To Boldly Go: Why Do We Explore?

Overview

Image courtesy of NOAA Ocean Exploration.

TOPIC: Ocean Exploration

FOCUS: Students explore modern reasons humans explore the ocean.

GRADE LEVEL: 6 - 8 Science and Technology

TIME NEEDED: One to Two 50-minute class periods

DRIVING QUESTION: Why is it important for humans to explore the ocean?

OBJECTIVES/ LEARNING OUTCOMES: Students will:

- Identify contemporary reasons for ocean exploration.
- Discuss and explain why these reasons for exploration are important.

MATERIALS:

Student Handout (one per group, print or share digital copies)

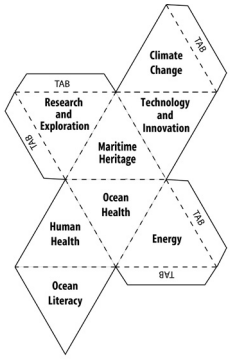
- Student Worksheet: To Boldly Go

Videos

- Going Deep in Search of Discovery (3:31) *NOAA Ocean Exploration*
- *Optional* The Value of Ocean Exploration (4:04) *NOAA Ocean Exploration*

Challenge Activity (materials for 1 group of 4-5 students)

- Dry erase board and marker or paper and pen/pencil
- Set of Learning Shape Octahedrons (Figures 1-4)
- *Optional: Figure 5 can be printed and used as a discussion opportunity.*



EQUIPMENT:

- Computer and projector for class viewing of videos
- Timer
- *Optional: Student laptops or tablets for extensions and/or additional researc*

SET-UP INSTRUCTIONS:

- Cue up any videos to show the class.
- All learning shapes should be printed in advance on card stock and taped securely.

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Performance Expectations (PEs)
MS-ESS3 Earth and Human Activity

Disciplinary Core Ideas (DCIs)
ESS3.A: Natural Resources
ESS3.C: Human Impacts on Earth Systems
ESS3.D: Global Climate Change

Crosscutting Concepts (CCs)
Influence of Science, Engineering, and Technology on Society and the Natural World
Science Addresses Questions About the Natural and Material World

Science & Engineering Practices (SEPs)
Asking Questions and Defining Problems
Constructing Explanations

COMMON CORE CONNECTIONS

ELA/Literacy - RST.11-12.1, WHST.9-12.1

OCEAN LITERACY ESSENTIAL PRINCIPLES AND FUNDAMENTAL CONCEPTS

Principle 7: FCs a-f

Educator Guide

Background

"We know more about the dead seas of Mars than our own ocean."

~ Jean-Michel Cousteau

Historically, explorers have been driven by a variety of motives to explore. For some, the primary reason was to expand their knowledge of the world. For others, economic interests provided powerful incentives, and many expeditions launched such missions to find a sea route to access the spices of Asia, or quests for gold, silver, and precious stones. Political power and the desire to control large empires motivated other explorations, as did the desire to spread religious doctrines.

The first ocean exploration for the specific purpose of scientific research is often considered to be the voyage of the HMS *Challenger*, conducted between 1872-1876. Curiosity, desire for knowledge, and quest for adventure continue to motivate modern explorers. But today, ocean exploration supports and enhances the work of many individuals and organizations working on key science issues, including climate change, energy, human health, ocean health, research and exploration, technology and innovation, maritime heritage, and ocean literacy.

Educator Note

- Students should be familiar with basic climate change and energy resource concepts.

FOR MORE INFORMATION:

- *Why Do We Explore the Ocean? Fact Sheet*

Why Do We Explore the Deep Ocean?

Despite the fact that the ocean covers approximately 70% of Earth's surface and plays a critical role in supporting life on our planet, our understanding of the ocean remains limited, with most of it still largely unexplored.

Ocean exploration is about making discoveries, searching for things that are unusual and unexpected. As the first step in the scientific process, the rigorous observations and documentation of biological, chemical, physical, geological, and archaeological aspects of the ocean gained from exploration set the stage for future research and decision-making.

Why Do We Explore?

