



EDUCATOR GUIDE

Grades 6-8

SEA LIONS

LIFE BY A WHISKER

K2 STUDIOS



DEFINITION FILMS



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**LESSON RUN TIME IS APPROX 55 MINUTES OR
CAN BE EXTENDED OVER A LONGER PERIOD.**



GLOSSARY

Terms used in this guide



Adaptation: A characteristic that makes an organism well suited to its environment

Community-based science: Also known as citizen science, this is science carried out by community members who do not necessarily have formal degrees or training in scientific research projects

Clade: A group of organisms descended from a common ancestor, as used in taxonomy

Climate change: Long-term rise in the average temperatures of the Earth's climate systems

Diagnose: To use symptoms to figure out what is making a patient sick or injured

Food web: A depiction of how energy moves through an ecosystem's trophic levels via predation

Haul out: When sea lions come on land to rest, sometimes in large numbers

Mammal: Animals that are: 1) warm blooded, 2) have hair,

3) breathe air, 4) have live births, and 5) drink milk when young.

Marine mammal: Mammals adapted to live all or part of their lives in the ocean and that depend on the ocean for food

Marine Protected Area: Marine areas with special rules that often limit or prohibit removing marine resources and species from these areas.

Maternal separation: When pups are separated from their mothers too early

Native: A species that is naturally found in a certain habitat

Pinniped: Flipper-footed marine mammals (seals and sea lions)

Symptom: A behavior or condition that usually signals the occurrence of a particular illness or injury

Taxonomy: Scientific efforts to systematically classify organisms



LESSON 1.

Sailing the Seven Sea Lions

Lesson Overview

In *Life By a Whisker*, sea lions are a lens through which to learn about issues affecting the ocean at large. Students will become familiar with broader biological and environmental concepts as well as human efforts to rehabilitate sick and injured sea lions.

Enduring Understanding

Students will learn to define **mammals**, **marine mammals**, and **pinnipeds**. They will become familiar with the seven sea lion species, including behaviors and **adaptations** associated with each and how they interact with humans.

Next Generation Science Standard Alignment

Science and Engineering Practices:

Obtaining, Evaluating, and Communicating Information
Engaging in Argument from Evidence

Disciplinary Core Ideas:

LS1B: Growth and Development of Organisms

Crosscutting Concepts:

Patterns

Influence of Science, Engineering, and Technology on Society and the Natural World

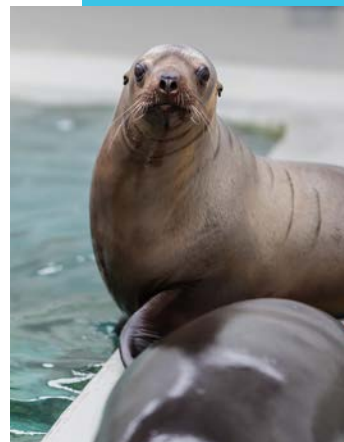
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1.2 Types of Marine Mammals	Page 38-39
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1.4 Sea lion Puzzle	Page 41-54
1.5 Sea Lion Fact Sheet	Page 41-54
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1.7 Field Biologist Portrait	Page 56

Preparation

- Smores's Portrait (Resource 1.1), Types of Marine Mammals (Resource 1.2), Seals vs. Sea Lions (Resource 1.3), Sea Lion Ranges (Resource 1.6), and Field Biologist Portrait (Resource 1.7) may be projected or printed to display for the class.

PATIENT STORY



NAME: Smores
 AGE: Pup
 DIAGNOSIS: Malnutrition and maternal separation
 TREATMENT: Feed

RESOURCE 1.1

- Print 1 copy of each Sea Lion Picture Puzzle (Resource 1.4) and Sea Lion Fact Sheet (Resource 1.5). They can be printed double-sided as a single sheet. If not, make sure corresponding puzzles and fact sheets are handed out together. If using as a puzzle, cut Sea Lion Picture Puzzle (Resource 1.4) into pieces. If printed double-sided with the fact sheet, puzzles can be assembled sea lion up (less challenging) or fact sheet up (more challenging). Or, don't cut the resource into pieces and use it as a worksheet.

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LESSON 1.

Sailing the Seven Sea Lions

Anticipatory Set

Display Smores' Portrait without sharing her name or story. To gauge background knowledge, ask students if they can identify this animal and what they know about this animal. As students discuss the photo, guide them to understand this is a sea lion and she will lead them through the remainder of the lesson.

Procedure

1. While Smores' Portrait (Resource 1.1) is displayed, tell students this animal is a **mammal** just like we are. Ask them to define a **mammal** and guide them to understand that **mammals** are warm-blooded, have hair, breathe air, give live birth, and drink milk when young. Ask them for examples of **mammals native** to your area. If students need support defining **mammals**, please refer to the WHALE acronym (Resource 1.1) in Lesson 1 of the Elementary School Educator Guide.
2. Ask students to define a **marine mammal**. Guide them to understand **marine mammals** are **mammals** adapted to live all or part of their lives in the ocean and depend on the ocean for food. Tell them there are 5 types of **marine mammals**. Display Types of Marine Mammals (Resource 1.2) and ask students to identify each group. Guide them to understand the common name and **clade**, if appropriate, of each group.
3. Tell students you are focusing on the group of **marine mammals** called **pinnipeds**. Display Seals vs. Sea Lions (Resource 1.3) and ask what differences they notice between the two animals. Guide them to note that seals have ear holes, short front flippers, and a gray to tan coat. Sea lions have ear flaps, long front flippers, and a darker brown coat. Tell the class they are going to dive deeper into learning about the seven kinds of sea lions around the world.
4. Break students into seven groups and pass out one Sea Lion Picture Puzzle (Resource 1.4) and corresponding Sea

Lion Fact Sheet (Resource 1.5) per group. If using these resources as a puzzle, ask groups to put the pieces together. Pieces may be taped together, but for multiple use it is recommended students instead lay pieces next to each other. Once puzzles are complete, ask groups to discuss the most interesting thing they learned about their sea lion. Ask them to discuss an answer to the prompt on their fact sheet and brainstorm one question they have about their sea lion.

5. Display Sea Lion Ranges (Resource 1.6) and ask groups to share the information on their fact sheet, as well as their questions, with the class. As each group shares their sea lion's range, label Sea Lion Ranges (Resource 1.6). When complete, the map should show the ranges of all seven sea lion species.
6. Ask students if any of their sea lions are threatened. If groups answer yes, ask them to explain why. Display Smores' portrait (Resource 1.1) again and explain that Smores was a Steller sea lion transferred to The Marine Mammal Center from the Northcoast Marine Mammal Center. Share that Steller Sea Lions are endangered in parts of their range and work from organizations like these is important to protect these species.

RESOURCE 1.7

Field biologists gather information about animals' behavior and bodies by collecting observations and samples. They conduct this work in the field, or out on the beaches, shores, and waters where sea lions spend their lives.



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LESSON 1. Sailing the Seven Sea Lions

7. Ask students what they The Marine Mammal Center does to help sea lions, such as Smores. Share The Marine Mammal Center's mission: to advance global ocean conservation through **marine mammal** rescue and rehabilitation, scientific research, and education. Guide them to understand the following definitions: rehabilitation (restoring to good health), scientific research (answering questions by testing hypotheses using data), and education (teaching people about the ocean and marine conservation issues). Ask students why The Marine Mammal Center rehabilitates **marine mammals** and emphasize they do it to learn about the health of **marine mammals** and the sea and to contribute to ocean conservation.
8. Ask students to think of why a sea lion pup like Smores would need to be rescued and what they think was done to help her rehabilitate. Share that Smores was rescued because she was separated from her mother before she could feed herself. Veterinarians and volunteers taught Smores how to hunt fish on her own and she was released near the Farallon Islands in California.
9. Display Field Biologist Portrait (Resource 1.7) and share that the work of The Marine Mammal Center and other rehabilitation organizations would not be possible without contributions from field biologists. Ask students to define a field biologist. Share that they are researchers that study wild animals by collecting specimens and observations. These specimens and observations help us learn about wild and healthy animal populations so we can better treat animals like Smores.

Lend a Flipper

Students can help sea lions like Smores by calling their local **marine mammal** rescue hotline if they see an animal in distress. Calling this hotline will alert a network of organizations, like the Northcoast Marine Mammal Center and The Marine Mammal Center, that there is an animal in need. These organizations are specially trained to rescue and rehabilitate distressed sea lions and will make sure the animal receives proper care.

Assessment

Check for understanding of key **mammal** characteristics and the 5 types of **marine mammals**. Ask students to share the most interesting sea lion facts they learned. Ask students to write down and share one question they have after the lesson to see if there are gaps in understanding that can be addressed in future lessons.

