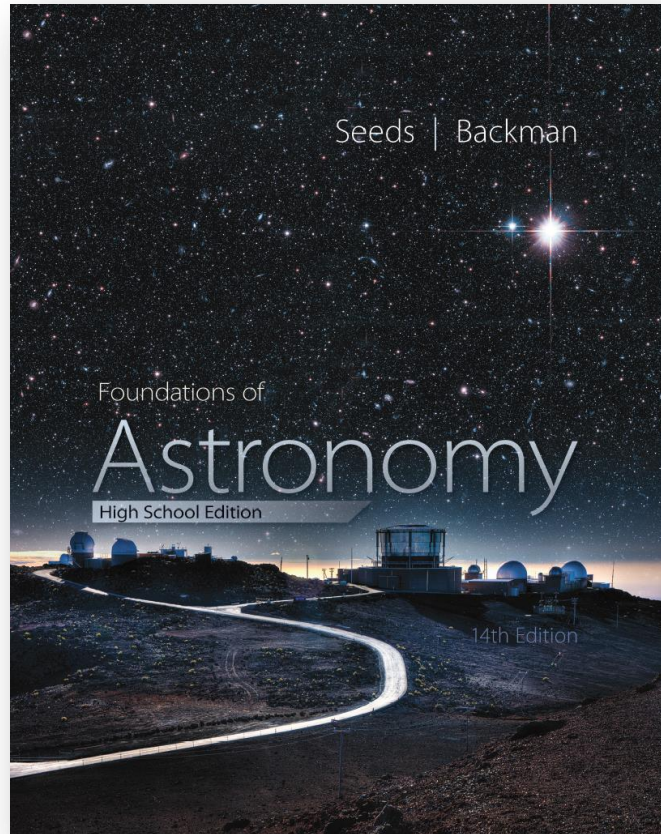


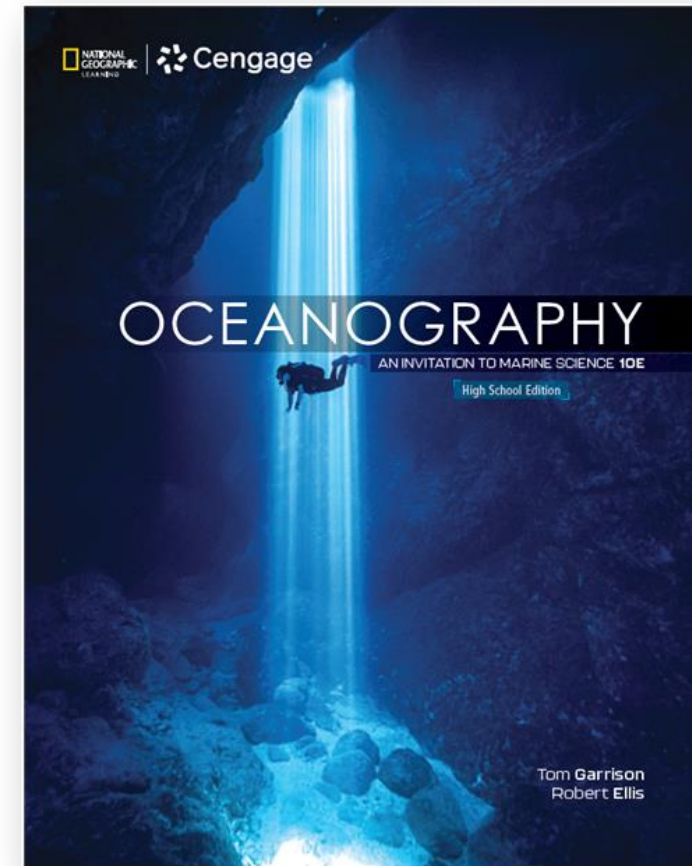
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Sunspots and the Solar Magnetic Cycle

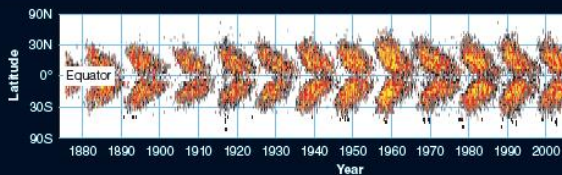
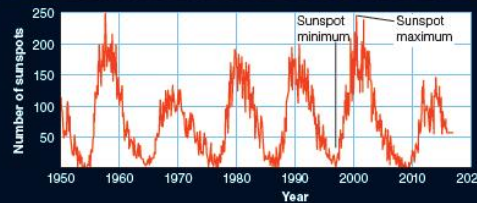
1 The dark spots that appear on the Sun are only the visible traces of complex regions of activity. Evidence gathered over many years and at a wide range of wavelengths shows that sunspots are clearly linked to the Sun's magnetic field.

Spectra show that sunspots are cooler than the photosphere with a temperature of about 4200 K. The photosphere has an average temperature of about 5800 K. Because the total amount of energy radiated by a surface depends on its temperature raised to the fourth power, sunspots look dark in comparison with the photosphere. Actually, a sunspot emits quite a bit of radiation. If the Sun were removed and only an average-size sunspot were left behind, it would be brighter than a full moon.

Visual

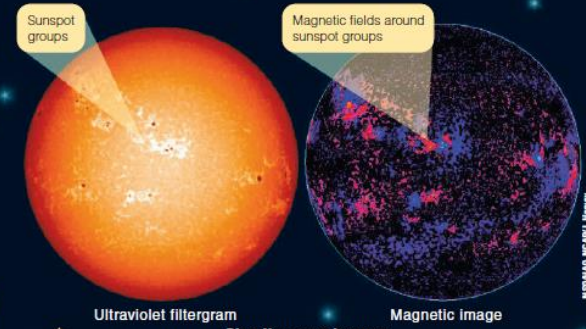
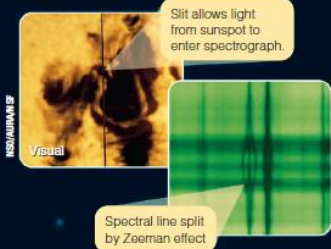
Umbra

Penumbra

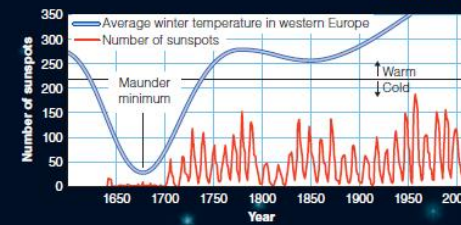


2 Visible maximum visible.

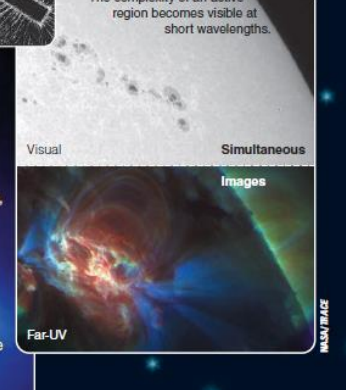
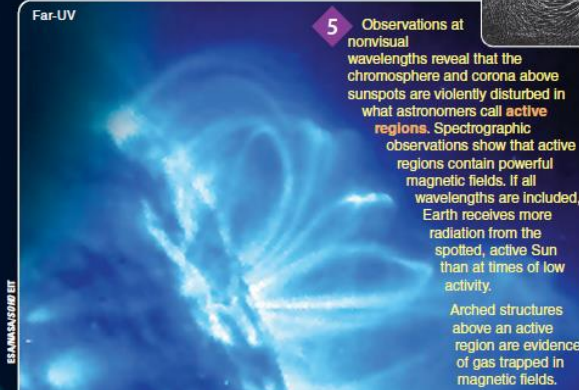
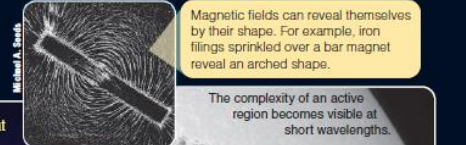
3 Astronomers can measure magnetic fields on the Sun using the **Zeeman effect**, as shown below. When an atom is in a magnetic field, the electron energy levels are altered, and the atom is able to absorb photons with a greater variety of wavelengths than the same atom not in a magnetic field. In this spectrum you see single spectral lines split into multiple components, with the separation between the components proportional to the strength of the magnetic field.



Simultaneous Images
3a Images of the Sun above show that sunspots contain magnetic fields a few thousand times stronger than Earth's. Such strong fields inhibit motions of ionized gas below the photosphere; consequently, convection is reduced below the sunspot, less energy is transported from the interior, and the Sun's surface at the position of the spot is cooler. Heat that is prevented from emerging at the sunspot's position is deflected and emerges around the sunspot, making the surrounding area hotter than the average photosphere. The deflected heat can be detected in ultraviolet and infrared images; the result is that the entire active region, including the sunspots, is actually emitting more energy than the same area of normal photosphere.



