



## Designing Solutions to Preserve Biodiversity

### OVERVIEW

In this collaborative activity, students explore major biodiversity threats and design, present, and refine solutions for preserving biodiversity. They also consider the roles of local partners and potential constraints in developing and implementing their solutions.

The activity focuses on the five threats to [biodiversity](#) represented by the acronym **HIPPO** (habitat loss, invasive species, pollution, population growth, and overharvesting). It uses HIPPO as a framework for understanding anthropogenic drivers of biodiversity loss and to ground students' solutions.

The activity also leverages [Wild Hope](#), a series of short films that highlight species and ecosystems threatened by biodiversity loss, as well as people working to protect them. *Wild Hope* episodes are developed for general audiences, and they can be used to incorporate stories into the classroom to support student understanding and engagement.

This activity contains the following parts:

- In **Part 1**, students apply the HIPPO framework to a case study about the endangered Hawaiian monk seal (*Neomonachus schauinslandi*). They begin by joining “Expert Teams” to learn about specific HIPPO biodiversity threats, then design and present solutions to help address these threats for the monk seals in particular.
- In **Part 2**, students watch and take notes on a *Wild Hope* episode of your choice.
- In **Part 3**, students apply their growing understanding of HIPPO to the *Wild Hope* episode. They join “Biodiversity Response Teams” to document HIPPO threats impacting the system from the episode and then design, present, and refine a new solution that addresses the biodiversity loss shown in the episode.

This document contains multiple resources for using the activity with students, including the following (use links to go directly to each section):

- [background](#) information on biodiversity
- [teaching tips](#) describing pedagogical approaches
- a suggested [procedure](#) for implementing the activity
- [assessment guidance](#), including sample answers and additional information for the questions in the “Student Handout”

Additional information related to pedagogy and implementation can be found on [this resource's webpage](#), including suggested audience, estimated time, and curriculum connections.

### KEY CONCEPTS

- Biodiversity, the variety of life on Earth, is important for both ecological processes and human communities.
- Human activities can threaten biodiversity through habitat loss, invasive species, pollution, population growth, and overharvesting (represented by the acronym HIPPO).
- A variety of solutions can be designed to address biodiversity loss.
- Designing a solution includes defining a specific problem, identifying potential partners, considering constraints, and refining based on feedback.

## STUDENT LEARNING TARGETS

- Describe five major ways in which human activities threaten biodiversity: habitat loss, invasive species, pollution, population growth, and overharvesting.
- Design, present, and refine solutions for reducing the impacts of human activities on biodiversity.
- Describe potential partners and constraints for developing or implementing solutions.
- Evaluate and provide feedback on potential solutions presented by peers.

## PRIOR KNOWLEDGE

Students should be familiar with:

- what organisms need to survive (e.g., food and water, space and suitable shelter, an appropriate range of climatic and environmental conditions)
- ecosystem interactions (i.e., ecosystems are composed of a variety of organisms, which interact in ways that influence their population dynamics, distributions, and diversity)
- how human activities may impact stability and change within an ecosystem

## MATERIALS

- copies of the “Student Handout”
- copies of the “Hawaiian Monk Seal Comic”
- copies of the “Expert Team Information Sheets”
- a [Wild Hope](#) episode of your choice
- (optional) the “Slide Deck,” which contains the illustrations from the “Information Sheets”

## BACKGROUND

**Biodiversity** is the variety of life on Earth at all levels. It includes the types of plants, animals, fungi, and microorganisms found in one area or across different ecosystems (e.g., a habitat, a mountain range, a country, or a continent). Biodiversity can also be reflected by the genetic diversity it represents.

Biodiversity is important for the well-being of our planet for many reasons, including the following:

- it influences numerous ecological processes and global climates (through its effects on the water and carbon cycles).
- Specific species, such as [keystone species](#) or ecosystem engineers, play important roles in regulating populations and transforming ecosystem properties.
- Humans depend on biodiversity for many resources (e.g., food, fuels, medicines) and ecosystem services (e.g., pollination, erosion control, water management).

