



## TOWARDS SDG14 -PROTECTING AND RESTORING OUR OCEANS USING UNDERWATER LABS

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### YOUNG REVIEWERS:



**ABDULLAH**

AGE: 13



**KATERINA**

AGE: 10



**SANTI**

AGE: 12



**TAIMOOR**

AGE: 12



**VOJTECH**

AGE: 12

The oceans that cover much of our planet are important for billions of people. But some human activities, like polluting the environment and catching too many fish, harm our oceans. Because of this, the United Nations created a big goal called Sustainable Development Goal (SDG) 14, Life Below Water, to help us make the oceans healthy again. Scientists have been observing and studying the oceans to come up with new ideas to save these waters and all the creatures that live there. Since all living things are connected, when the oceans are healthy, we can be healthy, too. One group of scientists has created a special place called the Coral Probiotics Village. There, they are working together to test new technologies and treatments to protect coral reefs and the organisms that depend on them. With this research, scientists can help people make better choices and help countries work together to take care of our big, blue planet!

## CLIMATE CHANGE

Long-term change in the Earth's climate that can be natural or triggered by human activity.

## OVERFISHING

Catching too many fish from the ocean faster than they can grow back, which can make it harder for sea animals and people to have enough fish in the future.

### Figure 1

The importance of our oceans and how the challenges they face affect the rest of the world. **(A)** Our oceans are important for several reasons: **(B)** they help people with healthy and nutritious food, jobs, and medicine, **(C)** they are also home to many sea creatures, and **(D)** they regulate the climate. However, our oceans face many challenges, including: **(E)** too much fishing, **(F)** pollution, and **(G)** climate change. Green arrows illustrate positive interactions, and red arrows illustrate negative interactions. The start of each arrow shows who/what starts the interaction, while the end represents who/what is affected. Created with BioRender.com.

Watch an interview with the authors of this article to learn even more! ([Video 1](#)).

## PROTECTING OUR BLUE PLANET

Most of our planet is covered by oceans and seas. Underwater habitats are home to lots of different creatures, they regulate Earth's climate, and are also very important for people's lives. Sadly, as the numbers of people, cities, and factories increase, big problems such as pollution, **climate change**, and **overfishing** are hurting the oceans and the animals that call it their home ([Figure 1](#)).

