Purpose of this Guide

- To help teachers guide their PreK-2 students through the Vanishing Acts exhibit.

How to Use This Guide

- In this guide you will find lesson plans, worksheets, and activities specifically designed to help younger students understand and appreciate the Vanishing Acts exhibit.
- Below is a list of the activities for students in PreK-2nd grade.
- Next to the title of the activity is a recommendation for when this activity might be most beneficial for students in relation to their visit to the Vanishing Acts exhibit.

Included In This Guide

- Tree-natomy Lesson Plan          Pre-visit
- Ideas for Related Activities     Pre- or Post-visit
- Leaf Shapes Handout              Pre-visit
- Tree Labeling Handout            Pre-visit
- Large Print Tree Part Labels     Pre-visit
- Tree Part Matching Handout       Pre-visit
- Word Search                      Pre- or Post-visit
- Trees are Important Handout      Post-visit

National Science Content Standards Addressed

- Science as Inquiry: Abilities necessary to do scientific inquiry
- Life Science: Characteristics of organisms

Time

Two 30 minute class periods
Lesson Plan Summary
Before you visit the Vanishing Acts exhibit, discuss tree anatomy and leaf shapes with your students. In the first part of this lesson, students will learn about different tree parts and their functions. In the second part of this lesson, students will learn about different leaf shapes.

Key Messages
• Trees have many parts and all the parts are very important to the tree.
• Leaves can be sorted and organized in many ways based on their features. Scientists sort trees into categories, sometimes based on their leaves.
• Trees are very important to people for many reasons.

Guided Inquiry Questions
Use these questions to guide inquiry before and during the lesson:
• What is the purpose of each different part of a tree?
• Why are trees important to humans and other animals?
• How are tree leaves sorted and organized?
TREE-NATOMY LESSON PLAN

PART ONE: TREE ANATOMY (:30 MINUTES)

Supplies Needed
- Based on a classroom of 20 students: 20 copies of the tree labeling handouts
- crayons/markers
- five pieces of brown yarn cut into 15 inch pieces (roots)
- brown paper bags or construction paper cut into five 5x5 inch squares (trunk pieces)
- five 5x5 inch leaf shapes cut out of green construction paper (leaves)
- brown paper bags or construction paper cut into five 10x2 inch shapes (branches)
- one copy of the “large print tree part labels:” leaf, root, trunk, branch, crown (print and cut at dotted lines)

Step 1: Discuss the different parts of a tree.
Students should label basic tree parts on their Tree Labeling handouts... roots, trunk, branches, leaves and crown. Explain the function of the different parts of the tree.

<table>
<thead>
<tr>
<th></th>
<th>Explanation of function for grades PreK-K</th>
<th>Explanation of function for grades 1-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roots</td>
<td>• Gathers water and nutrients from the soil</td>
<td>• Gathers water and nutrients from the soil</td>
</tr>
<tr>
<td></td>
<td>• Holds the tree in place, gives it support</td>
<td>• Holds the tree in place, gives it support</td>
</tr>
<tr>
<td>Trunk</td>
<td>• Holds the tree strong and tall</td>
<td>• Holds the tree strong and tall</td>
</tr>
<tr>
<td></td>
<td>• Moves food and water around in the tree</td>
<td>• Moves food and water around the tree – the xylem moves the water and the phloem moves the food</td>
</tr>
<tr>
<td>Branches</td>
<td>• Holds the leaves out so leaves can gather sunlight</td>
<td>• Holds the leaves out so the leaves can gather sunlight</td>
</tr>
</tbody>
</table>
### Trails

#### Explanation of function for grades PreK-K
- **Leaves:** Gather sunlight and air to make the food.
- **Crown:** Branches and leaves together make up the top of the tree.

#### Explanation of function for grades 1-2
- **Leaves:** Gather sunlight and air (carbon dioxide) to make the food using photosynthesis. The leaves need the nutrients from the soil and the water gathered by the roots (moved up the tree by the trunk) combined with the sunlight they gather to perform photosynthesis.
- **Crown:** Branches and leaves together make up the top of the tree.

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**Step 2: Tree Parts Activity**

- Provide each student with one of the “tree parts” listed above (cut brown paper bags, yarn, leaf shapes.) The students are going to build their own tree. Ask the students what part should come first.
- Based on the students’ decision (usually the trunk or the roots) begin building a tree on a bulletin board or a chalk/white board. Have the students bring up their tree parts one at a time to build the tree. Based on where you are building your tree, you will need something to attach the tree parts (you can use a stapler, magnets, tape, etc.)
- Have students also attach the “large print tree part labels.” (For 1st and 2nd grade, consider having the students write on their tree parts the appropriate name or function: “trunk” or “holds the tree strong and tall” on the brown squares, “leaf” or “makes the food” on the leaf shape, etc. For roots, you will need to attach a small piece of paper.)
- When you visit the Vanishing Acts exhibit, have students locate different tree parts. Some of the trees are very unique in their appearance!
PART TWO: LEAF SHAPES (:30 MINUTES)

Supplies Needed

- Based on a classroom of 20 students: 10 sets of leaf shapes.
- If possible, gather leaves from trees in your local area. You will need 10 of each type of leaf you gather. If you want to save the leaves to use multiple times, try drying them for a few days (pressed between books on newspaper) and then laminate them. Laminated leaves are great for leaf rubbings! Try to gather a variety of leaves, including evergreen and deciduous.
- If gathering leaves is not possible, print ten copies of the “leaf shape page” and cut the leaves apart on the dotted lines.
- Have students complete this activity in groups of two.

