360VR EXPEDITION GUIDE: EXPLORING OUR SEAS - LIFE ABOARD

About your 360VR Expedition

Join the Nekton research team as they explore the waters off Bermuda with submersibles, technical dive teams and a host of scientific equipment.

You will tour the Baseline Explorer, a specialized marine research vessel and learn about life afloat, science at sea and all the different roles and people that go into making this kind of expedition a success.

The deep ocean, below 200 meters is the beating heart of our planet. It represents 97% of our biosphere, providing food and valuable genetic resources, maintaining a stable climate, and even changing our ideas about life in the universe. Yet it is virtually unknown. We have better maps of Mars than we do of our own seabed and scientists estimate that only 0.0001% has been biologically sampled.

How to view this 360VR Expedition

This 360VR Expedition can be viewed at **https://encounteredu.com/discover/images/exploring-our-seas-life-aboard** or via the Google Expeditions app **http://edu.google.com/expeditions/**, search for 'Diving in a submarine'. For more guidance on using either 360VR or Google Expeditions, please see the Subject Updates: **How to: Quick start to 360VR in the classroom, How to: 4 ways to use 360VR in the classroom,** and **How to: Use Google Expeditions.**

This Expedition Guide provides detailed information about each of the 360˚ photos, known as panoramas, included in this expedition. Each 360˚ photo will have the following information to help you guide your students on the expedition:

- Description – to be used to introduce each panorama.
- Point of interest overview – points of interest is the term given to specific details on a panorama. These are numbered on an overview photo.
- Point of interest descriptions – a description of each point of interest allows the teacher to guide students around the panorama.
- Class discussion questions – a differentiated list of questions for class discussion is included at the end of each panorama section.

Panorama 1: Morning briefing

Welcome aboard the Baseline Explorer! We are at sea off the coast of Bermuda, exploring the deep ocean with submersibles, deep dive teams and other scientific instruments. You have arrived during the morning briefing, where Mission Director, Oliver Steeds, shares the day's priorities. Learn more about the different roles needed to make an expedition like this happen.

Point of interest 1: Mission Director

This is Mission Director, Oliver Steeds. He is in overall charge of the expedition working with a variety of different teams to run the expedition. It requires a lot of different skills and roles to explore the deep ocean, and not just science ones.

Point of interest 2: Principal Scientist

Prof Alex Rogers is the expedition's Principal Scientist. He works with a team of over 20 researchers to direct the science program. Much of the work on board involves planning the research, deploying subsea research equipment to collect samples and make observations underwater, and initial analysis.

Point of interest 3: Captain

Jeremy Addaway is one of the two ship's captains. Their job is to run the ship, get it to the research sites and also oversee the 'back deck' operations, where the dive team and submersibles are launched and recovered.

Point of interest 4: Head of Content

Will West is the Head of Content for the Nekton Mission. This means that he is in charge of creating all the videos, virtual reality experiences and photography that brings the expedition to a wider audience beyond science.

Point of interest 5: Surface Officer

Shane Zigler is the Surface Officer for the submersibles. He defines the dive goals and itinerary, briefs the submersible pilots, goes through safety checks and tells them when it is time to 'Dive! Dive! Dive!'.

Questions

Beginner

Question: What are some of the different roles involved in a marine research expedition?
Answer: Students should be able to list from those described in the POI: Mission Director, Principal Scientist, Captain, Head of Content and Surface Officer.

Intermediate

Question: What might be some of the other roles that are needed on a research vessel?
Answer: Some of the other roles that were in the team include: chef, submersible pilot, cameraman, science presenter, research scientists, diver, and boat operator.

Advanced

Question: Which role would you most like to perform on the expedition and why?
Answer: This is an open question. Students should be reminded of the variety of academic, vocational and creative roles available. Team bios are available on the Nekton website (www.nektonmission.org).

Panorama 2 Steaming!

'Steaming' is the nautical term for traveling between two places. Every day the Baseline Explorer and team would travel to a new research site to continue the exploration of the underwater world. You can see the back deck here, where much of the technical operations took place.

