

VANISHING ACTS: TREES UNDER THREAT



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:

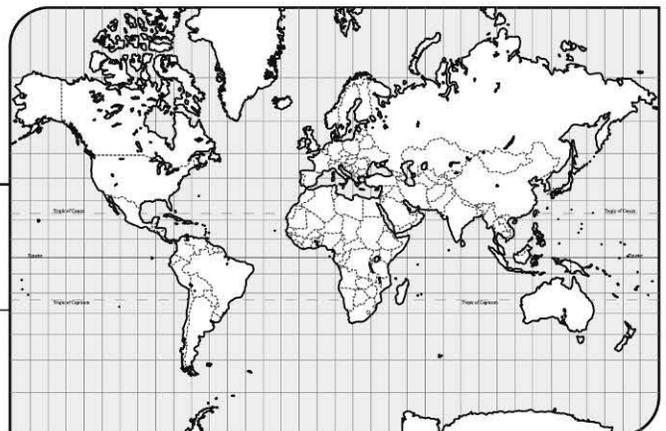
- Life Science: Interdependence of organisms
- Science in Personal and Social Perspectives: Natural resources
- Science in Personal and Social Perspectives: Environmental quality
- Science in Personal and Social Perspectives: Natural and human-induced hazards

Time:

One 45 minute class period

Teacher's Guide

Grades 9-12



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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?

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TREE-TIME LESSON PLAN

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.

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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

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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.

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- 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/> and the EPA's website on climate change at <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 Rembrandt 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.

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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.

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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.

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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.



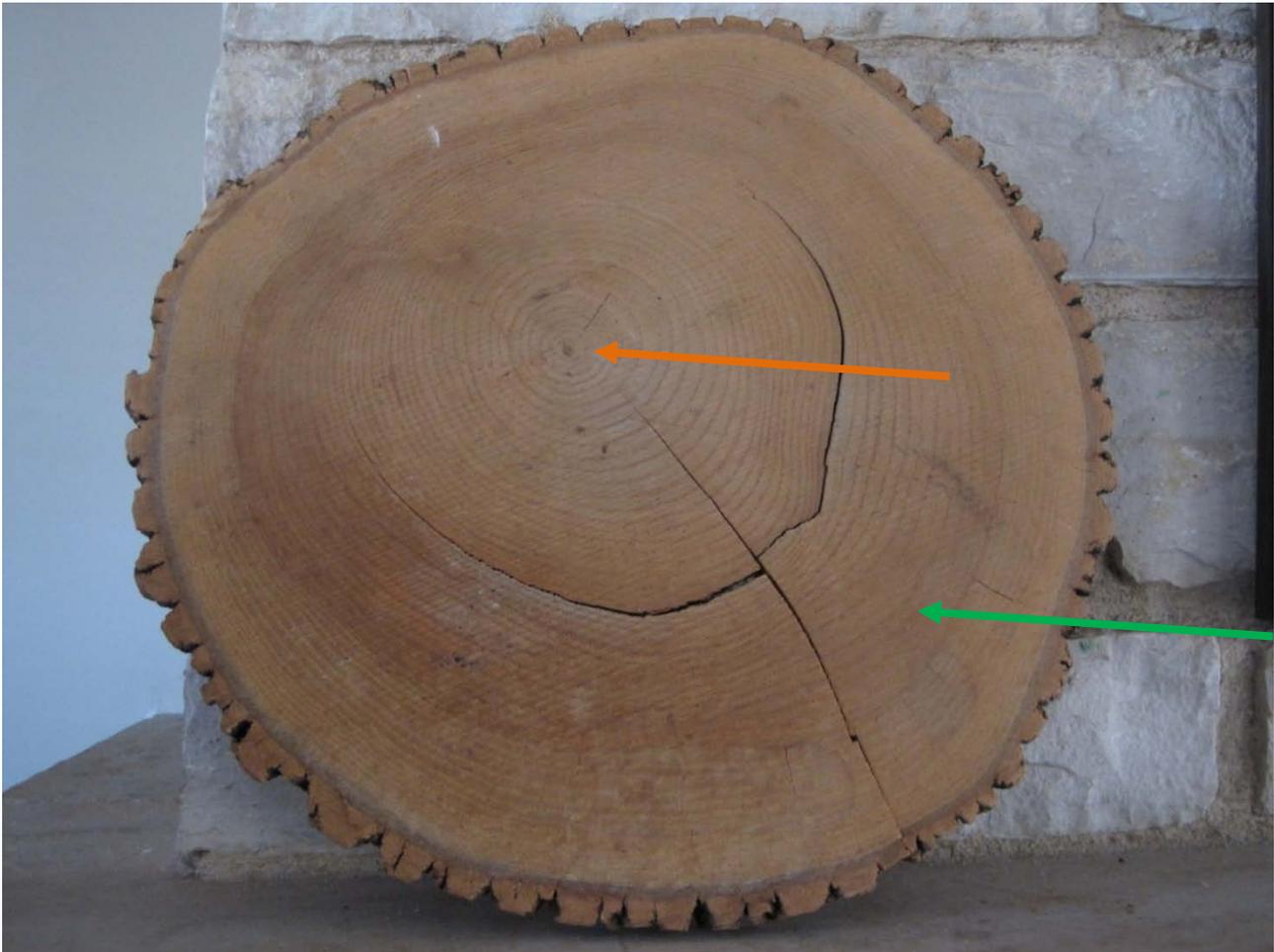
4.