Ocean
Conservation
Activity

Limit the use of
products with plastic
packaging



LESSON 2. Well Suited to the Sea

Lesson Overview

Life by a Whisker shows audiences sea lions are unique, intelligent, and charismatic. Each sea lion species has **adaptations** that make them well suited to the environment and deserving of human respect and protection.

Enduring Understanding

Students will explore how **adaptations** enable sea lions to navigate their habitats, pursue prey, and perform other behaviors. Special emphasis is paid to how **adaptations** can bring sea lions into contact with humans.

Next Generation Science Standard Alignment

Science and Engineering Practices:

- Obtaining, Evaluating, and Communicating Information
- Engaging in Argument from Evidence
- Planning and Carrying out Investigations

Disciplinary Core Ideas:

- LS4C: Adaptation
- ETS1B: Developing Possible Solutions
- LS3B: Variation of Traits

Crosscutting Concepts:

- Structure and Function
- Patterns
- Influence of Science, Engineering, and Technology on Society and the Natural World

Materials

- 2.1 Ketchum's Portrait Page 57
- 2.2 Sea Lion Adaptations Page 58-63
- 2.3 Sea Lion Pen Page 64

- 2.4 Engineer Portrait Page 65
- Paper
- Coloring implements (colored pencils, markers, crayons)

PATIENT STORY



NAME: Ketchum
 AGE: Yearling
 DIAGNOSIS: Malnutrition
 TREATMENT: Feed

RESOURCE 2.1

Preparation

- Ketchum's Portrait (Resource 2.1), Sea Lion Pen (Resource 2.3), and Engineer Portrait (Resource 2.4) may be projected or printed to display for the class.
- Print one copy of each Sea Lion Adaptation (Resource 2.2).

Anticipatory Set

Display Ketchum's Portrait (Resource 2.1) without sharing her name or story. Ask students to identify this animal. If needed, review terms like **mammal**, **marine mammal**, and **pinniped**, as well as key sea lion characteristics (long front flippers, ear flaps, and darker brown coat). Ask students to guess what special **adaptations** this animal has that allow it to thrive in coastal and ocean habitats.

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LESSON 2.

Well Suited to the Sea

Procedure

1. Break students into 5 groups and give each group 1 Sea Lion Adaptation (Resource 2.2). Ask groups to brainstorm what body part is illustrated in the image. Have each group share with the class, providing corrections as needed.
2. Give groups time to discuss why this body part is special and prepare answers to the questions on Sea Lion Adaptations (Resource 2.2). Ask groups to share with the class, providing corrections as needed so students recognize how these **adaptations** make sea lions well suited to their environments. Each member of the group should have the opportunity to share while the rest of the class writes down interesting facts they learn or questions they have now.
3. Display Ketchum's Portrait (Resource 2.1) again, this time explaining she was a patient at The Marine Mammal Center. Tell students that The Marine Mammal Center and other animal rehabilitation organizations house their patients in enclosures that are as similar to the wild as possible, so animals are still used to their natural habitats when they are released. Designing pens that allow sea lions to use their uniquely adapted bodies and behaviors is key in the rehabilitation process.
4. Display Sea Lion Pen (Resource 2.3) and ask students what they notice about this enclosure. As students volunteer observations, ask why they think the pens include those features. Guide them to notice the pools and raised pool edges, which provide areas for sea lions to swim and climb, two things they do frequently in the wild.
5. Pass out a piece of paper and coloring implements to each student. Give the class 10 minutes to design a pen for The Marine Mammal Center that would allow sea lion patients to use some or all of their **adaptations**. Ask them to label key elements of their pens and write a 1-2 sentence explanation

for how this feature related to sea lion **adaptations**.

Encourage collaboration while students work. Pass out a second sheet of paper to each student but instruct them to leave it blank.

6. After students design their pens, ask them to leave their drawing on their desk next to the blank paper. Give them 7-8 minutes to walk around and see what other students included in their designs. Ask students to write down compliments and constructive feedback about their peers' pen designs on the blank sheet of paper on each desk.
7. Display Ketchum's Portrait (Resource 2.1) again and explain that engineers and facilities staff maintain the pen where she healed. Share that Ketchum was found in San Mateo County suffering from malnutrition and trauma. She was a yearling and took about two months to fully recover. Once she was rehabilitated, she was released back into the wild.
8. Display Engineer Portrait (Resource 2.4) and explain that engineers and facilities staff are in charge of designing and maintaining the pens where patients heal. They control water clarity and salinity, devise new ways of making pens mimic natural habitats, and provide a safe, healing space for patients.

RESOURCE 2.7

Engineers can be involved in designing, building, and maintaining pens where sea lions are rehabilitated. They ensure water filters and other equipment function properly and can alter salinity and other pen and pool characteristics to provide the most healing environment for patients. Engineers work very closely with veterinarians to develop additional resources that can best support animal care.

ENGINEER



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LESSON 2.

Well Suited to the Sea

Lend a Flipper

Students can help sea lions like Ketchum by giving wild animals lots of space on the beach. Sea lions have **adaptations** that allow them to thrive in their habitats, but are not well equipped to handle the stress caused by human interactions. By giving sea lions space in the wild, we are helping them remain happy and healthy.

Assessment

Check that students know how each **adaptation** makes sea lions better suited for their environments. Finish by asking students to write down and share one question they have after the lesson to see if there are any gaps in understanding that can be addressed in future lessons.

Ocean Conservation Activity

Have a plastic-free
birthday party. Say no
to balloons



LESSON 3.

A Sea Lion's Life for Me

Lesson Overview

Life by a Whisker introduces viewers to an Australian sea lion pup, but sea lions are worth getting to know at all stages of their life cycle. Sea lions are dynamic animals that undergo changes throughout the year and as they mature from a pup to an adult.

Enduring Understanding

Students will learn the contexts and characteristics of different sea lion age classes, as well as the considerations humans should take when observing sea lions at each stage of the life cycle.

Next Generation Science Standard Alignment

Science and Engineering Practices:

Obtaining, Evaluating, and Communicating Information
Analyzing and Interpreting Data

Disciplinary Core Ideas:

LS1B: Growth and Development of Organisms
LS3B: Variation of Traits

Crosscutting Concepts:

Cause and Effect
Interdependence of Science, Engineering, and Technology
Stability and Change

Materials

- 3.1 Blarney McCresty's Portrait Page 66
- 3.2 Sea Lion Age Classes Page 67-71
- 3.3 Sea Lion Age Class Characteristics Page 72-73
- 3.4 Marine Sanctuary Park Ranger Portrait Page 74

Preparation

- Blarney McCresty's Portrait (Resource 3.1) and Marine Sanctuary Park Ranger Portrait (Resource 3.4) may be projected or printed to display for the class.
- Print several copies of Sea Lion Age Class (Resource 3.2). Cut out and shuffle the images, but keep them in sets for groups to put in order.
- Print one copy of Sea Lion Age Class Characteristic (Resource 3.3) and cut out each characteristic.

PATIENT STORY



NAME: Blarney McCresty
 AGE: Adult
 DIAGNOSIS: Domoic acid
 toxicosis
 TREATMENT: Medication and
 fluid

RESOURCE 3.1

Anticipatory Set

Display the Blarney McCresty's Portrait (Resource 3.1) without sharing his name or story. Ask students what they notice about this animal, guiding them to notice his large size and the sagittal crest, or bump, on top of his head. Thinking about these characteristics, ask them how old he might be and whether they think he is male or female. Lead students to figure out that he is an adult male California sea lion because of his sagittal crest.

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LESSON 3.

A Sea Lion's Life for Me

Procedure

1. Ask students, "What do marine sanctuary park rangers do in their jobs?" Help fill in any gaps in the job duties listed by sharing the following information: marine sanctuary park rangers patrol marine sanctuaries, making sure visitors follow sanctuary rules and keeping an eye on animals in the area. Share that because marine sanctuary park rangers sometimes patrol sea lion breeding colonies, they must know how to identify sea lions at different ages so they can collect information on how these colonies are doing.
2. Break the class into groups and pass out one Sea Lion Age Class (Resource 3.2) per group. Give the groups about 5 minutes to identify the unique physical characteristics of each age class and ask them to organize the images from youngest to oldest age class. Work the room and make corrections as students begin to order the images. Once groups are done, they should be able to compare the sea lion age classes side by side.
3. Pass out one characteristic from Sea Lion Age Class Characteristics (Resource 3.3) to each group. Give students 5 minutes to read the description and brainstorm which age class this behavior describes. Have groups share their answer and tell the class about the behaviors on their sheet. Option to extend this part of the lesson by researching sea lion skulls or teeth and incorporating those images into this lesson.
4. Ask each group to brainstorm threats or challenges to sea lions in their age class, as well as what people can do to reduce the impact of these challenges. Some examples might be **maternal separation**, plastic entanglement, or disease. For more information on threats, you may look at Lessons 6 and 7. Have groups share their ideas with the class.
5. Display Blarney McCresty's Portrait (Resource 3.1) again.