Point of interest 1: Fast launch

The fast launch accompanied the research vessel each day, working with the dive team, scouting locations with seabed mapping, transporting crew members and supporting the dive team.

Point of interest 2: Nomad and Nemo

Nomad and Nemo are the names of the two Triton submersibles used on the expedition. They are capable of operating at depths down to 1,000 feet and their life support systems can last for 96 hours.

Point of interest 3: A-frame crane

This large A-frame crane is a feature of many research vessels and is used for launching and recovering the submersibles from the back deck into the ocean.

Point of interest 4: Containers

Many research vessels have a large, open back deck. Different research teams then load containers onto this area and strap them down. The different containers used by the Nekton Mission included submersible support and repair, two science laboratories, dive operations support and a large refrigerator for storing samples.

Questions

Beginner

Question: What is the nautical word for traveling between two places?
Answer: 'Steaming' is the term used on board.

Intermediate

Question: Why did the mission need more than one boat/ship?
Answer: The mission needed more than one boat as there were many different jobs to do: supporting the submersibles, supporting the dive team, traveling to the research site and transporting members of the team ashore.

Advanced

Question: What are the benefits of using containers?
Answer: Each container on the expedition performs a different purpose. Containerisation means that the research vessel can easily be customized for each expedition, without the need for a perfectly designed ship.

Panorama 3 Planning the science

During the 'steam' there is time for planning the exact science for the day. The research was often focused on a series of seamounts around Bermuda. These submerged mountains support an array of life, but finding the best place for sampling is not a process of trial and error. Local knowledge is key.

Point of interest 1: Professor Alex Rogers

Professor Alex Rogers was the Principal Scientist on the expedition. Based at Oxford University, he has led numerous deep sea research expeditions; but each one is different. He needs local knowledge to guide his choice of sampling sites.

Point of interest 2: Chris Flook

Chris is an experienced marine researcher based in Bermuda supporting the team with his local knowledge. But with so little of the underwater explored, he was similarly amazed by what the submersible teams found.

Point of interest 3: Galley

Another nautical term, the kitchen is referred to as the 'galley'. As long as the seas were not too rough, the time during the steam was also an opportunity to make sure the team were well fed. An army marches on it's stomach!

Point of interest 4: Coffee station

The team were based on the Baseline Explorer for 4 weeks, with long hours guaranteed, up to 14 hours a day. Plenty of tea, coffee, water, fruit and biscuits were on-hand to power the crew through their work.

Questions

Beginner

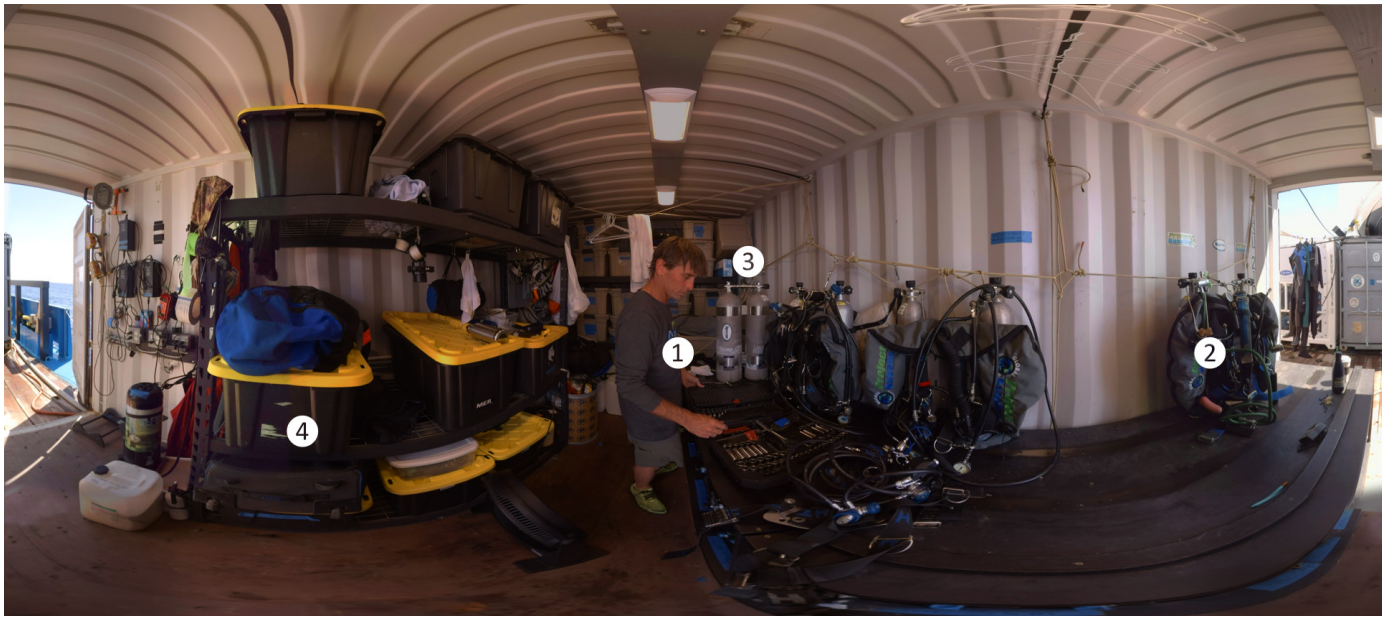
Question: How hard did the team have to work when they were on board?
Answer: During the 4 weeks of the expedition, the team often had to work up to 14 hours per day.

