Activity Duration:90+min | Ages: K-College | Theme: Earth-based Isolated and Confined Environments AND Functional Space Communities | **Advanced Activity**

Destination

Space Underwater

Designing Underwater Training Habitats

Activity Designed by Javier Montiel M.Ed.
SEEC CREW & CoSpaces Ambassador

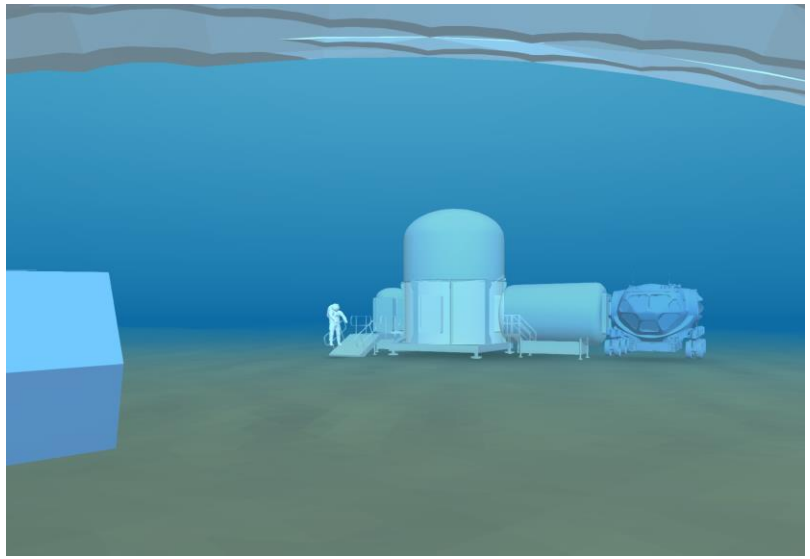
In this activity, the students will design and build an underwater habitat with household items or in virtual reality. The Ion Houston has partnered to test their prototypes in The Ion XR Lab .

Activity Overview

Designing and building underwater habitats is an activity for K-12 students of different skill levels. The overall mission is to build an architectural sketch concept and a model to support underwater human activity inspired by NEEMO (NASA Extreme Environment Mission Operations).

- ***Advanced***: *The student will sketch an underwater habitat. The challenge is to design an underwater 3D model in Tinkercad and export it to CoSpaces to create a virtual reality experience. (Suggested ages 11 and up)*

Aquarius Underwater Lab. 3.5 miles off Key Largo, Florida and 62 ft. underwater.



