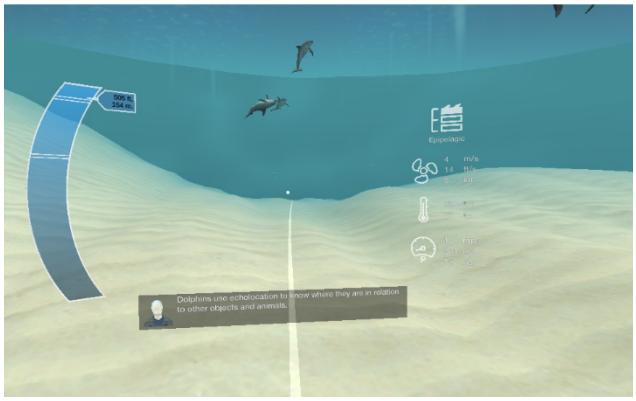
FUTURE U.

Educator Introductory Guide for Discovery Oceans

Experience Flow

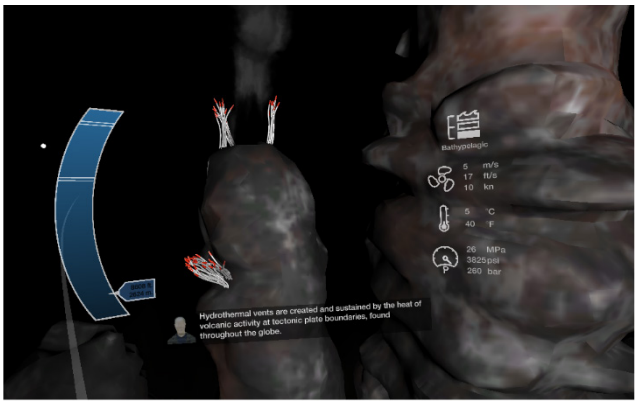
The experience takes the user on a mission to explore an underwater volcano and hydrothermal vents with the Echo Voyager. The Echo Voyager is one of Boeing's underwater products that is used to research the oceans. This experience starts when the user meets a scientist, Pryscila, on the pier who describes the mission at hand and the user is directed through the steps. See the Interaction section review how to skip to the next step.

Once the user has had a chance to review the mission, they can see the view from the 360 camera that is attached to the front of the Echo Voyager. The heads up display shows many details. The left-most shows the depth that submarine has reached. Pryscila takes the user along the mission, and informs them as new and interesting fish pass by, text being displayed along the bottom. The right-most shows (from top to bottom) the current layer of the ocean, the speed, the temperature, and the pressure.



The Echo Voyager travels pretty quickly, but the user can slow it down to look around. See the Interaction section review how to slow down the Echo Voyager.

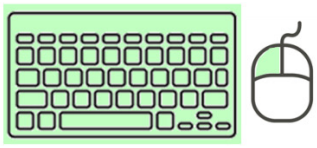
The user glides along the predetermined path and sees sea life in the different layers of the ocean to explore underwater volcanos and hydrothermal vents. The Echo Voyager releases a small drone which collects samples and then they resurface. Pryscila then reviews what they found from the samples collected.



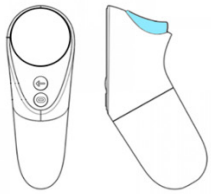
Interaction

Guide While Pryscila is explaining the mission at hand, you can let her know when you're ready for the **next step** by:

Press any key to continue

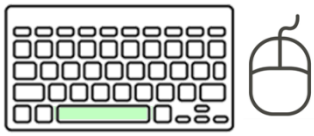


Press the trigger to continue

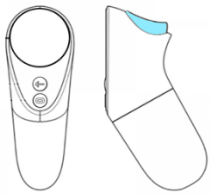


Once you've started the mission, to **slow down,** you can:

Press and hold the space bar to slow down. Let go to continue at the automated speed

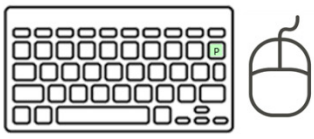


Press and hold the trigger to slow down. Let go to continue at the automated speed

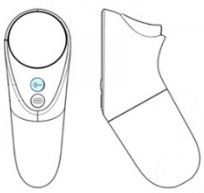


You can access the **pause menu** at any time during the experience The pause menu allows you to pause, skip forward to the mission, and start over.