Currently, biodiversity is in crisis. According to the *Living Planet Report* ([WWF 2022](#)), wildlife populations have declined an average of 69% between 1970 and 2018. Other human impacts include loss of species, disruption of natural ecosystems, and ecological imbalances. These changes to biodiversity will have significant repercussions on ecosystems and human communities.

Although it is important for students to understand the magnitude of the problem and the human activities that lead to biodiversity loss, designing solutions also requires hope. This message of hope is central to the *Wild Hope* series, which explores successful and collaborative solutions to biodiversity threats.

## TEACHING TIPS

### Pedagogical Approaches

This activity uses the [jigsaw approach](#), a cooperative learning strategy in which “expert groups” of students familiarize themselves with a specific concept, then recombine into “jigsaw groups” to share and synthesize knowledge. This approach helps students develop teamwork skills and encourages them to direct their own learning.

- In [Part 1](#), students join **Expert Teams**, which are the expert groups. Each Expert Team focuses on one of the five HIPPO threats and how it specifically impacts the Hawaiian monk seal. At the end of Part 1, each Expert Team presents their assigned HIPPO threat and their proposed solution to the class.
- In [Part 3](#), students join **Biodiversity Response Teams**, which are the jigsaw groups. Each Biodiversity Response Team should contain students from all five Expert Teams. The Biodiversity Response Teams document HIPPO threats impacting a new system (from the *Wild Hope* episode) and apply their growing understanding to design new solutions. At the end of Part 3, each Biodiversity Response Team presents their ideas to their class and works to refine their solutions based on peer feedback.

Consider assigning or having each team choose a leader. The team leader should help manage time, facilitate and support a collaborative environment where all students participate, and help ensure that the team’s presentation reflects the collective ideas of the entire group.

You may also want to assign or have students choose who will present for each Expert Team and Biodiversity Response Team presentation before students begin Parts 1 and 3 of the activity, respectively. Choosing who will present helps students organize and prepare for their presentations.

### Adjusting Activity Length

To allow time for group work and discussions, this activity is designed to be conducted over three to four 50-minute class periods. Length may vary depending on students’ level of [prior knowledge](#), time for scaffolding, and your own goals for the class.

To reduce in-class time, consider the following options:

- In **Part 1**, students will need time to read the “Hawaiian Monk Seal Comic” and the relevant “Expert Team Information Sheet.” Consider assigning students to Expert Teams and having them read these materials as a homework assignment prior to the class activity.
- In **Part 2**, students watch an episode of *Wild Hope*, which may be about 30 minutes long. You could have students watch the episode as homework or select only specific parts to show in class.

You could also consider using only specific parts of the activity. Some examples:

- You could use only **Part 1**, which focuses on the Hawaiian monk seal case study. This will introduce students to the HIPPO framework and have them explore threats to and solutions for the monk seals only.
- You could use only **Parts 2–3**, which focus on the *Wild Hope* episode. You may need to provide some more background on biodiversity and HIPPO beforehand.

## PROCEDURE

### Before the Activity

Begin by providing a context for the activity that is relevant to your students and your classroom learning goals, which could include:

- a brief [background on biodiversity](#)
- student reflections on the importance of biodiversity to ecosystems and humans
- a brief introduction to HIPPO, which could include writing out what each letter in the HIPPO acronym represents on the board or providing a short explanation of HIPPO as a framework for grouping human

activities that negatively impact biodiversity. (A detailed explanation is not needed, as students will explore HIPPO more during Part 1.)

- an outline of the [pedagogical approaches](#) that will be used in this activity
- expectations for individual and group work, including how their work will be assessed

### **PART 1: Exploring Threats to and Solutions for the Hawaiian Monk Seal**

Part 1 uses the Hawaiian monk seal as a guiding phenomenon for understanding biodiversity and drivers of biodiversity loss, and designing solutions to preserve biodiversity. It can be used to address the driving questions “In what ways do humans impact biodiversity?” and “How can negative human impacts be addressed to preserve biodiversity?”

Divide the class into at least five **Expert Teams**, one for each of the five HIPPO threats (habitat loss, invasive species, pollution, population growth, and overharvesting).

- If there are not enough students for five teams, consider skipping population growth, as this often exacerbates the four other threats.
- If there are more than five teams, you can assign multiple teams to the same threat.
- Consider having team leaders and assigning presenters, as suggested in the [“Pedagogical Approaches”](#) section.

