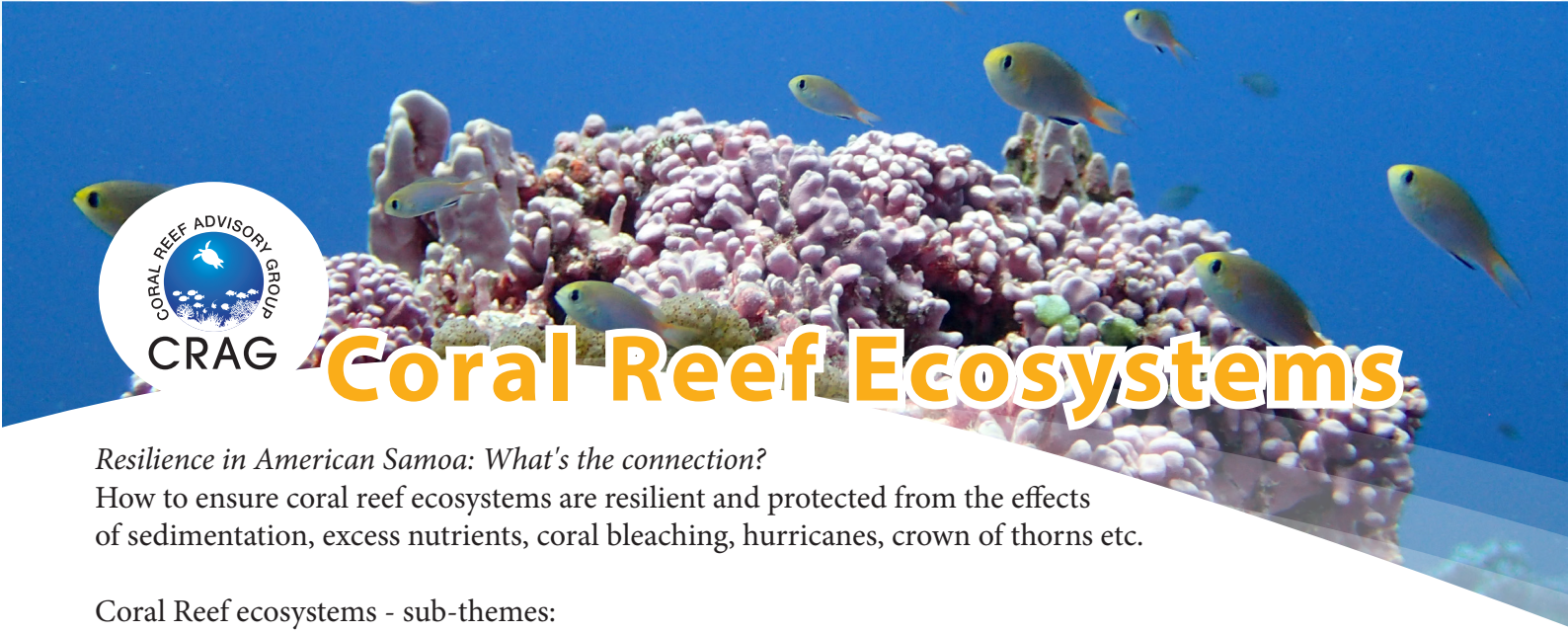

Coral Reef Ecosystems

Resilience in American Samoa: What's the connection?
How to ensure coral reef ecosystems are resilient and protected from the effects of sedimentation, excess nutrients, coral bleaching, hurricanes, crown of thorns etc.

Coral Reef ecosystems - sub-themes:

