

# WE NEED YOUR HELP!

We are glad to provide these materials for free. In order for us to continue receiving funding for new materials, we need to collect information on how they are used.

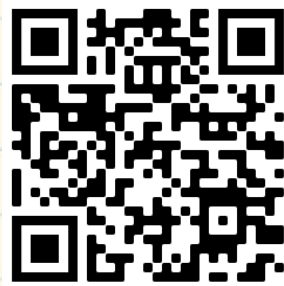
**Thank you for taking the time to answer the following one-minute survey.**



## There are three ways to complete the survey:

**1**

Scan this code with your smartphone camera



**2**

Type the following link into your web browser:  
<https://plantheroes.org/educator-survey>

**3**

Email your answers to:  
[plantheroes@publicgardens.org](mailto:plantheroes@publicgardens.org)



- 1) Job title
- 2) Name of organization you belong to
- 3) What kind of educator are you?
  - Teacher
  - Summer camp counselor
  - Home schooler
  - Public garden educator
  - Informal educator
  - Other (please describe)
- 4) What grade level do you teach?
  - Elementary (K-5)
  - Middle School (6-8)
  - High School (9-12)
  - Other (please describe)
- 5) Specify what subject area you teach:
  - Science
  - Math
  - Language Arts
  - Social Studies
  - Other (please describe)
- 6) How many students do you teach in a school year?



# Field Guide:

## White Pine Blister Rust

*White pine blister rust is a deadly disease that affects the branches and trunks of white pines. It causes extensive damage to pine forests in the United States and Canada.*



**Plant  
Protection  
Program**

AMERICAN PUBLIC GARDENS ASSOCIATION



Photo: USDA Forest Service, Bugwood.org



# WHITE PINE BLISTER RUST

## Signs and Symptoms

When white pine blister rust infects a branch, it can kill the phloem tissue (food transport cells) around the entire branch, causing the branch to die and leaving infected trees with brown, dying canopies. >>



Signs refer to the visible presence of a pest or disease. Symptoms are visible clues that a plant might be suffering from a specific pest or disease issue.

Close-up of the blisters caused by white pine blister rust (*Cronartium ribicola*) on a pine branch. These blisters break through the tree's bark when the fungus is ready to reproduce. The yellow parts in the blisters are the spores, which are the reproductive structures that carry information to make a new fungus.

Pine branches infected with white pine blister rust often become fatter, or swollen, where the fungus is causing damage. The "blisters" caused by this fungus can also be seen here.

A currant (*Ribes* spp.) leaf carrying the white pine blister rust fungus appears to be covered in rust! >>>



Close-up of the bottom side of a currant leaf infected with white pine blister rust. The hairlike orange structures in the picture release spores of the fungus, which can infect white pines.



