NAVSEA
SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS

#SeaworthySTEM

Glowing Jellyfish

Grades 3-5

Teacher Guide

Seaworthy STEM™ in a Box Series

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Glowing Jellyfish

Teacher Guide for 3-5

Seaworthy STEM™ in a Box Educator Kit description:

Seaworthy STEM™ in a Box activities are a Navy initiative to provide enhanced Naval-relevant, standards aligned, hands-on activities to K-12 teachers and students. Components of this program include, curated sets of classroom activities that aim to build deep conceptual understanding in Naval-relevant content areas. The kits also includes comprehensive lesson plans, material lists, scientific background information, STEM related literacy books, and student activity sheets. The Seaworthy STEM™ in a Box program is designed to support teachers as they select content, acquire materials, and implement more hands-on STEM activities in their classrooms. Increasing student access to hands-on STEM activities, also increases awareness of STEM career paths, engage students in STEM, and support development of student's abilities in STEM content.

The Seaworthy STEM™ in a Box kits were designed to guide students through the scientific inquiry-based theory and the engineering design process. The content and Naval-relevant activities are aligned with the Next Generation Science Standards. The topics and content covered within the lessons are connected and scaffolded based on distinct grade bands (K-2nd, 3rd-5th, 6th-8th, and 9th-12th).

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Lesson Title: Glowing Jellyfish

Time:
60 minutes or Multi-day lesson

Student Objectives:

Students will receive background information about Jellyfish and other deep sea creatures that use bioluminescence to survive in their environment. Students will build and create their own glowing jellyfish which will allow them to experiment with the movement of the jellyfish in the bottle. This activity is similar to a Cartesian diver experiment.

Lesson Overview:

Students will learn about deep-sea animal characteristics and traits they have to survive in the extreme oceanic environment. Students will learn that our understanding of deep aquatic environments is very limited due to the physical dangers and technical difficulties of exploring deep areas that have a tremendous amount of water pressure. Students will design and build a glowing jellyfish using a pipette, a chenille stick, and tonic water. Students will be challenged by demonstrating and building a "jellyfish" that is affected by the laws of buoyancy. Finally, students will observe the "diving" movement and bioluminescence of the jellyfish within the sealed bottle using a black light.

Next Gen Science Standards:

3-ESS2-2
3-LS3-2
3-LS4-2
4-LS1-1
5-PS3-1
5-LS1-1

Notes

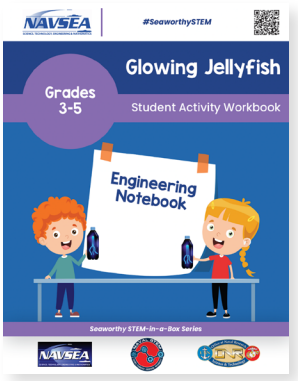
Materials and Equipment List (Per Student):

- [x] Tonic Water
- [x] 1 Pipette
- [x] 1 Chenille Stick
- [x] 1 plastic cup, (for testing area)
- [x] 1 Empty plastic water bottle
- [x] Water
- [x] Black Light

It's very important to purchase water bottles with thick bottle caps! Please test your water bottle before buying a whole class set.

Student Activity Sheets/Handouts:

Glowing Jellyfish Student Activity Workbook

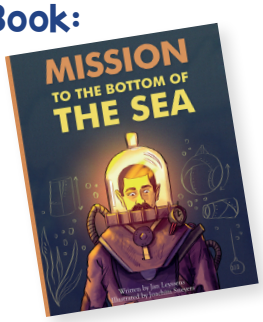


Technology Tools:

Black Light

Suggested STEM Related Literacy Book:

