



A northern cardinal perched on an American Holly.



Eastern Hemlock cones.

Evergreen West Virginia

GOAL

Students will develop an understanding of the distinguishing characteristics and ecosystem services provided by two important evergreen tree species in West Virginia. Students will evaluate the threats posed by human impacts on evergreen ecosystems, such as the introduction of HWA on hemlock populations, as well as efforts to conserve them.

Understandings

- Evergreen trees can be needle-leaved (“softwoods”) or broad-leaved trees (“hardwoods”).
- Evergreen trees provide essential ecosystem services year-round:
 - Food and shelter in the winter, particularly for birds
 - Water uptake and filtration
 - Carbon sinks
 - Windbreaks
 - Beauty!
- Invasive insects threaten hemlocks and contribute to reduced biodiversity and ecosystem services.
- Human impacts on wild evergreen survival are extensive and preventable.

Knowledge (K) and Skills (S)

K: Define evergreen vs deciduous.

K: Name two or more ecosystem services provided by the Eastern Hemlock (*Tsuga canadensis*) and the American Holly (*Ilex opaca*).

K: Explain what conditions each species requires to grow successfully.

S: Identify an Eastern Hemlock and an American Holly.

S: Identify the seed-bearing part of each tree. **seasonal*

S: Identify evidence of HWA (hemlock woolly adelgid). **seasonal*

1) **Background Exploration** -- 10 minutes +

21st century West Virginia is richly diverse in its types of forests. This diversity includes a mix of northern and southern tree species, and upland and lowland tree species.

We often like to think of trees in two categories:

Deciduous -- trees that lose their leaves during the colder months

Examples: oaks, maples, hickories, tulip poplar, birch, beech, baldcypress

Evergreen -- trees that hold onto their leaves year-round. Evergreens are *forever green!*

*Examples: conifers like pines, cedars spruce, fir, juniper, hemlocks
broad-leafed trees like magnolias, hemlocks, hollies*

(Conservation managers and arborists often separate trees into different categories that are important to their work, like *hardwoods* and *softwoods*.)

Some evergreen tree species, like pines, are among our most commercially valuable species for lumber, pulp and furniture. Evergreens are also important in ornamental and landscape plantings. For example, they make up the whole Christmas tree industry in WV. We celebrate evergreens for their unique beauty. They remind us of the abundance of life in our mountains all year long.

Evergreen trees are keystone species in some of these forests types, providing critical ecosystem services.

What is an [ecosystem service](#)?

Evergreens continue photosynthesis year round. Evergreens continue to convert atmospheric carbon dioxide into oxygen year round, managing climate change. They also continue to cycle water through our forests, filtering out impurities in the soil.

Evergreens provide wildlife habitat year round.

Food -- evergreens provide seeds and berries in the middle of winter, a lifeline for birds and mammals.

Water -- evergreens contribute to soil moisture year round.

Shelter -- evergreens provide shelter from precipitation and wind year round. Needle beds are soft bedding for mammals.

Space -- evergreens provide vertical and horizontal structure in the forest.

What do you think: does a standalone evergreen tree, or a Christmas tree farm, provide the same ecosystem services as a wild one in the forest?

Case Study: Hemlocks and Hollies

Review a profile of the [Eastern Hemlock](#) (*Tsuga canadensis*) and [American Holly](#) (*Ilex opaca*) -- aloud or individually. Compare and contrast -- think of their characteristics, ecosystem services, cultural uses, and potential threats to survival.

How are hemlocks and hollies alike?

- Both are evergreen throughout their range.
- Hemlocks and hollies are often found in the understory.
- Both hemlocks and hollies can grow in acidic soils.
- Both have limited commercial value today, but have important cultural use value -- in ornamental plantings, landscaping and traditional medicine.

How are they different?

- Hemlocks are needle-leaved. Hollies are broad-leaved.
 - Hemlocks produce seed-bearing cones. Hollies produce berries.
 - Hemlocks begin as an understory species, but can be dominant or codominant in certain forest types in WV. Hollies are always an understory species.
 - Hemlocks are threatened by a non-native invasive pest called hemlock woolly adelgid (HWA). American hollies are not currently threatened by a non-native pest.
 - Hemlocks are ancient! Some Eastern hemlocks are over 1000 years old.
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2) **Backyard Adventure: Evergreen Detectives!** -- 20 minutes +

Step 1. Break into small groups of evergreen detectives.

Step 2. Provide each group with two [“case file” activity pages](#) and a tree guide.

Review the information they will need to collect for each evergreen case file.

Step 3. Explain that each group will choose a different path within a defined area to locate two different evergreens.

You can make this into a *tree sneak* by asking participants to pretend they are a camouflaged animal trying to get to shelter in the winter woods. *Think short bursts of movement followed by a frozen silence!*

Step 4. Identify the evergreens using the tree guides provided.

Complete the activity pages. Emphasize using a variety of senses (minus taste), without damaging the trees or disturbing wildlife. Detectives are stealthy!

Step 5. Share back your case files with all participants.

How many different species of evergreen did you find? Which were the most common?