Ask students to state the age class of this animal. Ask what physical characteristics tipped them off, as well as what behaviors they would expect from an animal of this age. Share that Blarney McCresty came from Monterey County due to Domoic acid toxicosis, which is the result of toxic algae blooms. Emphasize that he made a full recovery after only two weeks and was released back into the wild.

6. Display Marine Sanctuary Park Ranger Portrait (Resource 3.4). Explain that once in the wild, marine sanctuary park rangers like Dirk are often the first line of defense in keeping sea lions safe. They make sure human visitors keep their distance, enforce sanctuary rules, and report sick or injured animals to organizations like The Marine Mammal Center, who are trained to rescue and rehabilitate these species.

Lend a Flipper

Students can help sea lions like Blarney McCresty by walking or riding their bikes instead of driving. Burning fossil fuels, like coal, oil and natural gas, releases carbon dioxide in the atmosphere. This excess carbon dioxide acts like a heat-trapping blanket and contributes to warmer ocean waters, including along the California coast. Warmer waters can lead to more toxic algae blooms and more sea lions with Domoic acid toxicosis. By doing their part to reduce carbon emissions and address **climate change**, students are helping sea lions and people stay safe.

RESOURCE 3.4

Marine Sanctuary Park Rangers, like Dirk, are responsible for patrolling marine sanctuaries and ensuring the safety of visitors, wildlife, and the environment. They make sure visitors follow all posted rules while also providing interpretive services so guests can better understand and appreciate the habitats around them.



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LESSON 3.

A Sea Lion's Life for Me

Assessment

As students are working in groups, provide guidance to ensure students can distinguish between age classes. Ask students to write down and share one question they have to see if there are any gaps in comprehension that can be addressed in future lessons.

Ocean
Conservation
Activity

Don't use plastic bags,
bring your own reusable
one from home



LESSON 4.

A Pup's Perspective

Lesson Overview

Life by a Whisker stars Otto, an Australian sea lion pup. Pups are born on land but must learn to hunt and navigate in the ocean. This lesson delves deeper into the growth and experiences of Otto and other pups in the wild.

Enduring Understanding

Students will explore how pups develop during their first few years, sometimes requiring human care if separated from their mothers prematurely.

Next Generation Science Standard Alignment

Science and Engineering Practices:

Analyzing and Interpreting Data

Disciplinary Core Ideas:

LS2C: Ecosystem Dynamics, Functioning, and Resilience

LS1B: Growth and Development of Organisms

ESS3B: Natural Hazards

Crosscutting Concepts:

Cause and Effect

Structure and Function

Materials

- 4.1 Percevero's Portrait Page 75
- 4.2 Mother & Pup Matching Game Page 76
- 4.3 Veterinarian Portrait Page 77

Preparation

- Percevero's Portrait (Resource 4.1) and Veterinarian Portrait (Resource 4.3) may be projected or printed to display for the class.

- Print several copies of Mother & Pup Matching Game (Resource 4.2). Keeping them in sets, cut out and shuffle species names and behaviors so students can match them.

PATIENT STORY



NAME: Percevero
 AGE: Pup
 DIAGNOSIS: Malnutrition and maternal separation
 TREATMENT: Feed

RESOURCE 4.1

Anticipatory Set

Display Percevero's Portrait (Resource 4.1) without sharing her name or story. Ask students which age class this animal belongs to and help students figure out that this is a California sea lion pup. Ask students what they think this pup needs to survive. Lead a discussion on the ways that pups rely on their mother's milk, protection from predators and elements, and time to learn to swim and hunt on their own.

Procedure

- Break the class into groups. Pass out one Mother and Pup Matching Game (Resource 4.2) per group. Give groups 5 minutes to match behaviors to sea lion species. Remind students to think about what they learned about different

CONTINUED...



LESSON 4.

A Pup's Perspective

sea lion species and their pup rearing tactics thus far.

2. Have groups take turns sharing one mother and pup match until all are complete. If a group does not make a correct match, give them a few moments to work together to correct their answer.
3. Assign each group one mother and pup behavior. Ask groups to brainstorm why this sea lion species developed this behavior. In other words, how does this behavior make this sea lion well suited to their environment? Allow each group to share their work. Ask students to write down questions and things they find interesting as they listen to other groups.
4. Introduce students to the term **maternal separation**, when pups are separated from their mothers too early. Ask students to share what happens to pups when they don't spend enough time with their mothers.
5. Display Percevero's Portrait (Resource 4.1) again and explain this animal was admitted to The Marine Mammal Center due to **maternal separation**. Explain that in many cases, pups become separated from their mothers when humans come too close and scare the mother off. Encourage students to keep their distance if they see pups or wildlife on the beach. Share that Percevero is a California sea lion separated from her mom in a year when waters were exceptionally warm. Percevero was tube-fed until she had enough teeth to start eating fish. She was released into the wild a month later once she could eat solid food.
6. Display Veterinarian Portrait (Resource 4.3) and explain veterinarians are key in rehabilitating patients like Percevero suffering from **maternal separation**. Veterinarians make sure pups get enough food, vitamins, and nutrients to grow strong and gain blubber so they can return to the wild able to stay warm and hunt for themselves.

Lend a Flipper

Students can help sea lions like Percevero by being sure to stay far away from mothers and pups on the beach. Getting too close to a pup can scare away the mom, leading to **maternal separation**. By leaving sea lion mothers and pups alone, students will help ensure pups can stay with their mother as long as possible and learn how to hunt and swim on their own.

Assessment

As students work in groups, make sure students use evidence to support their arguments for why sea lions have different mother and pup behaviors. Ask students to write down and share one question they have to see if there are any gaps in understanding that can be addressed in future lessons.

MARINE SCIENCE CAREER

RESOURCE 4.3

Veterinarians like Dr. Cara, help to prevent, **diagnose**, and treat illnesses and injuries in animals. They can prescribe medications and treatments and perform surgeries and other procedures.

VETERINARIAN





LESSON 5.

Fish Finders

Lesson Overview

Life by a Whisker shows some of the **adaptations** that make Australian sea lions so interesting. Sea lions are skilled predators, hunting vertebrate and invertebrate species in diverse habitats. This lesson focuses on hunting **adaptations** that make sea lions adept marine predators.

Enduring Understanding

This lesson will teach students about sea lion diets, as well as the unique **adaptations** that can lead to sea lion-human interactions while these animals are on the hunt.

Next Generation Science Standard Alignment

Science and Engineering Practices:

- Developing and Using Models
- Obtaining, Evaluating, and Communicating Information

Disciplinary Core Ideas:

- LS2A: Interdependent Relationships in Ecosystems
- LS4C: Adaptation
- LS2B: Cycle of Matter and Energy Transfer in Ecosystems

Crosscutting Concepts:

- Systems and System Models
- Structure and Function

Materials

- 5.1 Henry's Portrait Page 78
- 5.2 Sea Lion Food Web Page 79-80
- 5.3 Sea Lion Hunting Adaptions Page 81
- 5.4 Wildlife Videographer Portrait Page 82

Preparation

- Henry's Portrait (Resource 5.1) and Wildlife Videographer Portrait (Resource 5.4) may be projected or printed to display for the class.
- Print as many copies of Sea Lion Food Web (Resource 5.2) as desired. Keeping the **food webs** in sets, cut out and shuffle images so students can arrange them in order.
- Print one copy of Sea Lion Hunting Adaptations (Resource 5.3) and cut out each **adaptation** to pass out to each group.

PATIENT STORY



NAME: Henry
 AGE: Yearling
 DIAGNOSIS: Blind
 TREATMENT: Long-term care

RESOURCE 5.1

Anticipatory Set

Display Henry's Portrait (Resource 5.1) without sharing his name or story. Ask students if they notice anything different about this sea lion. Explain that this animal is blind. Ask them how they think his behavior might be affected given its loss of sight. Aim for students to come to the conclusion that this sea lion's ability to hunt is compromised.

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LESSON 5.

