**OCEAN EXPLORATION TRUST**

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**STEM LEARNING MODULES**

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**Links to Next Generations Science Standards |**

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.

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**Background Needed |** Reasons why humans explore the ocean, Nautilus Exploration Program, basic STEM concepts, career counseling

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**Assessment |** Extended Response Rubric provided

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**Materials/Resources |**

- Access to an internet connected computer
- A set Ocean Exploration Team Cards (http://nautl.us/2bimupx) per student group

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**Overview**

This module is designed to introduce students to the many STEM role models who sail on E/V Nautilus as part of the Corps of Exploration. There are more than 150 explorers who sail with the ship per expedition season. This module will give students guiding questions and information on how each member arrived at their current STEM career and what role the fill aboard the E/V Nautilus. During the live expedition season, students can visit www.NautilusLive.org to send in questions for these mentors and join the conversation live.

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**Objectives & Learning Outcomes**

- Students will be able to examine different STEM careers involved with ocean exploration.
- Students will understand different positions aboard a ship of exploration.
- Students will meet members of the Nautilus Exploration Program’s Corps of Exploration.
- Students will be able to explain various pathways to highlighted STEM careers.
- Students will be able to formulate compelling interview questions that address some of the challenges ocean explorers face.
- Students will use supporting scientific evidence and engineering designs to present an argument for why their own method and or designs could be a solution to a given problem.

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**Guiding Questions**

- Why do we explore the ocean?
- What types of jobs are needed on a ship in order to successfully explore the world’s oceans?
- How did successful STEM role models achieve their current positions?
- What are some common themes in the pathways for different STEM careers?
Activity/Tasks
Students will:
- Meet and learn about various STEM careers featured in the Nautilus Exploration Program.
- Learn about what pathways exist to pursue careers in STEM.
- Discuss the duties and responsibilities for each role on the ship.
- Formulate interview questions that they would ask of an explorer that would answer scientific questions and engineering challenges.
- Decide if they are a scientist or an engineer; students will answer one challenge question and in written and/or verbal form craft an argument that supports with clear reasons and relevant evidence why their design and/or method is a feasible solution to the question.
- Interact with a current STEM role model onboard the E/V Nautilus.

Lesson Procedure/Directions
1. Introduction
   - If the class has not discussed ocean exploration, consider examining how humans and the ocean are interconnected; the relationship between the ocean and humans and the goals of ocean exploration. If needed an overview of the Nautilus Exploration Program using season highlights and program videos would benefit students about to meet the members of the Corps of Exploration.
   - If your class has not discussed STEM previously, begin the lesson with a short discussion asking students how Science, Technology, Engineering and Mathematics impact their lives.
2. Inquiry
   - Give each group a set of ocean exploration team cards and have students match the tools with the roles of the ocean explorers.
   - Have students complete student worksheets 1 and 2.
3. Interaction
   - If you are delivering this lesson during the expedition season, visit www.NautilusLive.org. While the team is exploring students can submit questions to the live feed and listen directly to members of the Corps of Exploration inside the control van.
Extensions & Adaptations

Advanced
Integrate geography into the lesson. Give students a map with latitude and longitude lines. Ask students to plot exploration points within the season’s exploration goals. (www.nautiluslive.org/expedition/2016).

Have students research additional equipment that might be used in the onboard wet lab.

Extension
Meet the Team! Read short biographies of members of the Corps of Exploration www.nautiluslive.org/people. Watch video video interviews; have students work together to research a famous explorer of the past and present their results to the class. Alternatively, students could research an important ocean discovery of the past and present their research to the class.

Student Procedure
1. Read student sheet instructions.
2. Select a role aboard the E/V Nautilus and follow questions on the sheet in order to research that role.
3. Share with your group and then the class the role and responsibilities of the team member you researched.
4. Choose a role and formulate interview questions that you would ask of an explorer that would answer scientific questions and engineering challenges ocean explorers face.

Student Data: Write which tools each explorer uses. Select one tool and write two to three sentences describing how that tool helps the explorer.

Chief Scientist: Sample collection box, microscope, lab supplies, specimens

Video Engineer: Cables, cameras, white/color balance arm

Argus Pilot: ROV Argus, A-frame, winch, control room

Hercules Pilot: ROV Hercules, ROV shop, tether and fiber optic cable

Navigator: Sonar, bridge communication, satellite and GPS systems

Data Logger: computers, data programs, note taking, saving images

Expedition Leader: Situation Report, dive site maps,

Captain and Crew: life rafts and immersion suits, bridge, engine room

Science Communication Fellow: Satellite, studio camera, ship to shore interactions

Sample concept map:
**Learning Goals**

- Examine different STEM careers involved with ocean exploration.
- Understand different positions aboard an exploration ship.
- Get acquainted with the many members of the Corps of Exploration.
- Explain various pathways to highlighted STEM careers.
- Formulate compelling interview questions to address some of the challenges ocean explorers face.
- Use supporting scientific evidence and engineering designs to present an argument for why your own method or designs could be a solution to a given problem.

**Challenge:** What do ocean explorers do and what tools do they use? Read the roles of the explorers and decide what tools they use to carry out their responsibilities. Match the cards. Explorers can use more than one tool.

**Introduction |**

Ocean exploration at sea is a complex challenge that requires planning and organizing a highly-skilled and collaborative team of people and providing them with the necessary equipment. Explorers on the team have different roles, mixed skills, and diverse backgrounds. They need a multitude of tools to do their jobs. While some roles may share tasks or equipment, everyone relies on one another to successfully complete the expedition.

