



Name: _____

Date: _____

Student Exploration: Coral Reefs 2 – Biotic Factors

[Note to teachers and students: This lesson was designed as a follow-up to the Coral Reefs 1 – Abiotic Factors lesson. We recommend doing that activity before trying this one.]

Vocabulary: biotic factor, black band disease, invasive species, white band disease

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

In 1992, Hurricane Andrew left a wake of destruction through Florida. One victim of the storm was a reptile-breeding facility. Over 900 Burmese pythons were set free, and today thousands of pythons live in Florida. These pythons are an **invasive species**, or a harmful species not native to the region.



1. What impacts do you think the Burmese pythons might have on local ecosystems?

2. In general, why might ecologists be concerned when new invasive species arrive in an ecosystem? _____

Gizmo Warm-up

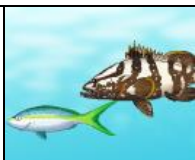
Like terrestrial environments, coral reefs can be damaged by invasive species. Reefs are also impacted by disease-causing bacteria, humans, and other **biotic factors**, or living parts of the ecosystem. In the *Coral Reefs 2 – Biotic Factors* lesson, you will explore how these factors affect coral reefs.



1. On the CONDITIONS tab, select **Fishing**. Set **Net fishing** to 50%. Click **Advance year** 10 times. What changes do you notice on the **Coral reef** tab? _____

2. On the DATA tab, select every organism. What happens to the reef populations? _____



Activity A: Fishing regulation	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Click Return to original settings and Restart. • On the CONDITIONS tab, check that Fishing is selected. 	
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Introduction: Fishing is a major part of many Caribbean economies. The yellowtail snapper and Nassau grouper are important food fishes. However, a lack of adequate regulation has led to overfishing in many areas and consequent damage to reefs. The goals of this activity are to observe the effects of overfishing and determine how much fishing the reef can withstand.

Question: What are the effects of fishing on the reef ecosystem?

1. Describe: On the CORAL REEF tab, click on the stoplight parrotfish, queen angelfish, yellowtail snapper, and Nassau grouper. Describe what each of these fishes eat.

Stoptlight parrotfish: _____ Yellowtail snapper: _____

Queen angelfish: _____ Nassau grouper: _____

2. Predict: Set **Grouper** to 70%. How do you think this level of fishing will affect the populations of the other fish in the simulated reef? Explain your reasoning.

3. Experiment: Select the DATA tab, and check that every species is selected. Click **Advance year** 10 times. Which fish populations increased, and which fish populations decreased?

4. Explain: Why do you think the snapper population changed the way it did? _____

5. Predict: Click **Return to original settings** and **Restart**. Set **Snapper** to 70%. How do you think this will affect the other fish populations? Explain your reasoning.

(Activity A continued on next page)

Activity A (continued from previous page)

6. Experiment: Click **Advance year** 10 times. What changes occur? _____

7. Explain: Explain the results of the last experiment. Why did the grouper, parrotfish, and angelfish populations rise? Why did the sea urchins decline? How did this affect algae?


8. Explore: Click **Return to original conditions** and **Restart**. Experiment with different levels of **Net fishing**. Net fishing kills all fish approximately equally. It also can damage delicate corals. For each experiment, run the simulation for approximately 40 years to see the long-term effects on the reef. Summarize the results of each experiment in the table below.

Net fishing level	Results
20%	
40%	
60%	
80%	

9. Draw conclusions: What level of net fishing can the model reef sustain? _____

Explain. _____



Activity B: Disease	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Click Return to original settings and Restart. • On the CONDITIONS tab, select Disease. • On the DATA tab, select every organism. 	
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Introduction: Corals are susceptible to many diseases, including **black band disease** and **white band disease**. Other reef animals are also affected by disease. For example, in 1983 a mysterious plague wiped out most of the long-spined sea urchins throughout the Caribbean.

Question: How are reefs impacted by disease?

1. Observe: Select the **CORAL REEF** tab. Set the **Black band infection rate** to 100%. Click **Advance year** several times. Which coral appears to be affected, and what do you see?