4 Historical records show that there were very few sunspots from about 1645 to 1715, a phenomenon known as the **Maunder minimum**. This coincides with the middle of a period called the "Little Ice Age," a time of unusually cool weather in Europe and North America from about 1500 to about 1850, as indicated by the blue line in the graph at left. Other such periods of cooler climate are known. Evidence suggests that there is a link between solar activity and the amount of solar energy Earth receives. This link has been confirmed by measurements made by spacecraft above Earth's atmosphere.



5 Observations at nonvisual wavelengths reveal that the chromosphere and corona above sunspots are violently disturbed in what astronomers call **active regions**. Spectrographic observations show that active regions contain powerful magnetic fields. If all wavelengths are included, Earth receives more radiation from the spotted, active Sun than at times of low activity. Arched structures above an active region are evidence of gas trapped in magnetic fields.

CREATE LEARNING OPPORTUNITIES FOR ALL STUDENTS



13 Life in the Ocean

LEARNING OBJECTIVES

- 13.1** Identify the main points of Darwin's theory of evolution by natural selection.
- 13.2** Describe how organisms may change or diversify through time.
- 13.3** Explain how dramatic environmental change can affect communities of organisms.
- 13.4** Describe how life is classified.
- 13.5** Identify the characteristics of living organisms that distinguish them from nonliving things.
- 13.6** Explain how energy is captured, stored, and dispersed through communities.
- 13.7** Discuss how elements are cycled between living organisms and their surroundings.
- 13.8** Describe the primary environmental factors that influence the success of marine organisms.

A variety of temperate fish swim above a bat ray looking for food in the surfgrass and algae beds of the Cortez Bank. Brian Skerry/National Geographic Image Collection

ENGAGE STUDENTS WITH AUTHENTIC NATIONAL GEOGRAPHIC EXPERIENCES

Insight from a national geographer



Mark Thiesen/National Geographic Image Collection

old houses rapidly sink to the seafloor. In doing so, the creatures have to travel to the deep sea, where it can be much colder. That, through this process, giant tube worms can live for more than two weeks, making them the longest-lived animals in parts of the world, these organisms are called extremophiles.

When it comes to the flow of water, Dr. Kakani Katija, principal engineer at the Monterey Bay Aquarium Research Institute, is an expert. "If we really want to understand the ocean, we have to look at the flow of water," she says. "Giant tube worms are one important group of organisms in the laboratory. They can be harvested, and collected specimens can be used to study the flow of water."

To study the zooplankton in the deep sea, Dr. Katija uses an imaging instrument, called DeepPIV, which is operated by a remotely operated vehicle. DeepPIV projects a laser sheet into the water, and a high-definition camera on the vehicle captures the illuminated by the laser.

Source: Steph Yin, "In Disposable Deep-Sea Dives," National Geographic, March 5, 2017

© Monterey Bay Aquarium Research Institute

insight from a national geographer



animal, a small worm, that lives in water hotter than 350°C (660°F) in the hottest water. When they were first discovered, they turned out to be giant tube worms.

Among hundreds of other species, and a red-blooded brittle star, and the mantle cavity.

On board Lulu, [Dr. Earle] spent half of the 2.5 meter (8 foot) tubes a new variety of

National Geographic Magazine

insight from a national geographer



James A. Sugar/National Geographic Stock/National Geographic Image Collection

DR. SYLVIA EARLE
From my perch toward me, I rather a large, out to touch the cluster of pale got permission glided upward moving when finally, I had to

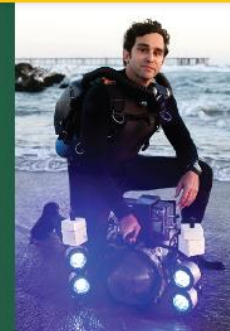
Seeing a creature unlike any I had ever seen, a creature such as I, inspired in me a sense of wonder. On an ancient planet, the first and only species to survive water, air, and biosphere—and the first to survive but could initiate Earth's sixth period.

Cephalopods may have an advantage in a lineage that has endured several waves of extinction. 65 million years ago when dinosaurs faced extinction, prosperity. Some variation on the cephalopod swim in future seas.

Source: National Geographic Ocean Atlas, 2017

Background photo: PULSE/Corbis

insight from a national geographic explorer 6.1



National Geographic Image Collection

DR. DAVID GRUBER discusses the phenomenon of biofluorescence in marine life.

Over the past decade, scientists have discovered the blue ocean is actually ablaze with color. From corals to sea turtles to eels, countless marine species are biofluorescent or have the ability to reflect the blue light hitting a surface and reemit it as a different color. "Biofluorescence in the marine environment is like this constantly unfolding mystery novel," says David Gruber, a marine biologist and National Geographic Explorer at the City University of New York.

"Biofluorescence is not to be confused with bioluminescence, in which animals produce their own light via a chemical reaction.

If bioluminescence is the equivalent of glow sticks that you crack open on the Fourth of July, biofluorescence is more akin to fluorescent paint glowing under a blacklight", Gruber says.

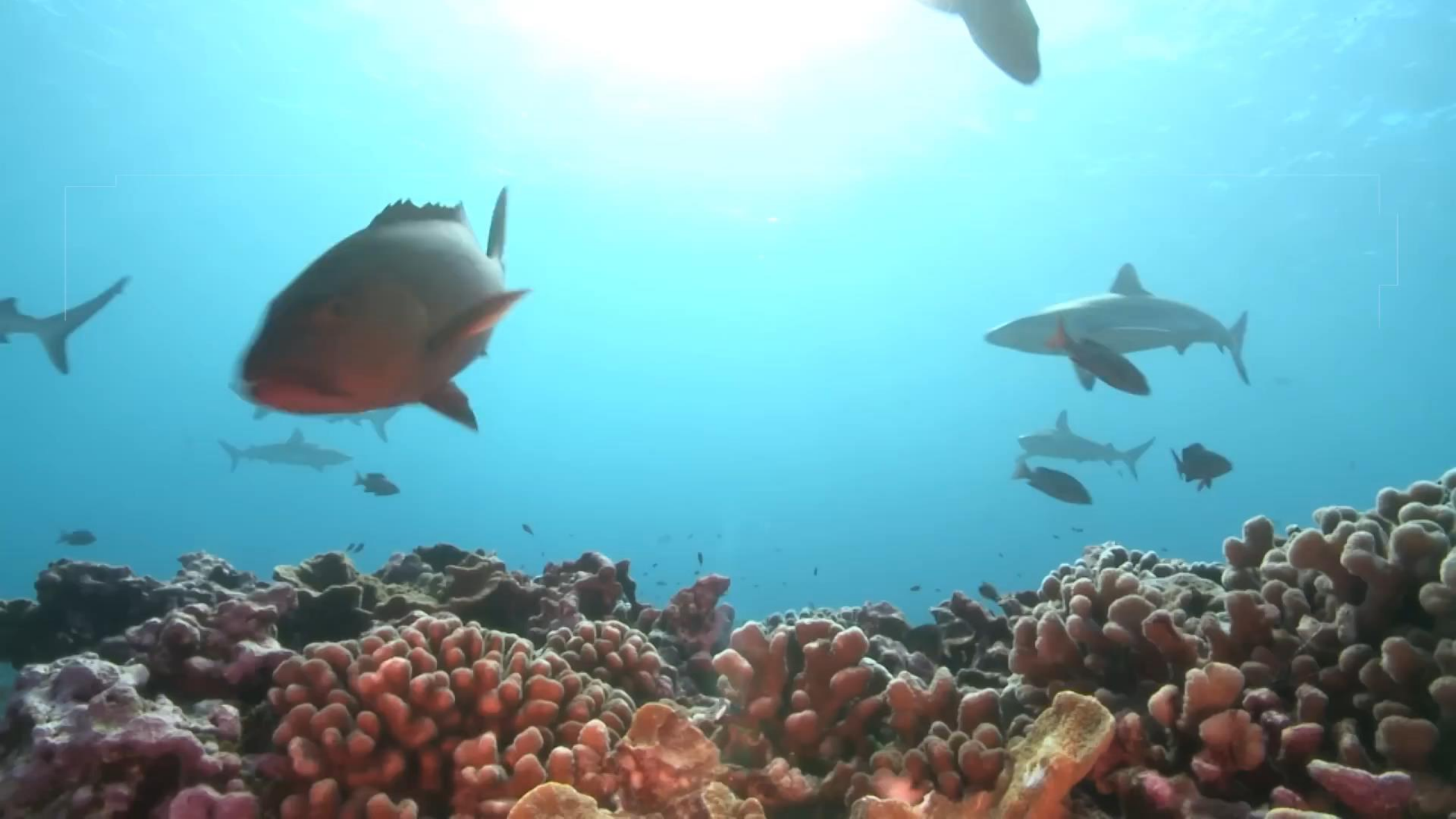
Biofluorescence could be employed for a number of reasons. They include finding or attracting prey, defense, or some kind of communication. Researchers have found evidence for biofluorescence in more than 200 species of fish, like red-glowing gobies. Humans see light in shades of red, green, and blue; underwater, the red and green from the sun get absorbed by the seawater and they don't make it to depth, only blue does. Below the surface, objects appear dark and blue, so it's hard to pick out fluorescent organisms without special equipment.

