

THINKING AND ACTING  
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SCIENTIST

TEACHER'S GUIDE

# Seeing the Trees through the Forest

How does deforestation of the Indonesian  
rainforest affect the population of the orangutan?

GRADES 9–12

Life Science





# Seeing the Trees through the Forest

<b>Grade Level/Content</b>	9–12/Life Science
<b>Lesson Summary</b>	In this lesson, students discover how the environmental changes due to deforestation may change the population size of some organisms.
<b>Estimated Time</b>	2, 45-minute class periods
<b>Materials</b>	Internet access, graphing software or graph paper, calculator, <a href="#">Investigation Plan</a> , <a href="#">Observation Form</a> , journal
<b>Secondary Resources</b>	<ul style="list-style-type: none"><li>• <a href="#">Deforestation Data</a></li><li>• <a href="#">NASA Deforestation of Tropical Rainforests</a></li><li>• <a href="#">Forest Cover</a></li><li>• <a href="#">World Preservation Foundation</a></li><li>• <a href="#">Loss of Biodiversity (Genetic Diversity)</a></li><li>• <a href="#">Nine Maps that Explain the World's Forests</a></li><li>• <a href="#">Species Population Changes</a></li></ul>
<b>NGSS Connection</b>	<b>HS-LS4-5</b> Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
<b>Learning Objectives</b>	<ul style="list-style-type: none"><li>• Students identify evidence that deforestation results in a decreased population (and potential extinction) of certain species.</li><li>• Students evaluate and critique evidence to determine if it can be used to construct logical arguments that identify causal links between deforestation and the changes in the number of individual species.</li></ul>

## How does deforestation of the Indonesian rainforest affect the population of the orangutan?

Human activities impact species biodiversity and genetic diversity in ecosystems. As the human population has increased, the demand for resources has also increased. More people require more food, consume more materials, and produce more waste. One resource in particular that has been used extensively is land. People need land to live on and to grow their food. As a result, deforestation occurs at an alarming rate.

Cutting down forests means that organisms living in the forests lose habitats. Without a safe place to live and raise their young, species populations decline. This decline reduces genetic diversity. Lack of genetic diversity may lead to localized extinctions of some species.

## Investigation is based on the Van Andel Education Institute (VAEI) Instructional Model for Inquiry-Based Science.

### In all investigations:



Students don't know the "answer" they are supposed to get.



Students play a driving role in determining the process for learning.



Teachers and students construct meaning together by journaling.



Students are working as hard as the teacher.

# Part 1

## INVESTIGATION SETUP

Students need the following:

- Internet access
- Graphing software or graph paper
- Calculator
- [Investigation Plan](#)
- [Observation Form](#)
- Journal

# Part 2

## INVESTIGATION FACILITATION



### Question

*Introduce the investigation question.*

#### **How does deforestation of the Indonesian rainforest affect the population of the orangutan?**

##### CURIOSITY

Bring in a globe or a physical map of the world for students to study. Have students identify where the tropical rainforests are located. Encourage students to ask questions about the characteristics of tropical rainforests and what species might live there. Then, introduce the investigation question.

##### STUDENT CHOICE

Use the Indonesian rainforest and the orangutan as an example, but help students take ownership of their learning by allowing them to choose a particular rainforest and a particular species to investigate.



### Personal Knowledge

*Students capture what they already know about deforestation and species populations.*

- Write the following words in a list: *tropical rainforests, deforestation, rainforest animals, rainforest plants*. Brainstorm to find out what students already know about these topics.

##### STUDENT ENGAGEMENT

Bring in or show several pictures of tropical rainforests and some of the representative species living within them. See if students can identify any of the species. Ask students to discuss how loss of habitat can lead to species extinction.

##### DISCOURSE

Conduct a *Think, Pair, Share* to make sure all students are participating. Ask students to think about what they already know about these topics. Have them share their thoughts with a partner, then ask pairs to share their thoughts with the class.



## Prediction

Students communicate an expected outcome, based on prior knowledge.

- Have students make a prediction about the relationship between deforestation and the population of a species.
- Predictions can be presented as *I predict \_\_\_\_\_ because \_\_\_\_\_.*

1  
2  
3

## Investigation Plan

Students conduct research on rates of deforestation and changes in species population size.