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TREE COOKIE PHOTOGRAPHS

#1

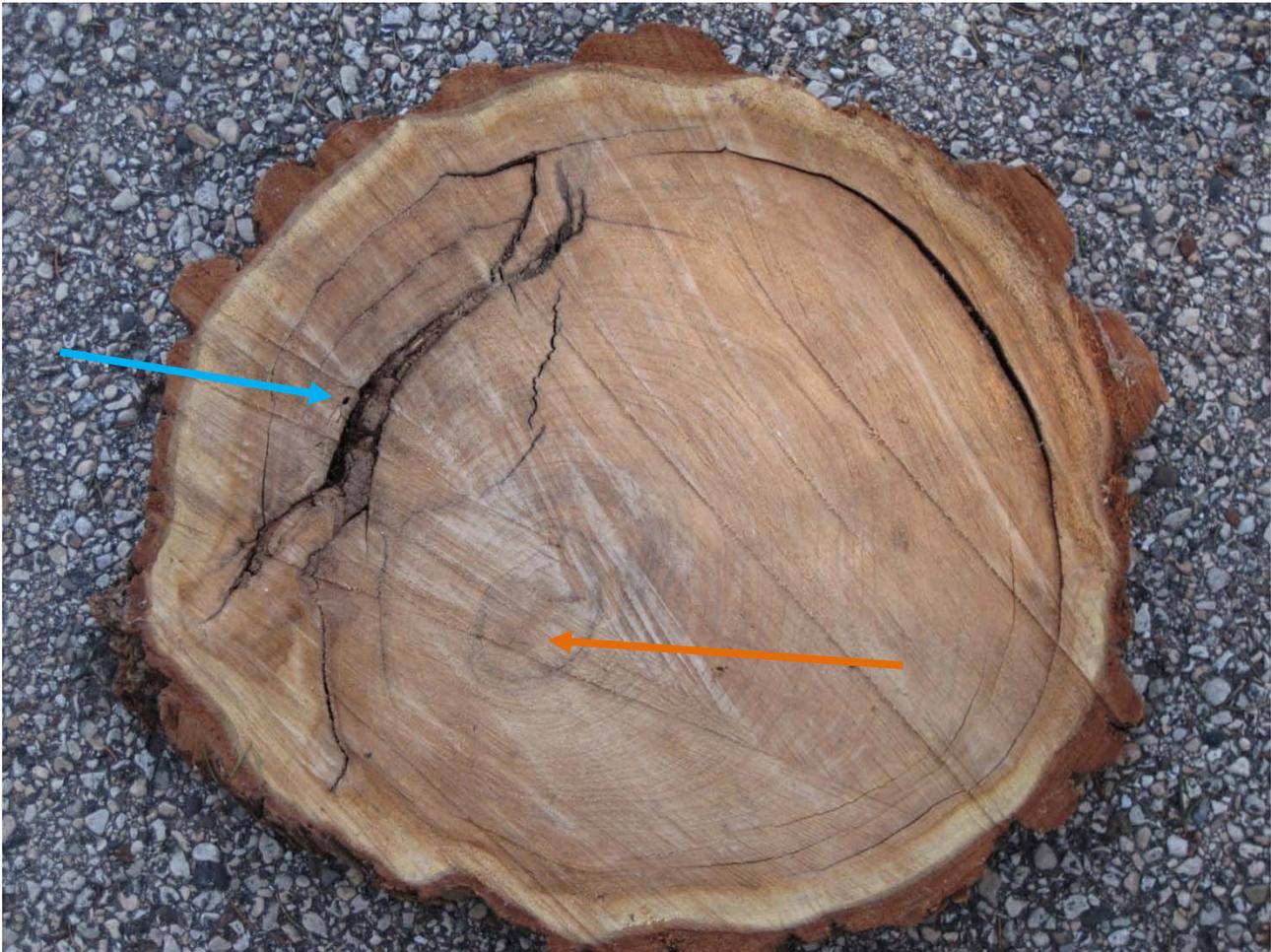


Notice that the center growth is not at the center of the circle (orange arrow). This could be due to something blocking the tree on one side or the tree growing on a hill. If you look closely at the bottom right of the tree cookie, you can see the different colors of the spring growth and summer growth 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.)

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TREE COOKIE PHOTOGRAPHS

#2



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.

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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?

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8. What are three things you can do to help trees?

a. _____

b. _____

c. _____

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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:
 $600 \div 117.647 = 5.1$ 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!

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This traveling exhibit is
made possible by a grant from:



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