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LESSON PLAN



Climate Change and Animal Habitat: Investigating the Chesapeake Bay

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Lesson Overview

Climate change influences species habitat range and distribution. Projected changes in temperature and precipitation could further shift ecosystems and contribute to species' extinction (USGCRP 2023). Cultural identity, economics, and food are also related to the distribution of ecosystems. Exposing students to topics such as environmental stewardship or ecological connectivity early in childhood education creates a framework to build upon for more complex issues (Hahn 2021; Dominguez Contreras and Krasny 2022).

Learners are introduced to the fundamental concepts of habitats, ecosystems, and migration while also building an understanding of the intersectionality of climate factors that play a role in the movement and extinction of ecosystems. While factors such as habitat loss, monoculture, and pesticide use each modify ecosystems, researchers have found that changing environmental conditions such as temperature, precipitation, pH, and salinity play a role in the migration and distribution of species (NOAA 2019). Learners are asked to consider the value of ecosystems.

Viewing the topic of climate change through a Chesapeake Bay watershed lens, this concept-based instructional exercise aids in the development of critical thinking and problem-solving skills while drawing on the Geo-Inquiry framework, empowering young learners through project-based exploration (National Geographic Society 2017). To prepare for the activity, educators may reference the resources available that outline the causes, impacts, and solutions to climate change in the Chesapeake Bay (USGCRP 2023; NOAA 2021). They may also reach out to collaborate with specialists in their school division or local university extension office, scaffolding the knowledge across grade levels and disciplinary backgrounds. A field trip to a local wetland, nature preserve, or schoolyard meadow may allow for ecological discussions and give hands-on opportunities to connect with the subject matter. Other local resources such as outdoor learning centers, local science centers, National Geographic Kids, or university extension programs can also offer insights.

This learning activity was created with elementary students in mind and builds on existing learning objectives. *Bee Movie* introduces the topic of climate change, but some challenges may arise in the implementation of this activity. Students have a range of experiences, and many may have little understanding of the impact, importance, or intersectionality of climate change. Some school populations do not have access to or are unable to prioritize outdoor educational opportunities. For these reasons, a teacher must decide whether pre-teaching to increase background knowledge is needed for their student population. Section 2 of the Educational Guide gives suggestions.

Another challenge may be in the independent research portion of the lesson. For various reasons, not all students may be able to accomplish this challenge. To support all learners, offering students a choice of working individually or with partners may be appropriate. Sharing within a group setting may be most beneficial to some students. Students may also be offered additional options on process and product, such as drawing, writing, typing, or dictating. Meeting the needs of student populations requires all types of educational pedagogical strategies. Finally, a scaffolded version of the worksheet could be produced to meet students at their grade or experience level. The Geo-Literacy framework allows for students and educators to strategize and prioritize interactions, intersections, and implications based on their individual classroom needs.

Duration of Lesson

Two periods (60 minutes each)

Preparation and Equipment Needs

The National Geographic Society Geo-Inquiry Process presented in this lesson is a five-step method designed to address a local issue. Students first formulate a question linked with a local issue (Ask). Students then collect data (Collect); data may be qualitative

or quantitative, formal or informal. The next steps of the Geo-Inquiry Process are Visualize and Create. Depending on the grade level, students may draw mental maps or use ArcGIS to help organize and communicate their data. The final stage is important: Action. Students use the new knowledge to take some type of action (Oberle et al. 2019; Schell, Mohan, and The Instructional Materials and Professional Development Committee 2013).

Educator Needs

- Background knowledge
- Local field guides
- Crayons or colored pencils
- Worksheet

Objectives

Building on both the *Geography for Life* standards (Heffron and Downs 2012) and Virginia Department of Education (2018) Science Standards of Learning, the driving question this lesson asks students to consider is as follows: *Is there a connection between climate and habitat change in Virginia? If there is, should we care?*

The goal is to have students come to an understanding of the linkage between climate change and habitat. Building fundamental knowledge at an early age helps students understand the climate crisis (Hahn 2021; Dominguez Contreras and Krasny 2022). Concept-based instruction works well when students can view an issue through a local perspective such as the Chesapeake Bay watershed because the effects are more visible in their own community. Students can then use their critical thinking and problem-solving skills to apply the concepts across classes and as they advance in their schooling.