Press the "P" key to access the Pause Menu



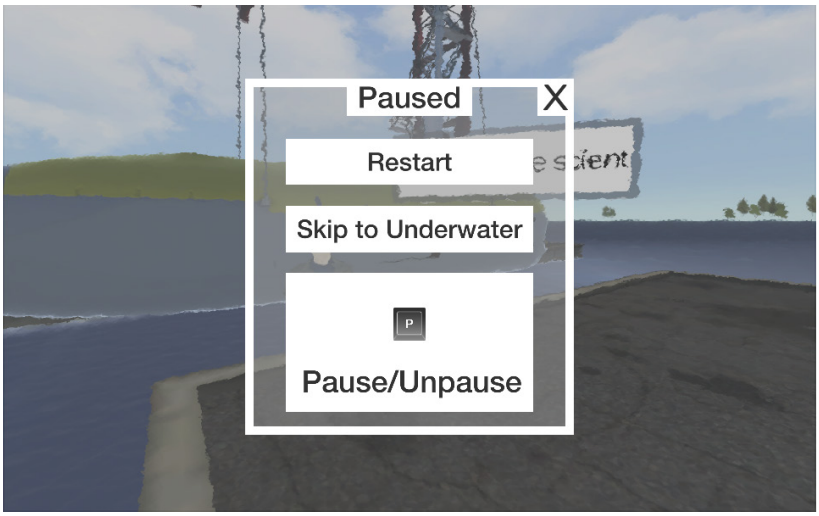
Press the back button to access the Pause Menu



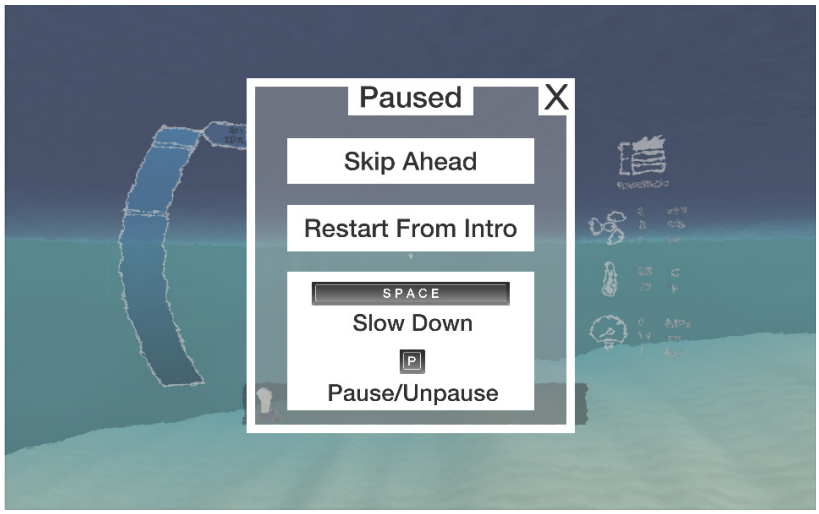
Pause Menu and Skipping through Sections of the Experience

Within the Pause menu, you can skip through the experience. This experience is divided into three steps: Introduction, Underwater, and Conclusion. While you are in the introduction, you can open the pause menu, and skip forward to the underwater sequence. While in the underwater sequence, you have the option to start over, or skip forward to the results of the mission. The pause menu that appears in each section is shown below.