1. Coral reef science
2. Coral Reef Fish
3. Resiliency and sustainability of coral reef ecosystems

1. CORAL REEF SCIENCE

Topic	**a) What is a coral?**
Objectives	Students should be able to define what a coral polyp is and describe the symbiosis relationship with the algae/zooxanthellae (pronounced zoo-zan-thel-lee)
Duration of activity	30 minutes
Materials	1. Polyp photos or draw a polyp on the board
Activity	Looking at a picture of a coral ask the class whether they think a coral is an animal, plant or a rock. Use the information above to explain symbiosis and the role of the zooxanthellae. Teach them the rhyme: "Zoo-xan-thel-lae in my belly yummy"
Supporting Information	Despite their 'rocky' appearance, corals are living organisms. **Class discussion:** talk about symbiosis – **special relationship between two living organisms.** Think of examples of relationships in the animal/ plant world. A coral polyp is similar to an anemone – it has a soft body and stinging tentacles to catch food. A coral is made up of individual units called polyps and has a relationship with a type of algae called zooxanthellae. The zooxanthellae living in the body tissues of a coral polyp use sunlight to produce food through photosynthesis and as a result, create a byproduct that the coral can use as food. **The zooxanthellae provide corals with food; in return, the coral provides the zooxanthellae with shelter and nutrients that it needs to live.** Corals also capture food. At night, they stretch out their stinging tentacles and catch the microscopic organisms that float in the water and digest them in their stomachs. So, corals have two ways of getting food—through zooxanthellae and capturing microscopic organisms.
Supporting resources: Coral Reef booklet - page 02 & 03	

Take home task :

HOW DOES CORAL FEED AND WHAT DO THEY EAT

Topic	**b) Coral Polyp feeding adaptations**
Objectives	Students should be able to describe the advantage of feeding in colony compared to individual polyp and explain how coral feed during day and night times.
Duration	20 minutes
Materials	Cheerios or small candy, photos of polyps
Activity	1. Have the students act out the actions of being a coral polyp. With their arms in the air have them form polyp tentacles, and tell them to open and close their hands. 2. Take some cheerios / small candy and throw them above where they are standing and ask them to catch as many as they can without moving around. 3. Ask them to count how many they caught. 4. Now tell them that polyps live in colonies, so get them to move closer to each other. Once students are tight together ask them to put their arms in the air again. Take some cheerios / small candy and throw them above where they are standing and ask them to catch as many as they can. 5. Ask them to count how many they caught this time and if they understand why it's better to be part of a colony rather than as an individual.
Supporting Information	Looking at a picture of a coral ask whether they think a coral is an animal, plant or a rock. Talk about the coral and its feeding behavior. Corals are formed by a tiny little animal called a polyp. The polyps are little animals that live in the crevices of the coral. They have little tentacles surrounding their mouth which they use to catch their food (similar to anemones). Coral polyps feed on plankton. Plankton are tiny little organisms that move where the currents take them. All hard corals are stationary or 'sessile' meaning they are stuck to the ground and they can't move or swim, therefore they have to wait for the currents to bring their food.
Supporting resources	Coral Reef Booklet

BUILD YOUR OWN CORAL REEF TO SIMULATE CORAL REEFS

Topic	**c) Build a coral polyp and coral reef**
Objectives	Students should be able to create their own reefs using house hold materials to simulate coral reefs
Duration	1 hour
Materials	Construction paper, clay, coloring pens, long tube balloons , toilet paper roll, glue, scissors,
Activity	Build a coral polyp following the instructions on 'Make a Coral Polyp worksheet'. Using the indi-vidual polyps put them together to form a coral reef, identifying the location and importance of the reef flat, reef crest, and the reef slope.
Supporting Information	Corals build a skeleton that is like a foundation made out of calcium carbonate - it looks like rock. How do they do this? A coral polyp secretes layer upon layer of calcium carbonate under-neath its body. As time goes by, the skeleton grows larger and larger, and the polyp lives on its outside edge. As long as a polyp can get the right building material from the water, it can build a strong skeleton. The skeleton provides protection and support – corals that build these skele-tons are called hard corals. Hard corals are often called the reef builders because their skeletons provide support for other corals and other organisms. When hundreds or thousands of coral polyps build their skeletons close together, they create a calcium carbonate structure that provides habitat and food for a variety of organisms. This is known as a coral reef. There are soft corals, who do not build calci-um carbonate skeletons. Instead they have spines that support them. They are not considered reef-builders.
Supporting resources	Paper polyp and coral reef Edible coral reef: coral reef cake - make a coral reef out of cupcakes use sprinkling for the effects of sedimentation. At end ask "who wants to step on the reef?"