In 2016, Gruber and his colleagues developed a "shark-eye camera" to see the world from the perspective of two species of biofluorescent sharks—the chain catshark and the swell shark. They found that these species absorb blue light and reemit it as green. "We also studied the sharks eyes and found that they can only see blue/green. The "shark-eye" camera was designed based on their vision and we found that they could see other biofluorescent sharks better than non-fluorescent objects. This is because the green biofluorescence creates contrast in the all blue deep waters," Gruber says.

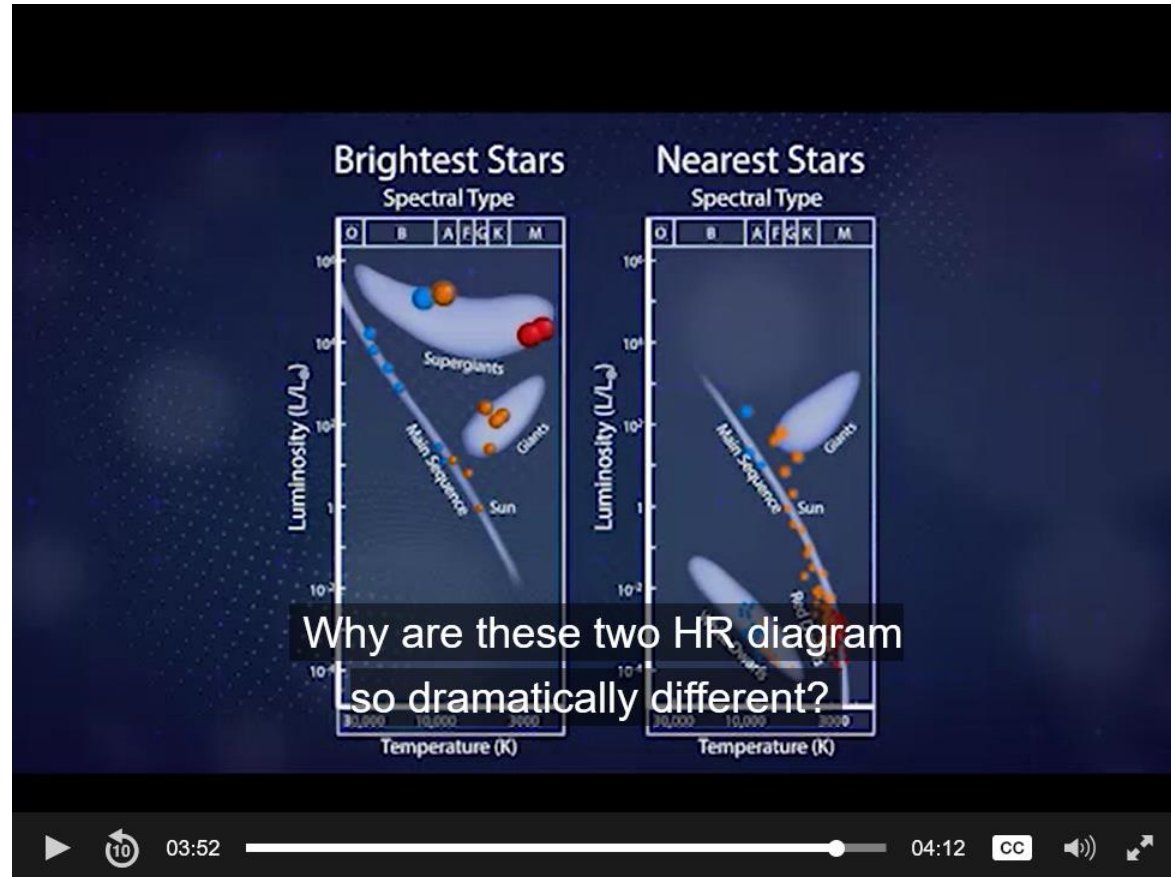
"Imagine being at a disco party with only blue lighting, so everything looks blue," Gruber told National Geographic at the time of the discovery. "Suddenly, someone jumps onto the dance floor with an outfit covered in patterned fluorescent paint that converts blue light into green. They would stand out like a sore thumb. That's what these sharks are doing."

Source: National Geographic.com Explorers Festival: "See Amazing Ocean Creatures that 'Glow,' by Elaina Zachos; published June 11, 2018

National Geographic Explorer David Gruber shot this photo of a swell shark with a biofluorescent camera that casts a blue light, which the shark's skin reemits as green.



ACTIVE LEARNING AND REAL-WORLD LABS



Waypoints Videos Narrated by Author Mike Seeds

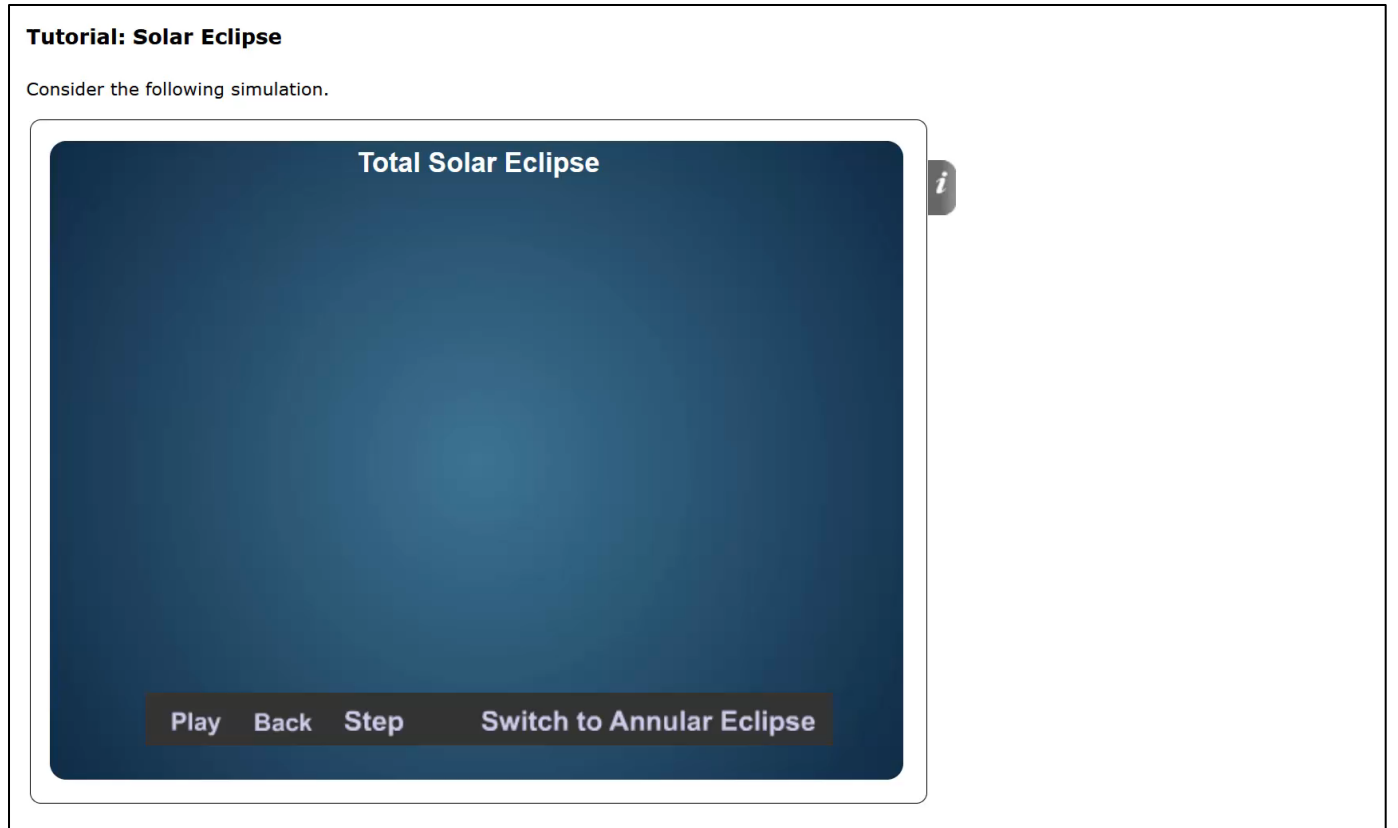


Clarify Important Concepts
Through Dynamic Interactions in Multimedia
Presentations

