this lesson is based on the desire to reach a larger audience to engage students in learning about wildlife conservation through game-based learning using the hellbender as a focal species. The hellbender Minecraft game presents an opportunity for students to learn about hellbender life-history and importance as a keystone species. Students also learn about anthropogenic challenges like pollution and sedimentation. In addition, students work through different conservation efforts with conservationists including a field-based activity doing surveys, a lab-based activity focused on hellbender husbandry, and a conservation practice and partnership activity.


HELP THE
HELLBENDER
A MINECRAFT
CONSERVATION
QUEST

Example photos for hellbender Minecraft world.





Example of great hellbender habitat.



Great hellbender habitat includes large rocks and cobble, clean flowing water, and vegetation along the riverbank to protect the quality of the water. Photo Credit: Nick Burgmeier

Example photos for group problem identification activity:



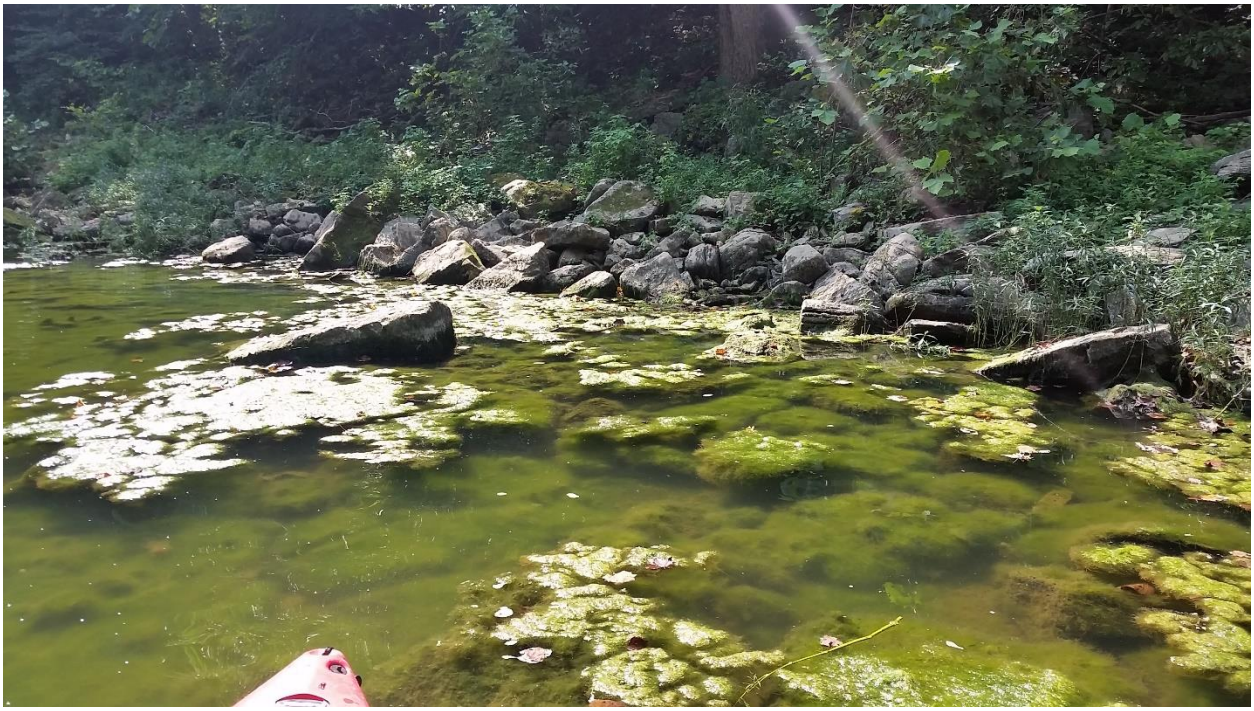
Dam in stream changing water flow and blocking aquatic wildlife movement. Photo Credit: Nick Burgmeier



Stream bank erosion causing sediment to erode into the river. Photo Credit: Nick Burgmeier



Stream bank erosion causing sediment to erode into the river. Photo Credit: Nick Burgmeier



Algae bloom in stream lowering dissolved oxygen levels. Photo Credit: Nick Burgmeier



Runoff from farm field leading to the river. Photo credit: Eliza Hudson



Excess nutrients entering the river from a livestock pasture. Photo credit: Cora Brown



Cows in river adding manure leading to excess nutrients. Photo credit: Sherri Reinsch



Stream bank erosion causing sediment to erode into the river. Photo Credit: Sherri Reinsch



Cement plant next to river with industrial runoff. Photo credit: Eliza Hudson



Culvert draining from agriculture field with no real riparian buffer. Photo credit: Eliza Hudson



Construction site by river with erosion problems. Photo credit: Eliza Hudson

Ecology 101: How the Environment Impacts Wildlife

What Is Ecology?

Ecology is the study of how living things (plants, animals, people) interact with each other and with their environment. Ecologists ask questions like: - Where do organisms live? - What do they need to survive? - How do human actions affect ecosystems?

An **ecosystem** includes all the living (biotic) and nonliving (abiotic) parts of an area—such as plants, animals, water, air, soil, and sunlight—working together.