Modern Reasons for Ocean Exploration

Climate Change – Climate change refers to any significant change in the measures of climate for extended periods of time. This includes changes in temperature, precipitation, ocean heat, wind patterns, sea level, sea ice extent, and more. The exact relationship between the deep ocean and climate change is not fully understood. One potential impact of global climate change includes weakening of large-scale ocean circulation, or thermohaline circulation (THC), which plays an important role in transporting heat, dissolved oxygen and nutrients, species distribution, and trade routes. Ocean exploration provides some of the essential knowledge about ocean-atmosphere interactions that is needed to understand, predict, and respond to these impacts. Learn more about the impacts of climate change.

Energy – Ocean energy resources include non-renewable sources such as oil and gas, as well as renewable sources, such as the energy of offshore winds, waves, and ocean currents. Ocean exploration can reveal new energy sources, and help protect sensitive environments where these resources are found. Methane hydrate, a relatively stable, ice-like substance that is created in deep-ocean sediments and under conditions of low temperature and high pressure, has a unique chemical composition and structure that makes it a research interest for energy officials, climate scientists, and ecologists alike. Learn more about methane hydrates.

Human Health – Our ocean and coasts affect us all—even those of us who don't live near the shoreline. A healthy ocean and coasts provide us with food, recreation, climate regulation, and even medicine! Almost 50% of the medicines we use today come from "natural products," or chemical compounds produced by a living organism. Medicines like morphine and penicillin are chemical compounds made by plants or microorganisms (bacteria and fungi) that treat pain or fight infection. Expeditions to deep-sea habitats have found several new species sources for powerful new antibiotic, anti-cancer and anti-inflammatory drugs. Learn more about natural products in the deep sea.

FACTSHEET | oceanexplorer.noaa.gov

Modern Reasons for Exploration

Climate Change: The ocean has a major influence on weather and climate, but we are still learning about deep-ocean processes that affect climate.

Energy: Ocean exploration contributes to the protection and management of unique and sensitive environments where new energy sources exist.

Human Health: Expeditions to the unexplored ocean almost always discover species that are new to science. Many animals in deep-sea habitats have been found to be promising sources for powerful new antibiotics, anti-cancer, and anti-inflammatory drugs.

Ocean Health: Many ocean ecosystems are threatened by pollution, overexploitation, acidification and rising temperatures. Ocean exploration can improve understanding of these threats and ways to improve ocean health.

Research and Exploration: Expeditions to the unexplored ocean can help focus research into critical areas that are likely to produce tangible benefits.

Technology and Innovation: Exploring Earth's ocean requires new technologies, sensors and tools and the need to work in extremely challenging environments is an ongoing stimulus for innovation.

Maritime Heritage: Marine archaeology involves the study of ancient human objects, such as shipwrecks, found beneath the water's surface. Studying underwater cultural heritage sites can help us understand the past, connect us to our ancestors, and teach us lessons on how humans and the environment can impact each other.

Ocean Literacy: Ocean exploration can help inspire new generations of youth to seek careers in science, technology, engineering, and mathematics and offers vivid examples of how concepts of biology, physical science, and earth science are useful in the real world.

Educator Guide cont.

Introduction

Have students form groups of 4-5 persons. Make sure each group has a paper to write on or a dry erase board and marker.

Start by asking students to brainstorm reasons why they think time and money is spent exploring our ocean. Have them take about 5 minutes to brainstorm and record those reasons on their group paper or dry erase board. Each group will share one reason with the class.

Tell students to keep their ideas in mind as they watch the Going Deep in Search of Discovery video to give them some context on ocean exploration. After playing the video, students may observe that some of their ideas are similar but that they also heard new reasons. Keep these discussions short as they will have time to dive deeper into discussion later in the lesson.

Tell each group they will now participate in a matching challenge race.

Learning Procedure

Provide each group with a set of prepared Learning Shape Octahedrons (Figures 1-4), and distribute one Student Worksheet per group.