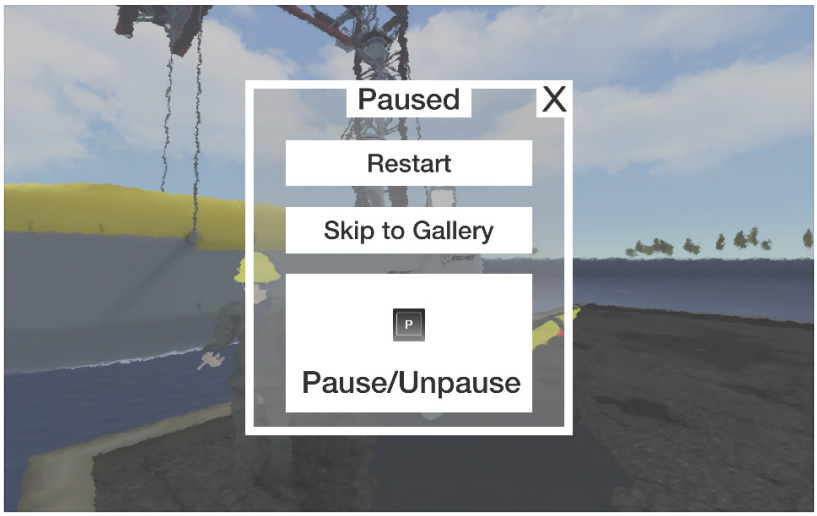
Pause Menu shown in Introduction:



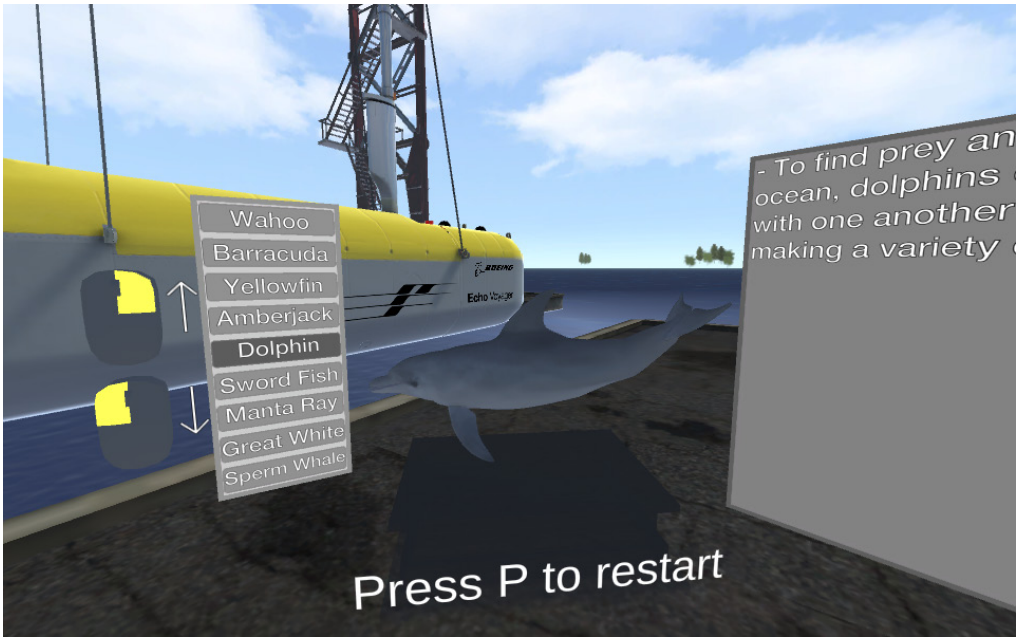
Pause Menu shown in the Underwater section:



Pause Menu shown in the Conclusion:



In the conclusion, the pause menu offers an option to skip the gallery. The gallery shows each of the fish highlighted in the experience with the information associated with it. The user can scroll through the list using the left and right clicks on their mouse.



The full script has been included in this guide to help educators preview information presented in the experience and to help students as they complete the Extended-Reality Companion Activities on the Boeing Future U site https://www.boeingfutureu.com/.