Step 1: Preparing to Sort

- Ask students how tree leaves might be sorted and organized.
- Explain to students that scientists who study trees group them according to different features. Trees that have something in common are grouped together. For example, fir trees all have needle shaped leaves that are flat, while pine trees have needle shaped leaves that grow in little bunches. They may look similar from a distance, but when you look close the leaves tell you something important about the tree.
- Explain that evergreen leaves stay on the tree all year long and deciduous leaves fall off the tree every autumn. Have the students hold up an example of an evergreen leaf. Then have the students each hold up a deciduous leaf. Ask a few of the students how they knew the answer to that question (some possible answers are: this looks like the leaves we rake up in the autumn, or we have a tree that looks like this and it keeps its leaves all year).

Step 2: Leaf Sorting Activity

- Have the students look at the 10 leaf shapes they have on their table. Have the students sort them into two piles: evergreen and deciduous. Easy, right? Now let’s try some harder sorts.
- Have the students look at the 10 leaf shapes and sort them by color. If this activity is done in the fall, you might have some great colors to sort. If this activity is done in the spring, have the students sort by shades of green, not all greens are the same!
• Have the students look at the 10 leaf shapes as a whole group again. This time, have them sort the leaves by size. This can get more complicated if you have compound leaves, such as leaves from a black walnut or an Ohio buckeye. The leaf in this case is actually made up of several leaflets on a stalk, whereas simple leaves have only one leaf. For example, the leaflets on a black locust may look small, but its compound leaf, made up of many leaflets, will usually be larger than the simple leaf from a maple tree. However, not all compound leaves are larger than simple leaves.
• Ask the students to look at their leaves again. With their partner, they should choose another way to sort the leaves. This will require the students to examine other similarities and differences in the tree leaves. As long as they can explain their “sort,” there are no wrong answers to this!
• When you visit the Vanishing Acts exhibit, ask students to look closely at the leaf shapes.

Simple Leaf:
Maple

Compound Leaf:
Walnut
IDEAS FOR RELATED ACTIVITIES:

• Have each student do a leaf rubbing and add it to your bulletin board tree from part one of this lesson.

• Take students on a leaf walk. Each student should carry a “specimen bag” and gather their own leaves for part two of this lesson. Encourage students to select a variety of different types of leaves.

• Although not a tree, celery can easily show students how water and sap are moved up a tree “trunk.” Place a celery stalk in a clear plastic cup. Place water with red food coloring in the bottom of the cup. The students will be able to see the red “sap” travel through the celery’s “trunk” to the leaves.

• Have students adopt a tree in the school yard. Once a week, take a field trip to the tree. Make observations about the tree each time you visit – what animals do you see on the tree?; what do the leaves look like?; how has the tree changed since last week? Keep all of these observations in a journal or on a bulletin board so the students can see the changes over the course of the school year.
LEAF SHAPES
TREE LABELING

Name: __________________________________

Directions: Write the correct name for the part of the tree inside the arrow or box pointing to it. Label the following parts of the tree: roots, trunk, branch, leaf, crown.
Trunk
Root
Crown
TREE PART MATCHING ACTIVITY

Name: ________________________________

Directions: Draw an arrow from the word to the correct tree part picture. 
*Note: All the pictures are from trees in the Vanishing Acts exhibit!*

- **BARK**
- **SEED/CONE**
- **ROOT**
- **BRANCH**
- **TRUNK**
- **LEAF**
- **NEEDLES**
WORD SEARCH

Name: __________________________________

Directions: Find and circle the vocabulary words in the word search.

- Root – the underground part of a plant that absorbs water and nutrients from the soil and holds the plant in place
- Trunk – the main stem of a tree that supports the crown (tree top)
- Branch – a woody stem that grows from the trunk or main stem of a tree
- Leaf – the (usually) flat and green outgrowth of a plant stem
- Seed – the part of a plant that, under the right conditions, may grow into a new plant
TREES ARE IMPORTANT

Name: ____________________________

Directions: Think about what you saw at the Vanishing Acts exhibit. Write why you think trees are important on the branches of the Monkey Puzzle tree below.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

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________________________________________________________________________
Purpose of this Guide
• To help teachers guide their grade 3 - 5 students through the Vanishing Acts exhibit.

How to Use This Guide
• In this guide you will find lesson plans, worksheets, activities, and guided exhibit viewing questions specifically designed to help upper elementary students understand and appreciate the Vanishing Acts exhibit.
• Below is a list of the activities for students in 3rd – 5th grades.
• Next to the title of the activity is a recommendation for when this activity might be most beneficial for your students in relation to their visit to the Vanishing Acts exhibit.

Included In This Guide
• Tree-mendous Trees Lesson Plan Pre-visit
• Ideas for Related Activities Pre- or Post-visit
• Scavenger Hunt List Pre-visit
• Guided Exhibit Viewing Questions During visit
• Vanishing Acts Discussion Questions Post-visit
• Anagram Handout Post-visit
• Crossword Puzzle Post-visit
• Anagram and Crossword Answer Page Post-visit

National Science Content Standards Addressed
• Life Science (K-4): Organisms and environments
• Science in Personal and Social Perspectives (K-4): Types of resources
• Life Science (5-8): Populations and ecosystems
• Science in Personal and Social Perspectives (5-8): Populations, resources, and environments

Time
• One 45 minute pre-visit class period
• One 15-20 minute post-visit class period
Lesson Plan Summary

Before you visit the Vanishing Acts exhibit, discuss the many different purposes of trees. Through this scavenger hunt and discussion, begin to discuss the issues related to tree conservation. There are follow up questions to address with the students after they visit the exhibit. Through these lessons, help students understand that trees are tree-mendous!

