

# STEM PATHWAYS

## Submarine Exploration **STEM** Challenge!

### The Problem

Jack is an aquatic scientist exploring the lifecycle of the Pacific Seahorse. He needs a vessel to help him travel to the area between the surface and the ocean bed.

### The Challenge

Design a vehicle to help Jack capture video of Pacific Seahorses in their native habitat.

### Find a Solution

ASK: What are some possible ideas?

PLAN: Test out your ideas

CREATE: Put your ideas into action.

TEST: How well did your idea work?

IMPROVE: Review results & make changes.

### Things to Consider

1. How will the material you choose for your submarine affect its ability to float under the surface?
2. What material properties must you consider before adding them to your submarine?
3. What type of submarine will minimize the disturbance of the ocean life environment?

Authored by: Travis West, OSU Extension, Vinton County,  
4-H Youth Development Extension Educator, west.222@osu.edu  
740-596-5212, go.osu.edu/4HSTEMpathways



### Choose Your Design Materials

Plastic Egg (submarine)

Marbles

Coins

Wood Pieces

Beads

Cork

Washers

Paper Clips

Popsicle Sticks

#### SAFETY ALERT:

You don't want water to be leaking inside your submarine or on your internal materials. Check your seal before launching into the ocean.



THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES



# STEM PATHWAYS

## Submarine Exploration **STEM** Challenge!



**TIME: 30 MINUTES**

### Materials and Supplies

- Plastic eggs (one for each participant)
- Variety of small and heavy objects (craft sticks, marbles, coins, wood pieces, beads, cork, washers, paper clips)
- Tubing Plastic Container (3-5 gal. size – deep enough to accommodate floating, hovering in water & sitting on the bottom)
- Water (optional salt to add to water)
- Tape (to seal submarine shell from leaks)
- Record sheet & pen

### Design Space

- Table space with plastic eggs and design materials.
- Testing area with container half filled with water.
- Optional: 2<sup>nd</sup> container half filled with salt water for comparisons.



**SAFETY ALERT:** You don't want water to be leaking inside your submarine or on your internal materials. Check your seal before launching into the ocean!

### Engage the Learner

- How many ways are there to construct the submarine to accomplish the challenge? *Multiple*
- What forces are acting on the object? *Buoyancy – Force pushing up, Pressure – pulls sub to ocean floor, Drag – resistance of water pressure on outside of submarine*
- How might the material's selected affect the submarine's ability to float? *Dense materials like metal nuts will increase the effect of pressure on sub; less dense materials like wood pieces and craft sticks will increase buoyancy of submarine*

### Observations and Conclusions

- What materials seemed to move the submarine lower in the water? *Dense materials like metal nuts, etc. They are heavier (more mass) and therefore increase effect of pressure on submarine.*
- Does the submarine work in both salt and fresh water? *Salt water is more dense than fresh water, so submarine should float higher in the water.*

Reference: "Design a Submarine" by the Museum of Science in Industry; Chicago, IL.

### STEM Career Path ... Marine Engineer

- Who else might be involved? *Marine biologist, biological technicians, naval architects*
- Who benefits? *Improved safety for recreational boaters, naval officers, cruise ship travelers, ocean explorers and scientists. Ability to map uncharted waters, discovering new plant and animal life, tracking changes, retrieving sunken ships, etc.*
- What other issues are marine engineers helping to solve? *Designing vessels from aircraft carriers to submarines. More efficient propulsion and steering of aquatic vessels.*

Refer to Career Focus Card for more details.



**THE OHIO STATE UNIVERSITY**

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES



# STEM PATHWAYS

career

## Submarine Exploration STEM Challenge

Did You Know? Some of the largest submarines can stay submerged underwater for six months.

### SCIENCE

Marine Biologist

What conclusion can you draw from observing seahorses in their natural habitat?

- They are bad swimmers.
- They are fish.
- Male seahorses give birth.
- They eat almost constantly.

### TECHNOLOGY

Biological Technicians

How can studying with a submarine assist in preserving seahorse populations?

- Seahorses mate with their partner for life.
- Fifty-three species of seahorses are spread across the world.
- Sometimes seahorses stay on one plant for days because they are not good swimmers.

### ENGINEERING

Marine Engineers

What materials will help reduce the friction of a submarine?

- Buoyant materials are necessary to keep the submarine off the ocean bed.
- Submarines must be able to rise to the surface and float in the water.

### MATH

Naval Architects

What factors must be considered when designing an aquatic vessel?

- Computer specifications to establish basic characteristics of a ship, such as size, weight, and speed.
- Develop sectional and waterline curves and angles of the hull to establish the center of gravity and ideal hull form.
- Calculating the static and dynamic stability of a given vessel.
- Determining the force of buoyancy imposed on the vessel by the materials.



THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES



# STEM PATHWAYS

## Submarine Exploration STEM Challenge

### Marine Engineer

#### Finding Solutions For...

- Vessels from aircraft carriers to submarines
- More efficient propulsion and steering of aquatic vessels

#### Job Forecast Looks Like...

- **Median Income:** \$88,100 per year
- **Job Outlook:** 10% growth from 2012-2022
- **Job Environment:** Offices with access to computers, software and design tools, some time is spent at sea testing and maintaining vessels
- **Expected Growth Areas:** ships and systems to transport energy products, global transportation for liquefied natural gas

#### Skill Set Needed...

- **High School Courses:**
  - Math: algebra, trigonometry and calculus
  - Science: biology, chemistry, and physics
  - Specialized: drafting
- **Problem-solving:** apply engineering and technology to new circumstances
- **Teamwork:** design solutions involving biological, mechanical or environmental dimensions, work and receive feedback from a variety of backgrounds
- **Communication:** give clear instructions and explain complex concepts to teams
- **Ingenuity:** operations analysis to create a design and use critical thinking to anticipate and correct deficiencies.

#### Education and Training Required...

- **Entry Level Jobs:** Require Bachelor's degree
- **Additional Training and Certifications:** An exam to obtain a mariner's license from the U.S. Coast Guard. Cooperative engineering programs can provide valuable practical experience which is important to employers.



**THE OHIO STATE UNIVERSITY**

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES



Source:  
U.S. Department of Labor, Occupational Outlook  
Handbook, 2014-2015 Edition,  
bls.gov/ooh