Topic	**d) Coral reef ecosystem / food webs**
Objectives	Student should be able to • explain how every organisms are connected and their roles played in the ecosystem. • descirbe the food and energy relationships within a food web in a coral reef habitat.
Duration of activity	45 minutes
Materials needed	Marine animal puppets or pictures of marine animal found in the reef, rope (~30metres long)

Activity

1. Create a web of life where everyone is connected to each other based on predator, prey, shelter, resource, and habitat connections.
2. Explain the relationship between the different organisms on a coral reef using photos and puppets.
3. Form a circle and each student picks an animal or plant that they want to represent.
4. The person to whom the rope is passed must first describe their organism and then explain how their organism is connected to the organism from which the rope came. This could be sharing habitat, competitor, mutualistic partner, predator, prey or another ecological relationship. (Try to avoid having all the connections be predator/prey to demonstrate the larger ecosystem picture. Continue until everyone is holding a section of the rope that has now formed a web.
5. Once everyone is holding the rope, explain that everyone is connected. Next discuss how humans are part of this web of life. First focus on how people benefit from it – food, recreation, science, sources of pharmaceuticals, ecological functions that keep the ecosystem healthy. Now ask how humans might affect the web of life (e.g. erosion, pollution, development, human caused climate change, loss of food from overfishing, introduced species that out-compete, loss of habitat, etc.
6. Find a small student and have them lay on the rope web, then say there will be 3 species that you will select to disappear because of a particular human activity and explain why (e.g. pollution incident in the harbor or a natural impact such as coral bleaching).
7. Have each of the 3 students to drop their portion of rope and observe how the web becomes wobbly and unstable.
8. When the students gain composure, discuss the fact that everything is connected, that people benefit from the web of life and that if we upset the web, we end up harming ourselves and the planet.

Supporting Information:

Coral reefs are home to an abundant variety of living creatures—fish, turtles, sharks, eels, crabs, shrimps, urchins, sponges, and algae to name a few. In the Pacific islands, coral reefs have some of the highest biodiversity in the world. For example, the Samoa archipelago hosts over 250 different types of corals and nearly a 1000 types of fish. That is an amazing number of organisms!

So many organisms like to live on coral reefs because they provide shelter and food. To escape predators, animals can hide within cracks and crevices in the reef created by corals. Nearly every living thing on a reef is food for another organism, and together they make up a complex food web. Scientists are still discovering new species on coral reefs, which means that nobody knows exactly how many creatures live on coral reefs!

Supporting resources	Weave a food web - LESSON PLAN: What lives on a coral reef?

2. CORAL REEF FISH

Topic	Fish
Objectives	Students will be able to explain how features of fishes can reveal information about them, begin to develop a sense of the diversity of fishes and learn to record their findings by starting a fish journal.
Duration of activity	60-90 minutes
Materials needed	Paper and drawing materials Folder or large paper to make a journal cover Paper for journal pages

Activity

1. Arrange students into small groups and provide each student with two fish to "read." To illustrate the idea that "a fish is still a fish" despite variances in shape, size, color, number of fins, etc., the fish should be varied.
2. Provide time for open-ended discussion in small groups, encouraging children to ask each other questions about their fishes. Get them started with general questions, such as, "What can you learn about your fish just by looking at it?"
   Then ask them to address specific questions that they may or may not have covered. (You may choose to write the questions on the board, create a handout, or simply ask them verbally.)

   * Why do you think your fish is colored the way it is? Does it want to hide, or does it want to be seen? Why?
   * Look at its shape and coloring and think about where it might live. (On the bottom? In a cave? In seaweed? In a coral reef? In the deep?)
   * Does the fish swim fast or slow? Look at its size and shape for clues.
   * Look at the shape and size of its mouth. What do you think it eats?
   * Does the fish have any weapons or defensive devices that you can see?

3. After your students have finished their small group inquiries, lead a discussion with the entire class, allowing each group to talk about their fishes and encouraging comparisons with the fishes other groups were studying. Don't expect accurate answers to all questions because your students' experience with the topic is limited. Rather, the goal at this point is to encourage inquiry and curiosity. (Why are some fish long and skinny and others short and fat? Why are some fish colored so brightly? Doesn't that make them easier to catch?) Because your students will probably not be aware of all the possibilities, you should act as a resource to provide additional information. For example, students may not be familiar with the fact that coral reefs are filled with nooks and crannies that make ideal hiding places for very thin, flat fishes such as the angelfish.
4. Have the children draw each of their two fishes on separate sheets of paper. These will serve as pages in their Fish Journals. You will want to decide on a format for the journal so that it can be consistent as the students add to it. For example, for very young children, you may simply want to have them draw a picture of the fishes they study and add the names. For older children, you may want to have them include more information, which could require that the do some research. In the end, each student will have his or her own "encyclopedia of fishes" as a reference. You will also want the children to create their own folders or covers for the journals so that their pages are not misplaced. This can be done as a separate activity as time requires.