Mars habitat and vehicle in VR experience

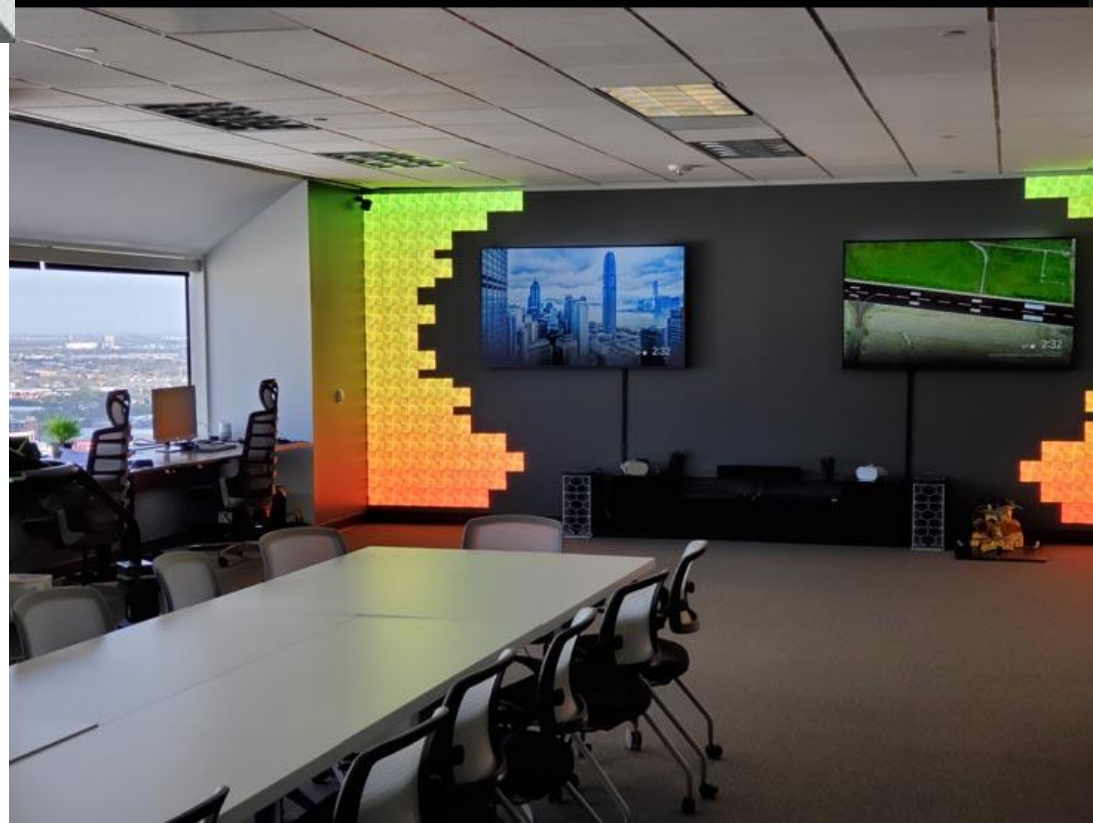
ion

Dare to explore in a professional VR studio

In partnership with The Ion Houston, SciArt Exchange students and participants can test their virtual reality prototypes in person at The Ion XR Lab with state-of-the-art VR headsets.

Come meet industry developers and innovators in this unique collaborative environment and get inspired by tomorrow's innovators.

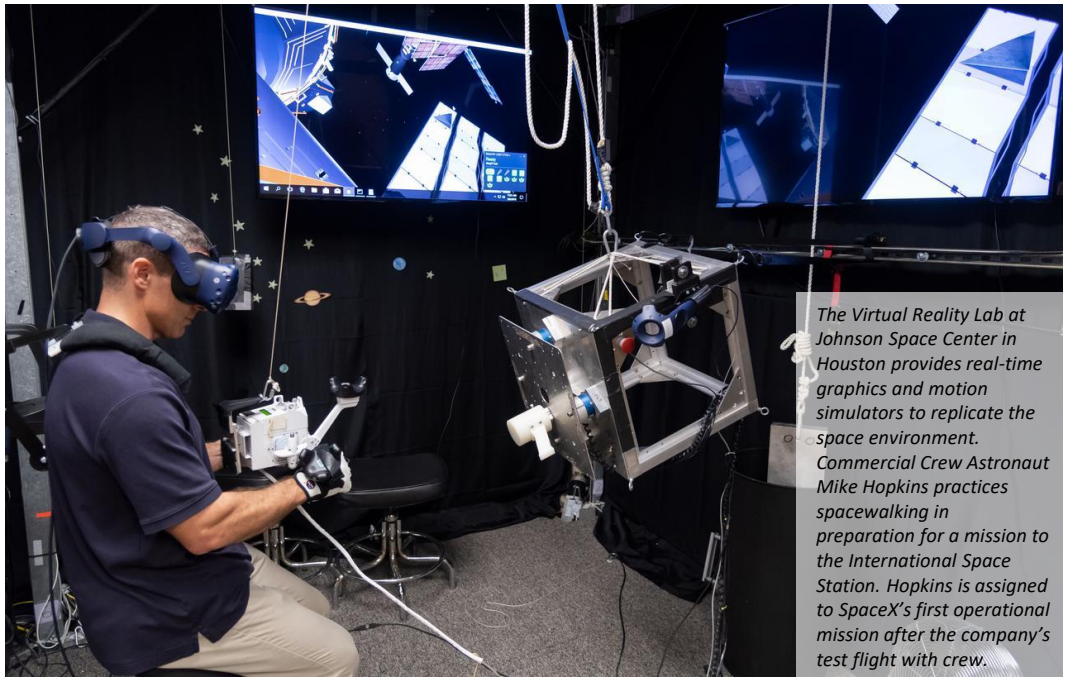
Once you finish with the virtual reality prototype, if you happen to live in or visit the city of Houston, please arrange to tour The Ion and test your virtual reality habitat.