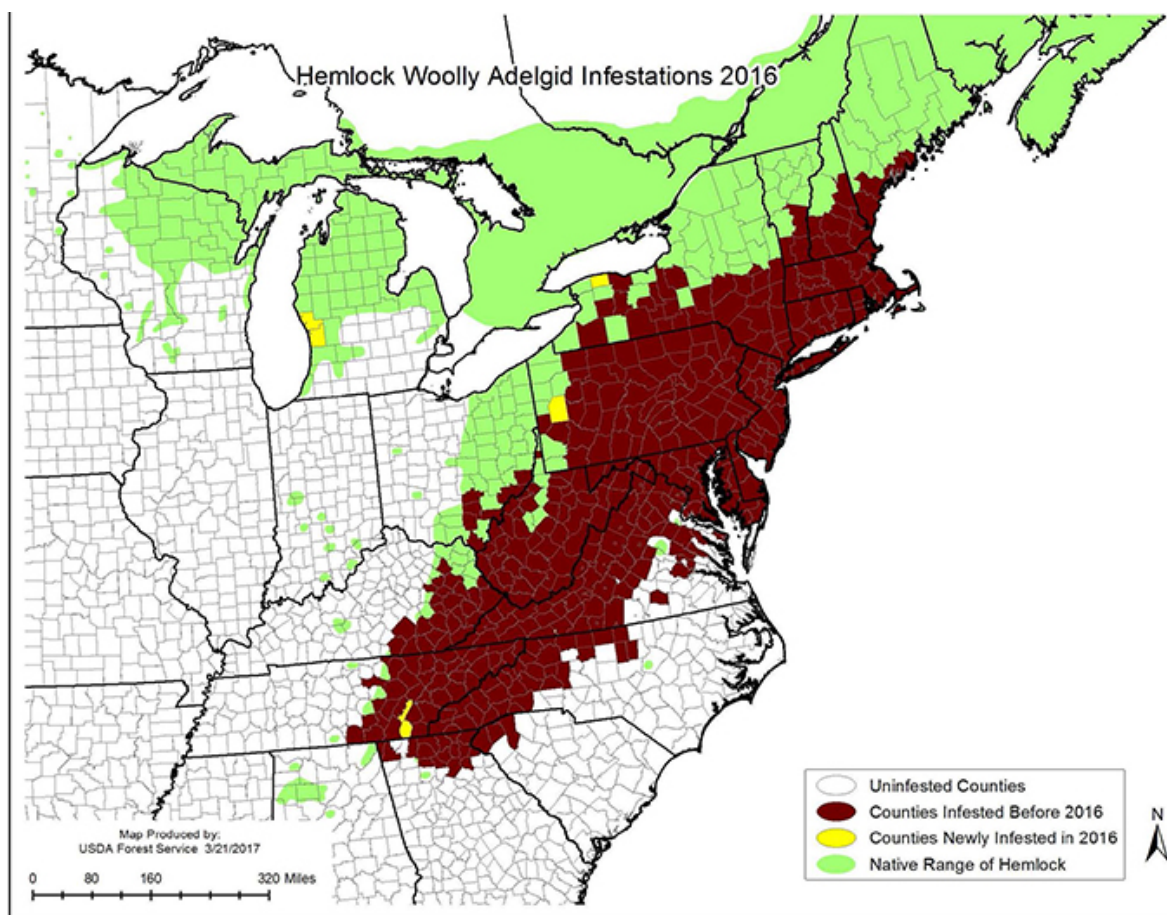
Step 6. Swap case files with another group. (optional)

Can you find one example of each species, using the case files alone (no guides)?

3) Stewardship in Action -- 10 minutes +

Threats to Hemlock Survival

Eastern hemlocks are currently under attack by an introduced sap-sucking insect called the hemlock woolly adelgid (*Adelges tsugae*), which is not native to Appalachia. Hemlock woolly adelgid (or HWA) has caused significant decline in hemlock crown health and tree mortality throughout most of its range. Without intervention, there is a very real possibility that Eastern Hemlocks could face extinction.



Efforts are underway to extend the lives of the remaining healthy hemlocks while conducting research on how best to reduce the impact of HWA on hemlocks.

- [Chemical control](#) -- to protect important stands or individual trees
- Cultural control -- selection and propagation of hardy individual trees
- [Biological controls](#)

What can you do to protect hemlocks in your life?

What can you do to prevent threats to evergreen survival?

More Activity Ideas

- **Develop [mnemonics](#)** to describe the ecosystem services of the Eastern Hemlock and American Holly.
- **Write [acrostic poems](#)** about each tree, describing their characteristics
- **Evergreen Inventory.** Survey a predefined area for all the evergreens present of a minimum size.
- **Conduct a bird count.** There are many [platforms](#) that can help with this, or you can use a [WV bird list](#) and field guide.
- **Make a [pinecone bird feeder](#).** Hang in a visible location, and keep track of who visits!



Additional Resources

[Intro to Evergreens](#) -- SciShow Kids intro video (5 minutes)

[Project Learning Tree: Educator Tips on Teaching Evergreens](#)

[National Park Service: Eastern Hemlock](#)

[WV Department of Natural Resources: Hemlock Forests](#)

Article: [Loss of Eastern Hemlock Will Affect Forest Water Use](#)

[OH Hemlock Conservation Plan](#)

Related WV Science CSOs

S.6.LS.2 Students will evaluate competing design solutions for maintaining biodiversity and ecosystem services.

S.6.LS.7 Students will construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

S.7.ESS.7 Students will apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

S.8.LS.2 Students will construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.