Supporting Information	Coral Reef Café - Students will simulate the variety of methods with which different fishes on a reef feed. Learn how the size and shape of a fish's mouth and teeth provide hints about what type of food it eats.

Topic	Sharks
Objectives	Students should be able to • describe the difference between a shark and a fish • explain how sharks uses different senses to locate prey in different environment
Grade 1 – 8. Marine ecosystems, shark biology and conservation.	
Materials needed	
Activity	Making Sense of Sharks (grade 1-5) From dark, deep waters to shallow sandy beaches, sharks' incredibly sharp senses make them the ocean's most successful predators. Get a sense of how sharks use their senses.
Shark! (for Grades 4-8)	Students explore the natural history of sharks and recognize that humans are an intercon-nected part of sharks' ecosystems. The student will be able to identify and describe various shark adaptations; compare and contrast sharks and bony fishes; use a dichotomous key to identify shark families; discuss what sharks eat; demonstrate the steps of the writing process; create an artistic impression of a fish; and discuss why sharks need conservation and how people can help conserve sharks.
Shark Surprise	Students will create an undersea environment in their classroom while researching interest-ing facts about their favorite sea creatures.
Grade Level: K-2	
Supporting resources	& SPREP Shark fact sheets

Topic	Fish Identification
Objective	The students will develop observational skills necessary to identify and measure fish. Actual size paper fish will be displayed and the students will learn how to look for distinguishing features such as, bars, eyespots, stripes, etc. They will also practice estimating the size of the fish by sight from a short distance. Students will recognize that living organisms are di-verse but individual species have characteristics that distinguish them from other species.
Duration of activity	45 minutes
Materials needed	Paper cut outs of fish species found in Samoa in their actual size Rulers, Fish identification guides
Activity	Introduction: "Did you know that there are more than 25,000 different sorts of fish in the world? How can an ichthyologist, a scientist who studies fish, tell them apart? (size, charac-teristics, fin shape, location). Scientists gather some data about the number and types of fish found along the coast. Knowing this infor-mation now will allow them to see if human development on the island will have big effect on the population of the fish. Today we are going to pretend that we are snorkeling and practice measuring and describing fish.

Procedure

1. Students will measure a body part (finger, hand, etc) with a ruler to use as a reference to estimate the size of the fish.
2. With a partner, students will take turns holding up a paper fish about 3 feet away, while the other partner uses their measured body part or their eyes alone to estimate the size of the fish. The actual size will be on the back of the fish so that the student can adjust their estimation if they tend to give higher or lower numbers.
3. After students have ample time to practice the class will be split into teams to compete with each other for the most accurate measurement of a fish.
4. Discuss features that help to identify fish. Using the paper fish, students can fill in a check-list of features found on the paper fish and then try to locate the picture of that fish in an identification book after the paper fish has been taken out of view.

Closure: "Who can name a way to identify one fish from another type of fish? Why is it important to make your observations about a fish quickly? (the fish may swim away) If you counted many types of fish one year and 3 years later that number decreases a lot, how is that information helpful?"

ASSESSMENT: A set of fish will be posted and labeled with a letter. The students will record the letter of the fish and their estimation of its size next to it. Results should be within 30% of the actual measurement for 50% of the fish.

Supporting Informtion	Standard length (SL): the length of a fish measured from the tip of the snout to the posteri-or extremity of the hypurals, the expanded bones at the end of the backbone that support the caudal fin
Supporting resources	Fish ID ppt presentation (from CRAG) REEF underwater guides and survey projects www.reef.org

3. RESILIENCY AND SUSTAINABILITY OF CORAL REEF ECOSYSTEMS

Topic	Fishing
Objectives	Students should be able describe how everything is connected, biodiversity is necessary and how these principles relate to an MPA, fisheries management.
Duration of activity	1 hour
Materials	Red Beans / Brown Beans / cheerios, Small cup - 4, Spoons – 6, Straws - 6