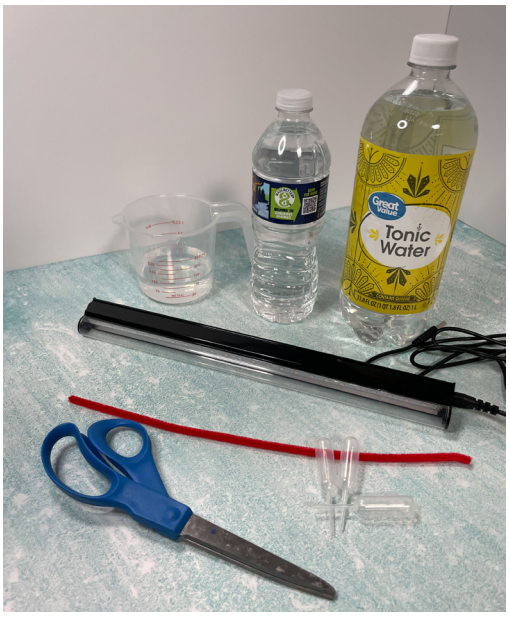
Mission to the Bottom of the Sea
by Jan Leyssens



Procedure:

1. The teacher will introduce the lesson by discussing about deep sea creatures and their animal characteristic traits. The teacher can use the following guided questions on the side panel.

2. Each student or team will receive the following listed materials.



3. The teacher will demonstrate and model how to create the jellyfish. Please follow the guided steps below.

   A. Take the mini pipette and fill the pipette completely with tonic water (this will act as the Jellyfish's head and is similar design as a Cartesian diver.) Explain to students about the air bubble within the pipette and the importance of the air bubble and buoyancy.

   B. Cut the chenille stick into thirds and wrap them around the tip of the pipette to create the tentacles of the jellyfish. (This will also be the weight to allow the jellyfish to sink.)

   C. Place the jellyfish inside the testing area. (A large open lid container filled with water.) Students will observe the jellyfish

The teacher can guide students through the following questions:

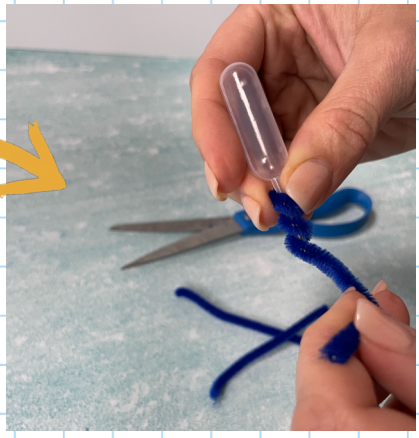
"What is a jellyfish and where do they live?"

"Do some jellyfish live at the bottom of the ocean?"

"Do you know of other deep-sea creatures?"

"How do these creatures survive where there is no sunlight?"

Helpful Tip:
Demonstrate how to fill a pipette completely by filling it up a little bit at a time while squeezing out the air in between "drinks" of tonic water.



sinking. Students will need to achieve the jellyfish barely floating, the top of the pipette barely floating in the testing area.

Important!

To achieve the barely floating phase, students will have to release 1 drop of tonic water from the pipette at a time. Then place jellyfish in water to observe it floating, if not, repeat by releasing 1 drop at a time!

D. Once the jellyfish is floating in the testing area, take the jellyfish out of the water and demonstrate to students they need to get the jellyfish to now barely float in the water bottle.

E. Place the jellyfish in the water bottle and secure the lid. ***Note- the jellyfish should be floating in the water bottle before placing cap. Encourage your students to make the legs vertical if using narrow bottles as they will be less likely to get caught on the sides.***

Helpful Tip:

If a student needs to retrieve the jellyfish out of the water bottle, have the student take the water bottle to a sink. Have the student overfill the waterbottle and the jellyfish should float to the top. This will make it easier for the student to retrieve the jellyfish.

4 Have students practice gripping the water bottle and squeeze the bottle, (holding the squeeze.) Students will observe the jellyfish moving down. Have students practice releasing their squeeze and the jellyfish should go up within the water bottle. ***Note- demonstrate how to squeeze and release the water bottle.***

5 Once practicing is complete, have students place the water bottle by the black light and turn on the light by a dark area. Students will squeeze and release the water bottle to observe the glowing jellyfish moving.

6. When observations are completed, designate students to clean up and the teacher will lead a whole group discussion and/or use the guided engineering student notebook to conclude the activity. The teacher can use the following guided questions to conclude the lesson.