Guiding Questions

1. How do climate and weather impact a species?
 - a. How might this be different on land or in the water?
 - b. What factors help explain where an animal lives?
2. If the climate changes—the earth warms, precipitation patterns become more chaotic, or salinity increases—what would happen to the species?
3. What are the advantages and disadvantages of changing organism habitats? How do species respond?
4. What is the difference between seasonal animal migration and animal movement caused by climate change?
5. What can we do to take care of Earth and its various ecosystems?
6. What is valuable about ecosystems found within the Chesapeake Bay?
7. What is valuable about ecosystems outside of the Chesapeake Bay watershed?

National Geography Standards

- Standard 7: The physical processes that shape the patterns of Earth's surface.
- Standard 8: The characteristics and spatial distribution of ecosystems and biomes on Earth's surface.

- Standard 14: How human actions modify the physical environment.
- Standard 15: How physical systems affect human systems.
- Standard 16: The changes that occur in the meaning, use, distribution, and importance of resources.

Virginia Department of Education Science Standards of Learning

The student will:

Grade 2

- Identify examples of weather and seasonal changes that happen slowly and quickly. (SOL 2.7c)

Grade 3

- Investigate and understand that ecosystems support a diversity of plants and animals that share limited resources. (SOL 3.6)
- Describe aquatic ecosystems and examples of animals and plants that live in each. (SOL 3.6a)
- Explain the relationship between population and community. (SOL 3.6c)

Grade 4

- Investigate and understand that organisms, including humans, interact with one another and with the nonliving components in the ecosystem. (SOL 4.3)
 - Interrelationships exist in populations, communities, and ecosystems. (SOL 4.3a)
 - Changes in an organism's niche and habitat may occur at various stages in its life cycle. (SOL 4.3c)
- Investigate and understand that weather conditions and phenomena affect ecosystems and can be predicted. (SOL 4.4)
- Common and extreme weather events affect ecosystems. (SOL 4.4b)

Grade 5

- Demonstrate an understanding of scientific and engineering practices by obtaining, evaluating, and communicating information.
 - Read and comprehend reading-level-appropriate texts and/or other reliable media and communicate scientific information, design ideas, and/or solutions with others. (SOL 5.1f)

Grade 6

- Investigate and understand that land and water have roles in watershed systems.
 - A watershed is composed of the land that drains into a body of water; (SOL 6.8a)
 - Virginia is composed of multiple watershed systems which have specific features; (SOL 6.8b)

- The Chesapeake Bay is an estuary that has many important functions; (SOL 6.8c) and
- Natural processes, human activities, and biotic and abiotic factors influence the health of a watershed system. (SOL 6.8d)
- Investigate and understand that humans impact the environment and individuals can influence public policy decisions related to energy and the environment.
 - Natural resources are important to protect and maintain; (SOL 6.9a)
 - Major health and safety issues are associated with air and water quality; (SOL 6.9c) and
 - Preventive measures can protect land use and reduce environmental hazards. (SOL 6.9e)
- **Extinction** is the termination of a species. Examples include dinosaurs, Tasmanian tiger, and dodo bird.
- **Pesticides** are a product that claims to kill, prevent, reduce, destroy, or repel an organism. Some chemicals can be poisonous. During rain events, pesticides and fertilizer wash into the Chesapeake Bay.
- **Monoculture** is the cultivation of a single crop in an area and can reduce ecological diversity. Such land use decisions increase the likelihood for pests or disease to destroy the crop.
- **Habitats** are the homes where species live. Through development and lack of protection, rainforests, wetlands, and other essential ecosystems are being lost; this is known as **habitat loss**.
- **Environmental stewardship** is the responsible use and protection of the natural environment.

Educational Guide

Timing depends on the student population. Some educators may integrate the activity across multiple class periods.

Part I. Background Context (15 Minutes)

Consider pre-teaching terminology and knowledge based on your grade level and student background knowledge. Educators may lead a field trip to a nearby park to discuss the topic of biodiversity and give hands-on opportunity to explore. Others may share and discuss someone such as Greta Thunberg who was *Time* Person of the Year in 2019 (Katzman 2020) and explains climate change issues. An experiment may showcase the effects of climate change (UCAR 2017) or students may read about climate change in the Chesapeake Bay (USGCRP 2023; NOAA 2021).