The Corps of Exploration works from the Exploration Vessel (E/V) Nautilus to explore parts of the ocean that are poorly understood. The ship can be home to up to 48 people: 31 in the science team that includes engineers, watch leaders, scientists, interns, and educators and 17 professional mariners as the ships’ crew. In this module, you will read the explorer cards to introduce yourself to some of the explorers’ roles and the equipment they use to successfully complete an expedition.

**Key Terms:**
- Ocean exploration, teamwork, remote operated vehicle

**Materials:**
- One set of ocean exploration team cards per group (http://nautl.us/2bimupx)

**Procedure:**
1. Obtain a set of cards from your instructor.
2. Read all the explorer roles and look at all the tools cards.
3. Match the cards.
4. Record your matches and complete worksheets 1 & 2.
5. Discuss your match choices as a class.
6. Complete the concept map.
You Become the Reporter!

What kinds of questions would you ask different members of the Corps of Exploration?

Write at least three questions for an explorer who has sailed on E/V Nautilus.

Check out the “Meet the Team” page of Nautilus Live to meet the many STEM rolemodels on the team.

www.nautiluslive.org

Which videos or bios are your favorite highlights of people in STEM careers?

Guiding Questions

1. Why do we explore the ocean?

2. What types of jobs are needed on a ship in order to successfully explore the world's oceans?

3. How did successful STEM role models achieve their current positions?

4. What are some common themes in the pathways for different STEM careers?
Worksheet 1

After reading through the explorer cards, write which tools each explorer uses. Select one tool and write two to three sentences describing how that tool helps the explorer.

1. Chief Scientist:

2. Video Engineer:

3. Argus Pilot:

4. Hercules Pilot:

5. Navigator:

6. Data Logger:

7. Expedition Leader:

8. Captain and Crew:

9. Science Communication Fellow:

II. Scientific Practice: Acting as chief scientist formulate a question that can be analytically answered by doing ocean exploration.
Worksheet 2- The Complexity of a Team

Did your group/class match any tools to different roles? Did you feel that more than one explorer might use the same tool(s)?

Starting with the Corps of Exploration in the middle create a concept map below depicting the complexity of the team.

II. Writing Assignment: If you could take on the role of one of the team members of the Corps of Exploration, which position would you pick? Explain why.
<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 Exemplary</td>
</tr>
<tr>
<td>**Content and Vocabulary</td>
<td>**</td>
</tr>
<tr>
<td>Explanation uses appropriate vocabulary. Student is able to provide clear examples of the content or justify their response. Student is able to discuss application of the content. Response contains no content errors.</td>
<td>Explanation uses appropriate vocabulary. Student is able to provide some examples of the content or justify their response and is able to discuss application of the content. Response may contain minor errors that do not detract from overall understanding of the topic.</td>
</tr>
<tr>
<td></td>
<td>**Language and Conventions</td>
</tr>
<tr>
<td>Student produces clear and coherent writing in which the development, organization and style are appropriate to task, purpose and audience. Demonstrates an exemplary command of standard English conventions.</td>
<td>Student produces writing in which the development, organization and style are appropriate to task, purpose and audience. Demonstrates a command of standard English conventions; errors do not interfere with understanding.</td>
</tr>
<tr>
<td><strong>Total Score:</strong></td>
<td><strong>Comments:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**How Large is Nautilus Nation?**

Tracking the reach of Ocean Exploration Trust’s education programs is essential in ensuring we are funded to continue making discoveries and inspiring the next generation of explorers.

<table>
<thead>
<tr>
<th>Name:</th>
<th>My Community (City, State):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email Address:</td>
<td></td>
</tr>
<tr>
<td>School’s Name:</td>
<td></td>
</tr>
<tr>
<td>Instruction date:</td>
<td>Grade level instructed:</td>
</tr>
<tr>
<td>Subject area:</td>
<td></td>
</tr>
</tbody>
</table>

**My education space is a...**

- Classroom
- After school program / Club meeting
- Fair / Festival / Event
- Museum / Science Center
- Other. Tell us more:

**Who did you engage in your teaching?**

- # Students
- # Community Members

**Select all the OET materials you used in your instruction:**

- STEM Learning Modules. Which ones? _________________________________________________________________
- Digital Resource Library materials. Which ones? _______________________________________________________
- Nautilus Live website: photo albums
- highlight videos
- live stream
- Meet the Team STEM mentor profiles
- Facebook (NautilusLive)
- Twitter (@EVNautilus)
- Instagram (@nautiluslive)
- Other. Tell us more: ____________________________________________________________

**What made working with OET resources valuable to your instruction (select all that apply)?**

- Hands-on activities
- STEM career connections
- Easy to use lessons
- Standards-based lessons
- Website resource access
- Real world application of curricula topics
- Excitement of cutting-edge discoveries / Unfamiliarity of deep ocean
- Another reason. Tell us more: ____________________________________________________________

Using OET resources increased my confidence in teaching my science, technology, engineering, or math subjects. □ Yes □ No

OET provided me with helpful and relevant teaching resources. □ Yes □ No

Using OET resources increased my awareness of STEM careers. □ Yes □ No

If yes, how so? How can we improve?

Please scan this document or snap a picture of it with your phone. Email the feedback or questions to education@oet.org. You can also submit feedback online: http://nautl.us/2cp3PNu

Thank You For All You Do!