Site	Text
Dry Dock Intro 1	Hi, I'm Pryscila! I'm so glad you could join me today! Press any key to continue. Press the trigger to continue.
Dry Dock Intro 2	I'm one of the scientists working with the Echo Voyager to explore our oceans.
Dry Dock Intro 3	The Echo Voyager, the big yellow submarine behind me, is an XLUUV, or eXtra Large Unmanned Underwater Vehicle.
Dry Dock Intro 1	Since it's unmanned, it doesn't have any room for people inside. Instead, we can go along for the ride virtually.
Mission Plan 1	Here is the current mission plan.
Mission Plan 2	As you can see, the path has already been set for the Echo Voyager to travel.
Mission Plan 3	Let's go over it now.
Mission Plan 4	Today we're going to be investigating an underwater volcano and nearby hydrothermal vents.
Mission Plan 5	Hopefully we'll also find some sea life on the way.
Mission Plan 6	We'll start at the surface and travel about 8,200 feet down.
Mission Plan 7	Then we'll launch a smaller drone from the Echo Voyager which will travel to the volcano autonomously and collect data for us.
Mission Plan 8	Next we'll reach a hydrothermal vent, which is like an underwater geyser.
Mission Plan 9	Water heated by magma shoots up through these vents and creates a unique environment for sea life.
Mission Plan 10	Trillions of microbes thrive among the hydrothermal vents.
Mission Plan 11	They may hold clues to the origins of life or help us learn how organisms survive in extreme environments . . . like other planets!

Site	Text
Mission Plan 12	We need you to help us collect some water and sediment samples near the vents for chemical and genetic composition testing.
Mission Plan 13	This can help us understand how life thrives among harsh chemicals, extreme temperatures, and darkness.
End Dry Dock Intro	I'm so excited to see what we find.
End Dry Dock Intro 2	Let's get to it!
Intro 1	Welcome to the Echo Voyager's camera feed. Take a second to familiarize yourself with the UUV.
Intro 1.5	The current depth is located on your left, on the right is the current zone, speed, temperature, and pressure.
Intro 2 Android	The expedition is automated, but we left the option to slow down the Echo Voyager in your hands. Press and hold the trigger to decrease the sub's speed.
Intro 2 WEBGL	The expedition is automated, but we left the option to slow down the Echo Voyager in your hands. Press and hold the space bar to decrease the sub's speed.
Epipelagic	We're currently in the epipelagic zone of the ocean! It extends as far as 650 feet deep. Here, is where you will find most of the ocean's life such as wahoo, tuna, and dolphins.
Dolphins:	Speaking of which, dolphin on the left!
Dolphins Fact 1	To find prey and navigate the ocean, dolphins communicate with one another underwater by making a variety of vocalizations.
Dolphins Fact 2	Dolphins use echolocation to know where they are in relation to other objects and animals.
Wahoo:	These fish are called wahoo. They're aggressive and have razor sharp teeth.
Wahoo Fact 1	Wahoo also have blade-like fins that help propel them through the water, giving them the distinction of being one of the fastest known fish in the world.
Barracudas:	These are barracuda. They bite, so it's a good thing we're only here virtually! Barracuda can swim up to 25 miles per hour, which helps them hunt or escape from predators.
Barracuda Fact 1	Shiny objects can attract the barracuda's attention. They usually hunt fish with silver or golden scales, but sometimes divers with shiny gear are mistaken for prey.

Site	Text
Amberjack:	Look now, a school of amberjacks. Female amberjacks are much larger than males and have a longer life expectancy.
Amberjack Fact 1	Amberjacks are typically greedy predators. They will feed on squid, fish, and some crustaceans.
Amberjack Fact 2	Amberjacks are not on the top of their food chain. Sharks and other larger fish consider them prey.
Great White Sharks:	Oh, look below! It's a frenzy of great white sharks. Great whites can grow to be 21 feet long and weigh up to 2,400 pounds.
Great White Shark Fact 1	Great white sharks have no natural predators, they're on the top of the food chain.
Great White Shark Fact 2	Great white sharks are a keystone species, meaning they are critical to the survival of other species in their ecosystem.
Great White Shark Fact 3	Great whites spend their time in temperate waters all over the world.
Mesopelagic	The Mesopelagic zone has the greatest temperature change over its span. Light becomes very limited and bioluminescence begins to appear in the darker areas.
Giant Manta Rays:	The giant manta ray is the largest ray and one of the largest fishes in the world. Giant manta rays have an average wingspan of 22 feet and can weigh as much as 3,000 pounds.
Manta Fact 1	Rays swim with their mouths open, filtering plankton and other small food from the water.
Manta Fact 2	Unlike other rays, mantas do not have a spine on their tails for defense.
Manta Fact 3	Due to their large size and speed, manta rays have very few natural predators.
Yellowfin Tuna:	These fish up ahead are yellowfin tuna. They spend most of their time in deep waters.
Yellowfin Tuna Fact 1	Yellowfin tuna have bodies shaped like a torpedo, and because of that are very fast!
Yellowfin Tuna Fact 2	The yellowfin tuna is very loyal to its school.
Sword Fish:	If you look carefully you might see a swordfish. Swordfish can often be found traveling alone.