Key Terms

- **Weather** refers to the condition of the atmosphere at a specific time and place.
- **Climate** is the weather a specific region averaged over a long period of time, typically 30 years or more. The planet is warming because of heat-trapping gasses (NOAA 2023).
- **Climate variability** is the way aspects of climate (such as temperature and precipitation) differ from an average.
- A **watershed** is an area of land that channels rainfall, snowmelt, and runoff into a common body of water. The Chesapeake Bay watershed encompasses six states—New York, Pennsylvania, West Virginia, Maryland, Delaware, and Virginia—and the District of Columbia (Washington, DC).
- An **ecosystem** is a biological community where living and nonliving organisms interact with their physical environment. Ecosystems are connected.
- A **species** is a similar group of living organisms which can reproduce with one another in nature and produce offspring.

Part II. ASK (30 Minutes)

Teacher Background: Bees are crucial to the health of our planet (Whang 2021). With nearly 80% of U.S. crops dependent on honeybees, humans are also connected to this species. Our economies and our food rely on healthy ecosystems. In some places such as Utah, the honeybee is highly connected to the culture and appears on coins and government buildings (Utah Capital Preservation Board 2023).

Increasing heat waves play a significant role in ecological systems. For example, fish thrive in certain temperatures and plants grow well under particular environmental conditions. Increasing the local temperature plays a role in the health of species. Soroye, Newbold, and Kerr (2020) found that an increasing frequency of unusually hot days is increasing local extinction rates. As average temperatures continue to rise, pollinators like honeybees may not be able to adapt quickly enough to respond to the changing climate. Members of other ecosystems, from fish to mammals, must also cope with changing environmental conditions. Climate change influences the range, distribution, and geographic patterns of species. For some species, temperatures modify reproduction habits or migration routes. For other species, essential food sources may move to other, more favorable areas or go extinct. Reproduction may be influenced by local climate variability. Other factors such as salinity, precipitation patterns, pH, and climate variability are also important in biodiversity and species sensitivity (USGCRP 2023; NOAA 2019).

1. Invite learners to think about the following questions and accept all answers in discussion. Consider writing answers on a board or chart paper to be revisited and revised after the lesson:
 - What value do ecosystems provide?
 - How are we connected to different ecosystems?
 - Why do certain organisms live in certain places?
 - What do organisms do when their habitats change?
 - How can we protect ecosystems—both the species and the habitats?
 - Think locally. Draw on local experiences. Students are more likely to connect with local examples than ones far away.

- Show a clip or retell the lessons from *Bee Movie* (2007). Students can share background knowledge about what causes extinctions or how environmental change modifies habitat or a species population.

Part III. COLLECT and CREATE (30 Minutes)

- Individually or with a partner, students should select a species—plant or animal—found in the local environment and research how climate change is affecting it. Collecting data on how oysters, bristle worms, or the Delmarva fox squirrel is being impacted by climate change will connect the student with the local species. A student worksheet can be found in the Appendix. Teachers may provide resources such as NOAA (2019) or field guides to help students or visit the school library.
- Students may illustrate their species. Crayons or colored pencils may be used. This component may be taken home to complete.
- Use the rubric (Table 1) for evaluation.

Part IV. ACT and Share with Others (30 Minutes)

- In class, take the opportunity for students to share their new knowledge. Not all species will be impacted in the same way by a changing climate. Some birds may migrate up a hill to find more favorable conditions, while fish may move poleward. Other non-climate factors (e.g., monoculture, pesticides, habitat loss) are also important to consider. Parts of the world are connected, and recognizing the role environmental change has on ecosystems links with standards of learning and essential questions for young learners.
- Collective action refers to a group of people working together to achieve a common objective. How can we address the issue of climate change—individually and collectively, across place and scale?

Part V. Reflection and Debriefing (15–20 Minutes)

Potential questions to discuss in a small-group setting:

- What lessons did students learn?
- Why do biodiversity and climate change matter?

- What could you invent that would help your organism to continue life in the Chesapeake Bay watershed?
- How could you share what you have learned with the community?

Extension Option

Students may expand their knowledge by mapping different ecosystems and exploring the spatial patterns.