Fish Finders

Procedure

1. Ask the class to define the term **food web**. Guide them to understand a **food web** illustrates how energy travels between different species through food. Break the class into small groups and pass out one Sea Lion Food Web (Resource 5.2) per group. Give groups 5 minutes to arrange the images into an accurate sea lion **food web**.
2. Have groups take turns explaining the relationship between two components of the web. Provide additional information and corrections as needed. Ask groups to state how they think energy moves between these organisms. In other words, how does one organism prey on the other?
3. Explain that sea lions have special physical and behavioral **adaptations** that make them great at pursuing their prey. If applicable, have students think back to what they already know from Lesson 2. Pass out one Sea Lion Hunting Adaptation (Resource 5.3) per group.
4. Give groups 5 minutes to brainstorm how this **adaptation** helps sea lions hunt their prey. They should also think about how this **adaptation** might bring sea lions into contact with humans. Have groups share their ideas with the class. Ask students to write down questions or things they find interesting as they listen to other groups.
5. Display Henry's Portrait (Resource 5.1) and explain he was found blind when rescued by The Northcoast Marine Mammal Center then transferred to The Marine Mammal Center for long-term care. Henry would be unable to fully hunt for himself in the wild but was otherwise in good condition, so The Marine Mammal Center worked with the National Marine Fisheries Service to house him at the San Francisco Zoo and Gardens, where staff are able to make sure he eats properly and Henry can live a full and happy life. Henry could complete the elements of free feeding but would not be able to survive in the wild without help from

people. Collaboration between The Marine Mammal Center, the San Francisco Zoo, and the Northcoast Marine Mammal Center resulted in the successful care of Henry.

6. Explain that some patients at The Marine Mammal Center don't know how to hunt for themselves and have to go through a process called fish school. Explain the four stages of fish school: fish milkshakes (blending up fish, formula, salmon oil, and medicines for tube feeding), hand feeding, string feeding (pulling a fish through water with string to simulate swimming), and free-feeding (tossing frozen fish into the pool for patients to "hunt").
7. Display the Wildlife Videographer Portrait (Resource 5.4) and explain that The Marine Mammal Center's fish school is based on sea lion hunting behavior in the wild. The Marine Mammal Center and other organizations often learn about hunting behavior with the help of wildlife videographers and documentary filmmakers who record sea lions pursuing prey in the wild. Videographers can even capture never-before-seen behavior, like cooperative hunting tactics used by Galapagos sea lions to catch tuna!

RESOURCE 5.4

Wildlife videographers record events on video. When recording sea lions, they often have to travel long distances and spend time in rugged outdoor environments, since this is where the animals live. This video footage allows people who cannot travel to these places to also observe and learn about sea lions.

VIDEOPHOTOGRAPHER





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LESSON 5.

Fish Finders

Lend a Flipper

Students can help sea lions like Henry by making sure no harmful chemicals, soaps, or other non-natural materials go down storm drains that empty into the sea. Although sea lions have **adaptations** that make them skilled hunters, they cannot catch prey that is not there. By making sure pollutants that can harm or kill fish do not go down drains and into the ocean, students can help protect sea lions' prey species and ensure the **food web** remains intact.

Assessment

Make sure students use evidence to support their arguments for why sea lions may have developed different hunting **adaptations**. Finish by asking students to write down and share one question they have after the lesson to see if there are any gaps in understanding that can be addressed in future lessons.

Ocean
Conservation
Activity

use natural products
without harmful
chemicals



LESSON 6. Catch or be Caught

Lesson Overview

Life by a Whisker reveals how Australian sea lions can be harmed by human interactions, even accidentally. This lesson focuses on commercial harvesting. Although sea lions are excellent predators, they are also hunted on accident and on purpose.

Enduring Understanding

Students will learn about past commercial sea lion hunting and how sea lions can be negatively impacted by modern commercial fishing methods.

Next Generation Science Standard Alignment

Science and Engineering Practices:

Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence

Disciplinary Core Ideas:

ETS1B: Developing Possible Solutions
LS2C: Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Concepts:

Cause and Effect
Structure and Function

Materials

- 6.1 Snouty's Portrait Page 83
- 6.2 Commercial Fishing Interaction Page 84
- 6.3 How Seafood is Caught: Gillnetting Video
- 6.4 Fisheries Observer Portrait Page 85
- Paper
- Coloring implements

Preparation

- Snouty's Portrait (Resource 6.1) and Fisheries Observer Portrait (Resource 6.4) may be projected or printed to display for the class.
- Print Commercial Fishing Interaction (Resource 6.2) and cut out the interactions to pass out to groups.
- Pull up How Seafood is Caught: Gillnetting Video (Resource 6.3): <https://youtu.be/AXyCCVxFmWk>

PATIENT STORY

NAME:	Snouty
AGE:	Juvenile Male
DIAGNOSIS:	Entanglement around nose and mouth
TREATMENT:	Disentangle and feed

RESOURCE 6.1



Anticipatory Set

Display Snouty's Portrait (Resource 6.1) without sharing his name or story. Ask the class if the animal appears healthy or not, and why, to come to the conclusion that this animal was harmed by fishing gear, in this case a device used to trap crabs.

CONTINUED...



LESSON 6.

Catch or be Caught

Procedure

1. To begin a discussion on the ways that sea lions are directly harmed from fishing gear, ask students why sea lions have blubber. Remind them blubber provides insulation against cold ocean waters. Ask how humans might use sea lion blubber, guiding them to discover blubber can be boiled down into oil for cooking or candle making. Share that pelts were also used to make clothing and sea lions were eaten. Sea lions were hunted commercially for these reasons for centuries. Many sea lion species still have not recovered.
2. Share that today, sea lions are not hunted commercially in most areas. However, they are still affected by commercial fishing. Break the class into groups and give each group one Commercial Fishing Interaction (Resource 6.2). Give groups 5 minutes to discuss how sea lions are harmed by this interaction and what might be done to prevent these interactions from occurring.
3. Have groups share the details of their Commercial Fishing Interaction (Resource 6.2), as well as their ideas for how to prevent these interactions from happening. After groups share, ask the remainder of the class if they have additional ideas for preventing this interaction from happening.
4. Once all groups have shared, tell students many commercial fishing boats have tried to reduce their negative impacts on sea lions and **marine mammals**. They are working with scientists and government representatives to design gear that catches fish but leaves sea lions unharmed. Watch How Seafood is Caught: Gillnetting Video (Resource 6.3) as an example. Ask students to explain how this fishing method potentially harms **marine mammals**, as well as how fishers are working to reduce these negative impacts.
5. Pass out paper and coloring implements to each student. Give students 10 minutes to design a piece of fishing gear that can catch fish, lobsters, or crabs but doesn't harm sea

lions. Ask them to label key elements of their gear and write a 1-2 sentence explanation for why they included this feature. Encourage students to collaborate. Pass out a second sheet of paper to each student but instruct them to leave it blank. Option to extend this lesson by having students complete research on fishing gear and create a proposal for their design.

6. After students design their fishing gear, tell them to leave their drawing on their desk next to the blank paper. Give students 5 minutes to walk around the room and see what other students designed. Ask students to write compliments and constructive feedback for interesting designs on the blank sheet of paper on each desk.
7. Display Snouty's Portrait (Resource 6.1) again and explain that their designs would prevent animals like Snouty from getting hurt. Share that Snouty was admitted to The Marine Mammal Center due to a crab trap entanglement. Veterinarians removed the entanglement and performed cosmetic surgery on Snouty's mouth before volunteers helped rehabilitate Snouty by feeding him and giving him antibiotics. Snouty was released at Rodeo Beach in the Golden Gate National Recreation Area, California.
8. Display Fisheries Observer Portrait (Resource 6.3) and explain that fisheries observers help keep sea lions and other **marine mammals** safe from intentional or accidental

RESOURCE 6.4

Fisheries observers accompany commercial fishing boats when they are at sea. They are responsible for recording the species that are caught by that boat's fishing gear. This can shed light on the rates that fishing gear captures target species versus bycatch. Fisheries observers also take note of other information, including the actual tonnage harvested by that boat.

FISHERIES OBSERVER



CONTINUED...



LESSON 6.

Catch or be Caught

harm from commercial fishing boats. Fisheries observers can report harmed sea lions to authorities and collect data on how “sea lion safe” fishing gear actually affects these species.

Lend a Flipper

Students can help sea lions like Snouty by using programs like Seafood Watch ® to make sure they eat seafood that has been sustainably harvested. By eating sustainable seafood, students will make sure they aren't eating seafood that was caught using methods that harm sea lions and other marine species.

Assessment

Work the room to make sure students are using evidence to support their arguments for how sea lions are harmed by different commercial fishing interactions. Ask students to write down and share one question they have after the lesson to see if there are any gaps in understanding that can be addressed in future lessons.

Ocean
Conservation
Activity

Make sure your
seafood has been
sustainably harvested



LESSON 7.

Too Close for Comfort

Lesson Overview

Life by a Whisker introduces audiences to Australian sea lions, which **haul out** on remote beaches far from humans. But other sea lions share rookery and **haul out** spots with humans who use coastal areas too. All sea lions face challenges from human interaction, as will be explored in this lesson.