Tell students their challenge is to be the first group to correctly match two facts with each of eight reasons we explore the ocean. Their Student Worksheet has one completed match. *Example: Climate Change:* ***Fact 1 - A1*** *(Earth's average temperature is now warmer than any time since at least 1400 AD) and* ***Fact 2 - B4*** *(Mountain glaciers are melting and polar ice is decreasing.)* Students do not have to write out the facts since it will take too much time. **Instruct** the students when to start. Depending on the level of the students, the matches should take about ten to complete. Students should indicate they have completed the challenge by raising their hand. First group to do so will be the winner. A small prize or extra points could be an incentive for students. Monitor the time to ensure students have the chance to complete the discussion portion of the lesson.

Putting the Pieces Together

After the winner has been verified using the Matching Challenge Answer Key (on page 4) and the challenge is complete, share the correct answers with the class. Then assign one reason to each group, i.e. climate change, energy, etc. Have them discuss the facts with their group and explain why these facts are important and why we should care. They should use the space on their worksheet to record their explanations.

Guiding Questions:

- Why are these facts important? Why do we or should we care?
- How are these important to you?

Have each group share and discuss their explanations with the class. If time does not allow for group presentations, the Student Worksheet can be used to evaluate their final explanations.

Show The Value of Ocean Exploration optional video as an additional wrap up.

Educator Guide cont.

Extensions

- Have each student make their own learning shape octahedrons using Figure 5 and the facts they research on the Ocean Exploration Facts webpage.

Assessment

Opportunities for formative assessment are embedded throughout the lesson through class discussions. The student explanations that are developed at the end of the lesson could be used as an opportunity for summative assessment.

LOOK FORS

The following components should be included in students' final explanations:

- Thoughts from specific facts explored during the challenge, class discussion, and videos.
- Explanations as to why these facts are important and why we should care about them.

Matching Challenge Answer Key

Reasons We Explore	Fact 1	Fact 2
Climate Change	**A1** - Earth's average temperature is now warmer than any time since at least 1400 AD.	**B4** - Mountain glaciers are melting and polar ice is decreasing.
Energy	**A2** - Includes renewable (ex. offshore wind) and non-renewable sources (ex. oil and gas).	**B8** - Methane is a natural gas found in the deep sea that represents a major source of energy.
Human Health	**A5** - The ocean is a source of compounds that can lead to developing new medicines.	**B5** - More antibiotic & anticancer substances come from marine animals, like sponges and octocorals, than from land animals.
Ocean Health	**A6** - Invasive species and over-exploitation of large species impact our ocean.	**B7** - Changes in water pH can affect how shells and skeletons of some organisms form.
Ocean Literacy	**A8** - Studying the ocean helps us understand our connection to the ocean.	**B3** - Ocean exploration can inspire new generations of problem-solvers to seek careers in science and technology.
Research and Exploration	**A4** - Various new species continue to be found in deep sea habitats.	**B1** - Exploring the ocean helps focus science into critical areas that can benefit mankind.
Technology and Innovation	**A3** - Autonomous Underwater Vehicles (AUVs) can map the seafloor without being connected to a ship.	**B6** - Technologies like modern computer networks and high-bandwidth satellite connections allow people to *virtually* participate in expeditions.
Maritime Heritage	**A7** - Exploration can elevate the history of Indigenous People's long and rich relationship with the ocean.	**B2** - Past human cultures can reveal how humans interacted with the world's ocean.

Figure 1. Make photocopies on card stock. Then fold on dotted lines and glue or tape under the matching edges.