Key Messages

• Many every-day objects come from trees.
• Humans depend on trees. Trees depend on humans.

Guided Inquiry Questions:

Use these questions to guide inquiry before and during the lesson:
• Why are trees important to humans?
• Why are trees important in the environment?
• What can humans do to help trees?
TREE-MENDOUS TREES LESSON PLAN

PART ONE: TREE PRODUCTS (:45 MINUTES)

Supplied Needed

- Scavenger Hunt List (copies for students)
- Items from student homework (Scavenger Hunt List)
- Vanishing Acts Discussion Questions (copies for students)

Step 1: Pre-Activity Homework

Distribute scavenger hunt lists to students (see “Scavenger Hunt List”) a few days before you plan to complete this activity. You can either have the students find all the items on the list, or divide the list up into sections and have students find just a few of the items. Some items may be challenging to bring into the classroom. Have students bring pictures clipped from magazines or from the Internet.

Step 2: Sorting Activity

Have students work in pairs or small groups to discuss their items. Give the students 5-10 minutes to divide their items into two categories – items that are tree products and items that are not tree products.

Step 3: Tree Products

Step two was a bit of a trick…all of the items on the scavenger hunt list are tree products! To understand the whole process, we are going to break our items into categories.

1. Have the students divide out WOOD PRODUCTS.
   a. Wood products are easy to see…trees are cut, sometimes treated with chemicals to keep them from decomposing, and then products are made.
   b. Items in this category would be hammer handles, pencils, etc.
   c. What other products can the students think of that are made from wood? (The list is endless, but in a classroom you might see doors, tables, desks, etc.)
   d. Explain to students that wood is made of tiny fibers called cellulose and a natural glue that holds them together, called lignin. We will be exploring the uses of cellulose and lignin in just a few minutes!
e. In the Vanishing Acts exhibit, the *Pau brasil* and *Swietenia macrophylla* (Big-Leaf Mahogany) are described as providing important wood products. Have students explore the importance of these trees when they visit the exhibit.

2. Have the students divide out FOOD PRODUCTS.
   f. This can be very easy at a glance…but can get more complicated as you look closely. Almonds, fruit from trees, and vanilla extract (made from the vanilla bean) from are clearly from trees. Maple syrup is boiled sap from sugar maple trees…but chewing gum is made from the sap of trees as well!
   g. What other food products can the students think of that are from trees?
   h. In the Vanishing Acts exhibit, there is a section on the *Malus sieversii* (Wild apple). Encourage students to explore this section in-depth when they visit the exhibit.

3. Have the students divide out BARK PRODUCTS.
   i. Some bark products are very obvious, like cork bulletin boards. Cork is the outer layer of bark on a tree. The Cork oak is the primary source of most cork products sold around the world due to its large layer of cork.
   j. Many different types of bark are made into medicines. Bark from the *Taxus brevifolia* (Pacific Yew) is made into the cancer treatment medication Taxol (this is explained in the Vanishing Acts exhibit). Other medicines have also been made from the bark of trees, such as Quinine, derived from the bark of the cinchona tree to treat malaria before synthetic varieties were created. (Other parts of trees, such as roots, leaves and wood, have also been used as medicines.)
   k. In the Vanishing Acts exhibit, the section about the *Magnolia officinalis* and *Prunus africana* (Pygeum) explains how they are used as medicine. Have students pay attention to the explanation on this part of the exhibit.

4. Have the students divide out PAPER PRODUCTS made from CELLULOSE.
   l. Cellulose is a compound in plants that gives plants support. It is the main compound in wood. Paper mills use cellulose from different sources, including recycled paper, wood chips, and sawdust from wood mills. Wood chips and other sources of cellulose are “cooked” with chemicals to create a thick pulp. The pulp is then washed and filtered. Clean pulp is divided out and pressed onto screens where the water drains off. Different chemical processes and flattening methods are used to refine the pulp into different paper products, such as coffee filters, computer paper, and cardboard.
   m. Items in this category would be paper towels, notebooks, toilet paper, wrapping paper, etc.
n. What other paper products can the students think of that are made from cellulose?

5. Have the students divide out other CELLULOSE PRODUCTS.
   o. Paper products made from cellulose are, like wood, fairly easy to see. But cellulose is used to make a wide variety of different products. It can be mixed with different chemicals to make fibers for carpets and wigs, and rayon for clothes and furniture! It is used to make cellophane, shatterproof glass, plastic for eyeglasses, thickeners for shampoo and toothpaste, and sausage casings.
   p. Items in this category would include anything not in the categories above, such as camera film, suntan lotion, crayons and sponges, toilet seats, tool handles not made of wood, etc.

Step 4: Vanishing Acts Exhibit Visit
Visit the exhibit. There are guided questions to help students view the exhibit. Some of these questions will relate to the activity they completed in step three. However, pointing out different parts of the exhibit listed in step three while they are visiting the exhibit will help them with the discussion questions in step five.

PART TWO: POST VISIT DISCUSSION (:20 MINUTES)
Distribute copies of the “Vanishing Acts Discussion Questions.” For younger learners, discuss each question before asking students to write their answers. For older learners, have students write their answers and then have a discussion about each question.

IDEAS FOR RELATED ACTIVITIES
- Have students draw and label the different parts of a tree cross section. Be sure to include inner bark, outer bark, cambium, heartwood, and sapwood.
- Students can do research about local endangered plants and animals. Most states have a department of natural resources or department of conservation which will have this information on their website. This is a great, simple research activity for beginning Internet research projects!
- Turn the discussion questions from the post-visit discussion into an essay project. Each student can write an essay based on one of the discussion questions.
SCAVENGER HUNT LIST

Look around your house and find as many of the following items as you can. Put these items in a paper bag and bring them all in to school. As you gather your items, try to determine if they come from trees.