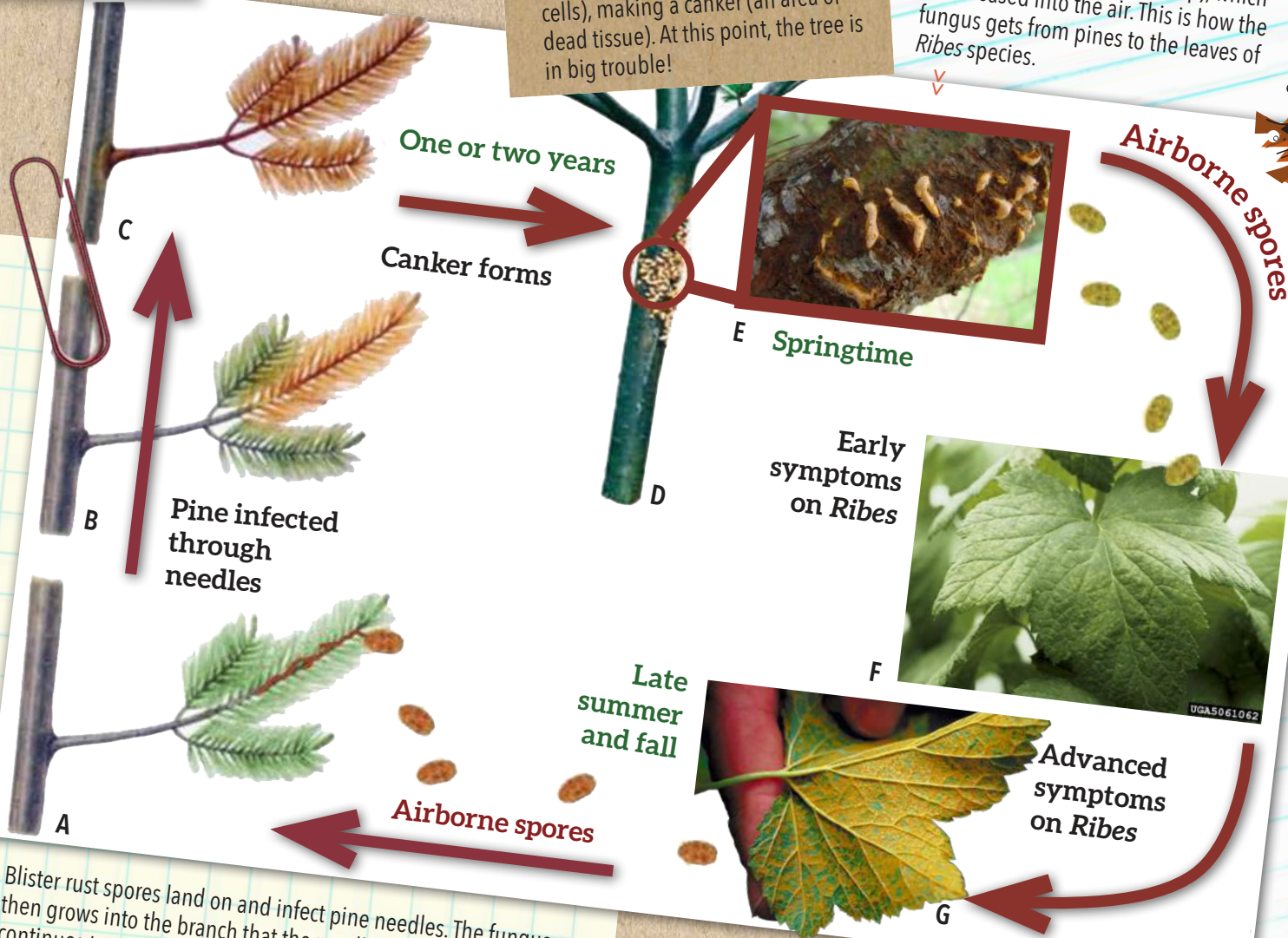


# WHITE PINE BLISTER RUST

## Life Cycle

When the fungus reaches the trunk, it kills the xylem (water transport cells) and phloem (food transport cells), making a canker (an area of dead tissue). At this point, the tree is in big trouble!

This is a white pine trunk infected with white pine blister rust. The white bumps on the trunk contain spores of the fungus (yellow dust in close-up), which are released into the air. This is how the fungus gets from pines to the leaves of *Ribes* species.



Blister rust spores land on and infect pine needles. The fungus then grows into the branch that the needles are attached to, and continues to grow down the branch and toward the trunk.

<< *C. ribicola* infects the leaves of *Ribes* in the spring, which doesn't really harm the plant. At first, the fungus makes yellow spots on the leaves.

<< In late summer, spores of the fungus are released from orange hairlike structures on the undersides of *Ribes* leaves, and float through the air until they land on a white pine!



# WHITE PINE BLISTER RUST

## Host Plants

Host plants are plants that white pine blister rust affects.

<< Cones, seeds, and leaves of the eastern white pine (*Pinus strobus*), the only species of pine in the eastern U.S. that suffers from white pine blister rust. These trees can easily be identified because they hold their needles in groups of five. Other pines, such as the Virginia pine, have different numbers of needles per bundle.