Intermediate

Question: Why is planning important on a science expedition?
Answer: To ensure that the sampling sites (this means the sites where the dive team and submersibles explored) were suitably chosen.

Advanced

Question: Can an expert professor explore effectively on his/her own?
Answer: However expert you are, you still need help. One of the abilities needed by the Chief Scientist is to bring a team together and work with others, like Chris on this expedition, who can supply additional knowledge.



Panorama 4 Dive container

The dive team on the expedition was made up of volunteers from the global dive community through Project Baseline. The dive team were deep dive specialists, 'technical divers' operating to depths down to 300 feet and staying underwater for 6 to 7 hours. Their work was vital in studying the shallower regions of the seamounts and surrounding areas.

Point of interest 1: Todd Kincaid

Todd is an expert diver and has explored many underwater cave systems. He led the dive team for the Nekton Mission. Here he works in the dive container on board, preparing the equipment for the day's dive.

Point of interest 2: SCUBA gear

SCUBA stands for Self-Contained Underwater Breathing Apparatus. It allows humans to swim and explore underwater for extended periods of time. The team used specialized equipment, including 'rebreathers' for their lengthy dives, including rebreathers.

Point of interest 3: Tank refill

The Baseline Explorer is equipped with pumps to refill the scuba tanks after dives. It is possible to compress over 5,000 liters of air into a single tank.

Point of interest 4: Dive kit

Being so deep for so long, the dive team need more than the standard scuba diving kit. They wore warm clothes underneath a dry suit, a completely water-sealed suit designed to keep the diver dry.