* Some items may be very hard to find or too large to fit into a bag. For those items, find a picture from a magazine or the Internet and put the picture in your bag.

- Paper towels
- ALMONDS
- RUBBER BAND
- PENCIL
- NEWSPAPER
- BASEBALL BAT
- CHEWING GUM
- SUNTAN LOTION
- SHAMPOO
- NOTEBOOK PAPER
- BOOK
- CORK BULLETIN BOARD *
- MAPLE SYRUP
- CRAYON
- RAYON CLOTHES
- CARPET
- Toilet paper
- WRAPPING PAPER
- CHOP STICKS
- VANILLA EXTRACT
- Taxol (anticancer drug)*
- Linoleum*
- Electrical tape
- Popsicle stick
- Sponge (synthetic)
- Plywood
- Tools or tool handles
- Kitchen cabinets*
- Car or bike tire*
- Camera film
- Toothpaste
- Fruit
GUIDED EXHIBIT VIEWING QUESTIONS

Name: __________________________________

Below are questions to answer while you are viewing the Vanishing Acts exhibit.

1. What are three reasons we should value threatened and endangered trees?
   a. _______________________
   b. _______________________
   c. _______________________

2. How many known tree species are threatened with extinction? ___________________

3. What tree has been used to create a medicine that helps treat cancer? _________________

4. What is the name of the oldest living thing on earth? What type of tree is it?
   _______________________________________________________________________

5. List three threats that can endanger trees.
   a. _______________________
   b. _______________________
   c. _______________________

6. Why are Fraser Fir trees, the most popular species of Christmas tree, threatened?
   _______________________________________________________________________

7. Why do scientists think that the Monkey Puzzle tree evolved to have spiny, scale-like leaves?
   _______________________________________________________________________

8. Which tree is used to make top quality violin, viola, and cello bows? _______________
9. What are two things you can do to help trees?
   a. ___________________________  b. ___________________________

10. What is the coolest new information you learned from this exhibit?
    ___________________________________________________________________

VANISHING ACTS DISCUSSION QUESTIONS

Name: ________________________________________________________________

1. Why are trees important to people?
   ___________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________

2. Why are trees important in the environment?
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________

3. How would our lives be different if we didn’t have trees?
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
4. What can people do to help trees?

______________________________________________________________

______________________________________________________________

______________________________________________________________
ANAGRAMS

Name: __________________________________

Unscramble the words below. Use the list of words at the bottom of the page to help. Write the letters in the grey boxes in the space provided to find out the secret message.

1. knoemy zlzupe __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
2. ntlsibrcoe nepi __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
3. upa slabri __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
4. texnitc __ __ __ __ __ __ __ __ __ __ __ __
5. degenerdna __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
6. ndwa woddoer __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
7. gbi flea hgaanmyo __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
8. tdthreeean __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
9. nesihce loangami __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
10. fapicic wye __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

Secret Message: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

Words to Use:
Dawn Redwood Pau Brasil Bristlecone Pine
Monkey Puzzle Big Leaf Mahogany Chinese Magnolia
Wollemi Pine Endangered Anhui Elm
Pacific Yew Fraser Fir Extinct
Pygeum Threatened
CROSSWORD PUZZLE

Name: _______________________________

Directions: Use the clues below to answer the crossword puzzle. Think carefully about what you saw at the Vanishing Acts exhibit...all the answers were there!
CROSSWORD PUZZLE CLUES

Across:

1. One way you can help trees is, instead of throwing out paper, ____________ it.
2. This tree is sometimes called the “Cadillac of Christmas trees” and grows in the southern Appalachian Mountains. It is used as the White House Christmas tree more often than any other species.
3. This bizarre looking tree is unlike most conifers because it will grow south of the equator…but don’t be fooled by the name, monkeys don’t live near this tree.
4. Another way to help trees is to use less gas. Instead of riding in the car every day to school you could ride your ____________.
5. ____________ means that a tree’s population is declining and is vulnerable to extinction.

Down:

1. ____________ means that the tree will soon be extinct if nothing is done.
2. ____________ means that the tree has completely died out and there aren’t any left of this species.
3. This type of pine tree grows in the western United States and is the oldest living thing on Earth.
Anagram Answers:
1. Monkey Puzzle
2. Bristlecone Pine
3. Pau Brasil
4. Extinct
5. Endangered
6. Dawn Redwood
7. Big Leaf Mahogany
8. Threatened
9. Chinese Magnolia
10. Pacific Yew
Secret Message: You Can Help

Crossword Answers:

Across:
1. Recycle
2. Fraserfir
3. Monkeypuzzle
4. Bike
5. Threatened

Down:
1. Endangered
2. Extinct
3. Bristlecone
Purpose of this Guide
• To help teachers guide their Grade 6 - 8 students through the Vanishing Acts exhibit.

How to Use This Guide
• In this guide you will find lesson plans, activities, and guided exhibit viewing questions specifically designed to help middle school students understand and appreciate the Vanishing Acts exhibit.
• Below is a list of the activities for students in 6th – 8th grades.
• Next to the title of the activity is a recommendation for when this activity might be most beneficial for your students in relation to their visit to the Vanishing Acts exhibit.

