ScienceNews
EDUCATOR GUIDE

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Earth May Be Hiding Thousands of Tree Species

SOCIETY FOR SCIENCE

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About this Guide

In this Guide, based on the online *Science News* article "Earth may have 9,200 more tree species than previously thought," students will learn about scientists' efforts to estimate how many tree species Earth has, analyze a related data visualization and discuss the implications the research has for conservation.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the online *Science News* article "Earth may have 9,200 more tree species than previously thought," which describes researchers' efforts to estimate the number of tree species on Earth. A version of the article, "Earth may be hiding thousands of tree species," appears in the March 12, 2022 issue of *Science News*. Related standards include NGSS-DCI: HS-LS2; HS-ESS3.

> **Student Comprehension Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular Discussion Q&A — Students will look at data from a primary research article to explore how tree biodiversity differs across continents and biomes. Related standards include NGSS-DCI: HS-LS2; HS-ESS3.

> **Student Discussion Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

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Article-based Comprehension, Q&A

Directions for teachers: Ask students to read the online *Science News* article "Earth may have 9,200 more tree species than previously thought," which describes researchers' efforts to estimate the number of tree species on Earth, and answer the following questions. A version of the article, "Earth may be hiding thousands of tree species," appears in the March 12, 2022 issue of *Science News*.

1. How many types of trees, or tree species, do scientists know about?

There are about 64,100 known tree species on Earth.

2. How many tree species have yet to be discovered, according to scientists' calculations? What is the new estimate for the total number of tree species?

There could be roughly 9,200 tree species that have yet to be discovered, scientists estimate. That means Earth could have about 73,300 tree species.

3. In your own words, describe the methods that scientists used to reach their findings.

The researchers analyzed global forest data, using statistics to calculate how many species might exist. Subtracting the number of species known to science from that number gave the team an estimate of how many species might still await discovery.

4. Why haven't the undiscovered tree species been found yet? Where might researchers discover many of these species?

Many of the tree species probably haven't been found yet because they are rare. And they probably live in regions with a lot of biodiversity such as the Amazon in South America.

5. What implications does the research have for the world's biodiversity, according to biologist Roberto Cazzolla Gotti?

Being able to estimate how many plant and animal species there are, and where they live, could help researchers figure out where to target efforts to preserve and restore biodiversity.

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Cross-curricular Discussion, Q&A

Directions for teachers:
Ask students to read the online *Science News* article "Earth may have 9,200 more tree species than previously thought" and skim the primary research article "The number of tree species on Earth" in the *Proceedings of the National Academy of Sciences*. Direct students to pay close attention to Table 1 and Figure 4 in the primary research article when they discuss the following questions with a partner. A version of the *Science News* article, "Earth may be hiding thousands of tree species," appears in the March 12, 2022 issue.

Want to make it a virtual lesson? Post the online *Science News* article to your virtual classroom. Discuss the article and questions with your class on your virtual platform.

By the numbers
1. In your own words, summarize the main research findings presented in the *Science News* article. Make sure your summary includes quantitative data.

Earth has 64,100 known tree species. Researchers estimate that there could be roughly 9,200 species that have yet to be discovered, and about a third of those species are probably located in South America, researchers say. Accounting for the number of total undiscovered species, there could be at least 73,300 tree species on Earth — about 14 percent more than previously thought.

2. Study Figure 4 in the primary research article "The number of tree species on Earth." What does the figure depict according to the caption? Explain in your own words what the figure shows. Make sure to define terms that may be unfamiliar to you, using outside resources if necessary.

Figure 4 depicts "species richness portioning among continents," according to the caption. In other words, this figure maps out the percentage of tree species unique to each continent, the estimated number of species shared by specific continents and the estimated percentage of tree species shared by all five continents. Students may be unfamiliar with terms such as species richness, which is the number of species in a defined region, and endemic — used to describe species that are found only in a particular region or locality.

3. What type of diagram is shown in Figure 4? How many ellipses are there and what do they represent? What do the bolded and nonbolded values represent?

Figure 4 is a complex Venn diagram. There are five intersecting ellipses, and each ellipse represents a continent. The bolded value in each ellipse is the portion of tree species found only on the continent relative to the estimated total number of species on that continent. The bolded value at the center of the diagram represents the estimated percentage of tree species shared by all five continents. The nonbolded values in

areas where ellipses overlap represent the estimated number of shared tree species among specific continents.

4. Describe how you can use the diagram to find the estimated number of tree species shared by each of two or more continents.

Since each ellipse represents a continent, look for where the ellipses of the continents in question overlap to find the number of tree species shared by those continents.

5. Which two continents share the most tree species? About how many species do the two continents share?

South America and North America share the largest number of tree species: 1,951.

6. What percentage of all estimated tree species is shared by the five continents?

The five continents share less than 0.1 percent of all tree species.

7. Study Table 1 in the primary research article and compare that information to what you learned from Figure 4. Which continent is the most diverse in terms of tree species? Explain your reasoning.

South America is the most diverse. Out of all the continents, South America has the highest species richness with 31,112 types of trees expected on the continent. About 49 percent of those tree species are endemic to South America, which means the species are found exclusively on that continent. That is the highest percentage of endemic tree species of any continent.

Branching out

1. Define the term biodiversity. Which terrestrial biome (desert, tropical forest, grassland, tundra, savanna, etc.) is the most biodiverse and why?

Biodiversity is the number and variety of species found within a geographic region. Tropical forests are the most biodiverse terrestrial biome. They tend to be near the equator, which contributes to a stable climate with lots of precipitation and sunlight, which promotes biodiversity.

2. What characteristics make this biome appealing to many types of plants and animals? How does your answer relate to your answer for question No. 7 in the previous section?

Tropical forests tend to be near the equator where the climate is relatively stable and where there tends to be a lot of precipitation and sunlight. Such conditions promote high levels of productivity among plants and

other primary producers. South America contains many tropical forests, so it makes sense that it would have the most tree biodiversity.

3. Why is identifying and studying new species important? How can it aid scientists' knowledge of an ecosystem?

Student answers will vary. Students may say that identifying and studying new species can uncover ecological relationships, giving scientists a better idea of how the ecosystem functions and the vital roles various species play. For example, perhaps a newfound tree species has a commensal relationship with certain soil bacteria, where the microbes help provide the tree with nutrients. Or perhaps the tree species has a mutualistic relationship with a rare bird species, where the tree provides the bird with shelter while the bird helps keep the tree safe from insect pests.

Extending estimations

In the research described in the article, researchers used data from the Global Forest Biodiversity Initiative and TREECHANGE databases to estimate the number of tree species that might remain unknown. This is an example of inductive reasoning, or observing patterns or trends to make a generalization. Give an example of a time when you've used inductive reasoning to make an estimation.

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Student Discussion Worksheet

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By the numbers

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3. What type of diagram is shown in Figure 4? How many ellipses are there and what do they represent? What do the bolded and nonbolded values represent?

4. Describe how you can use the diagram to find the estimated number of tree species shared by each of two or more continents.

5. Which two continents share the most tree species? About how many species do the two continents share?

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1. Define the term biodiversity. Which terrestrial biome (desert, tropical forest, grassland, tundra, savanna, etc.) is the most biodiverse and why?

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