



**Grades  
K-2**

# Oh Barnacles!

**Teacher Guide**



***Seaworthy STEM™ in a Box Series***





# Oh Barnacles!

## Teacher Guide for K-2



### 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: Oh Barnacles!



## Time:

1 Class period (45–60 minutes)

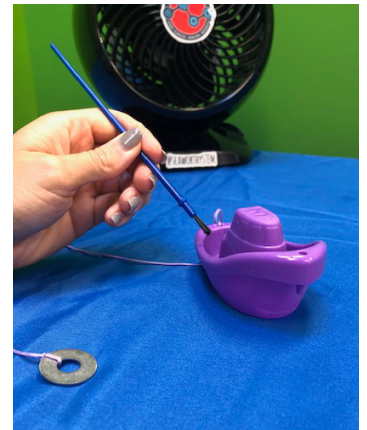
## Student Objectives:



Students will learn the effects of marine life on water crafts, which is a key consideration in the designing and building of water vessels. Students will learn how the Navy protects and maintains ships for safe operating conditions. Students will use problem solving skills to find a solution to protect their own boat from marine life such as barnacles.

## Lesson Overview:

Students will learn about crustaceans, in particular barnacles. Barnacles have a huge impact on the viability of a water vessel. Engineers in the field of ship design, have to problem-solve this impact on boats. The best solution is to seal and coat water vessels to prevent barnacles, algae, and other crustaceans from latching on the boat's surface. Students will work in teams and receive two toy boats. The Pom-Poms will act as barnacles in this activity. Students will first observe how barnacles attached to a boat's surface will cause drag. Then students will coat the second boat using petroleum jelly and observe how barnacles are no longer able to attach to the boat. The petroleum will act as an anti-fouling coat used by naval engineers to protect ships from marine life. This lesson was designed for students to receive the hands-on realistic approach that naval engineers use to solve this economical problem.



## Next Gen Science Standards (NGSS):

K-ESS3-1  
1-LS1-1  
2-LS4-1  
K-2-ETS1-1  
K-2-ETS1-3



A cross-disciplinary approach can accommodate diverse learning styles!

## Notes

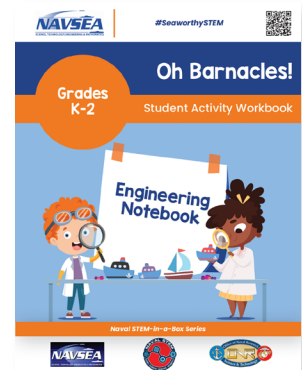


### Materials and Equipment List (Per Team):

- ✓ Water
- ✓ Foil pan
- ✓ 2 Toy boats
- ✓ 2 pieces of string, 12' inch each
- ✓ Petroleum jelly
- ✓ 3 Paint brushes
- ✓ 8 Pom-Poms
- ✓ 8 glue dots
- ✓ 2 washers (same weight)
- ✓ Stopwatch (or any timing device)

### Student Activity Sheets/Handouts:

Student Activity Workbook



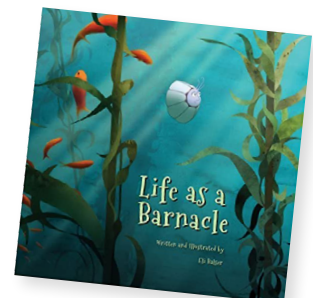
Washers of less mass will cause the boat to move more slowly, and make it easier to measure the difference in drag. Also, the overall impact of the barnacles will be more easily observed.

### Technology Tools:

Stopwatch (or any timing device) to measure and collect travel time of the boats, for comparing.

### Suggested STEM Related Literacy Book:

Life as a Barnacle by Eli Balser



## Procedure:

- 1 The teacher will give a brief introduction about drag, boats, and information about barnacles.  
(Read description below in Scientific Information.)
- 2 The teacher will introduce the activity and guide students through listed materials.
- 3 The teacher will divide the class into small groups, 3-4 students per group.
- 4 Each group will receive the following materials;
  - 2 toy boats- with string and washer attached
  - 1 foil pan filled halfway with water
  - 3-4 paint brushes
  - 8 Pom-Poms
  - 8 glue dots
- 5 Have teams place one boat in the water. Allow the washer to hang off the side of the foil pan. Have the students practice letting go of the boat and gravity should pull the washer to the ground, moving the boat! Teams can now practice releasing both boats at the same time.
- 6 Guide students by modeling how to place the “barnacles” (pom-poms) on only one boat by using the glue dots. Have the students place 4 barnacles on one boat.
- 7 Have students place both boats in the pan again, and experiment releasing the boats at the same time. Students will observe the drag created on the barnacle boat.
- 8 The teacher will direct students to use paper towels to dry off the non-barnacle boat. Students will now use the paint brushes to place a thick coat of “anti-fouling” (petroleum jelly) on the boat.
- 9 The teacher will then tell students to place the remaining barnacles on the now anti-fouling coated boat.