Give each Expert Team member a copy of the “Student Handout,” the “Hawaiian Monk Seal Comic,” and the “Expert Team Information Sheet” associated with their assigned threat. Inform students of the following:

- The “Hawaiian Monk Seal Comic” provides a brief introduction to the endangered Hawaiian monk seal and its biology.
- Each “Expert Team Information Sheet” highlights one of the five HIPPO biodiversity threats and how that threat specifically impacts the Hawaiian monk seal. The sheet also highlights some general (not exhaustive) solutions used to address the specific threat.
- Students will work with their Expert Team members to answer the questions in Part 1 of the “Student Handout” based on the threat they were assigned and their corresponding “Information Sheet.”

Also let students know the following:

- As explained in the “Student Handout,” each team will need to design a solution to address their assigned threat for the Hawaiian monk seal. Their team’s solution should be based on one of the general solutions in their “Information Sheet.” (This is so that students consider different types of solutions both now and in Part 3 of the activity.)
- Each team will present their solutions to the class. (Consider preselecting presenters, as suggested in the [“Pedagogical Approaches”](#) section.) There will be opportunities during the presentations to ask clarifying questions and to provide other teams with constructive feedback and suggestions.
- After the presentations, each team will have time to revise their solutions based on the questions and feedback they received.

### **Team Presentations**

Each Expert Team should present:

- their assigned HIPPO biodiversity threat (Questions 1–2 in the “Student Handout”)
- how that threat impacts the Hawaiian monk seal (Question 3)
- their team’s solution (Question 5) and its main steps for implementation (Question 6)
- potential partners (Question 7) and constraints (Question 8) for their solution

These presentations should summarize how each Expert Team understood their HIPPO threat and approached the design of their solution. Students can take notes on each team's presentation in Question 9 of the "Student Handout." Consider using the optional "Slide Deck," which has illustrations of all the HIPPO threats, to guide class discussion.

After each presentation, give students the opportunity to ask clarifying questions (or ask questions yourself if needed). This will help ensure that the key concepts and learning objectives are sufficiently addressed. Also give time for students to evaluate the proposed solutions and to give constructive feedback that will help each team refine their solution.

### **PART 2: Exploring a Biodiversity Case Study from *Wild Hope***

Students watch and reflect on a *Wild Hope* episode of your choosing. Visit the [Wild Hope landing page](#) to view all available episodes. Go to individual episode pages for additional materials, including transcripts and "at-a-glance guides" that summarize episode content.

Review potential episodes for suitability before assigning them to students. To choose the episode that is most relevant to your students and your classroom goals, consider:

- biodiversity threats and topics in each episode
- geographical locations (You may prefer a more local/regionally relevant example or an example in another area to which students can apply their learning.)
- people, groups, and communities represented
- types of solutions highlighted

As students watch the episode, they can take notes in Part 2 of the "Student Handout." The questions in Part 2 have students reflect on:

- biodiversity threats (including specific HIPPO threats) shown in the episode
- solutions used to address the threats and preserve biodiversity
- partners who helped develop or implement the solutions
- constraints on the solutions

### **PART 3: Designing Solutions for the *Wild Hope* Case Study**

Students now transfer their understanding from Part 1 to the *Wild Hope* episode.

Divide the class into new Biodiversity Response Teams that have at least one student from each of the five previous Expert Teams. Tell students that each Biodiversity Response Team is made up of students from each Expert Team, and that they will now use the knowledge they learned in their Expert Team to design a new solution for a biodiversity threat in the *Wild Hope* episode. They must use teamwork to:

- recognize the different HIPPO threats presented in the episode
- decide on a HIPPO threat that the team will develop a solution for
- design their solution, which should include potential partners and constraints

Remind students of the following:

- Again, each team will present their solutions to the class. (Consider preselecting presenters, as suggested in the "[Pedagogical Approaches](#)" section.) Similar to before, there will be opportunities to ask clarifying questions and to provide other teams with constructive feedback and suggestions.
- After the presentations, each team will have time to revise their solutions based on the questions and feedback they received.