Site	Text
Sword Fish Fact 1	Swordfish actually slash at their prey rather than stab at them.
Sword Fish Fact 2	Swordfish can move quickly and are one of the fastest fish in the ocean.
Bathypelagic	Now we've entered the bathypelagic zone, where most of the world's hydrothermal vents are found.
Bathypelagic 2	It's very cold and dark, the only light comes from the bioluminescent animals!
Echo Info 1	Let's talk a bit more about the Echo Voyager and our mission today. The Echo Voyager can perform long endurance operations for months at a time.
Echo Info 2	The Echo Voyager is programed to avoid obstacles in the water.
Environment Info 1	There are at least 20 to 40 volcanoes erupting on Earth at any given moment.
Environment Info 2	Cold water instantly chills and hardens extruded lava. This forms our ocean floor and islands.
Environment Info 3	The oceans contain 99 percent of the living space on the planet.
Sperm Whales:	Oh look, a sperm whale! Sperm whales can go 90 minutes between breaths, letting them dive to depths well over 4,000 feet.
Sperm Whale Fact 1	Adult sperm whales have the biggest brains of any animal on Earth.
Sperm Whale Fact 2	Sperm whales have small paddle-shaped fins used for steering.
Sperm Whale Fact 3	The clicking sounds that sperm whales make are one of the loudest known animal communication sounds.
Mini Send	Alright, we've reached the target depth! It's time to launch the scouting sub.
Vent 1	Hydrothermal vents are created and sustained by the heat of volcanic activity at tectonic plate boundaries, found throughout the globe.
Vent 2	Hydrothermal vents are openings in the rocky ocean bottom.
Vent 3	Hot water gushes out of hydrothermal vents after being heated by magma and hot rock below the sea floor.

Site	Text
Minisub Return	We're about ready to resurface, but first let's recollect our scouting sub.
Minisub Footage	Let's have a quick look at what the scout recorded.
End	Great! Now I'm going to cut the feed. I'll see you back at the surface shortly.
Dry Dock Ending Intro	After samples surface, they are analyzed by scientists. Here are the results.
Ending Info 1	We got a temperature reading around 750°F (400°C). That's 4 times hotter than water normally boils.
Ending Info 2	It may surprise you, but at depths greater than 7,000 feet, the water pressure is so great that water can no longer boil.
Ending Info 3	We found evidence of hydrogen sulfide in the water. Hydrogen sulfide is extremely toxic for life like us.
Ending Info 4	But to the organisms that live around these vents, it's a vital source of energy!
Ending Info 5	The giant tube worms you saw around the vents take in hydrogen sulfide and carbon dioxide.
Ending Info 6	And turn it into water, sulfur, and glucose.
Ending Info 7	So, what does this mean?
Ending Info 8	The study of hydrothermal vent ecosystems continues to redefine our understanding of how life develops on Earth.
Ending Info 9	In addition, enzymes found in vent organisms might lead to medical breakthroughs.
Ending Info 10	Did you know scientists have only sampled less than 1% of the seafloor? There is still so much out there just waiting to be discovered.
Ending Info 11	We hope you learned a lot on your mission about the different aspects of the known ocean and the Echo Voyager.
Ending Outro	See you next time!