



# Everblue Education

## Restore the Reef

We've learned so much about the diverse and amazing biological communities in coral reefs in our previous lessons! Unfortunately, many of these communities around the world are in trouble. In this lesson, students will think about how natural spaces they know have been changed by humans. They will also play a game where they get to manage a community fishery just like the community in this lesson's research paper by scientists Ruleo Camacho and Robert Steneck!

Everblue is a 501(c)(3) nonprofit dedicated to encouraging ocean-conscious living by increasing scientific literacy. Our online education resources connect current science to daily life, allowing you to learn about the ocean at your fingertips! Stay in touch by following @oceaneverblue on your preferred social media platform or by visiting our website at [www.oceaneverblue.org](http://www.oceaneverblue.org).

To help us keep the ocean ever blue, please share this program with the teachers and parents you know so we can spread ocean science far and wide. Partnering with marine scientists from around the world who study all parts of the ocean, we've created simple and engaging activities based on recently published papers! These activities connect you and your students to current research while fulfilling education standards for reading, math, science, and writing. Even though the activities are created for grade school, they're fun and informative for parents and siblings, as well! More activities will be available to download for FREE off of our website, with a new activity added every month.

### Research Paper:

Creating a TURF from the bottom-up: Antigua's community-based coral reef no-take reserve. *Ruleo Camacho and Robert Steneck. 2016.*

### Grade Level:

4-8

### Timing:

60 - 85 Minutes

### Materials:

Small objects to represent "fish" (Legos, dry beans, dry pasta, etc.), something to hold "fish," bowl or string, writing utensils, paper

### Common Core State Standards

English Language Arts: Presentation of Knowledge and Ideas Vocabulary Acquisition and Use	Math: Operations & Algebraic Thinking
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### Next Generation Science Standards

Science & Engineering Practices: Obtaining, Evaluating, & Communicating Information	Crosscutting Concepts: Stability & Change Cause & Effect	Disciplinary Core Ideas: Earth & Human Activity Ecosystems
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### Activity Overview

Title of Activity	Learning Cycle Stage	Time
Healthy or Unhealthy?	Invitation, Exploration	5 - 10 minutes
Managing a Fishery	Concept Invention	20-30 minutes
Peer into the Past	Application	30 minutes
Reflection	Reflection	5 minutes

### Appendix Contents

Appendix I Instructor Support	Appendix II Attached Lesson Materials
Ocean Vocabulary Common Questions	Game Cards



## Activity

### Healthy or Unhealthy?

In this activity, students will visualize and describe what they think the difference is between healthy and unhealthy reef ecosystems. (You may want to take brief notes in steps one and two to help the comparison in step three.) Note - There are no right or wrong answers in this activity. More information will be given about healthy and unhealthy reef communities in the later activities.

1. Have students close their eyes and ask them to visualize and describe a healthy coral reef.
2. Have students keep their eyes closed and this time ask them to visualize and describe an unhealthy coral reef.
3. Ask your students about some of the differences between the two visualizations.
4. Have students think about any experiences with ocean communities - *Finding Nemo*, aquariums, documentaries, etc. Ask students if they think those experiences were with healthy or unhealthy ecosystems.
5. Depending on their answer, ask your students what they think humans could do to keep this ecosystem healthy or help it become healthy.

### Managing a Fishery

*See our previous lessons “Tropical Reef Communities” and “Return to the Reef: Coral Bleaching” to learn more about corals and healthy reef communities.*

#### Background information:

Reefs are important to the health of so many animals, including humans! There are many small fishing villages and towns around the world that depend on tropical coral reefs to get their food. Reefs are also a big source of income for these communities since they can sell their catches at markets. Because these ecosystems are so important to these fishing communities, it's extra important for them to take care of their reefs so that they can continue to harvest from them far into the future.

Sometimes governments will issue laws setting limits on how many fish and other organisms can be removed from reefs. However, this doesn't always help the reef. Not all governments are able to enforce the laws they give around fishing, since it takes a lot of funding and resources to do so. Another way to regulate reef fisheries is for the people who use them to regulate themselves and their communities. This kind of fishery regulation is sometimes called a

**territorial use rights fishery**, or **TURF** for short. In a TURF, the community decides to set aside part of their reef as a reserve area where fishing is not allowed. This will eventually lead to more fish in the areas where they can still take fish, since the reserve acts as a place for fish to reproduce and then “**spillover**” into the surrounding sea. Increasing numbers of fish inside the reserve means that some of the fish will leave the reserve and be caught by fishermen. Ultimately, the reserve means more fish over the entire reef!