### Team Presentations

Each Biodiversity Response Team should present:

- the specific HIPPO threat/problem that they plan to address (Question 13 in the “Student Worksheet”)
- their team’s solution for the problem (Question 14) and its main steps for implementation (Question 15)
- potential partners (Question 16) and constraints (Question 17) for their solution

As in [Part 1](#), after each presentation, give students the opportunity to ask clarifying questions (or ask questions yourself, if needed, to ensure that the class understands the key concepts). Again, give students time to evaluate the proposed solutions and to give constructive feedback that will help each team refine their solution.

### ASSESSMENT GUIDANCE

The [presentations and discussions in Part 1](#) could serve as a formative assessment of students’ growing understanding of [key concepts](#) and demonstration of [learning targets](#). This is also an opportunity to provide feedback and guidance in preparation for Part 3. The [presentations and discussions in Part 3](#) can then serve as a summative assessment for students.

The following are sample answers for questions in the “Student Handout.” These answers highlight key points to help you anticipate student responses, but you are encouraged to accept varied responses to promote student inquiry, understanding, and confidence. Many of the questions are designed as open-ended opportunities for students to guide their own interests, understanding, and reasoning. Answers may also vary depending on the *Wild Hope* episode shown in [Part 2](#).

#### PART 1: Exploring Threats and Solutions for the Hawaiian Monk Seal

1. Which HIPPO biodiversity threat is your Expert Team focusing on?  
***Students should list their assigned HIPPO threat (habitat loss, invasive species, pollution, population growth, or overharvesting).***
2. Summarize your threat and the types of human activities that contribute to it.  
***Students should construct a concise description of their assigned HIPPO threat based on the longer descriptions in their “Expert Team Information Sheet.”***  
***Example answer for habitat loss:***  
***Habitat loss is when organisms lose places that they rely on for resources, such as food and shelter. Human activities that contribute to habitat loss include agriculture/farming, deforestation, and building cities/human structures.***
3. How does your threat impact the Hawaiian monk seal?  
***Students should construct a concise description of how their HIPPO threat impacts the Hawaiian monk seal based on their “Expert Team Information Sheet.”***  
***Example:***  
***Habitat loss can impact the Hawaiian monk seal in two ways. First, as more beaches are developed or used by people, less beach habitat is available for the monk seals to rest and raise their pups. Second, as ocean habitats change (due in part to climate change), the monk seals have fewer places to get food.***
4. With your Expert Team, pick a problem that affects the Hawaiian monk seal, *based on your HIPPO threat*, that your team plans to address. Describe the problem that your team chose, being as specific as possible.  
***Students should specify the problem that they will design a solution for. It is important for them to be specific, as each HIPPO threat impacts the monk seals in a variety of ways.***



**Example:**

*The problem we chose is the loss of the monk seals' beach habitats due to human use and development.*

5. Describe your team's solution, including *how* your solution would specifically address the problem. *The solution should address the specific problem in Question 4 and align with one of the general solutions in the students' "Expert Team Information Sheet." They should also explain how the solution resolves the issue.*

**Example:**

*Our solution is to develop a series of protected beach areas where humans are not allowed to go. Monk seals could rest and raise their pups in these protected areas without being disturbed. Since the monk seals have pups in the spring and summer, we would prioritize protecting the beaches they visit during these times.*

6. List **five** main steps needed for your solution. For example, what types of information, resources, actions, or activities might be required to successfully develop or carry out your solution?

*Students should list steps that go through the details of constructing and implementing their proposed solution.*

**Example:**

1. *Determine which beach areas the monk seals currently use and when.*
2. *Determine the areas that we could purchase and that are not currently protected.*
3. *Determine how much money we need to purchase and manage these areas.*
4. *Start an organization that will work to raise money and hire people to manage the areas.*
5. *Bring in celebrities and social influencers to get the word out and raise money.*