- Review the [Investigation Plan](#) as a whole class.
- Use the Indonesian rainforest and the orangutan as an example (or another of your choice to demonstrate where you found that information).
- Divide students into pairs. Have each pair choose a rainforest and species to investigate.
- Have them find data that shows the rates and amounts of forests that are being destroyed, as well as the changes in populations of animals in that rainforest. Advise students about trustworthy searches on the Internet, such as using .gov or .edu sites.

### CRITICAL THINKING

Use the [Fair Test](#) checklist to help students think critically about the investigation plan. Help them understand that a good investigation involves significant research and use of credible sources. The more critically students think about their investigation plan, the more confident they can be in their results.

**INVESTIGATION PLAN**  
**SEEING THE TREES THROUGH THE FOREST**

In this investigation, you will perform research and create graphs comparing rates of deforestation and changes in population sizes of several rainforest species.

1. Decide on the rainforest and species (plant or animal) you will study and record your choices on the **Observation Form**. (For example, orangutan in Indonesia or the golden tamarin in the Amazon.)
2. Search the Internet to obtain information about the rates of deforestation for your rainforest. Record your findings on the **Observation Form**.
3. Search the Internet to obtain information about the population changes of your species. Record your findings on the **Observation Form**.

You may use sites suggested below or you may find other sites that provide the needed information.

Suggested Sites for Deforestation Rates	Suggested Sites for Species Population Changes
<ul style="list-style-type: none"> <li>• Deforestation Data</li> <li>• Forest Cover</li> <li>• NASA Deforestation of Tropical Rainforests</li> <li>• Nine Maps that Explain the World's Forests</li> </ul>	<ul style="list-style-type: none"> <li>• World Preservation Foundation</li> <li>• Loss of Biodiversity (Genetic Diversity)</li> <li>• Species Population Changes</li> </ul>

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### Investigation Plan



## Observation

Students capture the data they obtain.

- Guide students as they search the Internet and obtain information about the rainforest and species of their choice.
- Have students record their data on the [Observation Form](#).

**OBSERVATION FORM**  
**SEEING THE TREES THROUGH THE FOREST**

NAME: \_\_\_\_\_  
DATE: \_\_\_\_\_

Rainforest: \_\_\_\_\_

**Rates of Deforestation**

Year	Amount Destroyed	Percent Coverage

Species: \_\_\_\_\_

**Population Size**

Year	Population Size

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### Observation Form



## Data Analysis

*Students make sense of their data by organizing it and representing it visually.*

Have students analyze their data. They may wish to use the [Data Analysis](#) prompt as a guide.

- Have students **evaluate** their data for trustworthiness. Ask students: Are you confident in your data? Are you confident in your sources?
- Then, have them analyze their data to find patterns and trends. They may **organize** the data and/or **represent** it visually to construct meaning. Students may want to create two separate graphs (deforestation and population sizes) before combining them into one larger one.
- Have students **interpret** what the identified patterns or trends mean.
- Ensure students have enough data for use as evidence to support a claim.

### CREATIVE AND CRITICAL THINKING

Ask students to evaluate and organize their data in a visual way. They must think critically as they evaluate the validity of their data and decide how to organize it. They must think creatively as they communicate their interpretation in the form of a graph, drawing, or infographic.



## Secondary Knowledge

*Students use secondary sources to understand the impact deforestation has on species population sizes.*

- Use these resources (or your own) and others to develop student understanding of how deforestation of the tropical rainforests is impacting species population sizes of various organisms.
- [Deforestation Data](#)
- [NASA Deforestation of Tropical Rainforests](#)
- [Forest Cover Foundation](#)
- [World Preservation Foundation](#)
- [Loss of Biodiversity \(Genetic Diversity\)](#)
- [Nine Maps that Explain the World's Forests](#)
- [Species Population Changes](#)

After reviewing these resources, students should have a general understanding of how deforestation is causing changes in rainforest species population sizes. They should also be aware of how deforestation impacts the genetic and species diversity of tropical rainforests.

### COLLABORATION AND CONSTRUCTION OF MEANING

Conduct a *Jigsaw* to help students work collaboratively. Place students in a “home” group and have each student choose a different article to read. After reading, the groups divide into new “expert” groups consisting of students who read the same article. The article is discussed and then students re-form into their home groups and share in the construction of meaning.



## Explanation

*Students write a claim and provide evidence and reasoning to support it.*

Students may wish to use the [Explanation](#) prompt to guide their writing.