Enduring Understanding

This lesson will teach students about the negative outcomes of accidental and intentional human interaction. Students will learn best practices for interacting with sea lions and other **marine mammals** in the wild.

Next Generation Science Standard Alignment

Science and Engineering Practices:

- Obtaining, Evaluating, and Communicating Information
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Planning and Carrying out Investigations

Disciplinary Core Ideas:

- ETS1B: Developing Possible Solutions
- LS2C: Ecosystem Dynamics, Functioning, and Resilience
- LS2A: Interdependent Relationships in Ecosystems

Crosscutting Concepts:

- Cause and Effect
- Stability and Change

Materials

- 7.1 Brittany's Portrait Page 86
- 7.2 Plastic Pollution Video
- 7.3 Sea Lion Grabbing Girl Video Video

- 7.4 Human Interaction Page 87-91
- 7.5 Rescue Portrait Page 92

Preparation

- Brittany's Portrait (Resource 7.1) and Rescue Portrait (Resource 7.5) may be projected or printed to display for the class.
- Pull up Plastic Pollution Video (Resource 7.2) <https://vimeo.com/113359330> and Sea Lion Grabbing Girl Video (Resource 7.3) on a projector or other display.
- Print Human Interaction (Resource 7.4) and cut out the different interactions.

PATIENT STORY



NAME: Brittany
 AGE: Yearling
 DIAGNOSIS: Gunshot wound
 TREATMENT: Medication

RESOURCE 7.1

Anticipatory Set

Display Brittany's Portrait (Resource 7.1), but don't share the patient's name or story just yet. Ask the class if they see anything surprising about this animal, and tell them this sea lion has a

CONTINUED...



LESSON 7. Too Close for Comfort

gunshot wound. Guide them to note the gunshot wound. Ask them how they think this animal sustained that injury. Guide them to the understanding that this animal was harmed by a human because the person and sea lion came too close to one another. Share that in the lesson, students might observe some unpleasant human-sea lion interactions, but will have time to reflect and debrief.

Procedure

1. Ask the class what they think a sea lion haul-out is. Remind them **haul outs** are areas where sea lions congregate onshore to rest. Ask students what other organisms might also use these beaches. Inform students that sea lions share beaches with humans that use these spaces for recreation and other purposes. Sea lions share their ocean environments with humans too, as we covered in Lesson 6 about sea lions and commercial fishing interactions.
2. Ask students to identify ways sea lions and humans interact. Write their answers on the board, in two columns representing direct and indirect impacts, but do not label these columns yet. Ask students what these two columns represent. Explain that the identified interactions represent direct and indirect human impacts. Discuss whether these interactions listed are intentional or unintentional impacts.
3. Preface the videos by sharing that direct and indirect human interactions with wildlife are not always pleasant to observe. Play Plastic Pollution Video (Resource 7.2) as an example of indirect human interaction. Ask students to write down plastic items they see in the water. Tell students that direct interactions are especially unpleasant, as they will see in the next video. Play Sea Lion Grabbing Girl Video (Resource 7.3) as an example of direct human interaction. Ask students to write down inappropriate human behaviors they observe. Remind students this animal is wild and did nothing wrong,

but was stressed by direct human interactions. To save time, it is recommended you show only a portion of each video clip.

4. Ask students to share the plastic and inappropriate human behaviors they observed in the videos. Have students share ways of preventing that plastic from entering the ocean, as well as what humans in the second video could have done to avoid this negative encounter. Ask students how they felt watching the videos, checking to see if any students appear especially bothered by the content.
5. Break students into groups and pass out one Human Interaction (Resource 7.4) per group. Give groups 7 minutes to read the resource and brainstorm whether it is a direct or indirect interaction, why this interaction occurs, and what could be done so this interaction happens less often.
6. Ask groups to share their answers with the class. After each group presents, ask the class if they have additional ideas for how to make that interaction happen less often. When other groups are presenting, ask students to write down questions or interesting things they learn.

RESOURCE 7.5

Rescue and Response staff members receive calls from the public on rescue hotlines, determine whether the animal needs to be rescued, and delegate the tasks needed to carry out the rescues. They train a team of volunteers who safely perform the rescue to bring the animals back to the hospital, as well as the release of animals once they have been rehabilitated.





LESSON 7. Too Close for Comfort

Lend a Flipper

Students can help sea lions like Brittany by calling your nearest wildlife rescue center when they see a sick or injured animal.

Students can support rescue centers that help wild animals by volunteering as well as organizing fundraisers to raise awareness and donate money to these organizations.

Assessment

As students work in groups, walk around the room to make sure they grasp the material and are working collaboratively. Finish by asking students to write down and share one question they have after the lesson to see if there are any gaps in understanding that can be addressed in Lesson 8.

7. Display Brittany's Portrait (Resource 7.1) again and ask students if this was a direct or indirect human interaction. Explain that it is a direct interaction. Tell them she would not have been injured if the person involved had interacted with the sea lion appropriately. Ask how they should interact with sea lions and other **marine mammals** in the wild. You may prompt them with ideas like keeping their distance, keeping dogs on leash, being quiet, not feeding wild animals, and calling a **marine mammal** rescue hotline if an animal seems sick or injured. Emphasize that if the person who shot Brittany had followed those rules, she would not have been injured.
8. Share that Brittany is an adult female California sea lion that was found on Cayucas State Beach with a gunshot wound. While many cases that involve a gunshot don't turn out well, she made a full recovery and was released back into the wild only one month after being rescued.
9. Display the Rescue Portrait (Resource 7.5) and share that luckily Brittany was found by The Marine Mammal Center's Rescue and Response Team, who worked together to capture her and bring her back to the Center for rehabilitation. Without Rescue and Response staff members, many animals like Brittany, who were injured by direct or indirect human interaction, would not receive treatment and might not survive. In this photo, The Marine Mammal Center's Special Rescue Operations team is working with partners in Mexico to rescue a California sea lion.

Ocean Conservation Activity

Call your local wildlife
rescue center when you
see an injured animal



LESSON 8.

A Changing Ocean

Lesson Overview

Life by a Whisker introduces viewers to some of the challenges faced by Australian sea lions. **Climate change** is altering the ocean in ways that have cascading effects for marine species. This lesson broadens that focus by exploring how the ocean undergoes seasonal and longitudinal changes that affect sea lions and other species.

Enduring Understanding

Students will explore how **climate change** affects sea lions, as well as the actions they can take to reduce their climate footprint.

Next Generation Science Standard Alignment

Science and Engineering Practices:

- Obtaining, Evaluating, and Communicating Information
- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions

Disciplinary Core Ideas:

- ESS3D: Global Climate Change
- ESS3C: Human Impacts on Earth Systems
- ESS3B: Natural Hazards
- ESS3A: Natural Resources
- ESS2D: Weather and Climate

Crosscutting Concepts:

- Patterns
- Influence of Science, Engineering, and Technology on Society and the Natural World
- Stability and Change
- Cause and Effect

Materials

- 8.1 Snitch's Portrait Page 93
- 8.2 El Nino Video Video
- 8.3 Climate Change Outcomes Page 94-95
- 8.4 Marine Science Educator Portrait Page 96

PATIENT STORY



NAME: Snitch
 AGE: Pup
 DIAGNOSIS: Malnutrition and maternal separation
 TREATMENT: Feed

RESOURCE 8.1

Preparation

- Snitch's Portrait (Resource 8.1) and Marine Science Educator Portrait (Resource 8.4) may be projected or printed to display for the class.
- Pull up El Niño Video (Resource 8.2): https://www.esrl.noaa.gov/psd/map/clim/sst_olr/old_sst/sst_9798_anim.shtml
- Print Climate Change Outcome (Resource 8.3) and cut out outcomes to pass out to groups.

CONTINUED...



LESSON 8.

A Changing Ocean

Anticipatory Set

Display Snitch Portrait (Resource 8.1) without sharing her name or story. Ask students what kind of ocean conditions this animal requires to live happily in the wild. Guide them to recognize this sea lion requires, amongst other things, ample fish and beach habitat for breeding and hauling out. What does the class think happens when sea lions don't have these things?

Procedure

1. Explain that sea lions' ocean habitats can change drastically for natural and human-caused reasons. One major natural change that occurs is El Niño, which affects water temperatures in the Pacific Ocean. Play El Niño Video (Resource 8.2) and ask students to take notes on interesting things they learn from the video.
2. Ask students what they noticed in the El Niño Video (Resource 8.2). Prompt with questions like: How does water temperature change? What areas are affected? How long does El Niño last? You may play the video again if needed. Option to extend lesson by finding graphs on ocean temperature during El Niño events and having students draw conclusion by interpreting the data.
3. Explain that warming water temperatures also occur due to **climate change**. Break the class into groups and pass out one Climate Change Outcome (Resource 8.3) to each group. Give groups 7 minutes to read the resource and brainstorm how sea lions are negatively affected by this phenomenon and what humans can do to prevent this from happening further.
4. Ask groups to share answers with the rest of the class. After each group presents, ask the rest of the class if they have additional ideas for how to make that **climate change** outcome happen less often. When others are presenting, ask students to write down questions or new, interesting things they learn.