7. Describe **three** specific partners that you could work with to develop or implement your team's solution.

*Examples are shown in the following table.*

Partner	Connection to the problem or solution	Potential role in your solution
<i>Conservation organizations</i>	<i>They may have more experience with protected areas and could also be working on other projects to help the monk seals.</i>	<i>These organizations could help us raise money and figure out how to manage the protected areas.</i>
<i>Local schools</i>	<i>Students at the schools may know about the monk seals and be interested in protecting them.</i>	<i>The students could teach their families, friends, and communities about the monk seals and how we can protect them.</i>
<i>Local hotels</i>	<i>Guests staying at the hotels may visit the beaches and come into contact with the monk seals.</i>	<i>The hotels could tell their guests to avoid the monk seals and spread awareness of the protected areas.</i>

8. List **two** potential constraints on your team's solution. Describe how these constraints might limit the implementation of the solution. *Students should list two constraints and describe how they would impact their solution. Potential types of constraints could include:*

- **financial cost**
- **time needed to implement the solution or achieve results**
- **environmental impacts**
- **human needs and safety**
- **legal requirements or restrictions**
- **cultural values**
- **aesthetics**
- **complexity**
- **reliability, longevity, or sustainability**

9. Take notes on each Expert Team’s presentation in the following sections. (You can skip the section for your own team.) Evaluate their proposed solution and provide constructive feedback, which could include suggestions or additional considerations that they could use to improve their solution. Be prepared to ask clarifying questions and to share your feedback with the other teams.

**Students can use this space to take notes on the presentations for each team. Refer to the [Part 1 Team Presentations procedure](#) for more information.**

10. After the presentations, work with your own Expert Team to list **three** ideas for improving your team’s solution. This could include addressing feedback or additional considerations.

**Students’ revisions should reflect their growing understanding, new ideas from the class discussion, and feedback they may have received. These revisions could include:**

- **improved descriptions of the problem or solutions**
- **additional important steps in the process**
- **additional partners or constraints**

## PART 2: Exploring a Biodiversity Case Study from *Wild Hope*

11. While watching the episode, take notes on the following topics. These notes will be helpful for the next part of the activity.

**Students’ notes will vary depending on the episode you selected. These notes can be used to guide their solutions in Part 3.**

a. What **biodiversity threats** (e.g., human activities that lead to biodiversity loss) were shown in this episode? Identify specific HIPPO threats (habitat loss, invasive species, pollution, population growth, or overharvesting) and provide evidence to support your claims.

**Each episode highlights several HIPPO threats, and students may also recognize threats that were not the central focus of the episodes. Students should provide evidence in support of each threat they document.**

b. What **solutions** were used to address the threats, and how can they help preserve biodiversity?  
**Answers will vary depending on the episode. For example, students may note that an education program was created to raise awareness of a biodiversity issue, or that community members worked together to carry out a specific project.**

c. What **partners** helped implement or develop the solutions?  
**Answers will vary depending on the episode. Examples may include local community members, scientists, spiritual leaders, conservation biologists, farmers, the military, local landowners, etc.**

d. What were the **constraints** on developing or implementing the solutions?  
**Answers will vary depending on the episode. Refer to Question 8 for some potential constraints.**

## PART 3: Designing Solutions for the *Wild Hope* Case Study

12. With your Biodiversity Response Team, complete the following table to describe how each HIPPO threat could apply to the *Wild Hope* episode that you watched. It will be helpful to reference your notes from Part 2. For each threat:



- Describe **examples** that provide evidence of that threat in the episode. If the threat was not shown directly in the episode, suggest a potential example of how it might apply in this situation.
- Describe specific **solutions** that people in the episode used to address the threat. If a solution for that threat was not presented in the episode, leave this part blank.

***Students should list the HIPPO threats they found evidence for in the episode, as well as any solutions that were shown. Not all of the threats will have solutions shown in the episode. Threats without a solution could be a starting point for students to design their own solutions.***