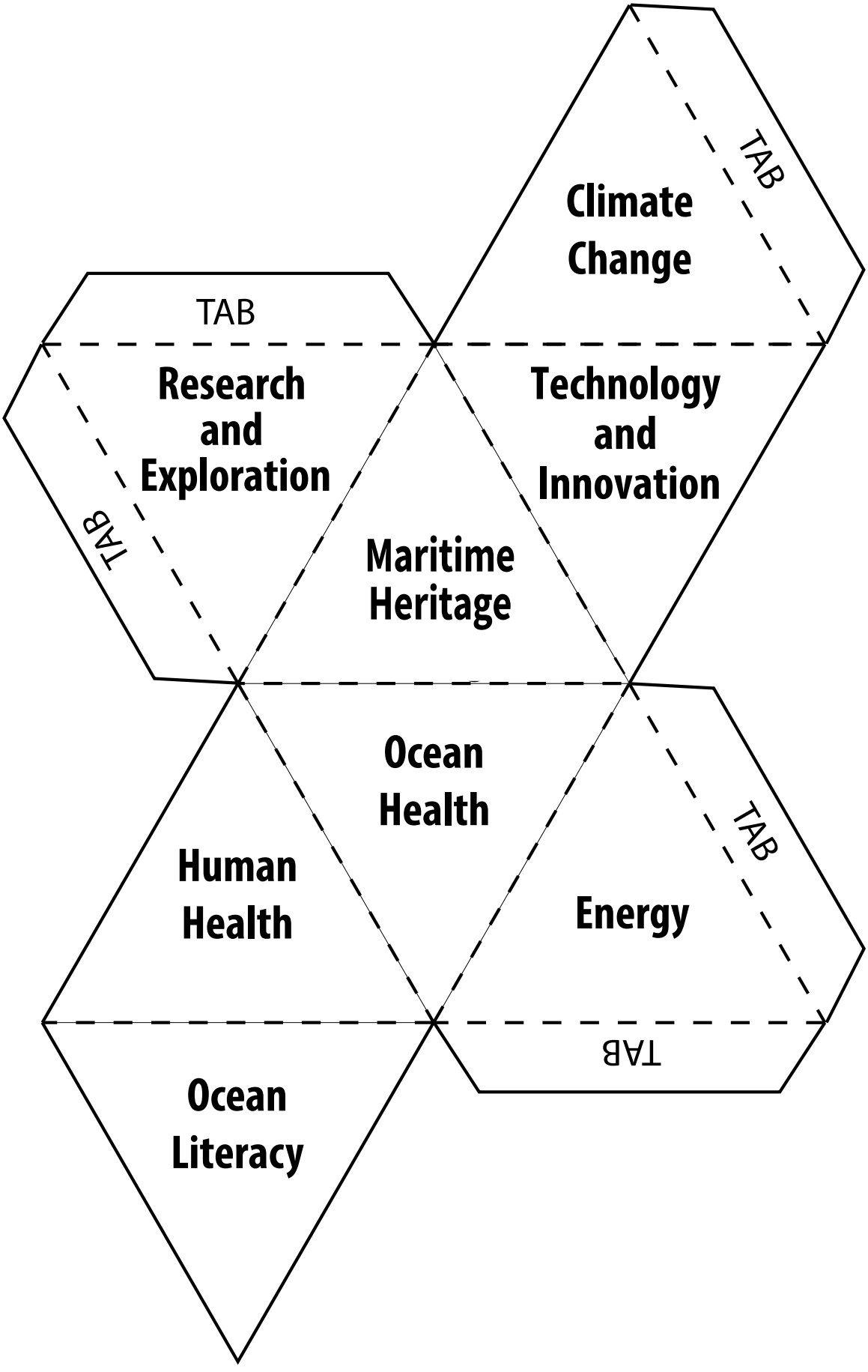


Figure 2. Make photocopies on card stock. Then fold on dotted lines and glue or tape under the matching edges.

