

STEAM FORWARD – EPISODE 1

Water Quality [Teacher Version]

Welcome to STEAM FORWARD!

Water's Vital Role to our Animals' Health!

Career: *Chemist*

Episode: *Water Quality*

Georgia Aquarium's Tropical Diver Gallery is home to an incredible Pacific Barrier Reef habitat— one of the largest living coral reefs in a North American aquarium and it's a massive marine jungle just crawling with all sorts of sea creatures.

Keeping the sea creatures healthy and vibrant is an important job. And maintaining the water quality in this habitat is vital to ensuring the marine life here can thrive.

How do you maintain the water quality? It all starts with Dr. Susan Goodrich, who works in the Water Quality Lab that keeps a constant eye on these waters.

During this episode, hosted by Dr. Meisa Salaita, we will take a deep dive into what is the chemical make-up of water and what it takes to maintain this environment.

Following Dr. Susan Goodrich's lead, you will investigate and dig deeper into Tropical Diver's saltwater chemical makeup!

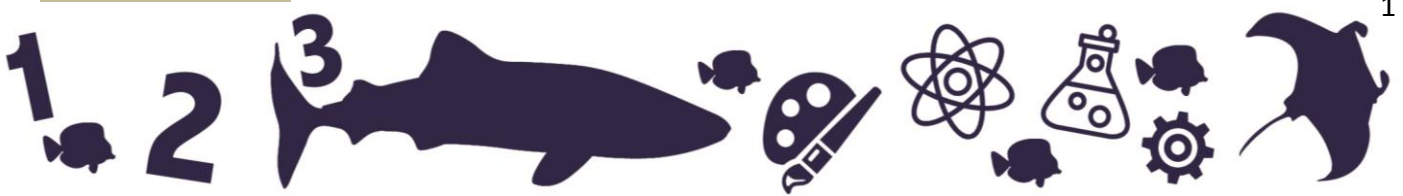
OBJECTIVES: Why am I learning this?

At the completion of this mini-unit, you will be able to:

- Explain the importance of coral reefs and how they're impacted by the environment.
- Conduct a scientific investigation on water quality.
- Describe the chemicals and variables that go into maintaining water quality.

THE ESSENTIALS: ASK & ANSWER

- 🐟 How does an organization like Georgia Aquarium maintain water quality?
- 🐟 What factors influence water quality?
- 🐟 What impact does water quality have on the habitat?



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Activity 1

Video segment: 00:00–3:15

OBJECTIVES: Why am I learning this?

At the end of this lesson, you will be able to:

- Explain the importance of coral reefs and how they're impacted by the environment.

Introduction

An important step in a scientific investigation is to conduct background research! Before we can learn about how changes in water quality might influence the Pacific Barrier Reef habitat, we need to learn more about corals.

Use the library or online resources to answer the following questions. Be sure to write down the sources where you found your information. A few reliable online sources are NOAA, IUCN, and Georgia Aquarium.

1. What kind of animals are corals? What are some other animals that are closely related to them?

Corals are invertebrates from the Phylum Cnidarian. They are related to jellies and sea anemones.

2. Where do corals live? How deep are they found? What water temperatures do they live in?

Corals are found mostly in the tropics in warm waters 70–85° F (21–29° C). They tend to be found in shallow waters, especially reef-building corals. Most are found in less than 70m of water although there are cold water corals found much deeper.

3. How do corals get their food?

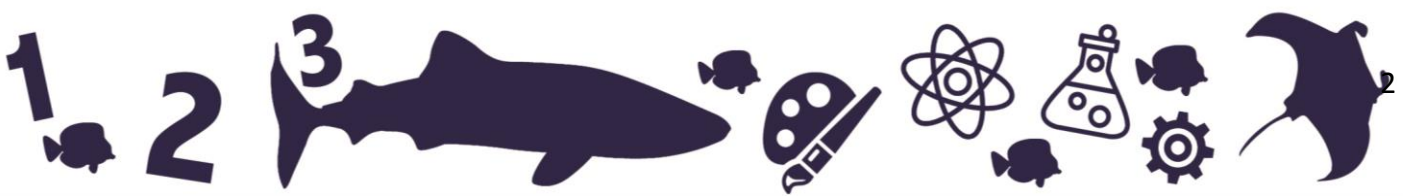
Corals can catch food using their tentacles, but they also get a lot of energy from the zooxanthellae that live inside their bodies.