- Have students use what they've discovered from their analyzed data to write an explanation that answers their investigation question. Have them write their explanation in their Lab Journal.
- Have students develop a **Claim** to answer the question: How does deforestation of the [Indonesian rainforest] affect the population of the [orangutan]?
- Then, have them add **Evidence** (the analyzed data) to support their claims.
- Finally, have them add **Reasoning** to their claims. Reasoning should include the information obtained from this investigation as well as science principles they have learned.

### Claim

*The population sizes of many species are dependent upon the amount of forest (habitat) available to them. As the amount of deforestation in Indonesia increases, the population of the orangutan decreases.*

### Evidence

*The evidence that supports this claim is shown in the graphs we made from our data. The overall trend seen in the deforestation graph is that the number of acres of forests that are lost has increased, and the amount of remaining tree cover is decreasing. This correlates with the population size graphs. As the amount of tropical rainforest deforestation increases, the population size of the orangutan decreases.*

### Reasoning

*Investigation: We searched credible Internet sites and recorded our data consistently. Our data shows a direct correlation between the amount of deforestation happening in the tropical rainforest and the number of species (population size) present. Specifically, the loss of habitat in Indonesia is steadily increasing. Since 2001, when hectare loss was at just over 200,000 ha., the area lost increased to nearly 840,000 hectares by 2012. At the same time, the population of orangutans has gone from 230,000 about 100 years ago to 104,000 on Borneo and a critically endangered 7,500 on Sumatra. As deforestation increases, the number of different species and the population sizes of those species decreases.*

*Science: We learned from the articles we read and from our class discussion that human activities play a large role in the loss of biodiversity in the tropical rainforest, as well as in the overall population sizes of different organisms. Several other species of animals and plants show a similar correlation between rate of deforestation and population size.*

### DISCOURSE

Have students conduct a [Present and Defend](#) to develop presentation skills as well as audience participation. Research teams present a summary of their investigation to the class. The class analyzes the information presented and asks clarifying questions, challenges and/or supports the arguments made, and even presents alternative explanations as appropriate. Research teams defend their explanation with evidence and reasoning. If students are doing the same investigation plan, choose 1 or 2 groups to share.



## Evaluation

*Students reflect on the investigation.*

- How confident am I in my results?
- What would my prediction be if I conducted this investigation again?

## Part 4

### INVESTIGATION ASSESSMENT AND EXTENSION



#### Application

Students demonstrate understanding of how rainforest deforestation affects population size of some species.

- Have students use their understanding of how deforestation causes many species to dwindle in population size to create an advertising program to convince corporations and/or government to reassess their plans for forest use.
- Have students discuss how scientists determine that species populations have disappeared (or are on the brink of extinction): Is this a direct result of deforestation or is this happening from other causes? (*white-faced spider monkeys, Brazilian bare-faced tamarins, giant otters*) Then, have students correlate what they know of the habitats of these species and how the habitats have changed.

#### Assessment

To assess understanding, ensure that students provide a thorough explanation of their investigation that shows they have obtained and evaluated evidence, and used it to construct a logical argument that shows causal links between deforestation and the changes in the number of individual species.

# INVESTIGATION PLAN

## SEEING THE TREES THROUGH THE FOREST

In this investigation, you will perform research and create graphs comparing rates of deforestation and changes in population sizes of several rainforest species.

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2. Search the Internet to obtain information about the rates of deforestation for your rainforest. Record your findings on the **Observation Form**.
3. Search the Internet to obtain information about the population changes of your species. Record your findings on the **Observation Form**.

The form is titled 'OBSERVATION FORM SEEING THE TREES THROUGH THE FOREST'. It includes fields for 'NAME' and 'DATE'. Below this, there is a line for 'Rainforest:'. The 'Rates of Deforestation' section contains a table with columns for 'Year', 'Amount Destroyed', and 'Percent Coverage', with 7 rows. The 'Population Size' section contains a table with columns for 'Year' and 'Population Size', with 7 rows. At the bottom right, it says 'Van Andel Education Institute | VAEI.org'.

You may use sites suggested below or you may find other sites that provide the needed information.

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# OBSERVATION FORM

## SEEING THE TREES THROUGH THE FOREST

NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

Rainforest: \_\_\_\_\_

### Rates of Deforestation

Year	Amount Destroyed	Percent Coverage

Species: \_\_\_\_\_

### Population Size

Year	Population Size