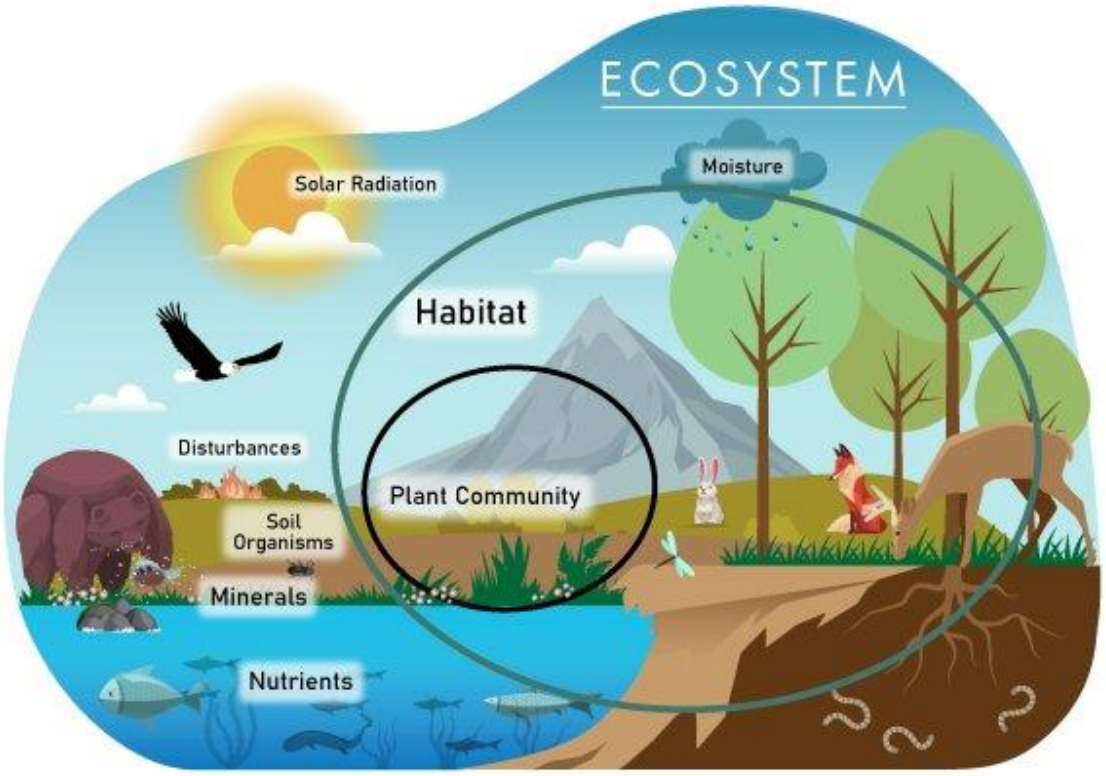


Photo Credit: https://www.epa.gov/air-quality/air-animals-and-plants

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Habitat & Habitat Quality

A **habitat** is the place where an organism lives. Every species needs: - **Food** – energy to grow and survive - **Water** – for drinking and bodily processes - **Shelter** – protection from weather and predators - **Space** – room to find resources and raise young

Habitat quality describes how well a habitat meets these needs. - **High-quality habitat** → healthy wildlife populations - **Low-quality habitat** → stress, fewer young, population decline

Examples: - A clean stream with rocks and plants = high-quality habitat for fish and insects - A polluted ditch with little vegetation = low-quality habitat

Environmental Changes & Wildlife

Changes in the environment can help or harm wildlife.

Natural changes:

- Floods, droughts, fires, seasonal changes

Human-caused changes:

- Urban development
- Agriculture
- Roads and dams
- Climate change

When habitats are altered or destroyed, animals may be forced to move, adapt, or they may not survive.

Pollution is anything harmful added to the environment.

Types of pollution:

- **Water pollution:** chemicals, fertilizer runoff, trash
- **Air pollution:** vehicle emissions, smoke
- **Soil pollution:** pesticides, heavy metals

Pollution can: - Poison wildlife - Reduce food sources - Damage habitats - Disrupt reproduction and growth

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Water quality refers to how clean and healthy water is for living organisms.

Healthy water has: - Enough oxygen - The right temperature - Low levels of pollutants

Poor water quality can cause: - Fish kills - Loss of insects (important food for fish and birds) - Algae blooms that block sunlight and oxygen

Because many species depend on water, water quality directly affects entire ecosystems.

Conservation means protecting and wisely managing natural resources.

Examples of conservation actions: - Protecting habitats (parks, wildlife refuges) - Restoring wetlands and forests - Reducing pollution - Using sustainable farming and fishing practices

Conservation helps ensure that wildlife and people can thrive now and in the future.

The Big Picture

Everything is connected:

Environment → Habitat Quality → Wildlife Health

When we protect habitats and reduce pollution, we improve water quality and help wildlife survive.

Think About It:

- How do your daily choices (what you buy, use, or throw away) affect the environment?
- What conservation actions could help wildlife in your community?