Included In This Guide
• Nature in Your Backyard Lesson Plan  Pre- or Post-visit
• Ideas for Related Activities  Pre- or Post-visit
• Research Activity  Pre- or Post-visit
• Guided Exhibit Viewing Questions  During visit
• Recycling Counts  Pre- or Post-visit
• Tree Haiku  Post-visit

National Science Content Standards Addressed
• Science Inquiry: Abilities necessary to do scientific inquiry
• Life Science: Structure and function in living systems
• Life Science: Populations and ecosystems
• Life Science: Diversity and adaptations of organisms
• Science in Personal and Social Perspectives: Populations, resources, and environments

Time
One 45 minute class period
Lesson Plan Summary
Before or after you visit the Vanishing Acts exhibit, explore endangered trees and plants in your local area. This Internet based research activity is a great way to help students explore the many valuable resources available on-line for different local, national, and international conservation efforts.

Key Messages
• Plants and animals are threatened/endangered for a variety of reasons.
• Many threatened/endangered plants and animals are very important.
• Conservation efforts can help threatened/endangered plants and animals.

Guided Inquiry Questions
Use these questions to guide inquiry before and during the lesson:
• Why is it important to help threatened and endangered species?
• Why are trees important in the environment?
NATURE IN YOUR BACKYARD
LESSON PLAN

ACTIVITY: RESEARCHING LOCAL THREATENED AND ENDANGERED PLANTS AND ANIMALS (:45 MINUTES)

Supplies Needed

- Computers and Internet access for students – if this is not available, this lesson plan can be modified to be done as a combination of homework and class work.
- Research Activity Page (copies for students)

Step 1: Select a local threatened or endangered plant or animal to study
Most states have a state department of natural resources or department of conservation. Visit their website and do a search for “threatened and endangered plants and animals.” For example, Illinois has the department of natural resources at http://www.dnr.illinois.gov. Visiting their website and typing the prompt into the search box, the first search result is a checklist. This will be the case for most states. All checklists are arranged a bit differently, but will have species names of endangered and threatened plants and animals. You can either select one for each of your students or provide your students with the list and have each student select his/her own species.

Step 2: Research Activity
Have students complete the “research activity” page for their plant or animal. They should, as much as possible, focus on local issues and sources. For example, research for the Blue Jasmine (Clematis crispa) in the state of Illinois may provide different answers than research on the Blue Jasmine in Missouri. However, sometimes specific information is challenging to find on a particular species in a particular state.

A few notes:

- The state department of natural resources or department of conservation is a great starting place for this project.
- This is a great opportunity to discuss with students about the reliability of some websites and the inaccuracy of others…you can find some really interesting websites on the conservation efforts of the passenger pigeon, for example, but it is extinct!
Some good websites to get started:

- [http://plants.usda.gov/threat.html](http://plants.usda.gov/threat.html) (United States Department of Agriculture threatened and endangered plants)
- [http://www.dnr.illinois.gov/](http://www.dnr.illinois.gov/) (Illinois Department of Natural Resources)
- [http://mdc.mo.gov/discover-nature](http://mdc.mo.gov/discover-nature) (Missouri Department of Conservation)
- [http://dnr.wi.gov/](http://dnr.wi.gov/) (Wisconsin Department of Natural Resources)
- [http://www.in.gov/dnr/](http://www.in.gov/dnr/) (Indiana Department of Natural Resources)

IDEAS FOR RELATED ACTIVITIES

- Extend this activity by having students make their own “Vanishing Acts” posters and put them on display in your classroom or school. The students can get really elaborate with presentation boards and resources from local forest preserves, state and county parks, etc.
- Have students write an essay about the threatened or endangered species they researched.
- Contact a local forest preserve, garden or arboretum and participate in a conservation project. This is a great link to the Vanishing Acts exhibit…many locations are constantly looking for help removing exotic and invasive plant species or restoring natural areas.
RESEARCH ACTIVITY

Name: ________________________________

1. List the three websites you used:
   a. ____________________________________________________________
   b. ____________________________________________________________
   c. ____________________________________________________________

2. What is the common name of your plant or animal? ________________________________

3. What is the scientific name of your plant or animal? ________________________________

4. Describe your plant or animal. Include a physical description and a description of its behaviors and habits (for an animal) or phenology (for a plant). Think about the species descriptions you read in the Vanishing Acts exhibit and try to include similar detail.
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

5. In your state, is your plant/animal currently listed as threatened or endangered?
   ________________________________

6. What has caused the population of your plant/animal to be considered threatened or endangered? Think about the different reasons listed in the Vanishing Acts exhibit, habitat destruction, over harvesting, invasive species, etc. Explain your answer.
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

7. What conservation efforts are underway to help your plant/animal?
   _______________________________________________________________________
   _______________________________________________________________________

8. Why is your plant or animal important? Think about the explanations you saw in the Vanishing Acts exhibit which explained the importance of the different trees.
GUİDED EXHİBIT VIEWİNG QUESTİONS

Name: ____________________________

1. What are the four reasons we should value threatened and endangered trees?
   a. ____________________________
   b. ____________________________
   c. ____________________________
   d. ____________________________

2. How many known tree species are threatened with extinction? ________________

3. What is the difference between a tree species that is “threatened” and a species that is “endangered”? ________________
__________________________________________________________________________
__________________________________________________________________________

4. What tree has been used to create a medicine that helps treat cancer? ________________

5. What is the name of the oldest living thing on earth? What type of tree is it? ________________

6. List five threats to endangered and threatened trees.
   a. ____________________________
   b. ____________________________
   c. ____________________________
   d. ____________________________
   e. ____________________________

7. Dawn redwood trees are now cultivated and grown throughout the world. Knowing this, why would it make a difference to preserve the sole remaining wild stand of dawn redwoods? ________________
__________________________________________________________________________
__________________________________________________________________________

8. Why do scientists think that the Monkey Puzzle tree evolved to have spiny, scale-like leaves? ________________
__________________________________________________________________________
9. Is it all right to let a species go extinct if we don’t know any benefits from it? Explain.
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

10. The trees in this exhibit are from all over the world. However, several are from right here in the
    United States. Are any of these trees from your state or near your region? If so, which ones?
_____________________________________________________________________________

11. What are two things you can do to help trees?
   a. ___________________________  b. ___________________________
RECYCLING COUNTS
How many trees can we save with our recycling?