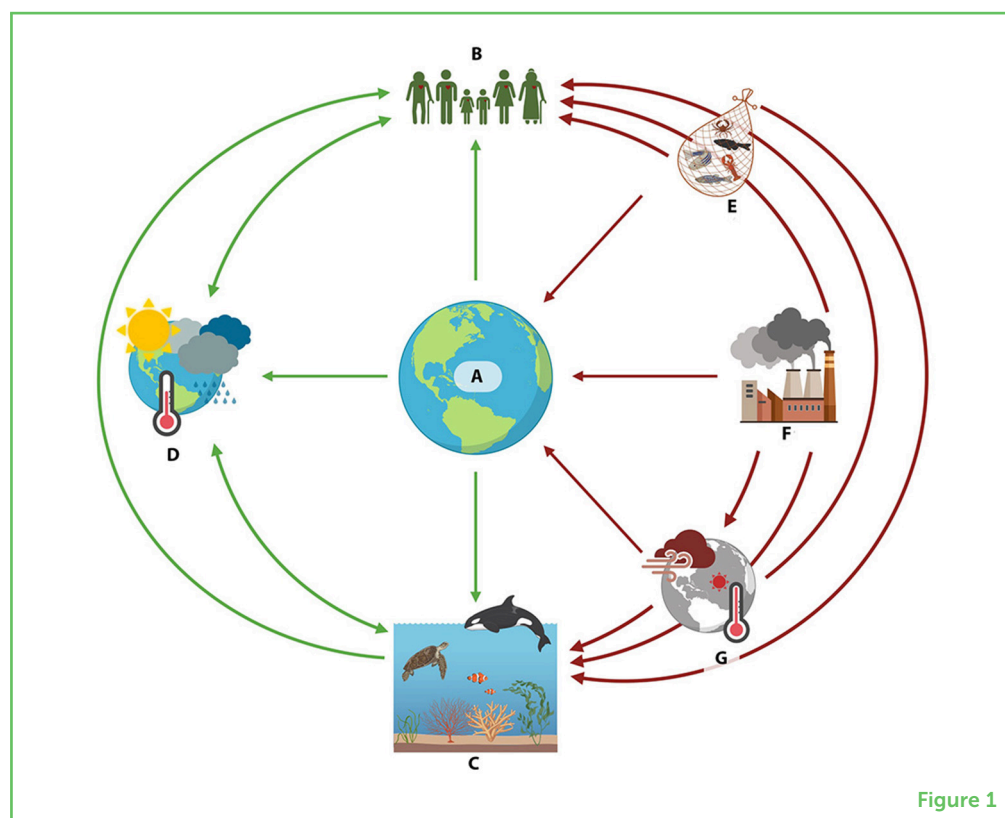


Figure 1

To help save the oceans and other parts of our planet, the United Nations created a set of 17 goals to make Earth healthy again, called [1]. Each SDG has a separate plan of action and unique targets, but is connected with other SDGs. SDG 14 is called Life Below Water and it is a plan to protect the oceans, keep them healthy, and make sure people use ocean resources more carefully. SDG 14 is connected with SDG 2 (Zero Hunger) and SDG 13 (Climate Action). For example, to move SDG 2 forward, we need to ensure the health and safety of marine life, since many people depend on fish and other seafood for their nutrition. To achieve SDG 13, we need to protect our oceans and their diversity because oceans act like big sponges that soak up carbon dioxide from the air, helping to keep our planet cool.

## MARINE POLLUTION

When bad stuff like trash or oil goes into the ocean, hurting sea animals and making their homes dirty and unsafe.

## MARINE RESOURCES

Things humans get from the ocean, like fish, minerals, or other things we can use to improve our lives. It is important to protect them so they do not run out.

## FISHERIES

The occupation or industry that takes fish or other sea animals from the ocean, seas, or lakes, generally for food.

SDG 14 has many targets, such as reducing **marine pollution**, controlling how many fish people can catch, increasing knowledge about the oceans, and improving how people use **marine resources**. Ocean scientists also share the same objectives. They study the oceans, like detectives, and try to find ways to fix the big problems our oceans are facing. But scientists cannot do this alone—they must share the results of their work with society, so everyone can make better choices and learn how to use ocean resources more carefully. Politicians and people in charge of countries and businesses also need to make decisions that protect the oceans. Caring for the oceans will help keep them safe and healthy for a long time, and will make them a better home for all the unique animals that live there.

## HOW CAN SCIENCE HELP?

Scientists play a key role in helping solve the problems of our world. They use their knowledge to collect important information about our oceans and to help make the United Nations' goals, like SDG 14, come true. In the case of the oceans, they do this by studying them to understand things like how warm or polluted the water is getting [2]. Such studies help scientists find out what is hurting the animals and other organisms living in the ocean, and how they can stop this harm from happening [3]. Scientists can then investigate new solutions and products that can help protect ocean organisms. They can tell people like you what you can do to help. They also tell the people who make the rules and take important decisions, like politicians and the government, what to do to keep the oceans safe.

Ocean scientists can also study **fisheries**, by working closely with fishermen and counting how many fish are caught to make sure people do not catch too many. Scientists also check where fishermen are catching the fish and if they are doing it safely, to protect the baby fish and other types of fish fishermen do not want to capture [4]. Scientists help make rules to protect animals that are at risk in the sea, by collecting information about where these animals live, what they eat, and where they have their babies. They even help design better places for fish to grow, like very big aquariums where we can get our fish, and reduce fishing in the open ocean [5].

Other scientists look at the homes of sea animals, like coral reefs. Coral reefs are complex underwater structures that are made up of lots of corals. Coral reefs are home to many animals that live in the ocean, but they are also very important for us. Reefs are like big shields that protect our shores from huge waves, and they also help make sand and store carbon, which is good to keep the planet from heating up too much. By studying coral reefs, we can learn about all the help and services they give us, and ensure they stay healthy so they can continue to help us. We can also learn which other organisms call coral reefs their home, and how to protect them, too.

## The Power Of Underwater Labs

Ocean scientists from all over the world try to work together as a big team every day. They do their research and write the results in articles for other scientists to read. By sharing what they know, everyone learns more about the ocean. The more scientists know, the better they can guide the people who make important decisions about the oceans, to make the right choices. The problem is that doing experiments, writing the results in articles, and sharing the data can take a lot of time. Also, some scientists sometimes work on the same things in different parts of the world without knowing someone else is doing it, too! On top of that, results would be better if scientists collected their data by doing similar experiments, at the same time, under the same conditions.