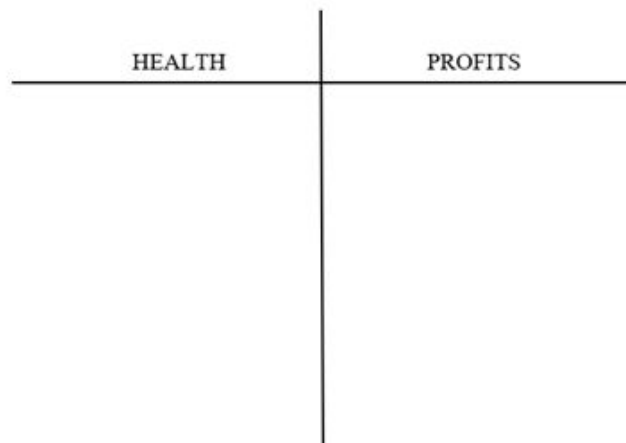
Game setup:

*For this activity, students will be playing a game to see what it is like to be members of a newly formed TURF. Students will work together to beat the game and achieve various goals, listed below. You, the instructor, will act as the “game master.”*

Welcome fishers! Today is the first day that our community will be using our reef as a TURF. Remember, this means that we won’t be fishing inside the reserve part of the reef.

How to start the game:

1. On the surface you are using for game play, designate an area to be the “reserve” where no fishing is allowed. Designate another area as the “fishable area”. You can do this with a bowl, piece of paper, looped piece of string, or whatever other object is convenient. Label each area accordingly.
2. Place 2 “fish tokens” per player in both the reserve and the fishable area (e.g. if you have 5 players, place 10 fish tokens in the reserve and 10 in the fishable area).
  - a. “Fish tokens” can be any small objects you have at home, such as dry beans, Legos, coins, etc.
3. Give each player a piece of paper and have them make two columns, one labeled HEALTH and the other PROFITS, as in the image below:



4. Print out game cards (provided in Appendix II; alternatively, if you do not have access to a printer, you can write out the instructions on the cards on pieces of paper). Stack them facedown in the game play area.

- a. Some game cards have specific instructions on them that alter game play. Cards entitled “Another Day, Another Fish” do not have any specific actions associated with them; simply add the normal amount of fish, if appropriate, for that day.
5. Keep a separate container with additional fish tokens as a “market/bank” that the game master can draw fish from.

Rules of game play:

1. During each turn, each player harvests fish from the fishable area outside of the reserve, which they can choose to sell or feed to their families, or give to another player in need. Each fish a player chooses to sell equals one point in the PROFITS section of their scorecard, while each fish they keep for themselves and their families equals one point in the HEALTH section. A player can take as many fish as they want on their turn, but they **must** take at least one (because people have to eat every day), even if the only fish left are in the reserve. Of course, the goal is to manage the fishery well, being careful enough about taking fish from the fishable area that players don’t have to take fish from the reserve.
  - a. If a player only takes one fish token on a turn, that token **must** go to feed them and their families. If they take multiple fish in a turn, then they may choose to distribute some of those points to their PROFITS.
  - b. A player can also choose to give one or more of their fish to another player, such as when another player either cannot take enough fish to sell at the market, or cannot take any fish to feed their family. After all, this is a community and no one wants to see their neighbors go hungry or poor! If they choose to help another player, they can give either a fish token from that day, or, if they took only one fish, they can give a PROFIT point to that player. The receiving player can then exchange that PROFIT point for a fish token from the “market” (not the reserve or fishable area; managed by the game master (instructor)).
2. One complete round of turns equals one “day.”
  - a. At the end of each “day”, the game master draws a game card and all players will follow the instructions on the card.
3. For every “day” that no fish are taken from the reserve, one fish token can be added into the reserve. After two days of not fishing in the reserve, every day after that 1 fish can be added to both the reserve and fishable area. After two more days, 2 fish can be added to both areas. After 2 more days, 3 fish can be added to both areas, etc.
4. The game master (instructor) is responsible for drawing game cards at the end of each day, managing the “bank” of fish tokens from which fish can be added to the

reserve or fishable area, and putting fish tokens traded for PROFIT and/or HEALTH points back into the “bank.”

Goals of the game:

1. Increase numbers of fish both inside of the reserve and in the community’s fishable area to 3 times the starting volume of fish.
2. Gain as many points for HEALTH and PROFITS as possible for each player.
3. Ensure that no player ever goes hungry.
4. Prevent the fishable area from being overfished (i.e. no fish left).