Activity

1. Students will simulate fishing activity in the world's oceans. As they go from season to season, they will begin to see how they are overfishing their oceans and/ or crash their fish stocks. They will then get an opportunity to reverse the clock and protect the stocks before they crash.
2. Each student will be a fisher, whose livelihood depends on his or her catch of fish. Lay out a blue tarp that will represent your ocean, and hand out a boat= cup, a fishing spear/pole = straw, and a net= spoon to each fisherman kid.
3. Lay a variety of fish= beans (different colors and sizes) our in your ocean. Explain to the kids not to eat any of the fish in the ocean until they are told they can start fishing.
4. Larger beans represent the most valuable fish (swordfish, tuna, marlin, etc.). Smaller beans represent the next most-valuable fish (cod, salmon, etc). And different colored beans represent different species of fish.
5. Each fisher has to catch at least 1 fish in each round of the game to survive (eating or selling fish).
6. Divide group into small groups of fishers per area on the ocean tarp and have them each select their ocean (Pacific, North Atlantic, Arctic, Mediterranean, etc.) You may want to have more fishers in areas where fishing is overexploited and unsustainable, such as Eastern Atlantic (see article below), Asia, Africa, etc.
7. During the process of the game the areas of unsustainable fishing areas will be more strongly affected by the kids fishing over time.
8. First Round/Season – students must hold hands behind their back and use their spear= straw from their mouth to suck up the beans from the ocean and put them in their boat (cup). This may represent fishing with a hand made spear that a small fishing village may use to catch fish. You can explain and increase the challenge by making the kids close their eyes as a parallel to how hard it is to catch fish with a spear above water due to the effects of bending light when looking down into the water. (Where the fish appears to be in the water is actually offset by the fact that light bends in water).
9. The fish (beans) remaining in the ocean after each round/season some of them represent the breeding population, so some new fish (beans) will be added in the ocean.
10. Time the round / season by saying "Start Fishing" – each season is 20 seconds.
11. The fisher counts his/her catch and records it on their paper for each Season.
12. Fishers who did not catch anything must sit out next season.
13. Add some new fish in the ocean for every few caught. However, you can bring in issues with population breeding, predators, food resources, disease, weather such as El Ninos and La Ninas can affect fish populations and therefore not every fish remaining in the sea will produce an equal number of fish for the next generation.
14. Second Season/Round – allow fishers to use one hand on the straw (holding it) during this season to represent a new technology that over time has advanced the fishing. Now the straw = fishing pole.

15. Repeat the steps above.
16. Third Season/Round -allow fishers to use one hand on the straw (holding it) during this season to represent a new technology that over time has advanced the fishing. Now the straw = fishing pole and boat with sonar.
17. Repeat the steps above.
18. Fourth Season/Round – Give each group a spoon to again represent a new technology that over time has advanced fishing. Now the spoon= trawl net
19. Repeat the steps above.
20. By this round some of the oceans may be fished out. ASK: What happened when a certain ocean group ran out of fish? How are the fishers to survive – what are the options?
21. Continue game until students create a sustainable fisheries practice or all is depleted. Then have a discussion about the groups fishing practices.

Follow up questions

1. How did it feel when you fished out your ocean?
2. What was your first thought on how to survive?
3. How did you feel when others joined your ocean?
4. How does overfishing affect ocean wildlife?
5. What happens to a natural resource when it is depleted?
6. How does this activity relate to our 4 Principles?
7. Discuss what groups came up with for sustainable fisheries (limits on take or type of fish, shorter seasons, labeling products sustainable or not, etc.)
8. Supporting Information

Discuss the concept of SUSTAINABILITY and reinforce the definition: "meeting the needs of the present without limiting the ability of people, other species, and future generations to survive.
Supporting resources
INFO SHEET: Facts on Fishing
INFO SHEET: What is an MPA?

- Community involvement - http://www.uri.edu/news/releases/?id=5231
- Pew Trust - http://www.pewenvironment.org/our-focus/ocean-1080/
- Fishermen perspectives - http://www.icsf.net/icsf2006/jspFiles/mpa/overview.jsp
- Marine Portal - http://www.speakupforblue.com/about
- MPA Lesson Vocabulary Guide http://www.mpa.gov/resources/glossary/

CORAL REEF ADVISORY GROUP
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