ACTIVE LEARNING AND REAL-WORLD LABS

Animation Tutorials

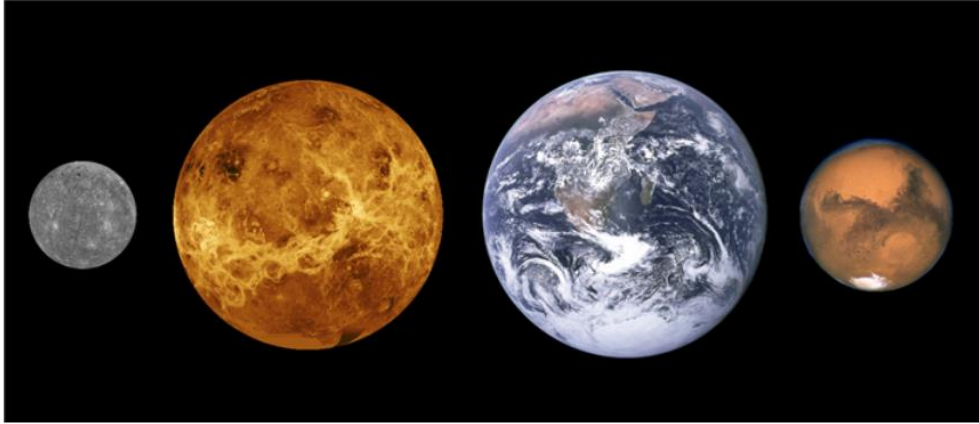
Students Observe and
Interact with an Animation
and Answer a Series of Auto-
Graded Questions



VIRTUAL ASTRONOMY LABS TO EXPLORE COMPLEX THEORIES

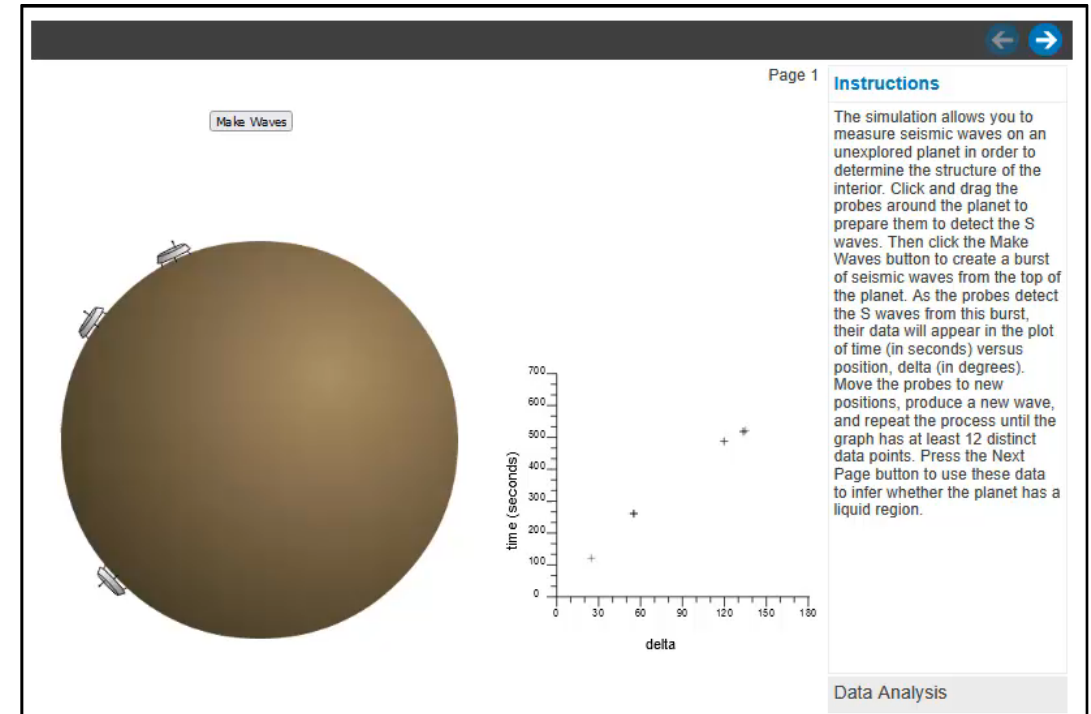
Welcome to Lab 5: Planetary Geology

Even though the planets in our solar system have different physical properties in terms of radius, mass, and density, they often have similarities to Earth, we can leverage that knowledge to understand conditions on other planets.



This lab will focus on the geology of Earth, since this is the planet that we know the most about. We will study the techniques that are used to study the Earth's interior. While studying the terrestrial planets, our approach will utilize comparative planetology, noting the similarities and differences between them.

**Mini-Lessons Combine Real
Astronomical Data with Simulations in
Modules Including Auto-Graded
Assessments**



CONNECT TO REAL-WORLD SCIENCE

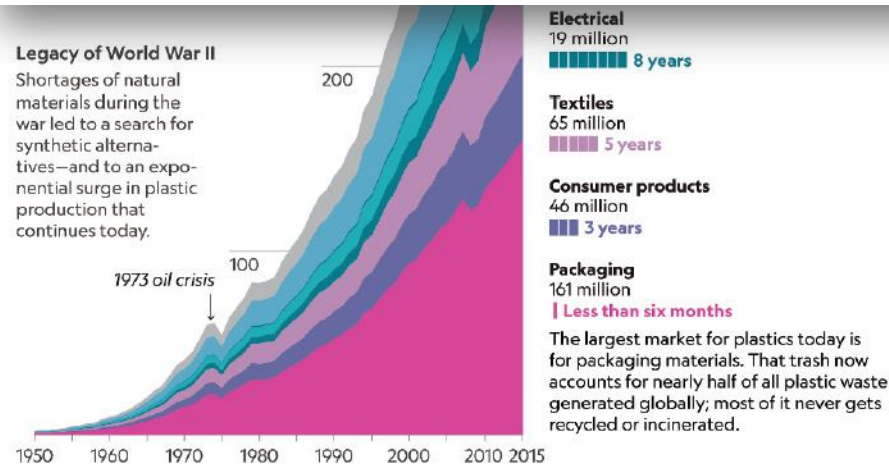
2.5e Satellites Have Become Important Tools in Ocean Exploration

The National Aeronautics and Space Administration (NASA), organized in 1958, has become an important institutional contributor to marine science. For four months in 1978, NASA's *Seasat*, the first oceanographic satellite, beamed oceanographic data to Earth. More recent contributions have been made by satellites beaming radar signals off the sea surface to determine wave height, variations in sea-surface contour and temperature, and other information of interest to marine scientists. Notable completed satellite missions include *TOPEX/Poseidon* (1992–2006), which was capable of accurately measuring sea surface height; *Jason-1* (2001–2013), which flew in tandem with *TOPEX/Poseidon* and had a primary task of monitoring global

which is part of the Earth Observing System that collects data concerning Earth's water cycle (**Figure 2.33**), and *OSTM/Jason-2* (launched in 2008) and *Jason-3* (launched in 2016), which both continue the tasks of *Jason-1* to provide information about circulation patterns and changes in sea level. Other missions are currently in the planning phase. *Jason-CS* will continue taking ocean surface topography measurements to better investigate climate, and *Surface Water & Ocean Topography—SWOT*—will be designed to improve ocean circulation, weather, and climate models.

A satellite system you can use every day? The U.S. Department of Defense has built the **Global Positioning System (GPS)**, a constellation of 32 satellites in orbit 17,000 kilometers above Earth. The satellites are spaced so that at least four are above the horizon from any

Malta (94.5 square miles). Its 174 turbines were installed in early 2020 and are capable of generating electricity for 1 million UK homes with clean energy. The first and only commercial wind farm in the United States is Block Island Wind Farm off the coast of Rhode Island. The U.S. Department of Energy has estimated that the farm has the potential to generate more than 2,000 megawatts of capacity per year. This represents nearly double the current electricity use.



JASON TREAT AND RYAN T. WILLIAMS, NGM STAFF
SOURCE: ROLAND GEYER, UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Jason Treat/National Geographic



17.4e Organisms Can Be Grown in Controlled Environments

Aquaculture is the growing or farming of plants and animals in any aquatic environment under controlled conditions. Aquaculture production currently accounts for almost half of all fish consumed by humans and is continuing to grow as a greater share of global fish production. Most aquaculture production occurs in China—which currently produces more than the rest of the world combined—and the other countries of Asia. In 2016, more than 80 million metric tons (88 million tons) of organisms were produced worldwide, with a total value estimated at US\$232 billion.

While inland aquaculture is responsible for almost two thirds of the organisms produced, ocean aquaculture produces more than one third. **Mariculture** is the farming of *marine* organisms in the open ocean, in coastal waters like estuaries and

CONNECT TO REAL-WORLD SCIENCE

HOW DO WE KNOW? 6.1

Does Hot Water Freeze Faster than Cold?

Every semester our students ask the same question: "Does hot water freeze faster than cold water?" Every semester we patiently answer "No." Why should it? If two equal amounts of water are placed in a freezer and one is warmer than the other, the cooler one will always freeze first. After all, the hot water must lose heat to come down to the starting temperature of the cool water, and by that time the water that started out cool might be near the freezing point.