To try to solve these challenges, a big team of ocean scientists is working together on a big project called the Coral Probiotics Village (CPV). Located in a coral reef in the Red Sea, in Saudi Arabia, the CPV is an underwater laboratory where scientists study ways to help marine organisms fight the challenges they face. Underwater laboratories are small areas on our oceans or seas that are easily accessible and can be visited by scientists to collect important data. Like in an above-water laboratory, scientists can run their experiments in underwater labs, but with real-world conditions—like ocean temperature, salinity (saltiness), and currents. CPV scientists work as underwater doctors, but for coral reefs. They want to answer questions about why coral reefs get sick as seawater warms up, or why the corals get stressed. The CPV is also like an underwater city, with streets, town squares, and neighborhoods, so scientists and visitors can more easily navigate the areas of this submerged laboratory. There are a lot of experiments being done at the CPV by scientists who study different topics. These scientists can share data with each other, compare their results, and gather more complete information about the ocean.

## Helping the Oceans With Bacteria

Remember when we said our planet's climate is changing? One of these changes is that the Earth is getting warmer. Corals do not like that, and they get sick when the water is too warm [6]. Scientists in the CPV are doing a very exciting experiment—they want to see if they can make coral reefs stronger (Figure 2). They give the corals special good bacteria called **probiotics** [7, 8]. People also take certain probiotics when their tummies are not feeling good, like after they eat something that makes them sick, or when they catch a stomach virus. These probiotics have good bacteria that will help our tummies feel better, so we get healthier. It is the same with corals. In the winter, scientists give some corals probiotics and leave others without probiotics. As temperatures start rising in the summer, corals start getting stressed and sick. After summer, when the temperatures go back down, the corals will either recover or die. CPV scientists collected coral health

### PROBIOTICS

Supplements containing live, good bacteria that make humans or other organisms healthier.

## Figure 2

Experiment to make corals stronger during times of stress (heat) in the CPV. **(A)** Coral in the CPV that was not given probiotics. **(B)** Coral in the CPV that was given probiotics (green cloud with good bacteria). Our results showed that corals that were given probiotics were healthier and not stressed after summer was over. Corals that were not given the probiotics had a difficult time recovering from heat stress, and they were still unhealthy or sick even when summer was over and the water was cooler. Created with BioRender.com.

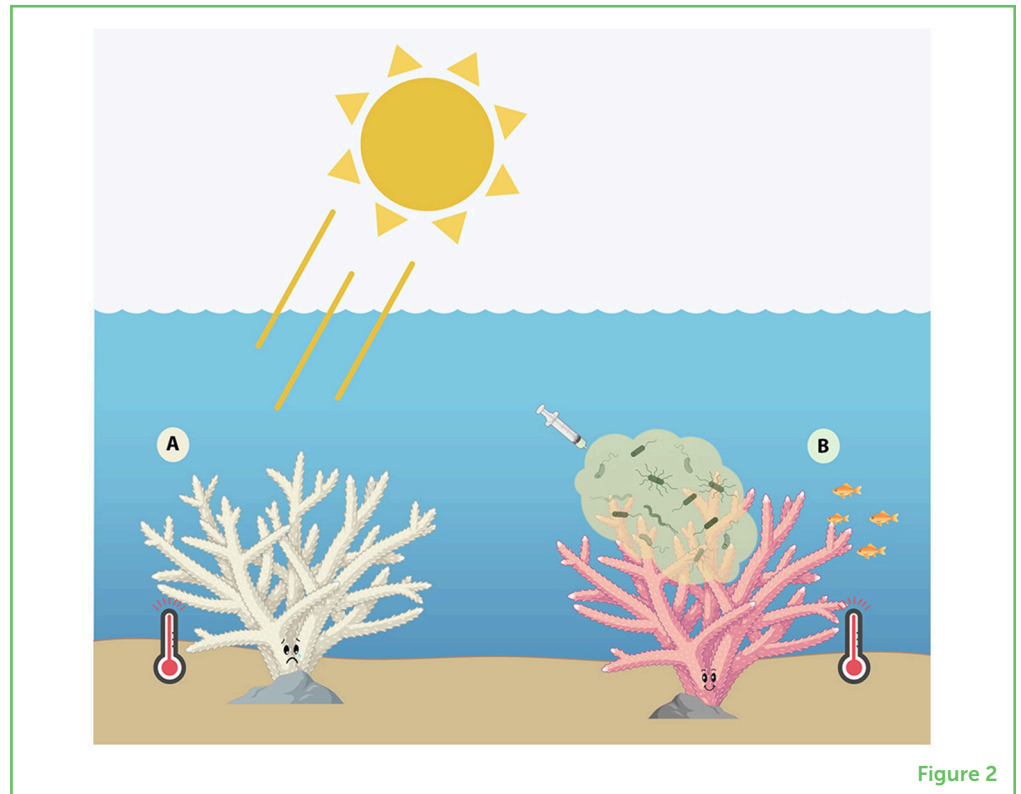


Figure 2

information before, during, and after the corals were stressed due to high seawater temperatures. They wanted to find out if the corals given the probiotics recovered faster than the ones that did not receive them. They found that probiotics helped the corals stay strong, even when the water was too warm. Probiotics also helped corals recover faster from their sickness compared to corals that were not given probiotics [9, 10].