13. With your Biodiversity Response Team, pick a problem, *based on a HIPPO threat you described in Question 12*, to develop a solution for. Describe the problem that you chose, being as specific as possible.  
***Students should describe the problem they will address and the specific way in which it impacts biodiversity in the episode.***
14. Describe your solution, including *how* your solution would specifically address the problem.  
***Students should summarize their solution and explain how it would address the problem they specified in Question 13. Their solution could be based on one of the general solutions from the “Information Sheets” from Part 1. Refer to Question 5 for an example answer.***
15. List **five** main steps needed for your solution. For example, what types of information, resources, actions, or activities might be required to successfully develop or carry out your solution?  
***Students should list steps that go through the details of constructing and implementing their proposed solution. Refer to Question 6 for an example answer.***
16. Describe **three** specific partners that you could work with to develop or implement your team’s solution. You may want to review your answers to Question 7 for ideas.  
***Refer to Question 7 for a list of possible partners and roles.***
17. List **three** potential constraints on your team’s solution. Describe how these constraints might limit the implementation of the solution. You may want to review your answers to Question 8 for ideas.  
***Refer to Question 8 for a list of potential constraints.***
18. Take notes on each Biodiversity Response Team’s presentation in the following sections. Similar to what you did in Part 1, evaluate their proposed solution and provide constructive feedback. Be prepared to ask clarifying questions and to share your feedback with the other teams.  
***Students can use this space to take notes on the presentations for each team. Refer to the [Part 3 Team Presentations procedure](#) for more information.***
19. After the presentations, work with your own Biodiversity Response Team to list **three** ideas for improving your team’s solution. This could include addressing feedback or additional considerations.  
***Similar to Question 10, students’ revisions should reflect their growing understanding, new ideas from the class discussion, and feedback they may have received.***

## OPTIONAL EXTENSIONS

This activity was designed as an introduction to biodiversity, the impacts of human activities on the environment, and potential solutions for biodiversity loss. To further examine theories of biodiversity, the importance of biodiversity to ecosystems, and human impacts on biodiversity and the environment, students could explore additional BioInteractive resources:

- The short film [From Ants to Grizzlies: A General Rule for Saving Biodiversity](#) can be used to introduce students to patterns of biodiversity with an emphasis on island biogeography, the species-area relationship, and human impacts. These concepts could be further examined using the [“Exploring Island Biogeography](#)

[through Data](#)” activity, or a variety of [biodiversity](#) and [WildCam](#) activities highlighting Gorongosa National Park in Mozambique.

- [BiomeViewer](#) is an interactive module that explores biomes, climate, biodiversity, and human impacts around the globe and at different times. Students could use this resource to explore patterns of biodiversity across Earth.
- [The Making of Mass Extinctions](#) is an interactive module that explores the environmental factors involved in five major mass extinctions. It could lead into [The Anthropocene: Human Impact on the Environment](#), which explores key human impacts on the environment and how they have affected Earth’s landscape, ocean, atmosphere, and biodiversity.
- A variety of BioInteractive films (e.g., [trophic cascades](#), [food webs](#)) and interactive media (e.g., [keystone species](#)) can be used to explore how species influence ecosystems and biodiversity patterns.
- BioInteractive’s short film [The Science of Climate Change](#) and [“The Impact of Wildfires”](#) activity could transition into other ways that humans can impact the environment and biodiversity.

This activity could also support a broader curriculum through extensions such as the following:

- Have students refine their Part 1 solutions by doing additional research on the Hawaiian monk seal. The [National Oceanic and Atmospheric Administration \(NOAA\)](#) and the [Marine Mammal Center](#) provide additional information and data about the biology of the Hawaiian monk seal, factors contributing to their decline (including aggressive monk seal males, shark predation, pollution, diseases, etc.), current solutions being applied, and recent news stories.
- Have students refine their Part 3 solutions by doing additional research on the story in the *Wild Hope* episode. Visit individual episode pages, listed on the [Wild Hope landing page](#), to find more resources as they become available.
- Have students transfer their learning to local conservation issues. They could explore ways to become active in the protection of biodiversity.
- Incorporate visual and conceptual models into the activity to help students make their reasoning more transparent and to organize and clarify their thinking ([Wilson et al. 2020](#)). Models can also be used as a tool to guide discussions and presentations to assess learning. For example, students could create models that outline how the different HIPPO threats impact focal organisms and/or are influenced by human activities.
  - The interactive tool [Model Builder](#) could support this modeling approach, particularly if there are certain models that students are expected to construct or learn.
  - The interactive module [Understanding Global Change](#) allows students and educators to build models that explain how the Earth system works and how human impacts influence this system.

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### Pedagogical Approaches

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### CREDITS

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