Right?

Well, yes and no.

Yes, because the logic above makes complete thermodynamic sense!

No, because other factors can intervene!

Curious? So was G. S. Kell, who wrote a paper on the subject for the *American Journal of Physics* (May 1969). He lived in Canada where many people apparently believe that, if left outside on a cold night, a bucket of hot water will freeze more quickly than a bucket of cold water. Kell tested this belief using covered buckets. The freezing went exactly as predicted above: The warmer water must first fall to the starting temperature of the cold water, and then its cooling curve (a graph of the fall in temperature with time) will follow the cooling curve already taken by the cooler bucket. The bucket containing cooler water always froze first. Good!

So why do many Canadians (not to mention American students) persist in their belief?



Figure A Lab students taking measurements of the freezing point of water.

Might there be a grain of truth here? Kell tried the experiment using buckets without lids. Now the water can evaporate, and hot water evaporates much more rapidly than cold water, especially in cold, dry winter air. He demonstrated that a bucket of water cooling from the boiling point to the freezing point would lose about 16% of its mass. Now there's

less water to freeze. A smaller volume of water initially at 0°C (32°F) will freeze faster than a larger volume if the same surface area is exposed to the cold.

And there's more. As you know, the latent heat of vaporization for water is very high (540 calories per gram). Water molecules escaping the surface of the hot water take away a very large amount of heat. The hot water's cooling curve plummets. All of these conditions together could make the hot water seem to freeze faster than the cold.

Even so, if the buckets are made of metal, much heat would be lost through the container walls to the cold air. It is unlikely that hot water in a metal bucket would freeze first. But what if the buckets are made of wood, an excellent insulator? Then most energy loss would occur through evaporation, and the initially hot water might actually freeze faster. (But this is not a variable that Kell tested for his paper.)

So should you make ice cubes with warm water? No, never. First you pay the electric (or gas) company to warm the water. Then you pay the electric company to run the refrigerator to bring the water down to tap temperature. Now you freeze the water. If you started with warm water, you'd have less ice. Would it really freeze faster? Reread the discussion of the scientific method in Chapter 1, and then check it out for yourself (**Figure A**)!

Promote Critical Thinking Skills as Students Make Observations and Gather Data to Answer Questions

CREATE LEARNING OPPORTUNITIES FOR ALL STUDENTS

QUESTIONS FROM STUDENTS

1. **If outgassing continues today, why aren't the oceans getting bigger? By now shouldn't they have covered the continents?**

Well, yes, outgassing does continue, but the water is being drawn from the mantle. Some marine geologists believe that the mantle shrinks a little, making the ocean basins a bit deeper, which accommodates the ocean's greater volume. Also, geological processes have increased the amount of continental crust, and water is drawn back into the mantle at subduction zones. Though some of this water eventually reappears at the surface in volcanic vapor, some is incorporated back into mantle material. It probably just about balances out.

2. **I see that there is 100 times more oxygen in the atmosphere than in the ocean. How can that be? Isn't water 86% oxygen by weight?**

Yes, but the oxygen of water (H_2O) is bonded tightly to hydrogen atoms. Unlike atmospheric oxygen, the

oxygen in water molecules cannot be used by organisms for respiration. Fish can't extract this oxygen with their gills. Marine animals must depend on dissolved oxygen, paired molecules of oxygen (O_2) present in the water and free to move through the gill membranes. Compared to the atmosphere, very little of this free oxygen is present in the ocean.

3. **Why does the ocean smell like the ocean? I can sometimes tell I'm near the coast before I see it.**

Salt doesn't have a smell, so microscopic crystals of salt are not responsible. A gaseous compound normally emitted by an abundant drifting photosynthetic organism (one of the phytoplankters you'll meet in Chapter 14) may be responsible for the characteristic scent. Dimethyl sulfide given off by *Emiliania huxleyi* combines with algae pheromones to make the sea smell like the sea.

FORMATTED FOR EASE OF USE FOR STUDENTS

6.1 A Note to the Reader

This chapter and the next work together as a pair. In this chapter, we'll first consider the physics of pure water—mainly its response to the input and removal of heat energy. Then we'll add some dissolved solids (salts) and see how properties change, and then discuss density stratification—an old friend from previous chapters. Last, we'll look at light and sound in the ocean.

In the next chapter, we'll investigate salinity in more detail and add concepts involving dissolved gases and the ocean's acid-base balance.

Together, these two chapters set the stage for the air-ocean interactions in the two chapters that follow.

6.2 Familiar, Abundant, and Odd

Water is so familiar and abundant that we do not always appreciate its unusual characteristics (Figure 6.1). Here you'll meet the water you never knew. This chapter introduces the characteristics that make water unusual—the molecule's polarity and the bonds that hold it together, the large amount of heat needed to change its temperature, and the heat needed to change its physical state. And, no, heat and temperature are not the same thing.

The high latent heat of fusion of water on the order of 80 cal/g is a result of water's thermal expansion. The high latent heat of fusion of water on the order of 80 cal/g is a result of water's thermal expansion. The high latent heat of fusion of water on the order of 80 cal/g is a result of water's thermal expansion.

Figure 6.1 Liquid water covers most of Earth's surface. Water's properties are familiar to us, but it is, in fact, an unusual compound. Its odd thermal properties are responsible for Earth's moderate climate, and its ability to dissolve nearly any substance was critical to the appearance and maintenance of life on Earth.



water has an important thermostatic balancing effect—an oceanless Earth would be much colder in winter and much hotter in summer than the moderate temperatures we experience.

The other lesson is the influence of density on ocean structure. You'll see that the ocean's structure and large-scale movement depend on changes in the density of seawater, with density dependent on temperature and salt content (salinity).

6.3 The Water Molecule Is Held Together by Chemical Bonds

Pure water is a compound—that is, a substance that contains two or more different elements in a fixed proportion. The familiar chemical formula for water, H_2O , shows that it is composed of the elements hydrogen (H) and oxygen (O) in a fixed proportion of two to one. Recall from Chapter 1 that hydrogen was formed shortly after the big bang and oxygen was formed inside the core of some stars through nuclear fusion. An element is a substance composed of identical particles called atoms that cannot be broken into simpler substances by chemical means.

"Standing on the shore and looking out to sea, the boy said, 'There's a lot of water out there.' And the wise old oceanographer responded, 'And that's only the top of it.'"
—Richard Ellis
Singing Whales and Flying Squid.

Atoms consist of varying numbers of protons and neutrons in its nucleus (center) and a cloud of orbiting electrons. The number of protons—the positively charged particles in the nucleus—is what defines an element. For example, any atom with six protons is carbon (Figure 6.2). Neutrons are neutrally charged particles in the nucleus that can result in different

Group																		Noble Gases	
IA(1)																		(18)	
Period	1	Atomic number — 11 Symbol — Na Atomic mass — 22.99																2 He 4.003	
	Atomic masses are based on carbon-12. Numbers in parentheses are mass numbers of most stable or best-known isotopes of radioactive elements.																		
	2	Transition Elements																10	
	3	Transition Elements																18	
	4	Transition Elements																36	
	5	Transition Elements																54	
	6	Transition Elements																86	
7	Transition Elements																118		

1	H	1.008																	2	He	4.003																																	
2	3	Li	6.941	4	Be	9.012																	10	Ne	20.18																													
3	11	Na	22.99	12	Mg	24.31																	18	Ar	39.95																													
4	19	K	39.10	20	Ca	40.08	21	Sc	44.96	22	Ti	47.90	23	V	50.94	24	Cr	52.00	25	Mn	54.94	26	Fe	55.85	27	Co	58.93	28	Ni	58.69	29	Cu	63.55	30	Zn	65.38	31	Ga	69.72	32	Ge	72.59	33	As	74.92	34	Se	78.96	35	Br	79.90	36	Kr	83.80
5	37	Rb	85.47	38	Sr	87.62	39	Y	88.91	40	Zr	91.22	41	Nb	92.91	42	Mo	95.94	43	Tc	98.91	44	Ru	101.1	45	Rh	102.9	46	Pd	106.4	47	Ag	107.9	48	Cd	112.4	49	In	114.8	50	Sn	118.7	51	Sb	121.8	52	Te	127.6	53	I	126.9	54	Xe	131.3
6	55	Cs	132.9	56	Ba	137.3	57	La	138.9	58	Ce	140.1	59	Pr	140.9	60	Nd	144.2	61	Pm	145	62	Sm	150.4	63	Eu	152.0	64	Gd	157.3	65	Tb	158.9	66	Dy	162.5	67	Ho	164.9	68	Er	167.3	69	Tm	168.9	70	Yb	173.0	71	Lu	175.0			
7	87	Fr	(223)	88	Ra	(226)	89	Ac	(227)	90	Th	(232)	91	Pa	(231)	92	U	(238)	93	Np	(237)	94	Pu	(244)	95	Am	(243)	96	Cm	(247)	97	Bk	(247)	98	Cf	(251)	99	Es	(252)	100	Fm	(257)	101	Md	(258)	102	No	(259)	103	Lr	(260)			