4. Why are corals important to other animals and even people? Describe how corals are important to other animals.

Corals create reef habitats that smaller species inhabit and find shelter. As the coral reef continues to grow, more species move in and create a dynamic food web that large reef species and oceanic species rely on as a food source and nursery ground.

5. What is coral bleaching? Why are scientists worried about coral bleaching?

Coral bleaching occurs when corals are under stress (From things like temperature, changes in light levels, or nutrients) and the coral expels the zooxanthellae that live in their bodies out. As a results the coral turns white. Scientists are worried as ocean temperatures rise, more corals are bleaching and destroying the reef ecosystems.





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Activity 2

Video segment: 3:19–4:55

OBJECTIVES: Why am I learning this?

At the end of this lesson, you will be able to:

- Conduct a scientific investigation on water quality.

Introduction

We've seen how many variables go into maintaining Georgia Aquarium's water quality. Let's dig deeper into Tropical Diver's saltwater chemical makeup. It's time to figure out whether the addition of the new rays has changed the water quality in the Pacific Barrier Reef. If the phosphate level goes above 0.30 ppm then the team needs to do something! The water test result is in Dr. Goodrich's hand. Next to the picture is the key.

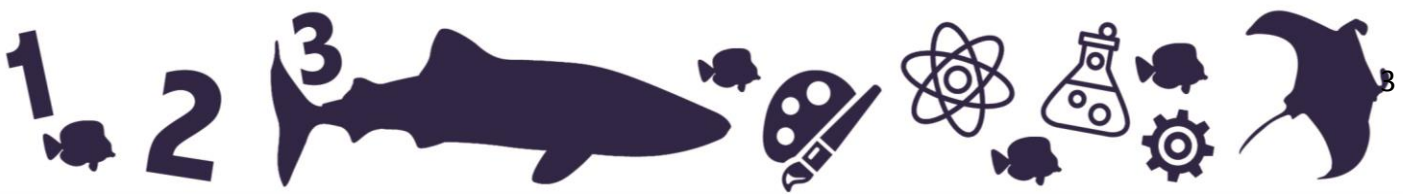
Phosphate Test Color Results

	0.25 ppm
	0.50 ppm
	0.75 ppm
	1.00 ppm
	1.25 ppm
	1.50 ppm
	1.75 ppm
	2.00 ppm
	2.25 ppm
	2.50 ppm
	2.75 ppm
	3.00 ppm
	3.25 ppm
	3.50 ppm
	3.75 ppm
	4.00 ppm



1. Based on the color of the water in the tube, what do you think the phosphate level is?

Accept answers around 0.5-1.00 ppm





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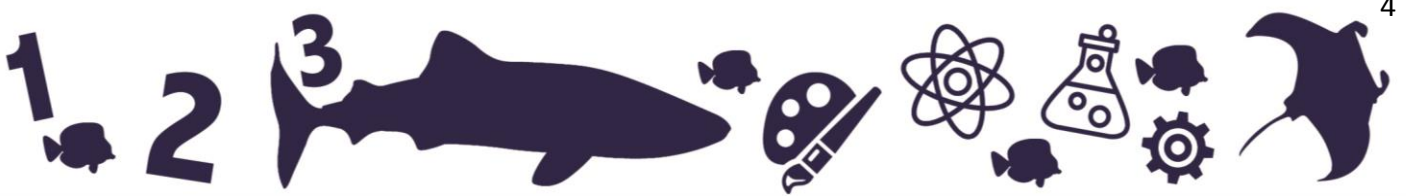
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2. Based on the results, what do you suggest Georgia Aquarium do? Why?

Do a slight water change, because the color of the sample is above the 0.3ppm phosphate level threshold and retest the water.

3. If the phosphate level were ok but the coral were not looking healthy, what would you do? Explain your answer.

Test other water quality parameters (such as pH, salinity, nitrogen, calcium, etc.) because corals need more than low phosphates to survive and grow.