## Peer Into the Past

In the research that this lesson plan is based on, scientists talked to fishers living on the Caribbean tropical island of Antigua to be able to learn from them and their life on the reef. The researchers also noted that since the coral reefs around the island of Antigua began to get sick and broken long ago, even most fishers living on the island today don’t know what a perfectly healthy reef looks like. Can you think of any places that have changed in your lifetime? *Help the students to think about places around them that may have undergone change in their lifetime - maybe construction of a new building in their neighborhood, a big move to a new house, or a change in their schools.* How did these places change? Did the change happen very quickly, or over a long period of time? *Allow the students a few moments of discussion.*

*For the next part of this activity, look at the interview questions included in Appendix III! You can print this sheet out if you like, or you can simply help your student(s) write the questions on their own sheet of paper. Once you have the paper and some writing utensils, read the next paragraph to your students:*

Think of someone older than you in your life. *Help the students think of a parent, grandparent, teacher, neighbor, or older sibling.* Find a moment to talk with them this week and have them answer the following questions (also listed in Appendix II).

1. What is one of your favorite places to visit in your neighborhood or city?
2. What did that place look like when you were younger? Tell me a few stories about that place and what you remember doing there.
3. What does that place look like now? Has anything changed?
4. If you still visit this place, have the changes impacted what you do in that place?
5. What is one of your favorite places to visit in nature? What is one of your favorite memories from visiting that place?

6. Have you noticed anything change about that place as you've gotten older?
7. Is that place in nature protected (like a special park, coastline, lake, mountain, or any other natural protected land or water?)

Then, talk with your interviewee about what you've learned about coral reefs in this lesson! If you want some discussion starters, you can talk about your answers to these questions below:

1. Do you think protecting certain places is important? Which kinds of places are important to protect, and why?
2. Do you think protecting certain places is more successful when only one group of people is involved in the decision-making, or when everyone is involved in the decision-making?
3. When we're working to protect coral reefs, why do you think it's important that we talk to people who live near the reefs?

## Reflection

As you and your student are cleaning up, talk to your student about what you just did together. Here are some guiding questions to help shape your conversation.

- What was your favorite part of our activity today?
- What is something that you learned about {lesson subject here}?
- Did you notice any patterns during our activity today?
- What is something you wonder about {lesson subject here}?
- What surprised you the most during our activity today?



## Appendix I - Instructor Support

### Ocean Vocabulary

- **Spillover** - The ecological concept that when you protect one area of the ocean, the fish living in that area will reproduce and then spill over into the surrounding ocean area, increasing the local fish population.
- **Territorial use rights fishery (TURF)** - This is a way to manage reef health by allowing fishers to collectively enforce fishing rules in the territory.

### Common Questions

*How does protecting a reef help local fishermen?*

Scientists who study Marine Protected Areas often refer to “spillover,” a phenomenon where marine protected areas allow populations of overfished species to recover. The healthy population can then “spill over” outside the boundaries of protection, boosting fish stocks. This phenomenon is being studied all over the world to assess how we can better manage our fisheries, so we can continue to support fishermen and a healthy ocean. Follow [@oceaneverblue](#) for all our summaries on up-to-date research!