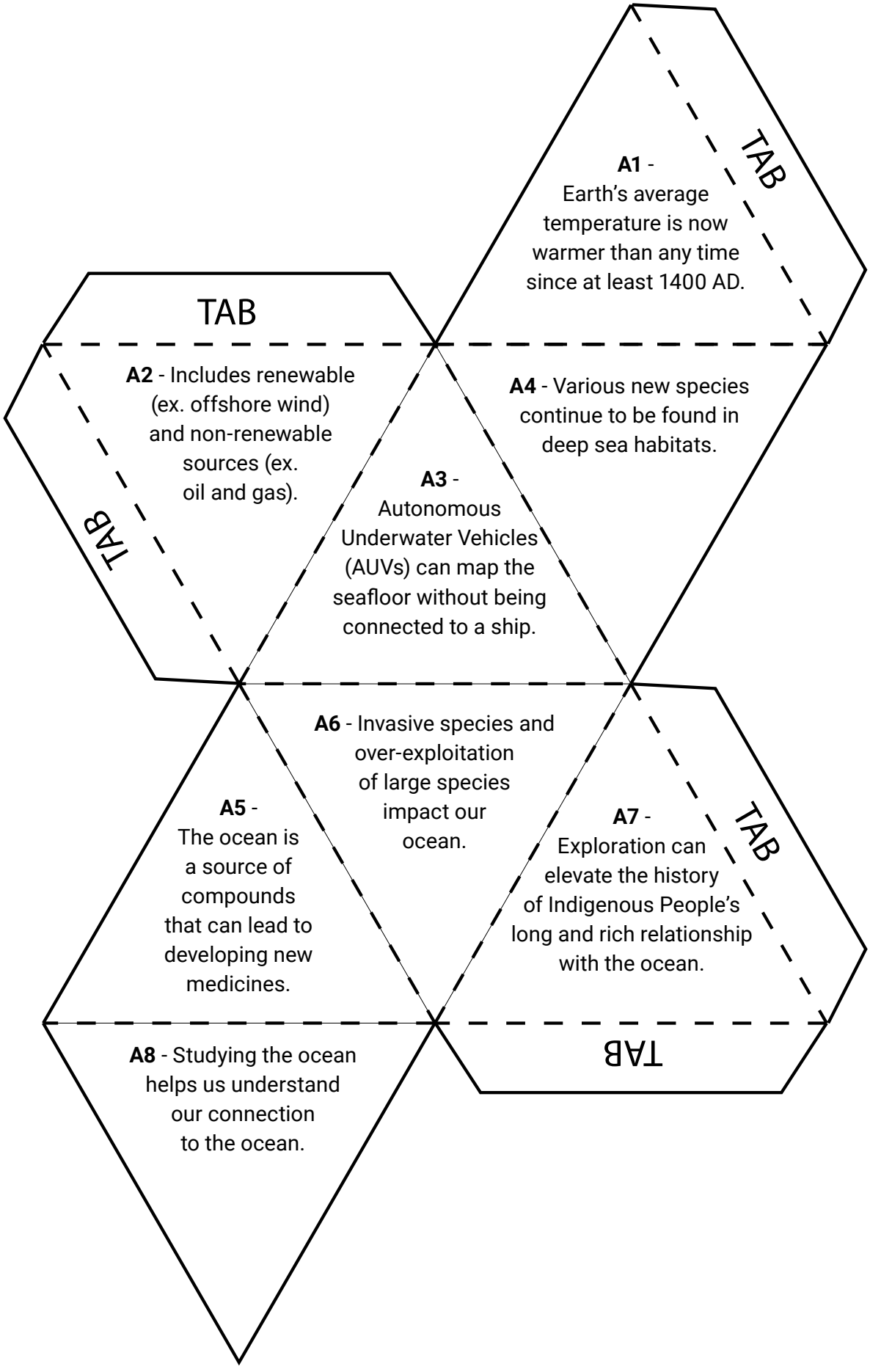


Figure 3. Make photocopies on card stock. Then fold on dotted lines and glue or tape under the matching edges.