Inner Transition Elements

Lanthanide Series	58	Ce	140.1	59	Pr	140.9	60	Nd	144.2	61	Pm	(145)	62	Sm	150.4	63	Eu	152.0	64	Gd	157.3	65	Tb	158.9	66	Dy	162.5	67	Ho	164.9	68	Er	167.3	69	Tm	168.9	70	Yb	173.0	71	Lu	175.0
Actinide Series	90	Th	232.0	91	Pa	231.0	92	U	238.0	93	Np	(237)	94	Pu	(244)	95	Am	(243)	96	Cm	(247)	97	Bk	(247)	98	Cf	(251)	99	Es	(252)	100	Fm	(257)	101	Md	(258)	102	No	(259)	103	Lr	(260)

Figure 6.2 Periodic table of the elements. This table shows all of the elements arranged by their atomic number—which is based on the number of protons the nucleus contains—and in periods and groups that illustrate which elements share particular properties. The atomic mass is the average mass of the protons and neutrons of that element's isotopes, and the groups are arranged by the number of electrons in the atom's outer shell which affects how it may bond with other atoms.

isotopes of an element. Some of these isotopes may undergo radioactive decay and play an important role in generating heat in Earth's interior (see Chapter 3). Electrons—tiny negatively charged particles found orbiting the nucleus in a cloud toward the outside of an atom—aid in chemical bonding.

Water is a molecule, a group of atoms held together by chemical bonds. Chemical bonds, the energy relationships between atoms that hold them together, are formed when electrons are shared between atoms or moved from one atom to another. A water molecule forms when electrons are shared between two hydrogen atoms and one oxygen atom (Figure 6.3). The bonds formed by shared pairs of electrons are known as covalent bonds. Covalent bonds hold together many familiar molecules besides water, including CO_2 (carbon dioxide), CH_4 (methane gas), and O_2 (atmospheric oxygen). These covalent bonds will be contrasted

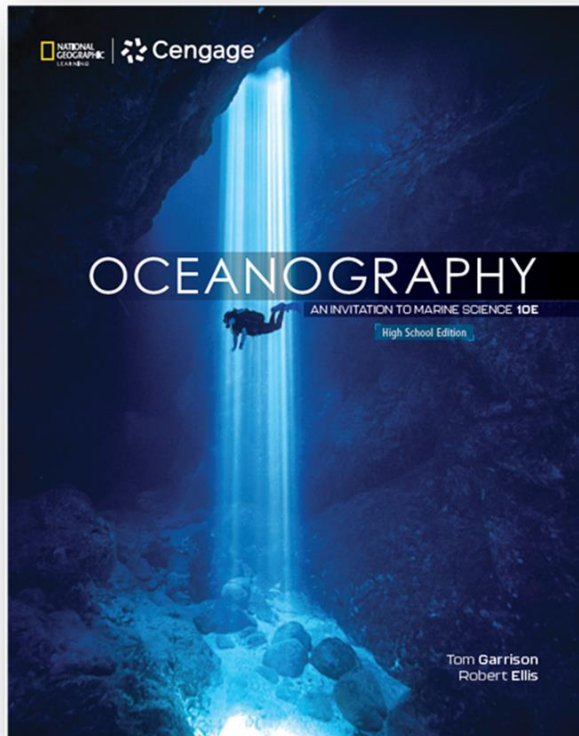
with ionic bonds in the next chapter which result from the transferring of an electron between atoms in many substances that dissolve in water such as salts.

Because of the way a water molecule's oxygen electrons are distributed, the overall geometry of the molecule is a bent or angular shape. The angle formed by the two hydrogen atoms and the central oxygen atom is about 105° . The angular shape of the water molecule makes it electrically asymmetrical. Each water molecule can be thought of as having a positive (+) end and a negative (−) end. This is because protons of the hydrogen atoms are left partially exposed when the negatively charged electrons bond more closely to oxygen. The water molecule behaves

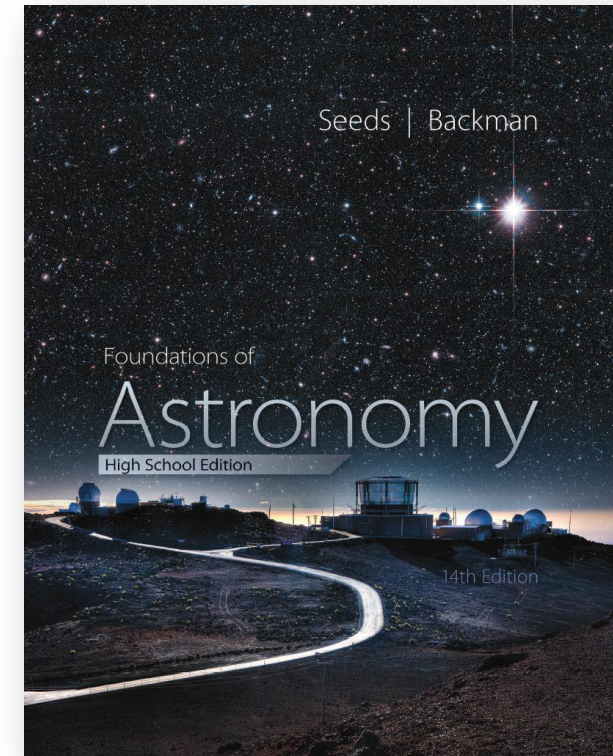
¹This unequal sharing of the electrons occurs because oxygen has six positively charged protons attracting the electrons, while hydrogen has only one.

BOOK WALK THROUGH

Chapter 15: Marine Animals



Ch. 3: Moon Phases and Eclipses



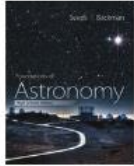
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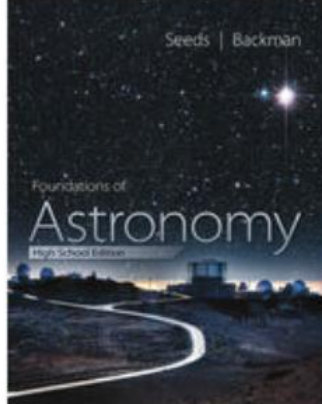
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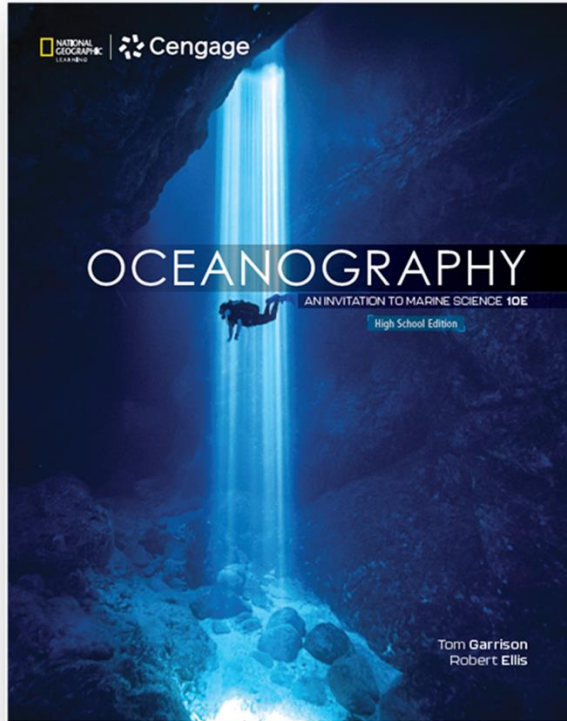
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Michael A. Seeds, Dana Backman
ISBN-10: 8214066697
ISBN-13: 9798214066691
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INSTRUCTOR MANUAL



Instructor Manual

Tom Garrison / Robert Ellis, Oceanography 10e @ 2022, 9780357452752; Chapter 10: Waves

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FORMATIVE & SUMMATIVE ASSESSMENTS

- Concept Checks
- Thinking Beyond the Figure
- Discussion Questions
- Chapter Knowledge Check
- Check Your Understanding
- Concept Animation Quiz
- Video Quiz

Figure 15.38

West Indian or Florida manatees (genus *Trichechus*). In spite of their appearance, manatees have a relatively low fat content and are vulnerable to cold shock.