   A. "Why do you think your jellyfish was able to go up and down in the water bottle?"

   B. "Why do we squeeze the bottle?"

   C. "Scientists have barely scratched the bottom of the surface when it comes to observation of the deep ocean, why?"

   D. What would scientist and engineers need to improve or build to dive to the depths of the ocean?"

Vocabulary Terms:

- **Bioluminescence:** the biochemical emission of light by living organisms such as fireflies and deep-sea fishes.
- **Buoyancy:** the tendency of a body to float or to rise when submerged in a fluid.
- **Density:** how much space an object or substance takes up (its volume) in relation to the amount of matter in that object or substance (its mass).
- **Mesopelagic Zone:** This barely-lit ocean layer is called the twilight zone. This zone appears deep blue to black in color and extends from 660-3,300 feet below the surface of the ocean making it impossible for photosynthetic organisms to survive.
- **Oceanic Zones:** is typically defined as the area of the ocean lying beyond the continental shelf, but operationally is often referred to as beginning where the water depths drop to below 200 meters (660 feet).

Scientific Background:

Jellyfish are just one type of bioluminescent animals within the oceanic environment. Scientist have discovered over 1,000 different types of species that emit light. Many deep sea creatures like fish, worms, algae, sharks, and sea stars use this process. Bioluminescence is the production and emission of light by a living organism. Animals will use this trait to signal predators and prey, attract potential mates, and other vital activities. Many deep sea creatures are bioluminescent and scientist have learned a lot about these creatures, however there is so much more to learn. Research is limited due to the fact that technology is not yet advanced enough to venture into the deepest zones of the oceans. Engineers and scientists are working together to create underwater vessels that are strong enough to withstand the incredible amount of pressure found at those depths. Deep-sea exploration will help scientists discover more about these sea creatures and will also enhance our understanding of the ocean.

The glowing jellyfish is able to “dive” within the water bottle because of the additional pressure created by the

student's hand squeezing the water bottle. The buoyancy caused by the air in the pipette causes it to float in a similar manner to a boat on top of the ocean. When the bottle is squeezed the pressure is equally distributed throughout the bottle in all directions including the jellyfish. When squeezed, water will go up into the straw tip of the pipette causing the jellyfish to sink. When the pressure is released the water will leave the straw tip of the pipette and the jellyfish will float back up to the top of the bottle.

STEM Related Career:

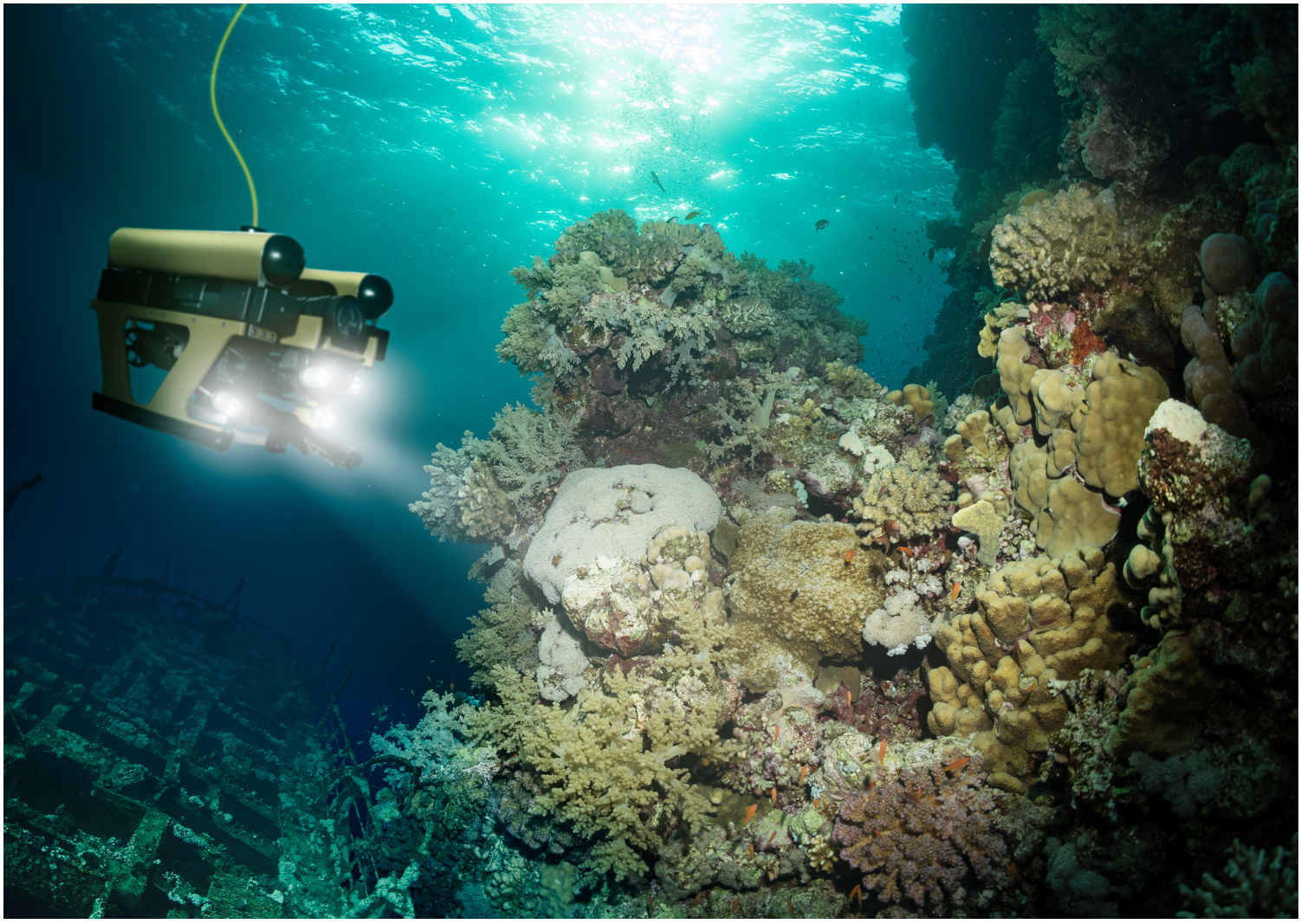
- Oceanographer
- Marine Geologist
- Deep-sea Biologist