5. Display Snitch's Portrait (Resource 8.1) again and ask students how they think this pup may have been affected by changes in ocean temperature. Explain that this pup may have been too weak to feed itself after warming waters forced fish into deeper, harder to reach waters. Share that Snitch was rescued and rehabilitated by volunteers who fed her fish. She made a full recovery and was released back into the wild.
6. Display Marine Science Educator Portrait (Resource 8.4) and share that it can be hard to make connections between human action, **climate change**, and stranded **marine mammals**. Thankfully, organizations like The Marine Mammal Center have dedicated educators who teach youth and the public about marine conservation issues, including **climate change**. Educators ensure people know what they can do to prevent **climate change** and protect **marine mammals** and the ocean at large.

RESOURCE 8.4

Naturalists educate the public about the environment and help the public learn what they can do to help maintain natural land for wild animals. Marine Science Educators specifically focus on educating the public on ocean conservation and science. This may include information about marine animals, ocean plants, and currents.

MARINE SCIENCE CAREER
MARINE SCIENCE EDUCATOR





Lend a Flipper

Students can help wild sea lions by reducing their contribution to **climate change**. Daily actions such as: reduce use of fossil fuels, like coal, oil and natural gas, by reusing items, wearing warm clothes instead of turning on the heater, eating more vegetables and less meat, unplugging electronics when not in use, and plant trees. Encourage students to talk to their friends, family and community about **climate change** and how we can all take action together.

Assessment

As students work in groups, walk around the room to make sure they grasp the material and are working collaboratively. Finish by asking students to write down and share one question they have after the lesson to see if there are any gaps in understanding that can be addressed in future lessons.

Ocean Conservation Activity

Say no to plastic straws. Use a reusable metal one instead.



LESSON 9.

Current Conservation

Lesson Overview

Life By a Whisker familiarizes students with **Marine Protected Areas** and how they impact marine species. This lesson will teach students about the successes and challenges of marine sanctuaries and marine parks.

Enduring Understanding

Students will learn how passionate advocates helped establish marine sanctuaries and parks for the benefit of myriad marine species, including sea lions.

Next Generation Science Standard Alignment

Science and Engineering Practices:

- Obtaining, Evaluating, and Communicating Information
- Engaging in Argument from Evidence
- Planning and Carrying out Investigations

Disciplinary Core Ideas:

- ETS1B: Developing Possible Solutions
- LS2C: Ecosystem Dynamics, Functioning, and Resilience
- LSB1: Growth and Development of Organisms

Crosscutting Concepts:

Patterns

Materials

- 9.1 Hoppie's Portrait Page 97
 - 9.2 Marine Protected Areas Map Page 98
 - 9.3 Sea Lion Raft Photo Page 99
 - 9.4 Marine Protected Area Case Study Page 100-106
 - 9.5 Senator Portrait Page 107
- Colored pencils, markers or crayons

Preparation

- Hoppie's portrait (Resource 9.1), Marine Protected Areas Map (Resource 9.2), Sea Lion Raft Photo (Resource 9.3), and Senator Portrait (Resource 9.5) may be projected or printed to display for the class.
- Print Marine Protected Area Case Study (Resource 9.4) and cut out the case studies to pass out to groups.

PATIENT STORY



NAME: Hoppie
 AGE: Pup
 DIAGNOSIS: Malnutrition and maternal separation
 TREATMENT: Feed

RESOURCE 9.1

Anticipatory Set

Display Hoppie's Portrait (Resource 9.1) without sharing his name or story. Ask students what age class this animal seems to be in, and explain that this is a sea lion pup. Ask if anything seems odd about where this pup is sitting. Students should comprehend this is a sea lion pup who should be in its mom's care, but was found far from the beach.

CONTINUED...



LESSON 9.

Current Conservation

Procedure

1. Display **Marine Protected Areas** of the World Map (Resource 9.2). Share that there are different names for **Marine Protected Areas** (MPAs), including "marine reserve," "marine sanctuary," or "marine park." Each MPA has special rules that visitors, businesses, and the government must follow. Ask students to discuss what those rules might be. Share these activities that may be banned in MPAs: extracting resources, mining, construction, flying aircrafts at low elevations, and fishing. Explain that MPAs are one solution to protecting sea lions from human impacts. MPAs are designated by the government, but community members and scientists recommend areas that need protection.
2. Ask the class to name pros and cons of MPAs. Explain MPAs have positive benefits, including protecting habitats and species so animal populations can grow. These effects spill over into adjacent areas, meaning areas next to MPAs also have more abundant populations of marine species that spilled out from the MPA. MPAs have negative effects too, like limiting commercially fished territories that bring economic profit and reducing areas available to harvest culturally important marine resources. MPAs can also limit recreational activities, such as collecting shells or fishing.
3. Emphasize MPAs benefit the entire ecosystem and everything living in it. Sea lions are one of those organisms. Here is an opportunity to discuss ocean **food webs**, if Lesson 5 has not been done yet. Display Sea Lion Raft Photo (Resource 9.3) and explain these sea lions are rafting, or gathering together in the water, in the Channel Island Marine Sanctuary. This is where California sea lions **haul out** to have their pups. Share that the animal in the opening was a pup that should have been in the Channel Island Marine Sanctuary, where it was protected.

4. Break students into 7 groups and assign each group a sea lion species and Marine Protected Area Case Study (Resource 9.4). Give groups 10 minutes to design an MPA for their sea lion. They should also prepare answers to the following questions using the information in their case study:
 - What threats does your sea lion species face?
 - What kind of area are you protecting? Will you include land and ocean areas?
 - Why did you choose this area?
 - What rules does your area need?
 - How do people use this area? How will they feel about this new MPA?
5. Ask groups to share about their MPA and how it will help their sea lion. Each member should have the opportunity to share something about their design. Ask students to write down a question or a few interesting things they learn from other groups.
6. Give groups 5 minutes to share and reflect on the interesting things they learned and make changes to their MPA design.

RESOURCE 9.5

Senators like Senator Schatz are legislators, or lawmakers, that write and pass laws. They are usually politicians that are elected by the people in the community they serve. Legislators, such as senators, can be national in the U.S. Senate, or more local such as a State Senator.



STATE SENATOR
MARINE SCIENCE CAREER

CONTINUED...



LESSON 9.

Current Conservation

7. Display Hoppie's portrait (Resource 9.1) again and explain this pup was found 100 miles inland up the San Joaquin River in California, far from safe spaces to grow like the Channel Islands Marine Sanctuary. Luckily, he was rescued by The Marine Mammal Center and diagnosed with malnutrition, which volunteers treated by feeding him fish and teaching him to "hunt" in his pool. He put on weight and was released at Chimney Rock in the Point Reyes National Seashore, California.
8. Display Senator Portrait (Resource 9.5) and share that work by legislators like Brian Schatz is key in establishing and maintaining MPAs. Senator Schatz, along with community members and **Native** Hawaiian leaders, helped gain support for the expansion of the Papahānaumokuākea Marine National Monument in Hawaii, one of the world's largest protected areas. Without legislators like Senator Schatz helping to draft and pass laws about MPAs, pups like Hoppie wouldn't have protected breeding colonies where they can safely learn and grow.

Lend a Flipper

Students can help sea lions like Hoppie by expressing their passion for ocean conversation to their legislators by writing emails or letters. Senators are even on social media, such as twitter, and want to hear from their constituents, especially youth. By helping legislators understand what changes you think are necessary to protect a species and why this species is important, they can aid in creating legislation to help your cause.

Assessment

Gauge each student's participation and input with their group as you walk around the room during the discussion. If you sense that students are left out, ask them questions as you observe their group. As students share aloud with the class, ask questions that connect back to the threats that have resulted in the designation of MPAs.

Ocean Conservation Activity

Ask your legislators to
pass legislation to ban
single-use plastic



LESSON 10.

Sea Sleuths

Lesson Overview

Life by a Whisker invites audiences to think critically about sea lion conservation. This lesson shows students that asking questions about patients at places like The Marine Mammal Center can shed light on the needs of wild animals. Sea lions are the focus of research at The Marine Mammal Center and in the wild so we can better understand how to protect these species and their habitat.