A Number
How many pounds of paper did you collect for recycling?
You can get this number in a couple different ways:
• Many places that recycle have scales and can tell you exactly how many pounds of paper products you provide for recycling.
• You will probably need to request this number specifically. Check with the recycling facilities at your school to find out how to obtain the pounds of recycled paper from your school.
• But not all is lost if you don’t have a formal recycling program at your school! Have your class recycle for a week. At the end of the week bring in a bathroom scale. Weigh one student. Then have that student hold the bag or bags of paper you collected for recycling. The difference is the pounds of paper you are going to recycle!

A Tree
The next thing we need is to know how many pounds of paper it takes to save a tree. This is challenging. Different types of paper require different amounts of tree pulp, so there is no easy answer. However, we can make some generalizations that help us get close to the answer.
• 1 ton (2000 pounds) of uncoated non-recycled printing and office paper uses 24 trees
• 1 ton of 100% non-recycled newsprint uses 12 trees
• A generally accepted average is that recycling 1 ton of paper saves up to 17 trees

The Math
To keep it simple, we are going to guess (hopefully incorrectly) that you are recycling 100% non-recycled paper
• We know that 2000 pounds = 17 trees
• If we divide 2000 by 17 we discover that
• 117.647 pounds = 1 tree
• If we divide “pounds of paper” by 117.647 we can find out how many trees your class will save.
• For example: If your school recycled 600 pounds of paper, your equation would look like this:
  
  \[
  600 \div 117.647 = 5.1 \text{ which would mean you saved 5.1 trees.}
  \]

At this rate, how many trees will your class/school save in a year? To calculate this, you also need to know how long it took you to collect the paper for recycling!
Haiku is a form of Japanese poetry. Traditional haiku poems link nature to human life. A haiku has no rhyming scheme and 17 syllables in 3 lines, 5-7-5. Traditional haiku indicate a season using nature words: cherry blossoms indicate spring, snow indicates winter. Sometimes these nature words are obvious and sometimes they are more subtle…but they always add more meaning to the poem through symbolism.

Think about the endangered and threatened trees you saw in the Vanishing Acts exhibit. Write a haiku about one of the trees you found particularly interesting. Think about what the trees mean to you and to other people around the world. Use nature imagery to try to convey those feelings.

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Some of Matsuo Basho’s haiku:

Won’t you come and see loneliness? Only one leaf from the kiri tree.

On a withered branch
A crow has alighted: Nightfall in autumn.

April’s air stirs in willow-leaves . . . a butterfly Floats and balances

The oak tree: not interested in cherry blossoms.

Matsuo Basho was a famous Japanese writer who lived from 1644-1694. He helped develop haiku as a form of poetry. He used haiku to comment on everyday human feelings and experiences.

Matsuo Basho wrote in Japanese, so the translated English versions of his Haiku don’t always follow the 5-7-5 syllable pattern.
Purpose of this Guide:
• To help teachers guide their high school students through the Vanishing Acts exhibit.

How to Use This Guide:
• In this guide you will find lesson plans, activities and guided exhibit viewing questions specifically designed to help high school students understand and appreciate the Vanishing Acts exhibit.
• Below is a list of the activities for students in high school.
• Next to the title of the activity is a recommendation for when this activity might be most beneficial for your students in relation to their visit to the Vanishing Acts exhibit.

Included In This Guide:
• Tree-time Lesson Plan  Pre or Post-visit
• Ideas for Related Activities  Pre or Post-visit
• Research Project Ideas  Pre or Post-visit
• Dendrology Worksheet  Post-visit
• Tree Cookie Photographs  Post-visit
• Guided Exhibit Viewing Questions  During visit
• Recycling Counts  Pre or Post-visit

National Science Content Standards Addressed:
• Life Science: Interdependence of organisms
• Science in Personal and Social Perspectives: Natural resources
• Science in Personal and Social Perspectives: Environmental quality
• Science in Personal and Social Perspectives: Natural and human-induced hazards

Time:
One 45 minute class period
Lesson Plan Summary:
Dendrology is the study of trees. One aspect of that is the close examination of tree rings. These rings don’t just indicate the age of the tree, they also tell us valuable information about weather and climate changes. In this lesson students will explore some of the things trees can tell us about history.

Key Messages:
• Dendrology, the study of trees, provides scientists with great information about our past – which can help us plan for the future.
• Examining why a plant becomes endangered helps scientists design conservation plans.
• Humans depend on trees. Trees depend on humans.

Guided Inquiry Questions:
Use these questions to guide inquiry before and during the lesson:
• Why is it important to help threatened and endangered species?
• Is it acceptable to let a species go extinct if we don’t know of any benefits from it?
• How can dendrology help with natural resource conservation?
ACTIVITY: DENDROCHRONOLOGY AND THE STUDY OF TREE TIME (:45 MINUTES)

Supplies Needed
• Dendrology worksheet (copies for students)
• Tree Cookie Photographs

Step 1: Vanishing Acts Exhibit Visit
While visiting the Vanishing Acts exhibit, have the students pay close attention to the *Pinus longaeva* (Bristlecone pine) panel. The exhibit explains that Methuselah, the oldest known Bristlecone pine, is 4789 years old. No, that’s no typo – Methuselah is getting close to its 4800 birthday! The exhibit also points out that most intermountain bristlecone pines live around 1000 years old, young compared to Methuselah.

