



Washington  
Department of  
**FISH and  
WILDLIFE**

# The Diversity of Climate Change

## 9-12 grade

Themes: Biodiversity, Climate Change

### Location:

**Remote learning modification:** Lesson can be taught over Zoom or Google Classrooms.

The PowerPoint, brainstorming, and assessments can be done in the classroom with student computers. The field location may vary depending on what project(s) students choose.

### Standards:

#### NGSS

##### HS-LS2-7

Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

##### HS-LS4-6

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

#### WA OSPI

##### ESE Standard 1:

Students develop knowledge of the interconnections and interdependency of ecological, social, and economic systems. They demonstrate understanding of how the health of these systems determines the sustainability of natural and human communities at local, regional, national, tribal, and global levels.

##### SSS3.9-12.6

Assess options for individual and collective action to address local, regional, or global

### Materials:

WDFW PowerPoints, En-Roads Instruction Sheet, Species Vulnerability Assessment Sheet, WDFW ecosystem master, student Excel workbooks, WDFW species master, student Excel workbooks

### Modifications, Adaptations:

For COVID-19 distance learning, or other remote learning modification, look for **Remote learning modifications** throughout the lesson plan.

### Objectives:

Students will...

1. Define biodiversity and list the threats to biodiversity.
2. Explain why biodiversity is important to them, to their community, and globally.
3. Assess a species' and an ecosystem's vulnerability to climate change.
4. Create a model to reduce global climate change by 2 degrees Celsius.
5. Evaluate how greenhouse reduction can impact biological, cultural, and economic systems.

### Vocabulary:

**Biodiversity:** The full range of life in all its forms. This includes the habitats in which life occurs, the ways that species and habitats interact with each other, and the physical environment and the processes necessary for those interactions.

**Climate:** The average daily weather for an extended period of time.

**Ecosystem services:** Benefits people obtain from ecosystems and wildlife.

**Exposure:** The degree or frequency which a species experiences a changing climate related hazard.

**Generalist:** A species who has a widely varied diet and can live in various habitats.

**Phenology:** Cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life.

**Sensitivity:** A species' ability/inability to persist under changing climate conditions.

**Specialist:** A species who has a limited diet and lives in a specific habitat.

**Vulnerability:** The degree to which a species is susceptible to, and unable to cope with adverse impacts of climate change.

**Weather:** The short-term conditions of the atmosphere.

### Procedure:

*This lesson is designed to be taught over multiple class periods.*

#### 1. Introduction to climate change and biodiversity

Open the WDFW Biodiversity and Climate Change PowerPoint. Click the slideshow tab at the top and then from beginning. Once the slide show is open, right click and turn on presenter view.

**Remote learning modification:** Slideshow can be taught over Google Slides, Classroom or Zoom or you can have students review individually.

- Ask students if they know what biodiversity is. Have them pair with a partner and give them two minutes to come up with a one to two sentence definition of biodiversity. Share ideas as a class and go through slides one and two which introduce biodiversity.

**Remote learning modification:** Break students up into small groups in Zoom/Google classrooms break out rooms.

- Introduce biodiversity at the three different levels that scientists measure. Washington is a biodiverse state. We are rich in species and ecosystem diversity.

- But why is biodiversity important? Why should we care about some fly we've never heard of or a fox we'll never see? Watch the three-minute video on slide six and then have students brainstorm ways that biodiversity helps support humanity. Introduce the term ecosystem services here.

**Remote learning modification:** Break students up into small groups in Zoom/Google classrooms break out rooms.



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- Despite its importance, Earth's biodiversity faces many threats and scientists estimate we are in the Anthropocene, the sixth mass extinction (anthro meaning human-caused extinction). Climate change is one of these threats, and one of the most difficult to solve because the issues are so complex.
- Global warming is not a debate. It is well-documented that the climate is warming due to an increase of greenhouse gas emissions. Climate models show that were it not for greenhouse gas emissions, Earth's climate would be in a cooling phase at this time. The good news is that we can still slow down, and prevent species extinction if we act, now.
- Climate change is already making real impacts here in Washington. Salmon are struggling with warmer stream temperatures, algal blooms are causing toxicity, and fires have increased in severity and frequency.

At the end of the PowerPoint, you will introduce the students' project. Students will choose way in which they are impacted by biodiversity or the lack thereof. Students should choose a specific topic. For example, saying "I benefit from clean water" is an accurate topic, but does not identify how biodiversity benefits that student. In this example, students should find a specific plant/animal/bacterium in their region that helped provide clean water.

Students will come up with a five to 10-slide PowerPoint or interactive presentation that states:

- How a decline in/the preservation of biodiversity affects them.
- A brief (1-2 slide) introduction to the topic.
- Consideration of what they might do if this service/biodiversity were to disappear.
- How they can work with others in their community to restore/preserve this important service.
- The presentation should include:
  - o Visuals and/or audio supplements like pictures, video, artwork, graphs, Podcasts etc.
  - o References they used to answer these questions.

Students will present to the class using technical terms learned thus far for five minutes.

## 2. Assessing species vulnerability of climate change

Open up WDFW Managing for Climate Change PowerPoint. Click the slideshow tab at the top and then from beginning. Once the slide show is open, right click and turn on presenter view.

**Remote learning modification:** Slideshow can be taught over Google Slides, Classroom or Zoom or students can review individually.

- Review impacts of climate change on species and ecosystems.
- Go over graph where European pied flycatcher chicks are now being born later than the caterpillars they eat. Review the term phenology.
- Climate change is complex in that it creates both habitat loss (which itself can cause a loss of diversity) for species and exacerbates other threats that species face (for example, ocean acidification).