Enduring Understanding

Students will learn how research can help protect **marine mammals** in the wild and at organizations like The Marine Mammal Center. Students will learn about how to use the scientific method to explore their own conservation topics.

Next Generation Science Standard Alignment

Science and Engineering Practices:

- Obtaining, Evaluating, and Communicating Information
- Engaging in Argument from Evidence
- Asking Questions and Defining Problems
- Analyzing and Interpreting Data

Disciplinary Core Ideas:

- LS2B: Cycle of Matter and Energy Transfer in Ecosystems
- ETS1B: Developing Possible Solutions
- LS2C: Ecosystem Dynamics, Functioning, and Resilience

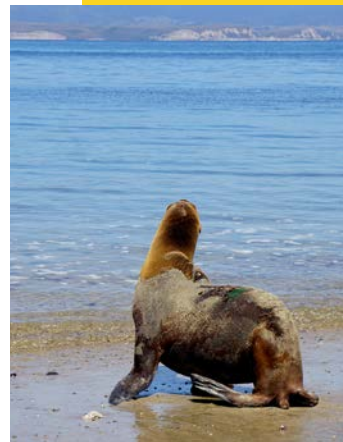
Crosscutting Concepts:

- Patterns
- Cause and Effect
- Influence of Science, Engineering, and Technology on Society and the Natural World

Materials

10.1 Gumdrop's Portrait	Page 108
10.2 Domoic Acid Attack	Video
10.3 Patient Diagnosis Graph	Page 109-110
10.4 Laboratory Technician Portrait	Page 111

PATIENT STORY



NAME: Gumdrop
 AGE: Adult
 DIAGNOSIS: Domoic acid
 toxicosis
 TREATMENT: Medication and
 fluids

RESOURCE 10.1

Preparation

- Gumdrop's Portrait (Resource 10.1) and Laboratory Technician Portrait (Resource 10.4) may be projected or printed to display for the class.
- Pull up Domoic Acid Attack (Resource 10.2): <https://youtu.be/123k3Ao53T0>
- Print seven of the Patient Diagnosis Graph (Resource 10.3).

Anticipatory Set

Display Gumdrop's Portrait (Resource 10.1) without sharing her name or story. Tell students she was sick, but with something

CONTINUED...



LESSON 10.

Sea Sleuths

that is hard to tell by looking at her. Ask students to volunteer some internal illnesses this animal might have. Ask what evidence they see in the photo that made them share these different illnesses. Tell them laboratory technicians often have to do research to figure out why their patients are sick. This research can also reveal what is happening in the ocean.

Procedure

1. Play Domoic Acid Attack (Resource 10.2) and ask students to take notes about the illness affecting the California sea lion in the video.
2. After watching, ask students what “**diagnose**” means. Explain that it is when we find out what’s making a person or animal sick by looking at **symptoms**, or signs in their behavior or body. Share that diagnosing a patient is the first step to rehabilitate sick or injured animals. Ask students to share **symptoms** they think are important to **diagnose** an animal. Prompt them to think of **symptoms** related to behavior, appearance, or test results.
3. Break the class into 7 groups and assign each group a sea lion species. Ask groups to brainstorm the diagnosis they think is the most common for their sea lion, as well as **symptoms** they would see in a sea lion with these health problems. Ask groups to share with the class and write down questions or new ideas as they learn from other groups.
4. Tell the class you will test the informed guess, or **hypothesis**, of the California sea lion group using data collected from The Marine Mammal Center. Pass out the Patient Diagnosis Graph (Resource 10.3). Ask students if they’re familiar with these **diagnoses**. Have them discuss each diagnosis and provide clarity where needed. Give enough information that students can define the diagnosis, but do not share about **symptoms** or causes because they will share these later in the lesson.

5. After discussing the **diagnoses** on the graph, ask students to answer questions A and B.
6. Assign each group one of the **diagnoses** on the graph. Ask groups to brainstorm answers to questions 1 through 4. Take 10 minutes to allow groups to share their responses. Every student should have the opportunity to share.
7. Ask groups to brainstorm questions about the diagnosis they studied. Each group should pick one question and brainstorm the information they need to answer that question, as well as how they would gather that information.
8. Display Gumdrop’s Portrait (Resource 10.1) again and share she was diagnosed with domoic acid toxicity. Ask students to share which **symptoms** were used to get this diagnosis and what might cause this illness. Share Gumdrop was treated with the Center’s domoic acid protocol, which involves feeding her uncontaminated fish and giving her fluids to flush toxins from her body. She made a full recovery and was released at Chimney Rock in Point Reyes National Seashore, California.

RESOURCE 10.4

Laboratory technicians like Carlos, conduct research, testing, and experiments to find solutions to larger problems within any scientific field. Their specific tasks can vary based on the research they’re aiding in, but typically include preparing experiments, testing samples, and maintaining lab equipment.



MARINE SCIENCE CAREER

LABORATORY TECHNICIAN

CONTINUED...



LESSON 10.

Sea Sleuths

9. Display Laboratory Technician Portrait (Resource 10.4) and explain lab technicians like Carlos are responsible for answering questions about sea lion **diagnoses** by collecting and analyzing samples and behavioral observations. By looking at blood, fecal, and urine samples, as well as observations of a sea lion's behavior, lab technicians can find out why an animal is sick or injured and help the veterinarians create a treatment plan.

Lend a Flipper

With more domoic acid toxicosis predicted with future **climate change**, students can help sea lions like Gumdrop by reducing the amount of carbon emissions they emit by carpooling, walking or riding their bikes instead of driving. By doing their part to reduce carbon emissions and address **climate change**, students are also helping sea lions. Students are the next generation and by also helping educate their parents and peers, they can create a chain reaction that can help slow down **climate change**.

Assessment

Ask students to write down the most interesting diagnosis and **symptom** they learned about today. Check for understanding of these key terms and provide guidance where there may be disconnect. Ask students to write down and then share anything they learned or questions they have after today's lesson.

Ocean
Conservation
Activity

Walk, carpool or ride
your bike instead of
driving



LESSON 11.

A Swell of Action

Lesson Overview

Opportunities for the public to get involved in scientific research have increased as it is challenging for scientists to collect, sort, and analyze data on their own. **Community-based science** projects allow the public to contribute to scientific projects in various ways, including sorting photos, collecting data in the field, or reporting sightings.

Enduring Understanding

Students will learn several ways they can get involved in scientific research and begin to understand the value of scientific research on wild animals such as sea lions.

Next Generation Science Standard Alignment

Science and Engineering Practices:

- Analyzing and Interpreting Data
- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information
- Planning and Carrying out Investigations

Disciplinary Core Ideas:

- LS2A: Interdependent Relationships in Ecosystems
- ETS1B: Developing Possible Solutions
- LS2C: Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Concepts:

- Stability and Change
- Cause and Effect
- Influence of Science, Engineering, and Technology on Society and the Natural World

Materials

11.1 Notebook's Portrait	Page 112
11.2 Zooniverse	Webpage
11.3 Stellar Watch	Video
11.4 Community-based Science Project	Page 113
11.5 Community Organizer Portrait	Page 114

PATIENT STORY



NAME: Notebook
 AGE: Pup
 DIAGNOSIS: Malnutrition and maternal separation
 TREATMENT: Feed

RESOURCE 11.1

Preparation

- Notebook's Portrait (Resource 11.1) and Community Organizer Portrait (Resource 11.5) may be projected or printed to display for the class.
- Pull up Zooniverse (Resource 11.2): www.zooniverse.org
- Pull up Stellar Watch (Resource 11.3): www.zooniverse.org/projects/sweenkl/stellar-watch
- Print 7 copies of Community-based Science Project (Resource 11.4).

CONTINUED...



LESSON 11.

A Swell of Action

Anticipatory Set

Display Notebook's Portrait (Resource 11.1) without sharing her name or story. Ask students to share what research they think is being done on sea lions like this. Ask who they think is qualified to do that research. Reiterate all sorts of people conduct scientific research—not just people in lab coats with degrees!

Community-based science projects create opportunities for community members to engage in scientific projects by collecting and analyzing data as well as sharing results.

Procedure

1. Explain that scientific research projects are important to learn about our world, but can be challenging to complete. Ask the class to share what they think some of the major challenges associated with completing a scientific research project. Guide them to the understanding that funding, remote locations, staffing, and getting the formal education often required to start a research project are some common problems.
2. Share that to overcome these challenges, some scientists are looking to community members to help them collect and analyze data. Some communities, meanwhile, are starting their own projects without waiting for scientists to get interested in the questions they want to answer locally.
3. Pull up Zooniverse (Resource 11.2) and scroll through a few pages to show students how many different community science projects exist—and this is just a limited selection! Ask students to point out some that seem interesting, and take a few minutes to explore the websites for those projects. Pay special attention to the tasks assigned to community members and the kinds of data used by the project.
4. Pull up Steller Watch (Resource 11.3) and explain that

scientists are learning about Steller sea lions by analyzing photos of this species at different locations. However, it takes a lot of time to look through these photos, and researchers can't do it all on their own. So, they've turned to community members to help them look through photos and identify branded sea lions. Spend a few minutes analyzing photos for the Steller Watch project. Congratulate the class on being active community scientists!

