

## Good “grief”! The corals are dying!

Scientists are sometimes asked to use their knowledge to design a solution to a problem. You are doing a summer internship in the Florida Keys. Some of the coral reefs there, like others around the world, are dying for various reasons.

Your science professors have asked you to design an artificial reef to help maintain biodiversity in the area. You will make a detailed sketch of your design. As a final project, you will present your design to the science professors.



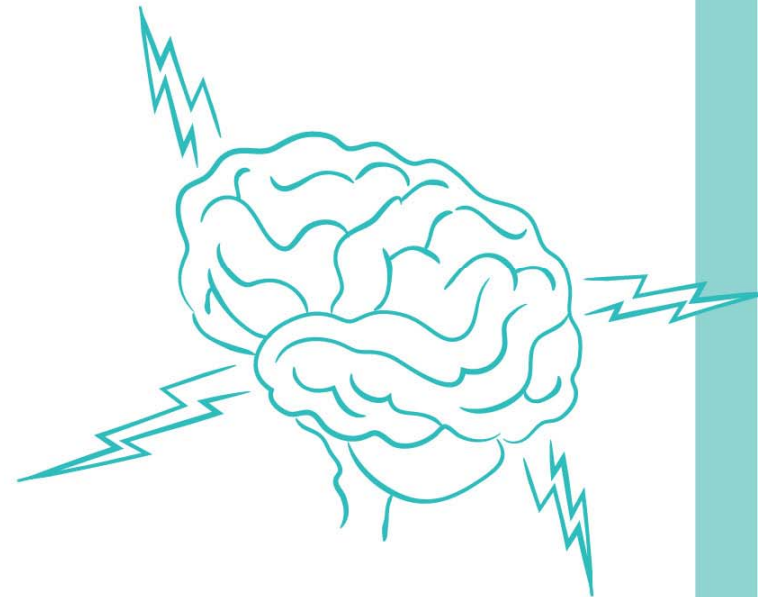
# Get Started!

- Research more information about biodiversity.
  - Define *biodiversity*.
  - How is biodiversity important to the health of ecosystems?
  - What are the main threats to biodiversity?
- Research more information about coral reefs.
  - How are they structured?
  - Why are they important to biodiversity on Earth?
  - What factors are threatening the health of coral reefs?
  - What are artificial reefs?



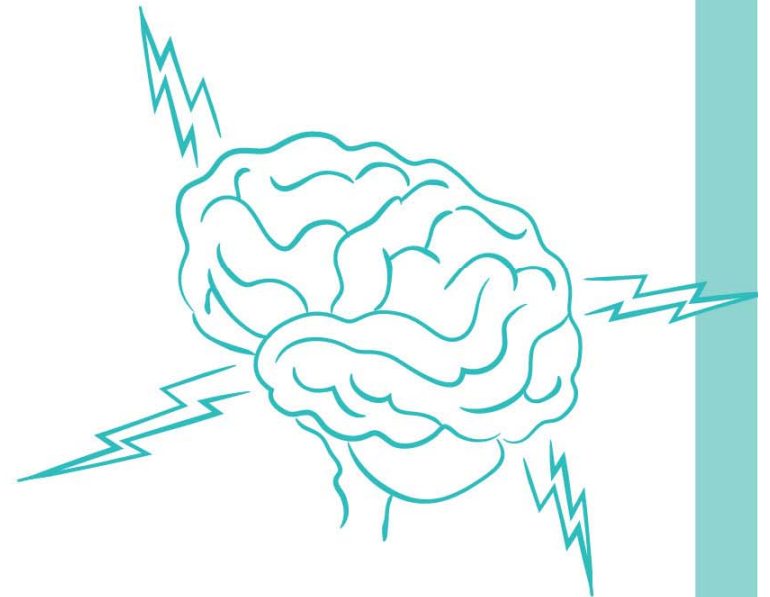
# Brainstorm Solutions!

- Plan a design for an artificial reef. Consider the following constraints and criteria as you plan.
  - Where will your artificial reef be located?
  - What materials will you use to construct your artificial reef? Can you recycle any materials to build your reef? Remember, the structure must be able to remain underwater indefinitely and it should not release chemicals that could harm living organisms. Also, organisms will need to be able to attach themselves to the reef. How will the texture of your materials accommodate this behavior?
  - How will you anchor your reef to the bottom so that it does not move? Keep in mind that your reef will need to be able to withstand waves and storms, including hurricanes.
  - What will be the dimensions of your reef?



## Brainstorm Solutions! continued

- How will your reef mimic the different types of habitats on a real coral reef? How will the design of your reef attract the same species that live on a real coral reef? Organisms should be able to move over, under, or through it in various places.
- What economic considerations do you need to think about? How much will your reef cost to build? Will it cost any money, time, or equipment to maintain it?
- Do you need to consider the culture of the people living near the location of your reef? Do they make their living by fishing on a coral reef? Do they rely on the fish and other organisms living on coral reefs for food? Are tourism and/or ecotourism important to the region?
- How will the colonization and biodiversity of species on your reef be monitored after becoming established?



# Work Through It!

- Finalize your design plan.
- Make a detailed sketch of your design. Include labels or a key that identifies the materials used. Be sure to include the scale at which your sketch is done as well.
- Check your design and sketch against the constraints and criteria listed previously. Finalize your design and sketch.
- Prepare a presentation for your science professors.
  - Include background information on the importance of coral reefs to biodiversity and the current threats to and health of coral reefs worldwide.
  - Include an explanation of your design and why you think it will be successful.
  - Address any of the constraints listed previously and explain how biodiversity on your reef will be monitored.