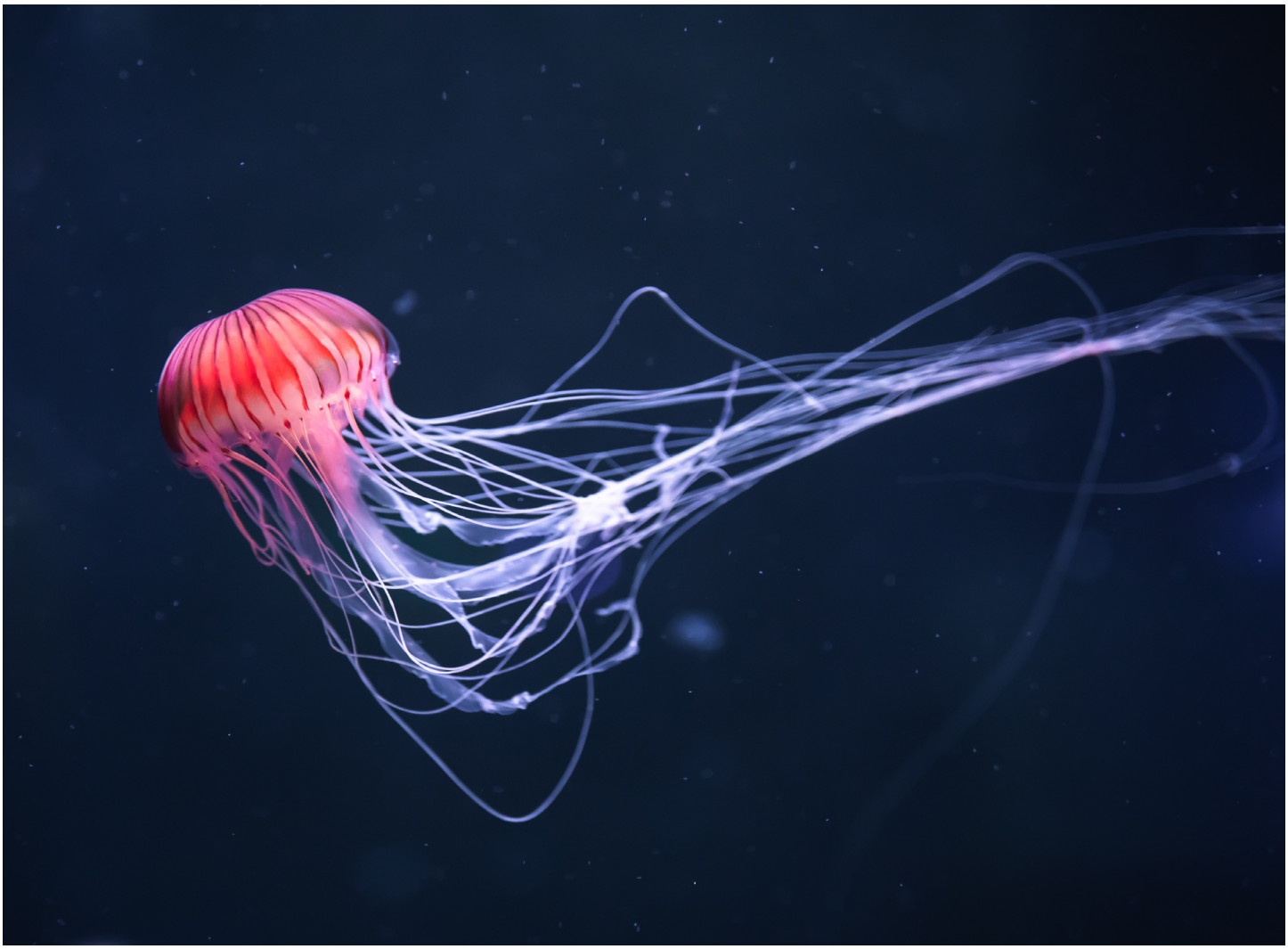
Fun Fact!

The anglerfish typically lives 1,000 meters below the ocean surface. The female Anglerfish are bioluminescent, the light is produce in the "esca". The bulbous appendage that is at the end of its "fishing rod". This light is used to lure its prey.

Fun Fact!

Since the Cold War, the Navy has made deep-sea research as a top priority. The Navy wanted to increase oceanographic knowledge and the ability of diving into the deep-ocean using submarines. With today's technology, Deep Submergence Vehicles, (DSV's) are robotic water crafts that are commonly used today to continue this research and discover.





The Seaworthy STEM™ in a Box curricula was developed through collaborative efforts of a team of individuals at the Naval Surface Warfare Center Carderock Division and Albert Einstein Distinguished Educator Fellows via an inter-agency agreement with the U.S. Department of Energy for the Albert Einstein Distinguished Educator Fellowship (AEF) Program. We are grateful to the following Content Specialists who contributed their knowledge and expertise by researching and writing on selected topics: Suzanne Otto, Stephanie Klixbull, and Thomas Jenkins. We'd also like to acknowledge the contributions of AEF participant Ms. Deborah Reynolds, the inaugural AEF Educator at Carderock that helped inspire the design of Seaworthy STEM™ in a Box content. With the help of Albert Einstein Fellow, Melissa Thompson, and Carderock Outreach Specialist, Ashlee Floyd, special additions to the curriculum such as career portfolios, workforce trading cards, and in-house short story publications are included that reflect the diversity of NAVSEA Sites.

It is the goal of the SeaWorthy Curriculum to embrace NAVSEA technologies from sites nationwide to empower the youth of our nation to purse STEM-centric career pathways. The views and opinions of the Content Specialists expressed herein do not necessarily state or reflect those of the AEF Program, the U.S. Department of Energy, or the U.S. Government. Reference herein to any specific commercial product, process, or service by trade name, trademark, service mark, manufacturer, or otherwise does not constitute or imply endorsement, recommendation, or favoring by the AEF Program, the U.S. Department of Energy, or the U.S. Government.

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