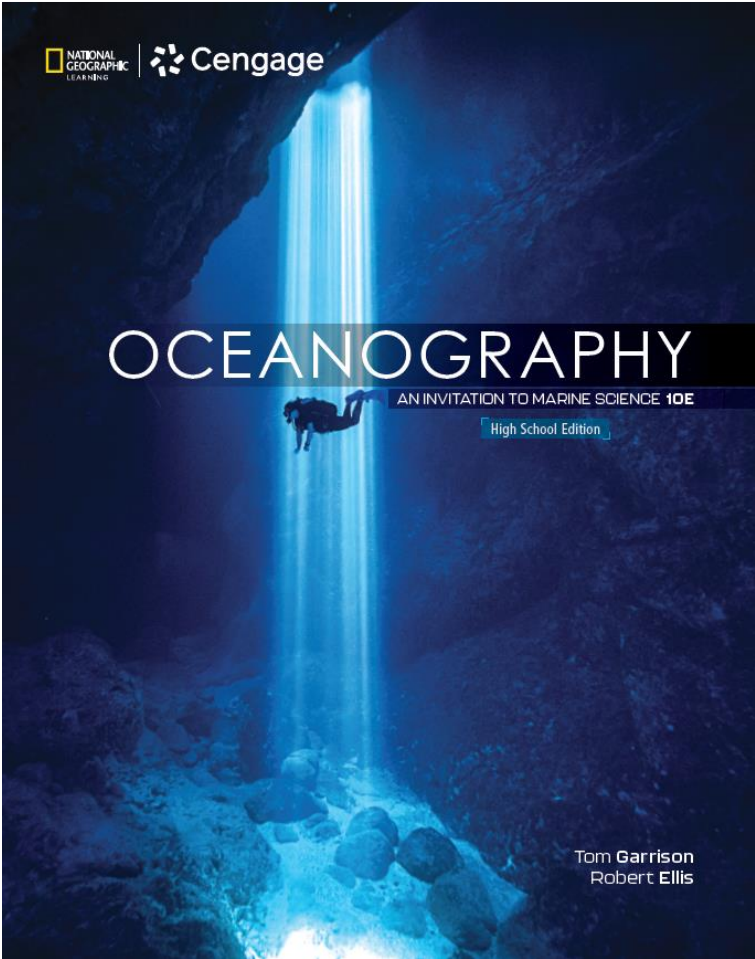
Neel Adsul/ Shutterstock.com

Thinking beyond the Figure

Why do you think manatees evolved to be so much slower than other marine mammals?

Answer ▾

ADDITIONAL RESOURCES



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Testing 1

File Edit Test Question Number of questions: 22

View: 10 questions Go to: Questions 1-10

Indicate whether the statement is true or false.

- Oceanic crust contains a higher percentage of oceanic ridges than oceanic basin floors.
ANSWER: False
- Active margins are typically located, in the Atlantic Ocean.
ANSWER: False
- Hydrothermal vents are found only in seawater.
ANSWER: False
- The Gulf of Mexico is located at an active margin.
ANSWER: False

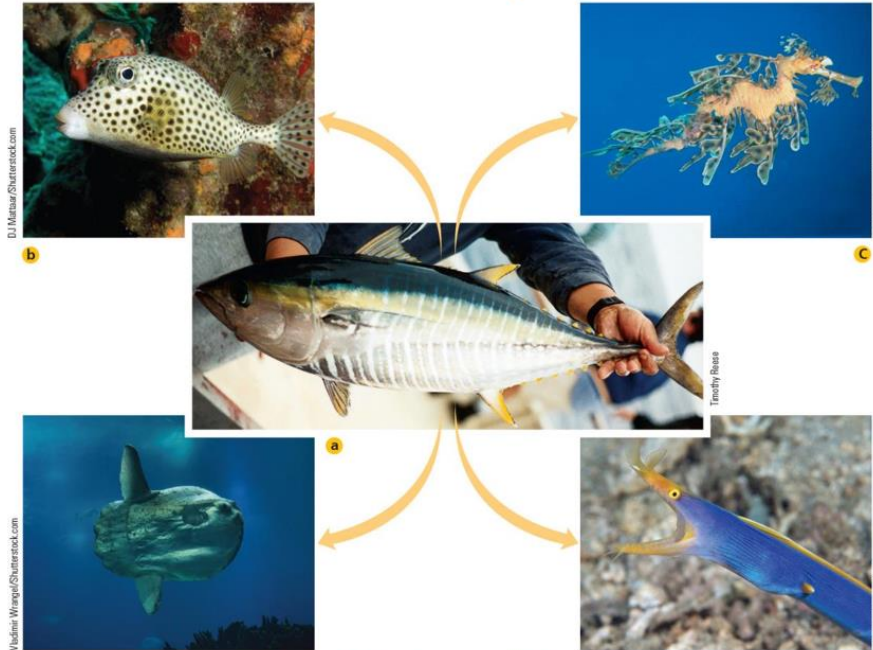
Indicate the answer choice that best completes the statement or answers the question.

- Where was the first hydrothermal vent discovered?
a. Mid-Atlantic Ridge
b. East Pacific Rise
c. Gulf of Mexico
d. Sea of Cortez
e. Juan de Fuca Ridge
ANSWER: b
- Which process gives trenches their unique arc-shaped depressions?
a. Spreading
b. Volcanic eruptions
c. Subduction
d. Turbidity
e. Erosion
ANSWER: c

DOWNLOADABLE POWERPOINTS

Fishes Are Successful Because of Unique Adaptations

- Movement, shape, and propulsion
 - Body and fins specialized



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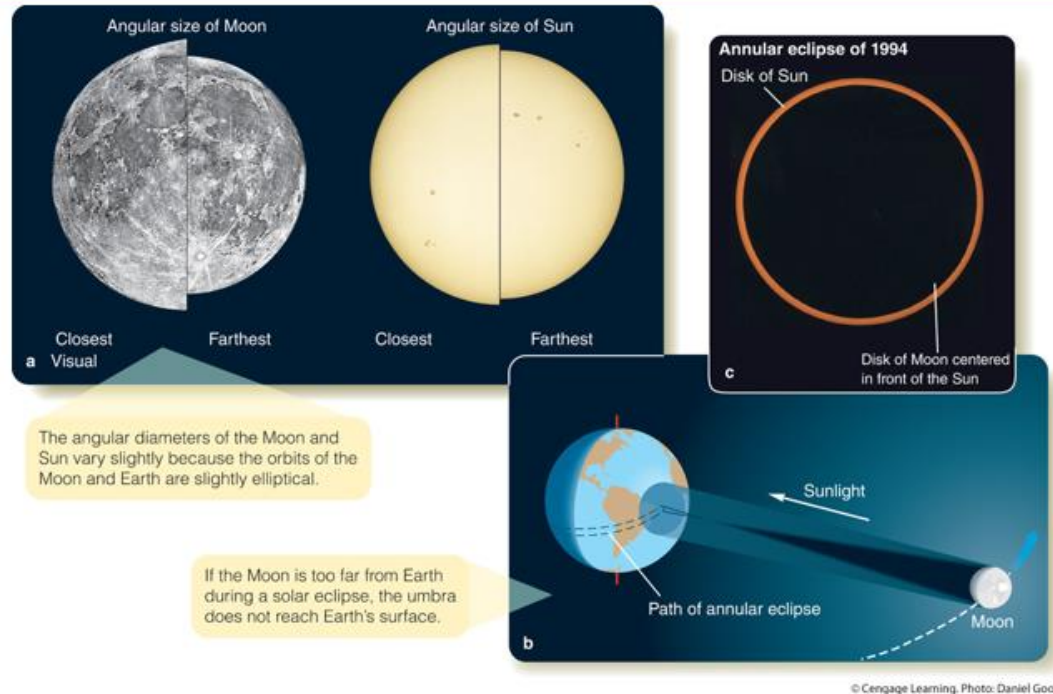
Think – Pair – Share Activity

- Break up into pairs and select a marine fish. Write down five facts with your partner about the biological and physical characteristics of your chosen fish species, highlighting specialized adaptations.
- Exchange ideas with another pair and take turns sharing the information you discovered. Write down additional adaptations provided by the other pair that are not on your list but may apply to your organism.
- Your group of four will share the information with the class.
- As a class, discuss the adaptations that allow marine organisms to thrive.

Research Activity

- Break up into pairs and compare marine reptiles and marine mammals.
- Exchange ideas with another pair and take turns sharing the information you discovered. Compare and contrast your findings with the other pair.
- Your group of four will share the information with the class.
- As a class, discuss the specialized adaptations of marine reptiles and marine mammals.