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Activity 3

Video segment: 4:59-6:03

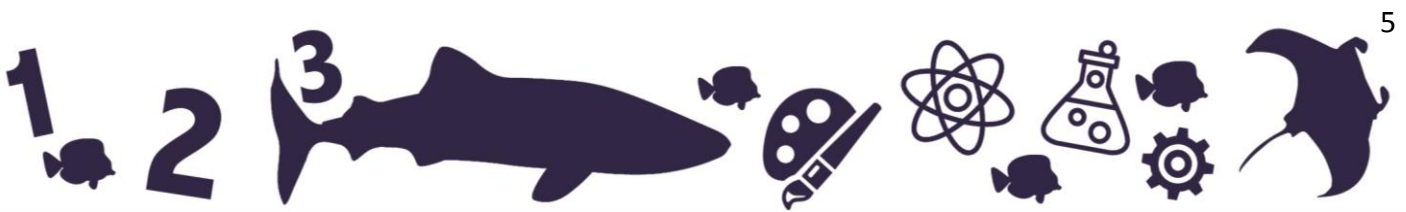
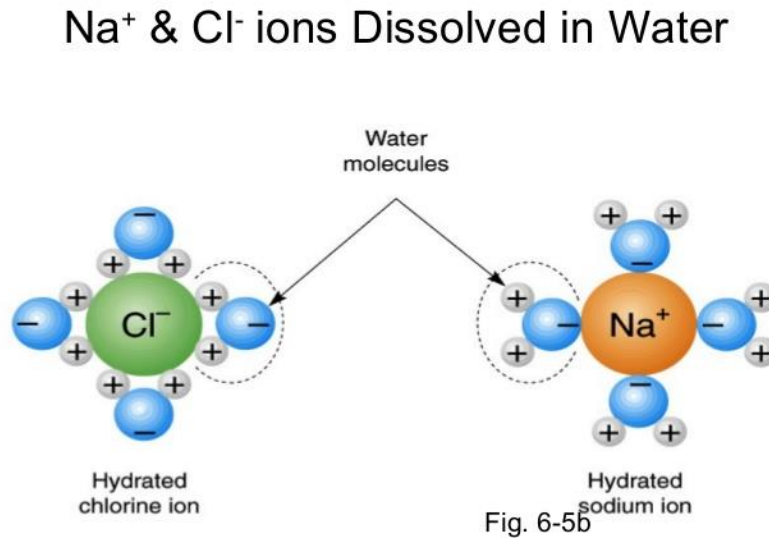
OBJECTIVES: Why am I learning this?

At the end of this lesson, you will be able to:

- Describe the chemicals and variables that go into maintaining water quality.

Introduction

Corals need the right chemical balance in their water to survive! We know saltwater is mainly comprised of two components, water (H_2O) and Salt ($NaCl$), or sodium chloride. We represent sodium chloride ions dissolved in water like this:





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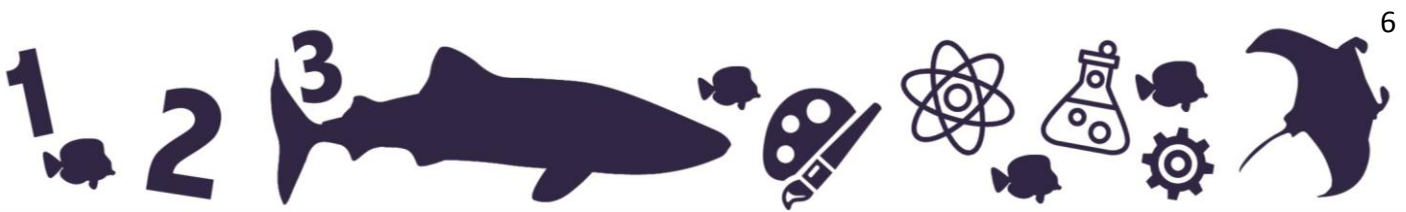
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The trace element calcium is essential for corals to build their skeletons. If the water becomes too acidic then the calcium carbonate that they use to build their skeletons starts to dissolve. Use the data in the table below to investigate the proper pH (a measure of how acidic water is) for corals. Remember, the lower the number the more acidic the water is.

Table 1. Growth rates of corals in different pH levels.