Questions

Beginner

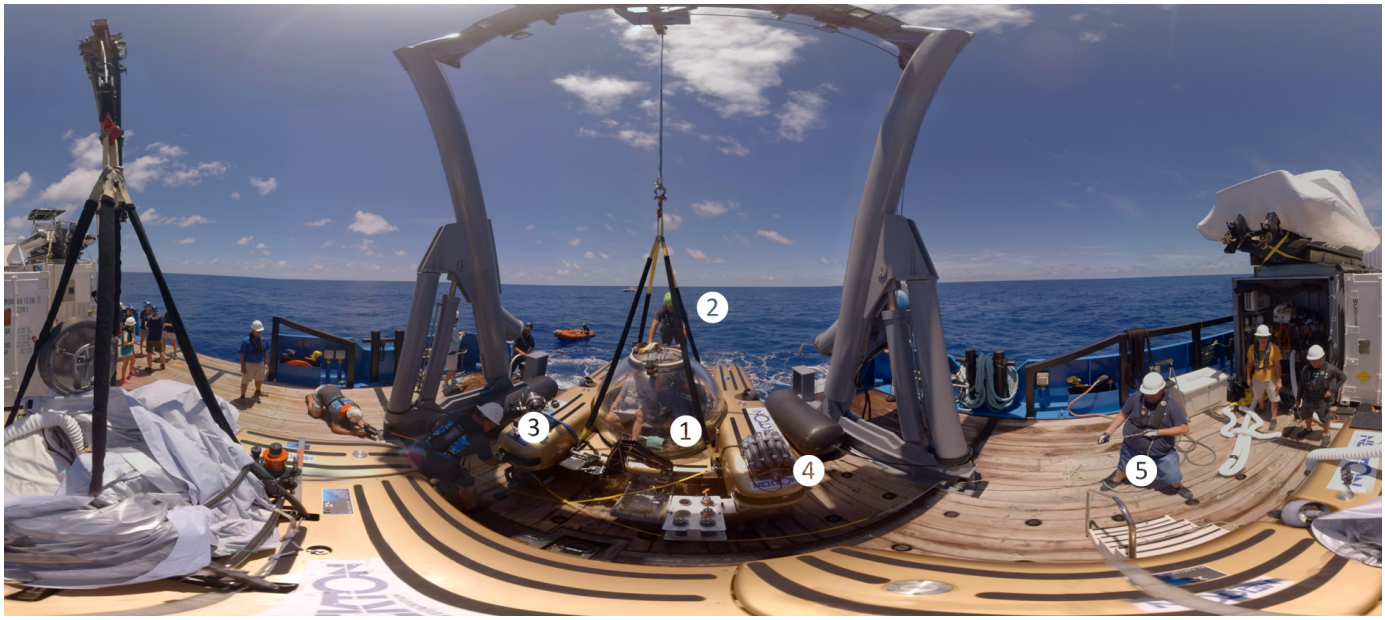
Question: What is SCUBA equipment and why is it useful?
Answer: SCUBA is the equipment used by divers to breathe underwater and mean that the team could explore the underwater world for longer periods of time.

Intermediate

Question: Why don't the team wear wetsuits or swimwear?
Answer: Exploring the ocean down to 300 feet isn't the same as diving on a tropical reef. The temperatures can drop rapidly as you go deeper, and the team are underwater for up to 7 hours.

Advanced

Question: What is the relationship between volume, pressure and temperature inside the scuba tanks?
Answer: Using Boyle's law, students should predict that if the volume of the gas decreases, then the pressure increases, assuming a constant temperature. If the gas warms up then the pressure increases and if it cools, the pressure decreases.



Panorama 5 Launching the submersible

With both submersibles diving twice a day, there was pressure on to get them into and out of the water as swiftly as possible, but also as safely as possible. The back deck is a hive of activity getting the submersibles ready to launch, followed by relative quiet. The submersibles explore the underwater world for up to five hours at a time taking samples as well as video recordings of the seafloor.

Point of interest 1: Entering the submersible

The submersible crew is made up of the pilot and scientist. They enter the submersible through a hatch while on deck and are then lowered into the water using the A-frame crane.

Point of interest 2: Diver

The role of the diver is to detach the straps connecting the submersible to the crane. They then jump from the submersible to a small boat before the dive.

Point of interest 3: Teledyne camera

This high resolution camera is used to record samples of underwater life for scientists to study in more detail after the dive.

Point of interest 4: Science instruments

Niskin bottles mounted on the submersible allow the scientists to capture water samples at different depths. A CTD (Conductivity Temperature Depth) sensor records salinity and temperature information. A sample box and hydraulic arm are used to collect physical samples of algae and coral.

Point of interest 5: Safety lines

Safety lines keep the submersible straight as it is raised on the crane. At $2million each, letting one of the submersibles knock into the ship during launch or recovery is not a great idea.

Questions

Beginner

Question: How do you think it would feel to dive in a submersible?
Answer: Open question for students to access at all levels.