- Climate change has altered species migration patterns and some individuals/populations spend more time in their historical summer areas.
- How do natural resource managers address this complex phenomenon?
  - o Resistance, resilience, transition and re-evaluation.
- Managers assess vulnerability by looking at what species or ecosystems are most vulnerable, and why.
- Some natural history traits make some species more vulnerable than others. Generally, the more specialized the species, the more vulnerable they are to climate change.
- Scientists and managers use sensitivity and exposure to climate change to assess a species vulnerability.
- Examples of vulnerable species include: redband trout, Canada lynx, Cascade red fox. Species not vulnerable include the peregrine falcon, a generalist species (a species who can eat a variety of foods and survive in a variety of environments).

You will share the student sheets of the Department's vulnerability assessments for Washington's ecosystems and species. The master sheets are for you to evaluate the student's assessments. Master sheets have the official WDFW vulnerability designations on them. Review how to use or look through the Excel documents with the students in class or online. The documents provide a description of sensitive and exposure traits for each species/ecosystem and lists potential resources. Using this data and any necessary outside research, students will fill out a climate change vulnerability assessment of one species and one ecosystem. Encourage students to review the methodology, climate information and ES (ecosystem) description tabs at the bottom of the species document. These tabs will show students how WDFW scientists assess this data.

After students have completed the assessments have them share with a partner in class to compare and contrast results. **Remote learning modification:** Break students up into small groups in Zoom/Google classrooms break out rooms.

Questions could include:

- How did vulnerable species vary from non-vulnerable species?
- How did vulnerable ecosystems vary from non-vulnerable ecosystems?
- Was it easy to find information on the species or ecosystem?
- What things can people in Washington do to protect the vulnerable species/ecosystem?
- Pretend you are a natural resource manager conducting an assessment on a species you have little information about. However, based on what you have been able to find, you think the species might be vulnerable. How would you proceed with the conservation of this species? What factors would you want to consider?

## 3. How do we keep climate change at a minimum?

Keeping climate change to a minimum is imperative not only for biodiversity, but also cultural diversity. People who are most impacted by climate change are often those who rely on biodiversity for their livelihoods and well-being. Just as some species are more vulnerable to climate change, some populations of people are as well. Global climate change is not just a Washington, United States, or North American issue. It may arguably be the world's greatest threat to diversity in




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general. This means that to find a solution, we must first look locally and regionally, but also remember the big picture globally.

In the next and final activity of this unit, students will use a global climate change simulator to try and decide what steps need to be taken globally to mitigate impacts of climate change on global diversity. [Please see supplemental sheet from En-Roads for simulation and assignment instruction.](#) Students will run the simulator individually or in pairs until they get their desired results. They will then answer the questions. You can decide if you want students to share their results as a class, or not.

 **Idea:** Show off your students' work! Share student projects from this lesson with WDFW.  
Facebook: @WashingtonFishWildlife  
Instagram: @TheWDFW  
Twitter: @WDFW  
#WildWashington #WildWa

**Did you teach this lesson? [Give us your feedback.](#)**

## Supplemental Activities:

- [Interactive courses on species adaptation during climate change-World Wildlife Fund \(WWF\)](#)
- [Participatory exercises for adaptation training-WWF](#)
- [Climate modeling resources and activities-Climat.gov](#)
- [Science models and research tools-Environmental Protection Agency \(EPA\)](#)

## Additional Resources :

### Educational lessons

- [8 ways to teach climate change in any classroom-National Public Radio](#)
- [Climate education-Alliance for Climate Education](#)
- [Climate education curriculum-Stanford Earth](#)
- [Climate change and youth-Cornell Climate Smart Solutions Program](#)
- [Toolbox for teaching climate and energy-Climat.gov](#)
- [Global climate change: understanding the greenhouse effect lesson for 6-12-PBS.org](#)
- [Climate change: the effects of global warming lesson-PBS.org](#)
- [Climate lesson plans- NOAA](#)
- [Climate resources for educators-National Aeronautics and Space Administration \(NASA\)](#)
- [A student's guide to global climate change- \(EPA\)](#)
- [Climate change in my backyard lesson-Chicago Botanical Garden](#)
- [Years of Living Dangerously Educational Resources-National Wildlife Federation](#)
- [School Yard and Biodiversity Education Guide-Association of Fish and Wildlife Agencies](#)
- [EnviroAltas lessons and interactive maps-EPA](#)
- [Climate Change though GIS-National Geographic](#)

## More information:

*You can use the following resources to build onto this lesson, or share these resources with students.*

- [Climate Change Effects on Forest, Alpine, and Western Prairie Habitats in Washington State- WDFW](#)
- [Designing climate change resilient culverts and bridges-WDFW](#)
- [Incorporating climate change into the design of water crossing structures-WDFW](#)
- [Taking Stock of Washington's Riches-Washington Biodiversity Council](#)
- [Biodiversity Conservation Strategy-Washington Biodiversity Council](#)
- [Washington's Biodiversity: Status and Threats-Washington Biodiversity Council](#)
- [Climate change and the future of biodiversity in Washington-University of Washington \(UW\)](#)
- [Defining biodiversity- King County](#)
- [Economic benefits of biodiversity-Conservation Tools](#)
- [Biodiversity 101-Landscape News](#)
- [Why is biodiversity important-Conservation International](#)
- [Climate change and coastal adaptation tools-Association of State Wetland Managers](#)
- [Climate change modeling tools-Klamath Bird Observatory](#)

## Videos:

- [Why is biodiversity so important-TedEd](#)
- [Global Weirding- PBS/Katherine Hayhoe](#)
- [Pacific Northwest, Alaska and the Islands- Global Weirding](#)
- [12 videos that help us understand climate change-Project Learning Tree](#)
- [A way forward: Facing climate change-National Geographic](#)