CPV scientists are always trying to find better and faster ways to help corals. One thing they are doing is testing an **automatic probiotic dispenser**. How does this work? Imagine two scientists who are so busy in the laboratory doing tests that they do not have time to get on a boat, go to the CPV, and give the probiotic medicine to the corals. With this automatic dispenser, all the scientists have to do is open an app on their phones and click a button. Fifteen km away, in the CPV, the probiotic dispenser located next to a coral will release the right amount of probiotics. The biggest goal is to turn this dispenser into a huge **irrigation system**, like the ones we see in our gardens and parks, but instead of water it will release probiotic medicine. This way, countries all over the world that have coral reefs in their waters can release probiotics next to the corals and help them get healthier! This solution involves experts in many fields working together, showing the importance of collaborations in ocean science. Remember: we can always do something alone, but we can do it faster—and better—if we do it together.

## AUTOMATIC PROBIOTIC DISPENSER

A device that releases probiotics in a coral reef and that can be controlled from far away.

## IRRIGATION SYSTEM

A set of tubes with small holes that take water or other liquids to specific areas, like plants in gardens or parks, to keep them healthy.

## OUR ROLE IN PROTECTING THE OCEANS

Our oceans are very important for our planet, and the United Nation's SDG 14 aims to ensure we take care of them. Scientists play an important role in helping Earth's oceans, but they need more help. You can be an ocean hero, too! To help our oceans and all the animals that live there, you can learn about how incredible the oceans are and tell others why we need to protect them. You can also use less plastic and help pick up trash near the water to keep it clean. When you learn more about fish and fisheries, you can choose seafood that causes less harm to the oceans. Based on everything you learn, you can talk to adults about the importance of making rules to keep the oceans and the creatures in them safe. Finally, you can join groups and activities that help scientists learn more about the oceans; and you can support friends who want to be ocean scientists.

When we all work together, we can make sure the oceans stay healthy and safe for everyone, including all the sea animals and ourselves. We need to take better care of our big, blue home!

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## YOUNG REVIEWERS



### ABDULLAH, AGE: 13

My name is Abdullah, and I am from Saudi Arabia. I love playing sports like football and volleyball. I am very interested in marine science and curious to learn more about nature.



### KATERINA, AGE: 10

My name is Katerina and I enjoy gymnastic, crocheting, and playing the piano.



### SANTI, AGE: 12

I am a Grade 6 student (from Spain) and I love science, math, and design. I have a family and live in Thuwal in Saudi Arabia.



### TAIMOOR, AGE: 12

Hai, my name is Taimoor. I am from Pakistan and I am 12 years old. My hobbies are games and playing cricket.



### VOJTECH, AGE: 12

I am a Grade 7 student who loves golf and spotting airplanes. My profile picture is a picture that I took.

## AUTHORS

### INÊS RAIMUNDO

Dr. Inês Raimundo, from Lisbon, Portugal, now based in Saudi Arabia, recently completed her Ph.D. in Marine Sciences at KAUST, focusing on enhancing the resilience of Red Sea coral reefs through the use of coral probiotics. With expertise in coral restoration and rehabilitation, and sustainability, Dr. Raimundo has published several scientific articles and engaged in ocean-focused outreach activities. Passionate about science communication, she bridges the gap between research and public understanding. Committed to SDG 14, her work aims to protect marine ecosystems, driven by a lifelong appreciation for the ocean and a dedication to coral reef conservation. \*[ines.goncalvesraimundo@kaust.edu.sa](mailto:ines.goncalvesraimundo@kaust.edu.sa)







### **RAQUEL S. PEIXOTO**

Dr. Peixoto's research focuses on manipulating coral-associated microorganisms, known as Beneficial Microorganisms for Corals (BMCs), to enhance coral resilience and resistance to environmental threats. Her pioneering work has established protocols and demonstrated the effectiveness of this approach, advancing marine microbiology and symbiotic interactions. As the founder and chair of the Beneficial Microbes for Marine Organisms network (BMMO), she aims to promote an international platform to convert basic knowledge into practical solutions for marine ecosystem protection, restoration, and sustainable development.

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