Activity background

NASA's analog missions are paving ways in space exploration. One of them is the **NASA Extreme Environment Mission Operation (NEEMO)**, where NASA tests underwater space exploration concepts and learns about the challenges of human isolation.

In these analog missions, astronauts, scientists and researchers learn how humans interact in extreme environments and conditions under water. To withstand extreme environments like what astronauts will face in space, designers must create appropriate habitats.



The Virtual Reality Lab at Johnson Space Center in Houston provides real-time graphics and motion simulators to replicate the space environment. Commercial Crew Astronaut Mike Hopkins practices spacewalking in preparation for a mission to the International Space Station. Hopkins is assigned to SpaceX's first operational mission after the company's test flight with crew.

NASA's current astronaut training extends beyond the analog missions to use virtual reality experiences. Using virtual and augmented reality, scientists, engineers, and astronauts are capable of saving time and money in training operations.

One of the most fascinating training programs in VR is the Virtual Reality Training Laboratory (VRL) at Johnson Space Center in Houston, where NASA has been studying the potential of astronaut training since the 90's using VR and simulation.

This program was formed after the Hubble telescope was launched. NASA realized that there was an issue with the primary telescope mirror. At that time, the Weightless Environment Training Facility (the predecessor of the Neutral Buoyancy Lab) was already providing analog experiences with physical tools, mockups and space suits to train the astronauts in these kinds of missions. Since the Hubble telescope was too large to fit in the Weightless Environment Training Facility, a team was formed to explore using VR software and hardware for training astronauts for a repair mission*.

*Training Astronauts using Hardware-in-the-Loop Simulations and Virtual Reality. Angelica D. Garcia, Jonathan Schlueter, Eddie Paddock

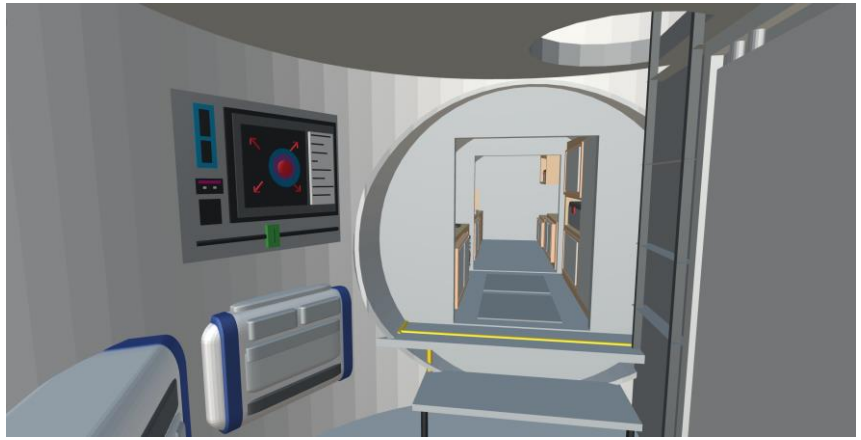
With current advancements that allow for affordable hardware and software for VR simulation, students can now learn first-hand the potential of using VR, just as the Virtual Training Lab team a Johnson Space Center did!