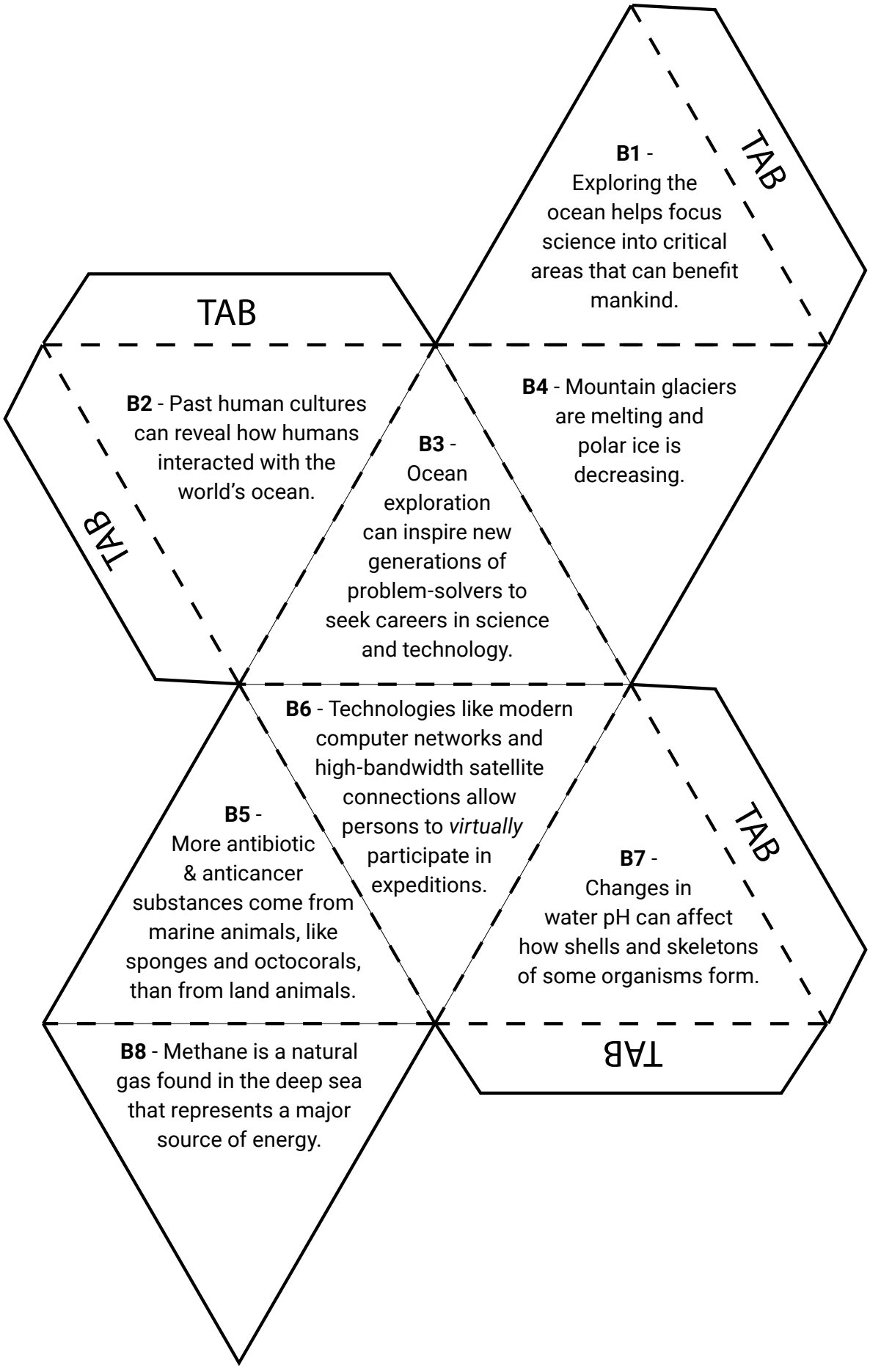


Figure 4. Make photocopies on card stock. Then fold on dotted lines and glue or tape under the matching edges.