Intermediate

Question: Can you describe how the submersibles are launched?
Answer: The pilot and scientist enter the submersible through a hatch and it is then lowered into the sea using a crane. Safety lines stop the submersible from knocking against the ship. A diver then detaches the straps from the submersible.

Advanced

Question: Why are there a range of science instruments on the submersible?
Answer: Water samples and measurements are needed to understand the physical and chemical oceanography. Limited physical samples are collected for identification and genetic analysis. Video recording allows for a wider record of the subsea world.

Panorama 6 Science container

The science container is where the samples are brought after they have been collected by the submersible. There are two main types of samples. Water samples collected with the Niskin bottles and physical samples collected using a hydraulic arm. Initial analysis is conducted on board and then samples are then stored in a refrigerated container for further analysis back in the researchers' universities.

Point of interest 1: Water samples

Heidi Kirsh measures the biological processes in the sea by studying levels of carbon in the water. She needs to add chemicals to the water samples to kill any plankton, to stop all respiration and photosynthesis. This ensures that the carbon levels do not change after sampling.

Point of interest 2: Sample tray

Physical samples of algae and coral collected using the mechanical grabber are laid out for further study. There may be many small creatures using the algae or coral as home and these are separated out using a pipette.

Point of interest 3: Photographic record

This research mission has probably found a number of species unknown to science. Alongside smaller samples used for genetic testing, Dr Thea Popolizio, a taxonomist, takes photos that allow the findings to be studied and shared with the scientific community.

Questions

Beginner

Question: How is the science container similar or different to your science laboratory at school?
Answer: This is an open question allowing students to answer at a variety of levels.

Intermediate

Question: How do the scientists prepare the samples for further study?
Answer: Water samples are treated to stop biological processes. Physical samples are photographed. Smaller creatures are individually collected and small pieces of larger samples are collected for genetic analysis.

Advanced

Question: How do you think digital technology, such as cameras, has changed how scientists can collaborate?
Answer: Scientists have long recorded the life they have discovered. Ernst Haeckel, a German naturalist working around the mid-1800s, drew exquisite images of the plankton he studied under a microscope. However, digital cameras mean that a researcher can email a photo to an expert on the other side of the world for their view.

Panorama 7 Media room

The Nekton Mission relied heavily on digital cameras and video as part of the mission. Using digital media allows the science findings and adventure to be shared more widely. One of the aims of the expedition was to engage the wider public and students in the wonder of the underwater world and this is where the team made that happen.

Point of interest 1: Science video transects

Both submersibles were equipped with cameras to record the seafloor and the variety of life. Hundreds of hours of footage need to be logged for further analysis by university-based researchers. That's Melissa's job!.

Point of interest 2: Communications logging

Three 360˚ camera units, four video cameras, over 20 GoPros... All this footage needed to be logged by someone to create the online videos to share with the wider public. Candice worked well into the night organizing all this.

Point of interest 3: On board editor

Will West, Head of Content, edits short videos to go up on the expedition's social media pages, so that anyone can be part of the expedition.

Point of interest 4: 360˚ team

The Nekton Mission were joined by a specialist 360˚ virtual reality media team from VRTUL. Their expertise helped to create the images for this Google Expedition and further virtual reality videos.

Point of interest 5: Organization!

Attention to detail and organization is essential. All cameras are labeled, the memory cards coded and logged and batteries charged. One small mistake could mean hours of extra work or missed scientific discoveries.

Questions

Beginner

Question: What are the different media roles on the expedition?
Answer: The media team consisted of a science footage coordinator, communications footage coordinator, editors, filmmakers and virtual reality specialists among other.

Intermediate

Question: What qualities are needed to be part of the media team?
Answer: The media team needed high levels of organization, technical skills for filming and editing, dedication for long hours and a lot of patience.

Advanced

Question: What video would you make about life on board a research vessel?
Answer: Open question allowing students to answer based on their own creativity and ideas. Suggestions can be sent to the Nekton Mission crew for future expeditions via their website www.nektonmission.org.