Western white pines (*Pinus monticola*) are majestic trees that were once very important for timber. Almost 90% of them outside of California have been killed by white pine blister rust. >>

<< Close-up of the cones and short needles of *Pinus flexilis*. The common name is "limber pine" because the branches are so flexible that they can be tied in knots! Unfortunately, this tree is very susceptible to white pine blister rust.



B



C UGA1169003





# WHITE PINE BLISTER RUST

## Host Plants 2

White pine blister rust requires two hosts to complete its reproductive cycle. Read below to learn more.



A

Leaves and fruit of a gooseberry currant, an alternate host of white pine blister rust. The fungus requires this plant or another alternate host to complete its life cycle, but on *Ribes* it only infects the leaves, which does not harm the plant very much.



Indian paintbrush (*Castilleja* sp), a small flowering plant native to the U.S., was recently discovered to be an alternate host for the white pine blister rust fungus! >>



D 5504540



B UGA1208042

Gooseberry currants (*Ribes montigenum*), alternate hosts of white pine blister rust, are small to medium shrubs with red or purplish fruit.



C UGA1353086

They might look pretty, but louseworts (*Pedicularis* spp.) were recently discovered to be alternate hosts for the white pine blister rust fungus!

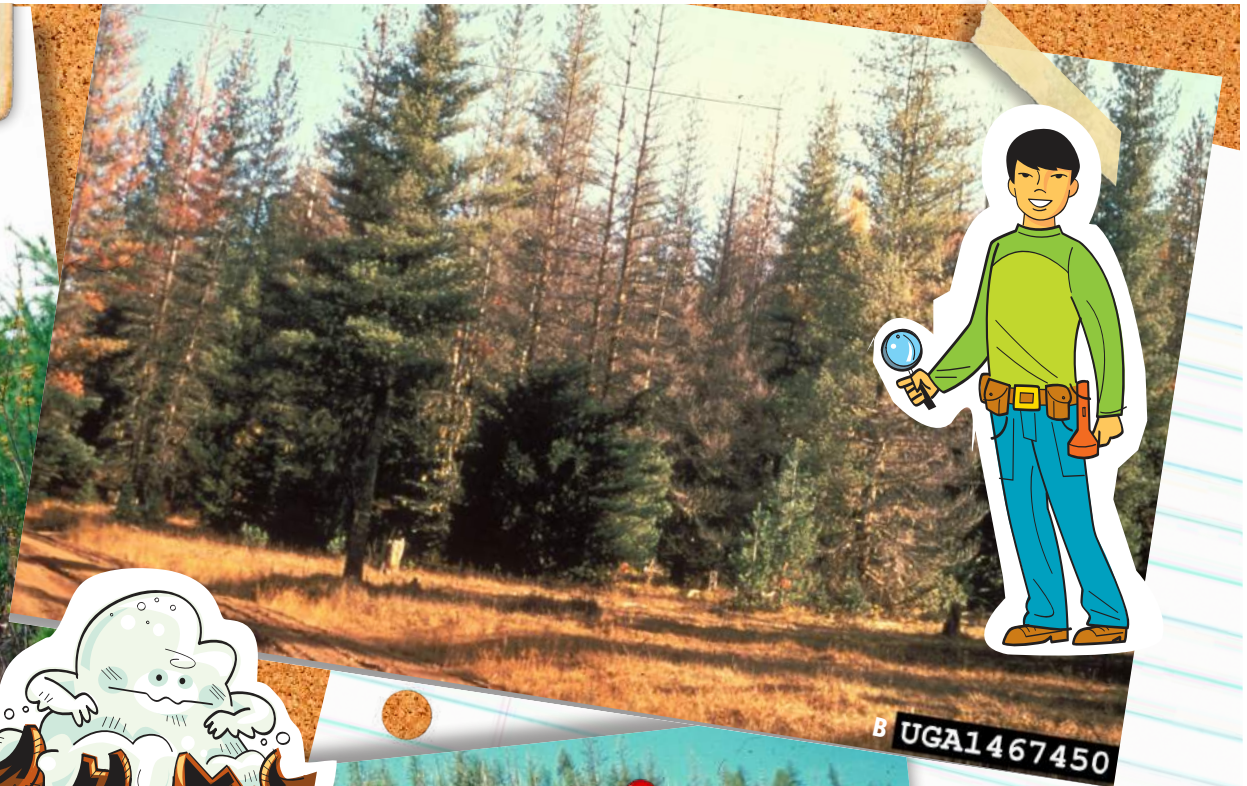


# WHITE PINE BLISTER RUST

## Damage



An eastern white pine (*Pinus strobus*) infected with white pine blister rust. Dead or yellowing tops are common on infected trees because the pathogen can cut off water and nutrients to the portion of the tree above the infection site.



B UGA1467450



C UGA1467412

^ Many of these pines have been killed by white pine blister rust. The reddish-brown, dead needles caused by this disease can be seen here.

<< White pine blister rust has killed most of the pines on this hillside.



# WHITE PINE BLISTER RUST

## Impact



⚠ Whitebark pine (*Pinus albicaulis*) is a very important species in the high mountains of the Western U.S. It may not be very abundant, but many animals and plants depend on it for survival. This species is highly threatened by white pine blister rust and the mountain pine beetle.



Pine trees are very important parts of their ecosystems. They provide food for many different animals, including red squirrels like this one.

This is a Clark's nutcracker (*Nucifraga columbiana*). They depend on seeds from the whitebark pine to survive, and bury large seed stashes in the ground! The pines depend on this special bird to plant their seeds so new trees can grow. Both whitebark pine trees and Clark's nutcrackers are in danger because of white pine blister rust! ⚠