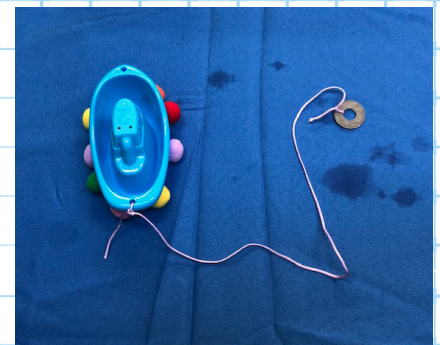
The teacher can guide students through the following questions:

“Do you observe how your boat moves in the water?”

“How can you make your boat go faster? Slower?”

“Which boat is slower (Why?)”

“Do you think the barnacles cause drag to the boat?”



(Helpful tip: The pom-poms may fall off at this point or in the water.)



The teacher can ask these guided questions:



"Does your boat still work in the water?"

"Did any barnacles stick to your second boat? (Why or why not?)"

"Do the barnacles stay latched on? Can you push them off?"

"Does the coated boat have any drag?"



"Oh barnacles! Would you look at that drag?"

- I0 Have teams experiment by placing both boats in the water again. Students will observe the difference in the newly coated boat.
- II To conclude activity, the teacher can guide students in cleaning up and completing the engineering workbook.

"Release the boat"



Barnacle boat

Non-barnacle boat



## Vocabulary Terms:

- Anti-fouling coat: A coating applied to the outer layer of the hull to limit biological growth (i.e. barnacles) on a ship or a boat.
- Crustacean- An aquatic organism in the same group as crabs, lobsters, and shrimp.
- Drag- A force that opposes the forward progress of an object as it moves forward through a fluid.
- Food Chain- A diagram showing how a living thing gets its food.
- Marine Ecosystem- An aquatic environment containing a high level of dissolved salt.

## Misconceptions/ Science information:

Barnacles are part of the crustacean family and play a key role in the marine ecosystem. Barnacles can play both a positive and negative impact within the marine ecosystem. Barnacles are filtering organisms and play a major role in the food chain of their ecosystem.

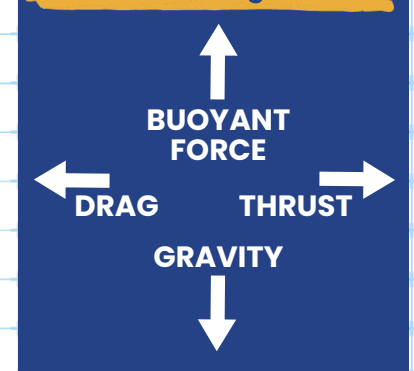
Unfortunately, Barnacles do also play a negative impact on human made vessels such as boats. Barnacle larva will attach themselves to objects in the ocean such as boats, whales, and rocks. They have a glue-like substance to attach themselves head-first to a host. This "glue" is extremely strong and even if the barnacle dies, the crustacean will stay attached. When multiple barnacles attached to a boat they can negatively impact the drag and weight of the boat. This impact will cause negative economic cost to fuel emissions and the life of a boat. To solve this problem, the Navy will coat boats with an anti-fouling paint that will help decrease any type of crustacean and algae trying to "stick".

A boat uses thrust to move forward. When something lessens the forward motion of a boat as it moves through the water, its called drag.

### Drag in Action!

A girl is walking down the street with an open umbrella. When the wind blows, the moving air enters the umbrella and forces the girl to step backwards.

### Force Diagram



## **STEM Related Career:**

- Marine Biologist
- Ship Design Engineer
- Mechanical Design Engineer

## **Reference Photos:**

Full size reference photos are on the following pages.





















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 pursue 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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