- Launch the National Geographic Society (2024) MapMaker (<https://www.nationalgeographic.org/society/education-resources/mapmaker-launch-guide>)
- Toggle to “Add Layer” and Type “Biomes” in the search bar.
- Zoom in on the Chesapeake Bay region and compare different ecosystems.
- Zoom in on another locations and compare these ecosystems with another place.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Notes on Contributors

Michele Sullivan incorporates aspects of the natural world into her lessons and emphasizes outdoor learning. For more than ten years, Michele has been a fifth-grade teacher with Fairfax County Public Schools. As an Eco Teams Leader for Mantua Elementary School, Michele works with students to plant trees on campus and install native, pollinator species in the bioretention facilities. Michele earned a Bachelor of Arts in Quantitative Economics from Stanford University and an MBA from the University of Virginia’s Darden School of Business.

Gretchen Maxwell is an Advanced Academic Resource Teacher in Fairfax County, Virginia. A career switcher, she wanted to implement change by encouraging and advocating for the students in her neighborhood Title 1 school, Westlawn Elementary. She is the daughter, sister, and mother of scientists and loves nothing more than using different pathways to expose students to new experiences outside. Gretchen earned her MS in gifted education from Arkansas State University.



Gabrielle Hurst is a K–6 Gifted Resource educator in the Virginia Beach City Public School System and Virginia Master Naturalist. These experiences help her incorporate citizen science activities into the classroom. For the last 15 years, her experience has included classroom instruction for third and fifth grade, sixth grade Advanced Life Science teacher, and a Gifted Resource

Table 1. Evaluation rubric.

| Points | 0 | 1 | 2 | 3 | 4 |
|----------------------|---|--|--|--|---|
| Organism Selection | Organism does not live in the Chesapeake Bay watershed. | | | | Organism lives in the Chesapeake Bay watershed. |
| Organism Information | No attempt to complete the task. | Answers are incomplete, are incorrect, and/or fail to demonstrate an understanding of the organism or its interactions within the Bay ecosystem. | Answers demonstrate minimal understanding of the organism and its interactions within the Bay ecosystem. | Answers demonstrate basic understanding of the organism but lack detailed information or evidence about the interactions within the Bay ecosystem. | Answers demonstrate an understanding of the organism and its interactions within the Bay ecosystem. |

teacher assisting grades K–5. She also oversees school garden projects and helps students learn about organic growing, composting, and sustainable acts. Gabrielle earned a BBA in accounting and an MS in Education from Old Dominion University.



Shelly Carter, an elementary school educator for more than 10 years, currently teaches preschool in Rockbridge County, Virginia. With a passion for social emotional learning and integrating students' well-being with all academic learning, she incorporates outdoor learning experiences into her curriculum. Shelly earned both a BBA and MAT from James Madison University.



Michael J. Allen, PhD, is an Assistant Professor of Climatology within the Department of Geography and Environmental Planning at Towson University. He previously served as co-coordinator of the Virginia Geographic Alliance and Geography Program Director at Old Dominion University. In addition to having interests in geographic literacy and climate education,

Dr. Allen explores the intersection of weather, climate, and human health. In 2023, he lived abroad as a U.S. Fulbright Scholar in Serbia.



Jamie Young is a National Geographic-Certified Educator and Geo-Inquiry Ambassador and has more than 20 years of teaching experience in public schools/college. She taught Earth Science for 19 years, and she exposed her students to experiential, place-based learning. She is presently a STEAM educator at Old Donation School in Virginia Beach, Virginia. She integrates climate issues into her coding and engineering design activities. An active member of the Virginia Geographic Alliance, Jamie has both a BS in Criminal Justice and Political Science and a master's degree in Education.

Lydia Belser is a Google-Certified Educator and National Science Foundation Robert Noyce Scholar. With more than 5 years of teaching experience in formal and informal K–12 education settings, Lydia works to further high-quality teaching in underserved areas. She most recently taught oceanography and environmental science at James River High School in Chesterfield County, Virginia. Lydia is a graduate of The College of William & Mary with a BS in biology and marine science and an MA in Education, with a specialization in curriculum and instruction in secondary science.



Anna Simon is presently a Geologist II at AECOM in Virginia Beach, Virginia. She previously was a science educator at Renaissance Academy in Virginia Beach, Virginia, for five years. As an alternative education teacher, Anna exposed her students to the community around them through local field trips and scientific inquiry. Anna earned a BS in Geology from Marshall

University and a master's degree in Oceanography from the University of Rhode Island.



Jennifer Whytlaw, PhD, GISP, is an Assistant Professor of Applied GIS in the Department of Political Science and Geography at Old Dominion University. Her research focuses on utilizing geospatial analyses and visualizations to understand how environmental hazard events influence personal understanding of vulnerabilities within communities.

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