⚠ In the high mountains of the Western U.S., nutritious pine seeds are a very important food for grizzly bears. If white pine blister rust kills all the pine trees, what will the grizzlies eat?!







Join our team of Plant Heroes and learn about trees, forests, and the natural world around you!

**PLANTHEROES.ORG**

**You can be a Plant Hero!**

Are you curious about plants and animals? Do you like asking questions about nature? Do you enjoy being outdoors and having fun, climbing trees, balancing on logs, or finding a new butterfly or beetle? If so, you are already on your way to becoming a Plant Hero! We invite you to join forces with Nate, Laura, Aponi, and Frankie to protect the plants and ecosystems we all love.

**How can you become a Plant Hero?**

Join our team and go on a journey with Nate, Aponi, Laura, and Frankie. As a Plant Hero, you will learn to notice when plants are in trouble. You will also find out ways you can act quickly to help find solutions in your own neighborhood. Follow their adventures and learn how they help plants and ecosystems stay healthy.

**On the Plant Heroes website, you will find** materials to help you learn about plants, forest health, and ecosystem balance. The more you know, the more you can help protect plants and ecosystems in your own yard, neighborhood, and community!

**Plant Heroes strives to spark curiosity about nature and science in all children.**

Our program provides hands-on, nature-based learning materials for educators to engage children in topics of plant health, ecosystem balance, and forest health. We also spotlight the amazing work our public gardens do in protecting the plants and ecosystems we all depend on through our website and printed materials. Visit [plantheroes.org](http://plantheroes.org) today to learn more!

**Plant Heroes is brought to you by the American Public Gardens Association, founded in 1940.**

Over the last eight decades, the Association has supported the work of public gardens in North America and beyond. Our mission is to champion and advance public gardens as leaders, advocates, and innovators in the conservation and appreciation of plants. Our vision is "A world where public gardens are indispensable" as they provide botanic, conservation, community, education, and economic resources to their community.

The Association is committed to increasing the knowledge of public garden professionals throughout North America through information sharing, professional development, networking, public awareness, and research, so that they have the tools to effectively serve visitors and members.



**American  
Public Gardens  
Association**

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This publication was developed with financial support from the US Forest Service and the USDA Animal and Plant Health Inspection Service.