2. Predict: How do you think the reef will change when black band disease is present? _____

3. Observe: Click **Advance year** until you reach year 20. What changes do you see? _____

4. Analyze: Look at the coral populations in the **DATA** tab. Why do you think the population of staghorn corals increased? _____

5. Observe: Select the **CORAL REEF** tab. Click **Return to original settings** and **Restart**. Set the **White band infection rate** to 100%. Click **Advance year** two times. What do you see?

6. Observe: Click **Advance year** to year 20. What changes do you see? _____

Confirm your observations by viewing the **DATA** tab.

(Activity B continued on next page)



Activity B (continued from previous page)

7. Set up the Gizmo: Click **Return to original settings** and **Restart**. Coral diseases often crop up in reefs that are already stressed by high temperatures, high nutrient levels, or low pH. To model these conditions, select **Ocean conditions**. Set the **Ocean temperature** to 29 °C and **Ocean pH** to 7.7. Then, select **Land use** and set **Agriculture** to 50%. Finally, select **Disease** and set the **Black band infection rate** and **White band infection rate** to 100%.

Select the SUMMARY tab. What is the current coral stress level? _____

8. Predict: How do you think stressed corals will respond to disease? _____

9. Experiment: Click **Advance year** to year 20. How does the impact of disease in a stressed reef compare to the impact of disease in a healthy reef? (To make a direct comparison, run an experiment with the original settings and black and white band infection rates of 100%)


10. Predict: On the CONDITIONS tab, click **Return to original settings** and **Restart**. To model the die-off of long-spined sea urchins in 1983, set the **Sea urchin infection rate** to 90%.

How do you think this will affect the reef? _____

11. Experiment: Click **Advance year** to year 20. What changes occurred? _____

12. Infer: Parrotfish rely on corals for protection and shelter. Look at the parrotfish population over time. Why did the parrotfish population increase at first and then later decline?



Activity C: Invasive species	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Click Return to original settings and Restart. • On the CONDITIONS tab, click Invasive species. 	
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Introduction: A native of the Pacific Ocean, the red lionfish were first observed in the Atlantic Ocean in 1985. Red lionfish are voracious predators and are well protected by their toxic spines. Today they have spread throughout the Caribbean.

Question: How do invasive species affect reefs?

1. Predict: Select the **Red lionfish** checkbox. How do you think lionfish will affect the reef?

2. Observe: Select the **SUMMARY** tab. How many fish species are present on the reef? _____

3. Experiment: Click **Advance year** to year 20. What changes occur to the reef? _____

4. Observe: Look at the **SUMMARY** tab. How many fish species are present now? _____

5. Predict: How do you think the reef will react to a lionfish invasion if there are no sea urchins?

6. Experiment: Click **Restart**. On the **CONDITIONS** tab, select **Disease**. Set the **Sea urchin infection rate** to 100%. Click **Advance year** to year 20.

A. How did the lack of sea urchins change the effect of lionfish on the reef? _____

B. Explain these results. _____

(Activity C continued on next page)



Activity C (continued from previous page)

7. Predict: Click **Return to original settings** and **Restart**. On the CONDITIONS tab, select **Invasive species** and select the **Crown-of-thorns starfish** checkbox. The crown-of-thorns starfish is a native of the Pacific Ocean that has not invaded the Caribbean Sea—yet.

A. What does the crown-of-thorns starfish eat? _____

B. How do you think the crown-of-thorns starfish would affect Caribbean reefs? _____

8. Experiment: Click **Advance year** to year 10. What happens? _____

9. Extend your thinking: Click **Return to original settings** and **Restart**. Many Caribbean reefs face multiple environmental and biological threats. You can use the *Coral Reefs Gizmo* to design your own experiment to see how a combination of factors affects the reef. You can also design an experiment to see how quickly a reef recovers from a disturbance.

In the space below, describe your question, experimental design, experimental results, and conclusions. Continue on additional pages if necessary.

Question and hypothesis: _____

Experimental design: _____

Results: _____

Conclusions: _____