Some useful definitions:
• Dendrology: the study of trees and woody plants
• Dendrochronology: the study of tree time

Step 2: Understanding Dendrology
Explain the following to the students:
• You can count the rings in a tree and determine the age of the tree (which most high school students already know).
• How tree rings develop: During the spring and summer, a tree grows a new layer of wood. During the winter, the tree goes into a state of dormancy until the spring, when it has the energy resources to begin to grow again. Rings develop because of the clear distinction between the growing season and the dormant season.
• The cambium (a growing layer in the tree that produces new wood) frequently grows a light-colored band called earlywood in the spring and a darker colored band called latewood in the summer. When you look at a photograph of a tree cookie (See “Tree Cookie Photographs”) you will see a light and a dark colored section of each ring on many tree cookies – this is representative of just ONE year of growth.
• Dendrochronologists can determine a great deal more than just the age of a tree when they look at tree rings.
Step 3: Complete Dendrology Worksheet

As a class, work through the “Dendrology Worksheet.” Answers and explanations are described below. Note that the tree cookie drawings are very simple and show just one irregularity each. In reality, many tree cookies will show several irregularities that require skilled experts to interpret them (see Tree Cookie Photograph #2).

1. This tree has no irregularities. This is what a tree would look like if it were growing in perfect conditions and had consistent amounts of sunlight, water, and nutrients. How old would this tree be?

2. This tree cookie shows some narrow rings. These could be caused by drought or severe insect damage. If a tree suffers from severe insect damage or drought, it may lose many leaves and not be able to produce enough food to grow a regular ring of wood. A drought would decrease the amount of water. Root damage from construction or sidewalks can also create similar narrow rings. In these cases roots aren’t able to gather nutrients from the soil to assist in the production of food and therefore the tree grows very little that year. Marking how many years of drought or wet years can be very useful to understanding patterns in climate.

3. This tree shows damage caused by fire. Historically, many parts of our country had natural or man-made fires. Many trees are adapted to withstand such fires. Some are even adapted so well to the fire that they have fire resistant bark and require fire for their seeds to open! Noting historic fire trends can assist dendrologists in understanding the needs of different habitats which will then help in conservation efforts.

4. This tree cookie shows an uneven growing pattern that can be attributed to a couple things. It could have been growing on a slope or it could have had a fallen tree leaning against it. (See Tree Cookie Photographs #1.)

Step 4: Discussion - Why does this matter?

Explain the following information to students. Then lead a discussion in which they answer the questions listed below.

- As mentioned above, most intermountain bristlecone pines live for about a thousand years. But if the trees are cut down to produce a tree cookie, the tree is obviously no longer able to grow. Dendrochronologists instead use an increment borer to take core samples from trees (much like core samples from polar ice caps) that are about as thick as a drinking straw. This allows them to
study the tree rings without killing the tree.

- 1000-year-old trees are great for information, but what about places where there are no 1000-year-old trees? Dendrochronologists have come up with an answer to this as well. Cross dating is a method where one tree cookie or tree core sample is compared to others, possibly from a stump or other dead tree. By overlapping the ring patterns from many different trees, dendrochronologists can trace weather patterns for hundreds and thousands of years. Different trees species grow at different rates, so it is important that the same species are examined when cross dating. The method of cross dating is considered more accurate than radioactive carbon dating. It is a critical part of dendrochronology since it allows scientists to look back further than the age of a single tree.

**How can dendrochronology help with our understanding of climate change?**

Prompt students to think about the differences between weather and climate.

- Weather is atmospheric conditions over a short period of time, typically hours or days. Climate is the pattern of atmospheric conditions over long periods of time over large geographic regions – most scientists say the SMALLEST sample of time to explore climate is a 30 year period.
- With dendrochronology, we can explore long term trends in climate, not just weird weather. For example, if a region used to have a 50-year trend of drought one out of every 10 years, and two hundred years later has a 50-year trend of drought 1 in every 5 years, this would be indicative of a long term change.
- Think about the time-line chart that you saw in the Vanishing Acts exhibit... How far back did it go? Methuselah started its life around when Stonehenge was built in 2780 B.C. We know from climatologists that a lot of changes have occurred in the past 100 years since we have been collecting scientific data about precipitation and temperature. Think about what a tree that provides almost 4800 years of data can tell us about water resource changes!

**How would knowing about changes in climate be useful?**

- Simply put, like so many things, knowing about our past can help us plan for the future.
- Understanding the past environmental conditions helps us to understand our current environmental conditions, which in turn helps us to understand if what we’re experiencing is normal for a region or not. This helps us better understand how future environmental and climate changes will impact a region.
• Completing the worksheet in section one helped identify that many factors can influence a single tree’s rings. For this reason, cross dating is essential to giving scientists an accurate historical record to work with.

• There are many good internet resources on this topic. For further information, check out The Nature Conservancy’s website on climate change at [http://www.nature.org/ourinitiatives/urgentissues/climatechange/](http://www.nature.org/ourinitiatives/urgentissues/climatechange/) and the EPA’s website on climate change at [http://www.epa.gov/climatechange/](http://www.epa.gov/climatechange/).

**How can dendrochronology help with conservation efforts?**

• There are dozens of answers to this question. Knowing historic trends can help humans as we manage natural lands.

• For example, knowing that an area was historically a forest helps us to know about different plants and animals that existed there. As we learn about animals that are endangered, the knowledge of what environmental issues they used to face can help us understand what has changed to cause them to be threatened and endangered.