Annular Solar Eclipse



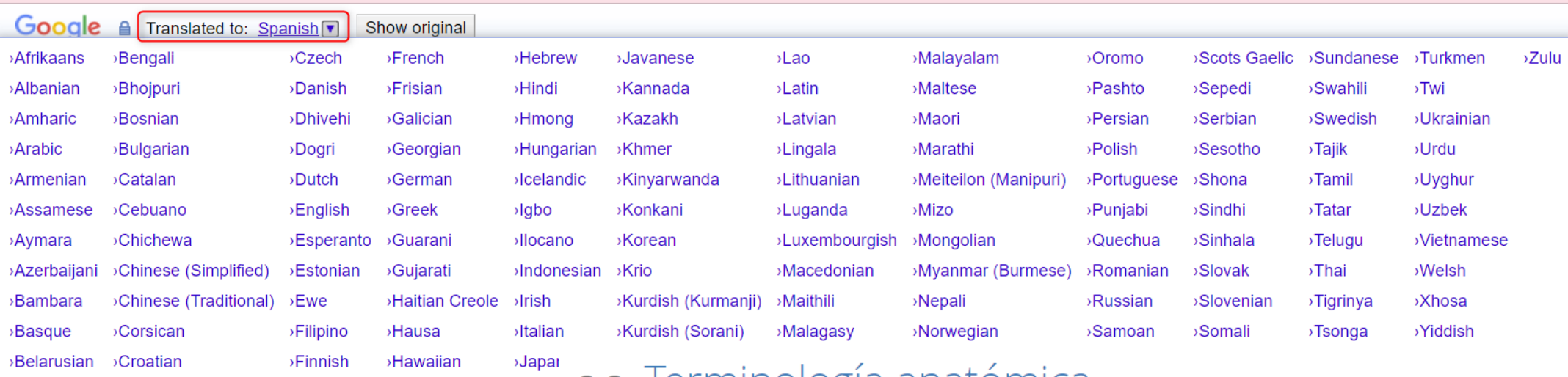
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Discussion Questions

- If a planet has a moon, must that moon go through the same phases that Earth's Moon displays?
 - Hint: What characteristics might the moon's orbit have to display the same phases?
- Which lunar phases would be visible in the sky at dawn? At midnight?
 - Hint: Think about where the Sun is relative to the Moon

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ELL Support in Various Languages



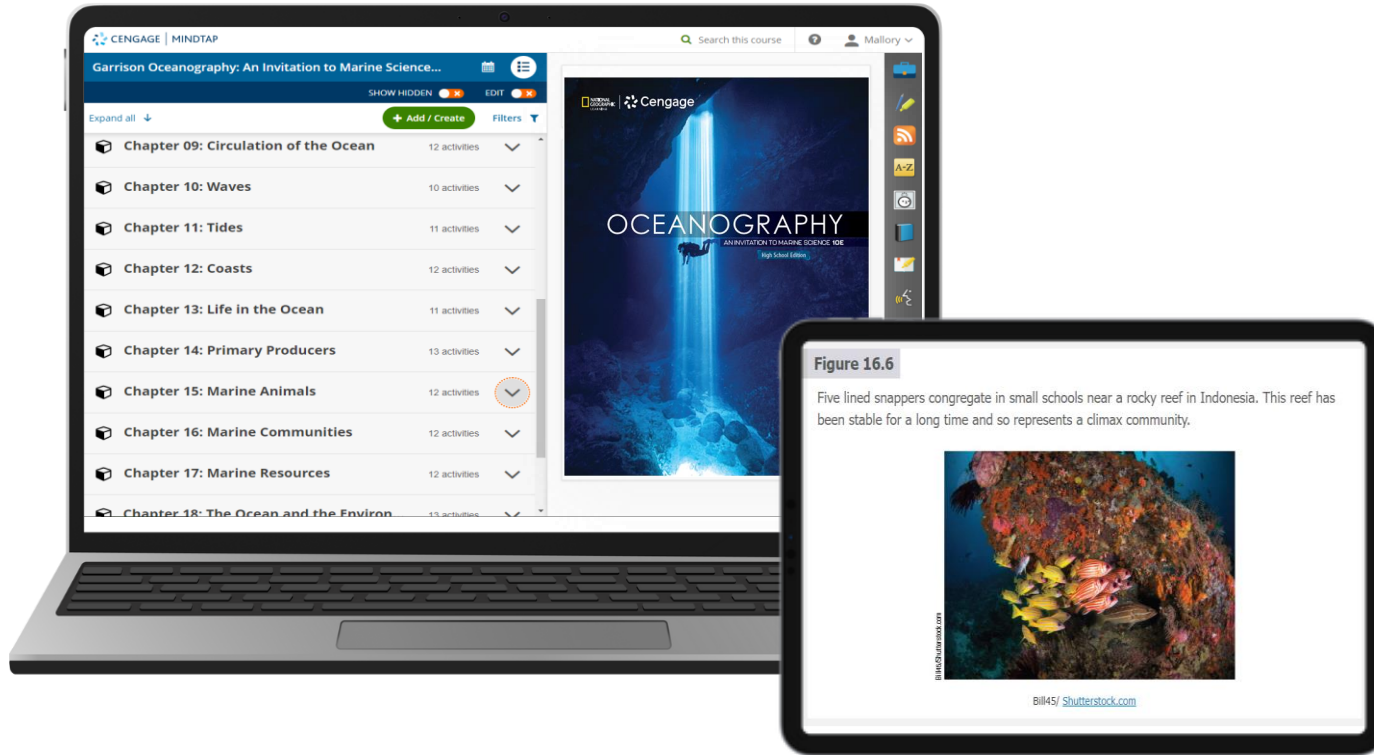
2-2 Terminología anatómica

En el estudio de anatomía y fisiología, se utilizan palabras especiales para describir la ubicación específica de una estructura u órgano, o la posición o dirección relativa de una parte del cuerpo con respecto a otra. El punto de referencia inicial utilizado es la posición anatómica. En la [posición anatómica](#), un ser humano está de pie erguido, con la cara hacia adelante, los brazos a los lados y las palmas hacia adelante ([Figura 2-1](#)).

Figura 2-1

Direcciones del cuerpo: Cefálico se refiere al cráneo o al extremo de la cabeza del cuerpo, y caudal se refiere al extremo de la cola. Anterior (o ventral) significa "frente" o "delante de". Posterior (o dorsal) significa "atrás" o "detrás de".

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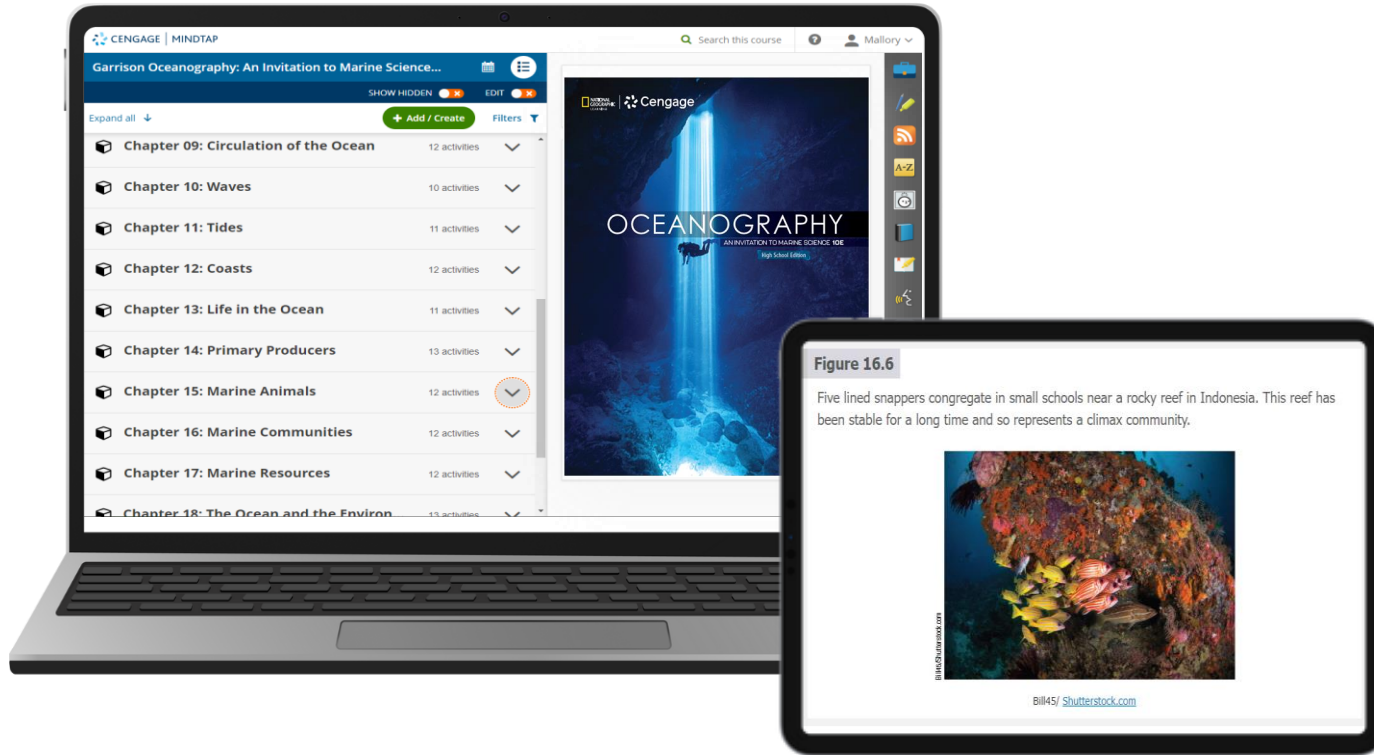
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