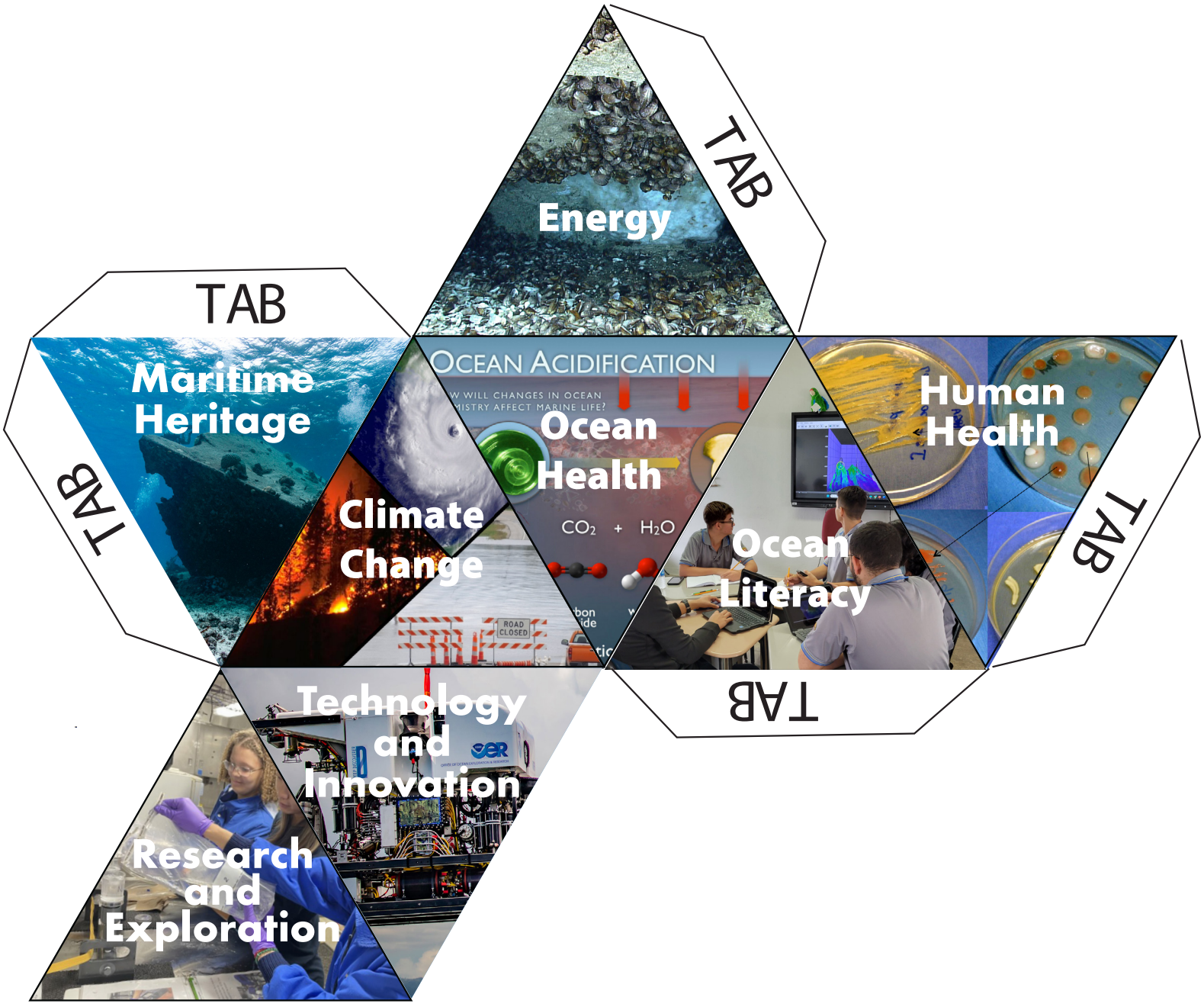
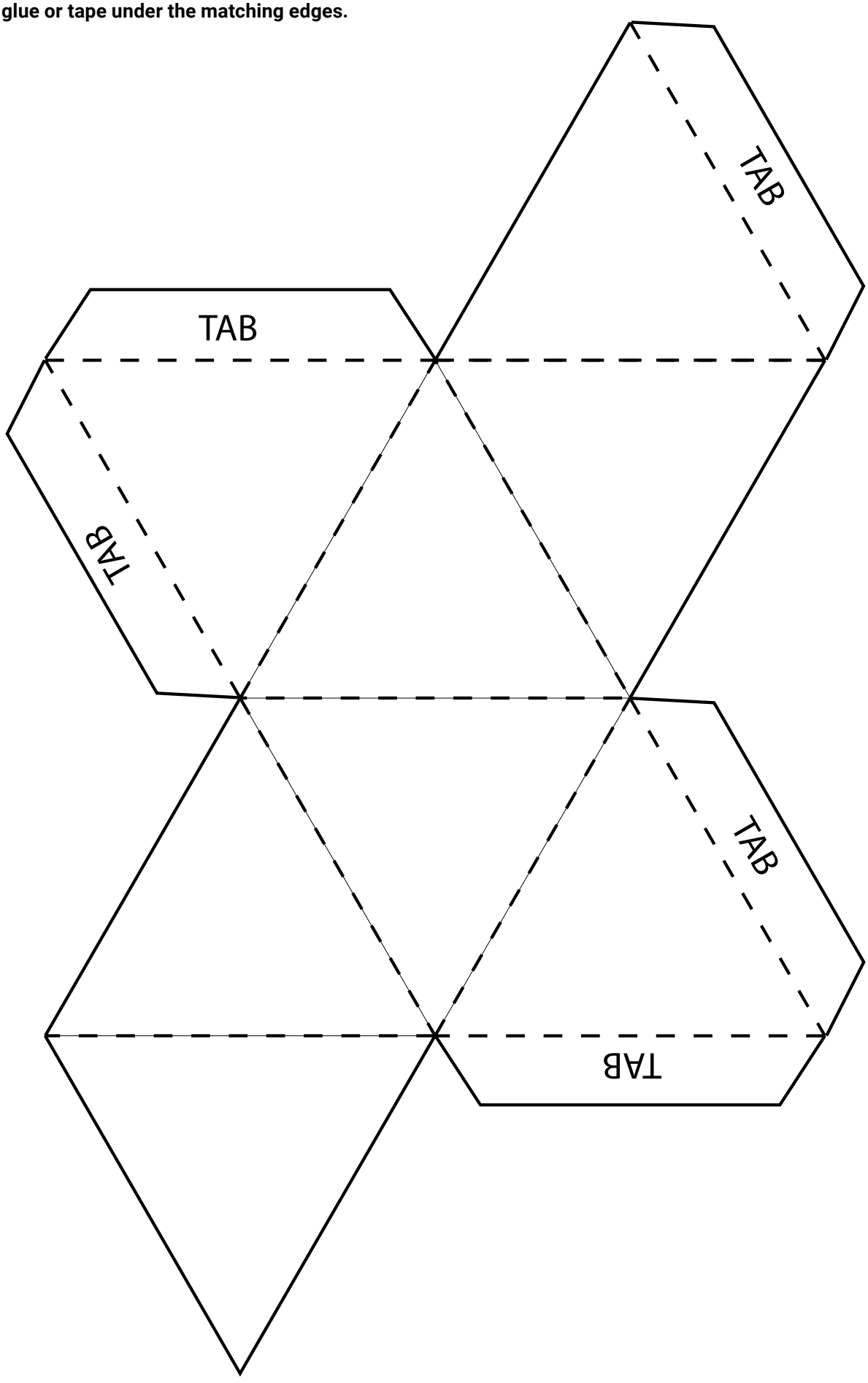