Replicate	pH	Growth Rate
1	7.5	0
2	7.5	0
3	7.5	0
4	7.5	0
5	7.5	0
1	7.9	0.25
2	7.9	0.35
3	7.9	0.15
4	7.9	0.3
5	7.9	0.2
1	8.3	1
2	8.3	1.1
3	8.3	0.9
4	8.3	1.05
5	8.3	0.95
1	8.7	0.4
2	8.7	0.4
3	8.7	0.6
4	8.7	0.2
5	8.7	0.4



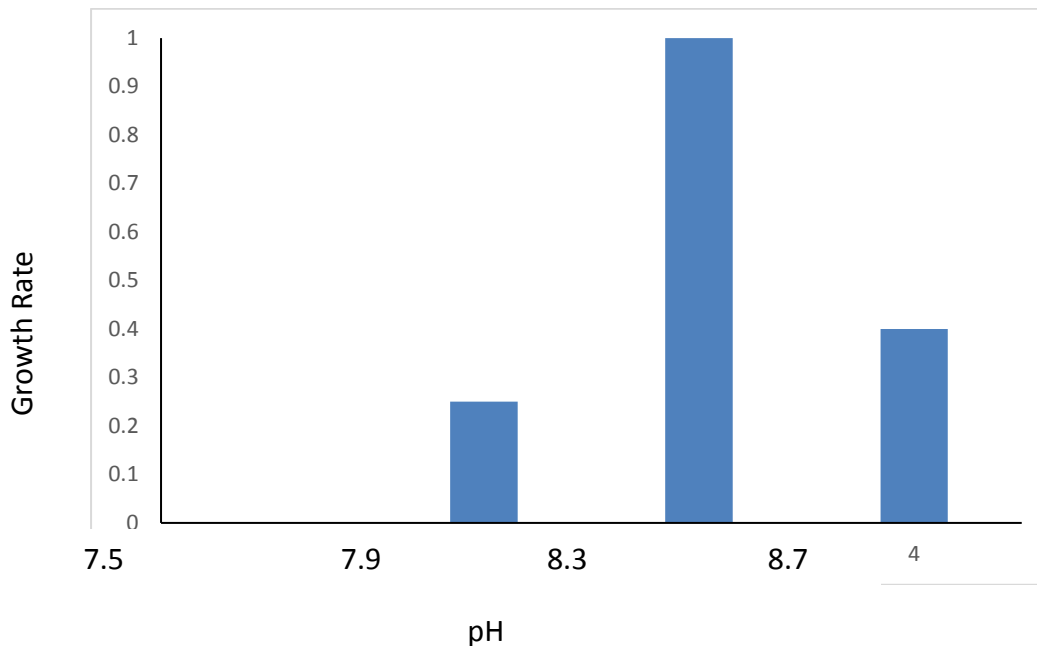
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1. Calculate the mean growth rates from Table 1 and use these to complete Table 2.

pH Level	Mean growth rate
7.5	0
7.9	0.25
8.3	1.0
8.7	0.4

2. Draw a bar graph of the growth rates in different pH levels.



3. As carbon dioxide levels increase in the atmosphere, the ocean becomes more acidic. Use your findings to explain how ocean acidification might influence the health of coral reefs.

My graph suggests that decreasing pH would be harmful to coral growth. That means if oceans become more acidic corals won't grow as well.



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In The Field

What better way to bring STEAM FORWARD alive than to meet an expert at Georgia Aquarium? Here, you will learn more about the background and experience it takes to be a member of the STEAM TEAM. Let's get up close and personal!

MEET AN EXPERT

Meet: DR. SUSAN GOODRIDGE, Manager, Water Quality Lab

Undergraduate school: Boston University

Undergraduate major: Science and Math Education

Graduate school: Boston University

Graduate certificate: Environmental Engineering

What is the most exciting part of your job at Georgia Aquarium?

I really enjoy the challenge of growing the Water Quality Lab into the Environmental Quality Lab. Because the ambient air mixes with the water and because lighting is a critical animal health component of a healthy habitat, I think it is logical to design, monitor and remediate all aspects of habitat.

What advice do you have for students interested in doing what you do?

I would urge students not to memorize data but to thoroughly understand the science; to ask the questions to not give up until the understanding feels solid. I would also urge them to polish their communication including verbal, written, and non-verbal. Many scientists fall short on their interpersonal communication and it is critical to become multi-functional.

What is something surprising or unexpected about your career path?

I never realized how much fun I could have while working hard. But when you find a job that matches your skills and passion, you have found gold!

What do you say to students who ask "Why am I learning this?"

I answer the question with an example. I show how algebra is used in the lab, I connect the periodic chart with water tests and animal health, I ask them how else they might find the answers they seek without the tools presented. And although no learning is ever wasted, as the amount of knowledge that is needed in today's world has grown exponentially, it might be necessary to filter out some things that might not be a priority to learn. I am honest about that.