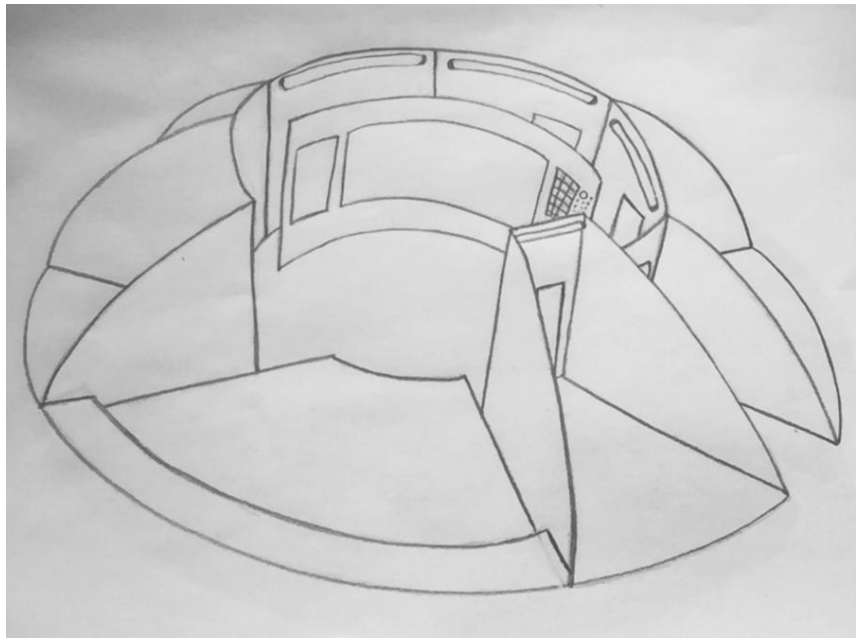
Materials and Method

- **Instructions:** Select your challenge and get the materials. If you are doing the advanced challenge for virtual reality, make sure you are over 13 years old. If you are underage, please read the restrictions links so your teacher or parent can help you to create an account.

Advanced *(suggested age 11+)*

- Paper or printed handout
- Pencil
- Optional VR headset
- Cellphone
- Tinkercad account (see restrictions for students under 13 years old)
- CoSpaces account (see restrictions for students under 13 years old)





Artwork concepts: Students from Instituto Independencia, Mexico

Safety

- Supervise students at all times, especially if they are using water, such as in small pool or bucket.
- If you are creating online accounts for the virtual reality challenge, make sure to follow the guidelines if the student is under 13 years old.
- f you are working with a hot glue gun, make sure to work in a well-ventilated area and away of flammable objects.

Activity for Advanced

Advanced *(suggested age 11+)*

Objective: Design and build a 3D digital mockup of an underwater habitat with Tinkercad. Once you finish designing the habitat, import your 3D model into CoSpaces to create a virtual/ augmented reality interactive version.

NEEMO background knowledge

•Watch the following video to learn about the NEEMO mission.

Open accounts

•Tinkercad account (see restrictions for students under 13 years old)
•CoSpaces account (see restrictions for students under 13 years old)

Plan

•Watch the following video to take a tour of the Aquarius underwater lab.
•Take an interactive tour of the interior and exterior
•Notice important elements in the construction of the habitat.

Research

•Conduct research about marine manmade underwater structures.
•What are the shapes, sizes, and elements that help support humans living and working underwater?

Sketching

•Start by sketching an underwater structure. Think of the habitat shape that can withstand the natural elements such as sea currents or hurricanes.
•Get inspired by nature: Is there an underwater living thing that is aerodynamic? Is there a way you can emulate the shape that makes this living thing successful underwater?

Getting started with CAD Design

CAD design is the way designers create prototypes using the computer before they are the real items are built. Follow the tutorial with the basics of CAD design with Tinkercad.
•*Setting accounts*
•*Working environment*
•*Manipulating objects*
•*Importing and exporting*

Getting started with VR/AR

Virtual and augmented reality is a method to visualize 3D images. Follow the tutorial with the basics of VR/AR design with CoSpaces.
•*Getting started with Cospaces*

Test/ Improve

•install the CoSpaces app in a cellphone to visualize your habitat once it is finished.
•If you have a VR headset you can place your cellphone inside the case to walk around your habitat.

Share

•Share pictures or a walkthrough video of your habitat.
sciartexchange.org/XpandYourHorizon-2020-001-design-your-habitat/entry_form/

Supplemental or Supporting Material

- *VR habitat samples from students in Mexico*
- *Nasa's Analog missions*
- *Tinkercad tutorials*
  - *Setting accounts*
  - *Working environment*
  - *Manipulating objects*
  - *Importing and exporting*
- *CoSpaces tutorials*
  - *Getting started with Cospaces*

NASA astronaut Jeanette Epps and European Space Agency astronaut Thomas Pesquet, who represent half the NEEMO 18 crew, waste little time in performing experiments and other assignments inside a 400 square-foot habitat housing them for nine days underwater off Key Largo. Photo credit: NASA

Activity Objectives

1. Illustrate and analyze relationships with material properties and shapes to solve problems using physical and virtual objects.
2. Construct three-dimensional structures to solve problems.

Keywords

space, virtual, VR, AR, habitat, NEEMO, NASA, UXD,

Standards

NGSS

K-2-ETS1-1.	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
3-5-ETS1-1.	**Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**
MS-ETS1-1.	**Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**