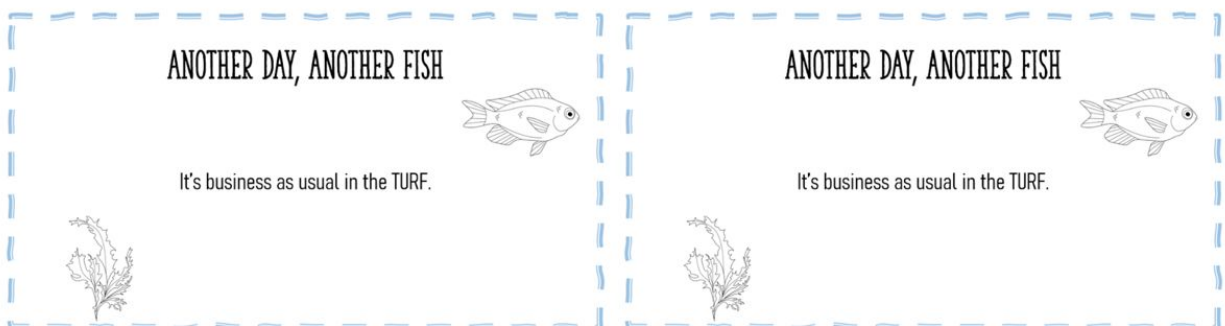
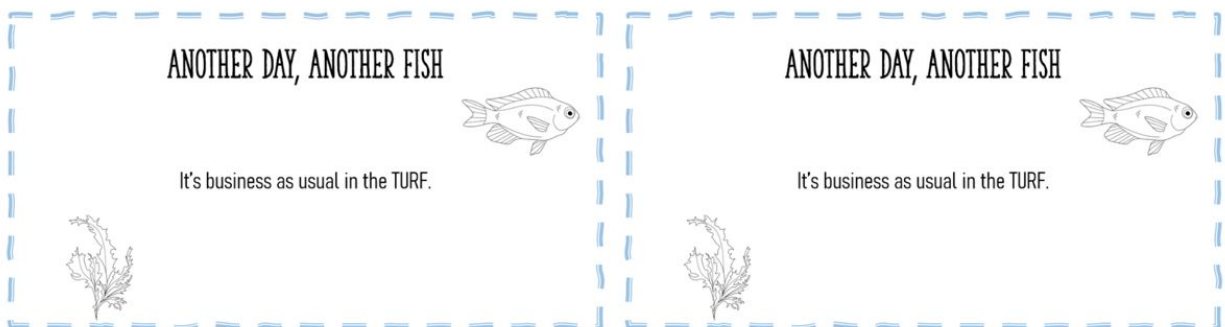
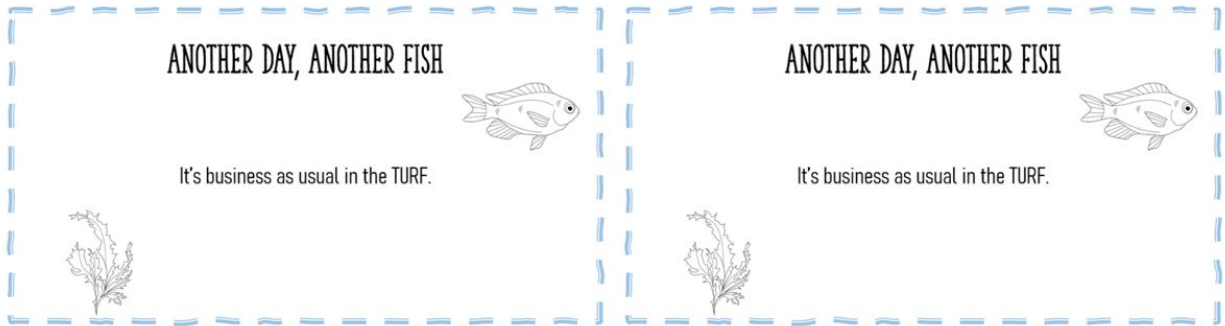
*Which is more successful, community-based marine reserves (or TURFs) or government-based marine reserves?*

It all depends on the regulation! In order for reserves and protected areas to be successful for bettering the health of an ecosystem, they must be well-regulated with enforced rules. Oftentimes, the best way to make sure rules are enforced is to involve the local fishing and tourism community - this way, members of the community feel a sense of responsibility and ownership in caring for the reef for their own well-being. Many government-enforced reserves are picking up on this, and recognizing the value and importance in involving the local communities in regulation and decision-making. It’s also doubly important to involve communities in protection efforts, since often, reserves protect cultural and heritage sites in the ocean as well as the natural ecosystems!



# Appendix II - Attached Lesson Materials

## Game Cards





### GRANT FUNDING!

Your TURF has been awarded grant money, so your fishing community can now afford to pay someone to watch over the reserve and ensure no one fishes there. For the next 3 days, choose one person to guard the reef (same or different person each day, up to the community to decide). The guardian will harvest no fish on their turn but can add 2 points to their money tally. Any "Illegal Fishing" game cards drawn during these 3 days can be ignored and another game card drawn. Add 5 fish tokens to the reserve.

### ILLEGAL FISHING!

Someone has broken community rules and fished inside the reserve. Remove 5 fish tokens from the reserve and do not add fish tokens to fishable area for 1 day.



### HEAT WAVE!

Climate change is causing sea surface temperatures to rise above seasonal norms, do not add fish tokens to the reserve for 2 days.



### POLLUTION!

A neighboring village has dumped sewage into the ocean, do not add fish tokens to the reserve for 1 day.



### SPAWNING EVENT!

Hooray! The fish in the reserve are feeling happy and healthy enough to reproduce, which means there will also be spillover to the fishable area! Add 5 fish tokens to the reserve AND the fishable area.



### HURRICANE!

Oh no, a dangerous hurricane has devastated your home, both land and sea. Remove 2 fish tokens from the reserve and 3 from the fishable area, and all players must skip 1 turn and lose 1 point from both PROFIT and HEALTH.



## Interview Questions

*Use this space to jot down notes from your interview!*

1. What is one of your favorite places to visit in your neighborhood or city?
2. What did that place look like when you were younger? Tell me a few stories about that place and what you remember doing there.
3. What does that place look like now? Has anything changed?
4. If you still visit this place, have the changes impacted what you do in that place?
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