• Dendrochronology can also help determine which conservation techniques are best. Examination of tree rings to prove a historic trend of fire in an area can help conservationists understand that prescribed burns are important.

**We’ve been talking science, but what other uses can you think of for dendrochronology?**

• Dendrochronology has been used in the art world, to date frames on Rembrant paintings and authenticate years that violins were made.

• Dendrochronology can help verify historical information. Think about folk stories of “the year without summer” or “the dry spring.” Examination of tree rings can help authenticate these and other stories.
IDEAS FOR RELATED ACTIVITIES

• Have students study tree cross sections or pictures of tree cross sections (many versions available on the Internet) and label the different parts. They should label outer bark, cork cambium, phloem, vascular cambium, sapwood, heartwood, pith, growth rings, early wood, late wood, and rays.

• Tree Identification – one of the ways to determine a healthy ecosystem is to have strong biodiversity. (Think about the Anhui Elm portion of the Vanishing Acts exhibit. That portion of the exhibit explained that Dutch elm disease killed 77 million American elms by the 1970s. With the death of the elm trees, many neighborhoods lost all their trees. Unfortunately, sometimes we have to learn a lesson twice to have it hit home... now many neighborhoods are going through a similar problem with Emerald Ash Borers killing their ash trees.) Have students identify trees in their neighborhood or around the school to determine if good species diversity exists in the area.
RESEARCH PROJECT IDEAS

1. Local, regional, and national climate trends – what does this tell us about the future? Include in your research how endangered trees, such as the bristlecone pine, can assist us in understanding these trends.

2. The many uses of dendrochronology – research art and history and discover the fascinating ways that this very specific science has been used in a variety of disciplines.

3. Career opportunities for dendrologists – it’s easy to think about forestry and the science of dendrology, but dendrology is a scientific field that overlaps into many different careers.

4. Local/regional threatened and endangered plants – Vanishing Acts examined trees from all over the world, some were from the United States such as the Fraser Fir and the Bristlecone pine. Others are from as far reaching places as China, Brazil and Bosnia. Across the United States there are plants listed as threatened and endangered in every local community and state. Explore these plants and the conservation efforts that exist to help save them.

5. Opinion Paper: Is it acceptable to let a species go extinct if we don’t know of any benefits from it? Make sure to include scientific details to support the opinion of the paper.

6. Local/regional conservation issues – Many times plant and animal species/communities may not be threatened nationally but are threatened or even endangered locally. Ranging from CAFOs (Controlled Animal Feeding Operations) affecting forest preserves (a local issue in Missouri) to recreational boating affecting the population of manatees (a local issue in Florida) these issues are very much dependent on the local ecosystems and the habits of the people who live in an area. Research issues relevant to your region or state.

7. Pygeum and Taxol are two medications that come from trees described in the exhibit. Explore the history behind using trees and other plants as medicines. This can be done in a general way, looking at an overall history, or in a more specific way, looking at just a few plants and their historical medicinal uses.
DENDROLOGY WORKSHEET

Name: ___________________  

Tree cookies are cross sections of tree trunks. Tree cookies reveal that the rings in a tree are not regular and perfect circles. Close examination of these cross sections can tell us important information about a tree and its history. Examine the tree cookie drawings below and write a brief description of what might have caused the irregularities in each. Provide a brief explanation about why this sort of information would be useful to a dendrochronologist.

1.  

2.  

3.  

4.
Notice that the center growth is not at the center of the circle (orange arrow). This could be due to something blocking the tree on one side or the tree growing on a hill. If you look closely at the bottom right of the tree cookie, you can see the different colors of the spring growth and summer growth in one tree ring – the spring growth is lighter and the summer growth is darker (green arrow). (The cracks in the tree cookie are due to the wood drying after it was cut.)
This tree cookie shows many different things. The center growth is not in the center of the circle, indicating that the tree was growing on a hill or had something obstructing it on the lower left side (orange arrow). The decay on the left side could be due to insect damage or disease. If you look closely near this damage you will see bore holes from insects (blue arrow). The straight lines across the face of the cookie are lines from the saw cutting the tree cookie.
GUIDED EXHIBIT VIEWING QUESTIONS

Name: ________________________________

1. What are the four reasons we should value threatened and endangered trees?
   a. ___________________________  c. ___________________________
   b. ___________________________  d. ___________________________

2. How many known tree species are threatened with extinction? ___________________________

3. What is the difference between a tree species that is “threatened” and a species that is “endangered”?
   _____________________________________________________________________________
   _____________________________________________________________________________

4. List five threats to endangered and threatened trees.
   a. ___________________________  d. ___________________________
   b. ___________________________  e. ___________________________
   c. ___________________________

5. Dawn redwood trees are now cultivated and grown throughout the world. Knowing this, why would it make a difference to preserve the sole remaining wild stand of dawn redwoods?
   _____________________________________________________________________________
   _____________________________________________________________________________

6. You are a 50-year-old American man. Like 60% of men your age, you have BPH. A friend’s symptoms disappeared after he took powdered pygeum bark. Pygeum is easy to find in stores. After learning about the status of the pygeum tree, what do you do?
   _____________________________________________________________________________
   _____________________________________________________________________________

7. Researchers do not tell people about the exact location of Methusela, the oldest living organism on Earth, or the location of mature Wollemi pines. Why?
   _____________________________________________________________________________
8. What are three things you can do to help trees?
   a. _____________________________
   b. _____________________________
   c. _____________________________
RECYCLING COUNTS
How many trees can we save with our recycling?

A Number
How many pounds of paper did you collect for recycling?
You can get this number in a couple different ways:
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- At this rate, how many trees will your class/school save in a year? To calculate this, you also need to know how long it took you to collect the paper for recycling!