# Finish Up!

- Evaluate your design.
  - Did you take all of the constraints and criteria into consideration? Why or why not?
  - What are some strengths and weaknesses of your design?
  - How could your design be improved?
- Compare your design to those of other interns. Evaluate their designs.
  - What are some of the strengths of their designs? What are some of the weaknesses?
  - How could the various strengths from all of the designs be incorporated into a single design that would be highly successful as an artificial reef?



# Good “grief”! The corals are dying!

## Project Overview

Scientists are sometimes asked to use their knowledge to design a solution to a problem. Your students are doing a summer internship in the Florida Keys. Some of the coral reefs there, like others around the world, are dying for various reasons.

Your students’ science professors have asked them to design an artificial reef to help maintain biodiversity in the area. Students will make a detailed sketch of their design. As a final project, they will present their design to the science professors.

- Students will research information about biodiversity, coral reefs, and artificial reefs.
- Students will plan a design for an artificial reef according to the constraints and criterion provided.
- Students will make a detailed sketch of their design. They will prepare a presentation that explains their design.
- Students will evaluate the strengths and weaknesses of their own design and identify ways to improve it.
- Students will evaluate competing design solutions.

## Objective

The goal of this project is to help students make a real-world connection to the following Life Science topic(s):

- Biodiversity is the variety of species found in Earth’s ecosystems.
- An ecosystem’s biodiversity is directly related to its health.
- There are systematic processes for evaluating solutions with respect to how well they solve a problem.

## Before You Begin

- Based on class size and student ability, have students work in groups of 2–4.
- Allow 5 class periods for this activity.
- Students will need access to computers and the Internet for research purposes.
- Prepare appropriate documents on how humans have designed solutions to maintain or restore biodiversity in other ecosystems. Examples include creating alternate routes around bridges or roads so that migration routes are not blocked, relocating predators, or building salmon bridges so the fish can still move upstream despite a dam.
- Prepare materials students may need to sketch their designs, such as computer software or drawing materials to make a blueprint.

## Additional Resources

The following information can be used to guide student research.

### Key Terms to Research

- Biodiversity
- Threats to biodiversity
- Environmental engineering
- Coral reefs
- Threats to coral reefs
- Artificial reefs
- Design constraints
- Design criteria



### Key Web Sites

- National Oceanic and Atmospheric Administration (NOAA)
- Woods Hole Oceanographic Institute (WHOI)
- Florida Department of Environmental Protection

### Rubric

Performance assessment rubrics can be found in **Blueprints for Success**.

### Guide the Investigation / Suggested Pacing

#### Day 1

##### **Good “grief”! The corals are dying! Slide**

- Introduce the project by reading the slide titled **Good “grief”! The corals are dying!**
- Distribute and review materials about biodiversity. Identify any misconceptions students may have about biodiversity.
- Distribute and review materials about solutions humans have used to maintain or restore biodiversity in other ecosystems. Examples include creating alternate routes around bridges and roads so that migration routes are not blocked, relocating predators, or building salmon bridges so the fish can still move upstream despite a dam.

### **Get Started! Slide**

- Have students divide up the research work on the **Get Started!** slide. Half of the group can research information on biodiversity, while the other half can research information about coral reefs. Then have each subgroup report their findings to the other.
- Check in with students to make sure they understand why maintaining biodiversity is important not just within an ecosystem, but also on Earth in general. How do humans benefit from high biodiversity? How do all living organisms benefit from high biodiversity?

## **Day 2**

### **Brainstorm Solutions! and Brainstorm Solutions! continued Slides**

- Read through the constraints and criteria for the design of the artificial reef listed on the **Brainstorm Solutions!** and **Brainstorm Solutions! continued** slides. Make sure students understand what each one means and why it is important to consider as they plan their design.
- Remind students to use the information they learned about coral reefs as they plan their design. The artificial reef should attract as many of the same species as possible that would live on a real coral reef.
- Remind students to think about the composition of the ocean floor when they are planning how to anchor their reef.
- Students may need to perform additional research on the local culture once they have determined the location of their reef. Have them consider both the possible positive and negative impacts their reef could have on the local society.
- The level of biodiversity on their reef will be one of the measures of its success (a criterion of the design).
- Students may need to perform additional research on how biodiversity is monitored on coral reefs or in other aquatic ecosystems.

## **Day 3**

### **Brainstorm Solutions! and Brainstorm Solutions! continued Slides**

- Guidelines specified on **Day 2** should continue.
- Make sure all students in the group participate in the discussions of the points on the **Brainstorm Solutions!** and **Brainstorm Solutions! continued** slides. Encourage students to take notes in response to each point on these slides.
- Students may generate questions as they work through the points on the **Brainstorm Solutions!** and **Brainstorm Solutions! continued** slides. Allow them to research as needed to find the answers.

## **Day 4**

### **Work Through It! Slide**

- Check students' design plans. Ask guiding questions if you see a glaring problem.
- Remind students to make their sketches neat and legible. They should include any labels needed. They should also include the scale at which their sketch is drawn.
- Remind students to keep their audience in mind as they prepare their presentations. University science professors will have excellent working knowledge of science terms and concepts.
- Students should use the information they found while researching from the **Get Started!** slide to prepare their presentations.

## **Day 5**

### **Finish Up! Slide**

- Have each group share its design. Groups should then evaluate the designs presented.
- Ask students guiding questions to help them determine the strengths and weaknesses of the different designs. Remind them that they are offering constructive criticism, not negative comments.
- You may choose to have students prepare a written response to each question on the **Finish Up!** slide.