Figure 5. Blank template for students to create their own facts. Make photocopies on card stock. Then fold on dotted lines and glue or tape under the matching edges.



Educator Guide Links and URLs

Page 1:
- NOAA Ship *Okeanos Explorer* (image): https://www.noaa.gov/news/okeanos-explorer-sets-sail-to-deep-waters-off-us-southeast-coast
- Student Worksheet: To Boldly Go (PDF): https://oceanexplorer.noaa.gov/edu/materials/to-boldly-go-student-worksheet.pdf
- Going Deep in Search of Discovery (video): https://www.youtube.com/watch?v=JB1kYcJLr6o
- The Value of Exploration (video): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex1903/dailyupdates/value/value-1920x1080.mp4

Page 2
- Why Do we Explore the Deep Ocean Fact Sheet (PDF): https://oceanexplorer.noaa.gov/edu/materials/why-do-we-explore-fact-sheet.pdf

Page 3
- Going Deep in Search of Discovery (video): https://www.youtube.com/watch?v=JB1kYcJLr6o
- Student Worksheet: To Boldly Go (PDF): https://oceanexplorer.noaa.gov/edu/materials/to-boldly-go-student-worksheet.pdf
- The Value of Ocean Exploration (video): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex1903/dailyupdates/value/value-1920x1080.mp4

Page 4
- Ocean Exploration Facts (webpage): https://oceanexplorer.noaa.gov/facts/facts.html

Information and Feedback

We value your feedback on this activity package, including how you use it in your formal/informal education settings. Please send your comments to: oceanexeducation@noaa.gov. If reproducing this lesson, please cite NOAA as the source, and provide the following URL: https://oceanexplorer.noaa.gov.