5. Break the class into 7 groups and assign each group a different sea lion species. Ask each group to brainstorm a few questions about their sea lion.
6. Pass out a Community-based Science Project (Resource 11.4) to each group. Ask groups to pick a question brainstormed in Step 5 and design a community-based research project to answer it, filling out the sheet as they go. Remind them this project can involve scientists to help with data collection and analysis, but there should be opportunities for community members like themselves to participate too.
7. Have each group share their community-based research project. Every student should have the opportunity to say something about their project.

RESOURCE 11.5

Community organizers help bring people together that have similar goals, interests, or missions. They coordinate cooperative efforts in communities to help promote legislation or research around their group's interests.



CONTINUED...



LESSON 11.

A Swell of Action

Assessment

As students work in groups to design their community-based science projects, walk around the room to make sure students are considering all steps of the scientific method. Help students identify appropriate data to answer their questions, as well as appropriate methods to gather that data. Finish by asking students to write down and share one question they have after the lesson to see if there are any gaps in understanding that can be addressed in the next lesson.

8. Display Notebook's Portrait (Resource 11.1) again and share that community scientists helped this animal by keeping an eye on identification tags that all patients are given before they leave The Marine Mammal Center. By reporting California sea lion tags observed in the wild, community scientists helped gather information about sea lion behavior and movement that helps veterinarians rehabilitate patients at The Marine Mammal Center. Notebook was diagnosed as malnourished and was released after being fed sea lion formula and fish, which helped her gain the weight she needed to survive in the wild.
9. Display Community Organizer portrait (Resource 11.5) and explain that this community science organizer gets community science projects up and running. Community organizers play an important role in marine conservation by getting more people involved in science projects, which helps us learn more about the ocean so we can protect it more effectively.

Lend a Flipper

Students can help sea lions like Notebook by contributing to scientific research in their community. **Community-based science** projects aid researchers in completing their extensive studies while also increasing students' scientific understanding and connection to environmental issues.

Ocean
Conservation
Activity

Contribute to
scientific research in
your community



LESSON 12.

Leave your Lega-sea

Lesson Overview

Life by a Whisker empowers viewers to take action to protect Australian sea lions and their environment. This lesson will help students identify what they can do to help marine conservation.

Enduring Understanding

The problems affecting the ocean and **marine mammals** can seem overwhelming, but there are simple actions students can take to help. Students will learn what they can do to contribute to marine conservation efforts and instigate positive change in our ocean.

Next Generation Science Standard Alignment

Science and Engineering Practices:

Obtaining, Evaluating, and Communicating Information
Engaging in Argument from Evidence

Disciplinary Core Ideas:

ESS3C: Human Impacts on Earth Systems
ETS1B: Developing Possible Solutions
LS2A: Interdependent Relationships in Ecosystems
LS2C: Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Concepts:

Cause and Effect
Influence of Science, Engineering, and Technology on Society and the Natural World
Stability and Change
Structure and Function

Materials

12.1 Abagnale's Portrait	Page 115
12.2 Solution Sheet	Page 116

12.3 Ocean Issues Case Studies	Page 117
12.4 A Day in the Life of a Youth Crew Vol...	Video
12.5 Volunteer Portrait	Page 118

PATIENT STORY



NAME:	Abagnale
AGE:	Adult
INJURY:	Starving
TREATMENT:	Feed

RESOURCE 12.1

Preparation

- Abagnale's portrait (Resource 12.1), Solution Sheet (Resource 12.2) and Volunteer Portrait (Resource 12.5) may be projected or printed to display for the class.
- Print Ocean Issues Case Study (Resource 12.3) and cut out each case study to pass out to groups.
- Pull up A Day in the Life of a Youth Crew Volunteer (Resource 12.4): <https://youtu.be/2RoRynwWJIM>

Anticipatory Set

Display Abagnale's portrait (Resource 12.1) without sharing his name or story. Ask students, "What is wrong with this image?"

CONTINUED.



LESSON 12.

Leave your Lega-sea

Guide them to the consensus this sea lion should not have trash around it before asking, “Where do you think the trash came from?” Pass sticky notes out to students and ask them to write down one word that describes how they feel when seeing this image. Have students partner up and discuss why they chose that word. Encourage students to practice silent, active listening by permitting each student 1 minute of uninterrupted talking time before switching. This allows students to share their thoughts without influence from their peers. Once everyone has shared, reunite the class and allow students to share any unique feelings they heard from their partners.

Procedure

1. Ask students to share some big issues affecting the ocean now. With each issue, ask them to hypothesize why that problem started and how it affects sea lions and other **marine mammals**. Discuss as a class how people might be part of each issue.
2. Display the Solution Sheet (Resource 12.2) on the board. You can tailor the Solution Sheet by making your own version that has only one or some of the solutions. If the issues brainstormed by the class are on the Solution Sheet, recognize that they align.
3. Break students into small groups and pass out the Ocean Issues Case Studies (Resource 12.3). You may need to devise your own case studies if you want to tailor the Solution Sheet (Resource 12.2) to address different ocean issues. Have each group study one ocean issue and brainstorm possible solutions before they share their findings with the class. As students share their solutions, write them on the Solution Sheet next to the appropriate Ocean Issue.
4. After students have shared their solutions, explain the difference between individual action and collective action.

Individual action is something you do by yourself, without needing someone else to get the job done. Collective action is something you do with a large group. For example, picking up trash from the beach is an individual action. Reducing the amount of trash in the ocean is a collective action, since accomplishing this requires many people to contribute.

5. Now that students have come up with some of their own solutions, keep them in their small groups and watch A Day in the Life of a Youth Crew Volunteer (Resource 12.4). Ask students what kind of work the volunteer does and what ocean issues they’re trying to improve. Ask the class what the ocean will look like or be like after this conservation action is done.
6. Still in their small groups, ask students to share something interesting they learned from A Day in the Life of a Youth Crew Volunteer (Resource 12.4). Ask students to share any new conservation action ideas they have after watching.

RESOURCE 12.5

Volunteers are people who go beyond their basic obligations by offering their free time to help an organization. Typically, volunteers choose to contribute their time to causes that align with their values or interests, and volunteer work can sometimes lead to a future job opportunity.

VOLUNTEER



CONTINUED...



LESSON 12.

Leave your Lega-sea

Assessment

To prompt reflection, ask students to write down how they feel about the ocean issues they talked about today, and if they are excited to do some of the conservation solutions they brainstormed. Ask students to write down and share with the class one individual action and one collective action they're excited to take to help the ocean.

7. Display Abagnale's portrait (Resource 12.1) again and share that he was rescued by The Marine Mammal Center due to a fishing gear entanglement around his neck and mouth. Luckily, the entanglement was removed by veterinarians at The Marine Mammal Center before dedicated volunteers helped rehabilitate Abagnale by feeding him fish and giving him antibiotics. Abagnale recovered and was released at Rodeo Beach in the Golden Gate National Recreation Area, California.
8. Display Volunteer Portrait (Resource 12.5) and explain that volunteers feed and medicate patients in addition to cleaning pens and doing any other work necessary to provide patients a safe space to recover. Without these volunteers, The Marine Mammal Center wouldn't be able to help Abagnale and the hundreds of other patients seen each year.

Lend a Flipper

Students can help sea lions like Abagnale by helping pick up trash or ensuring that they are not contributing to marine debris. Regardless of where you live, the trash on your street has the ability to enter the ocean through waterways. By volunteering your time in addition to leading a sustainable lifestyle, we can reduce the impact that our actions have on our sea lions.

Ocean Conservation Activity

Help pick up trash at your local beach or river



Types of Marine Mammals

What is the common name and **clade** (where appropriate) of each type of **marine mammal** below?

01.



02.



03.



04.



05.



Types of Marine Mammals Answer Key

Continued...

01.



Manatees and Dugongs
(sirenians)

02.



Seals and Sea Lions
(pinnipeds)

03.



Polar Bears

04.



Whales and Dolphins
(cetaceans)

05.



Sea Otters

Seals vs Sea Lions

Compare the California sea lion and Pacific harbor seal below. What are the three main differences between them?



California sea lion

VS



Pacific harbor seal

Sea Lion Puzzle

Australian Sea Lion



RESOURCE 1.5

Sea Lion Fact Sheet

AUSTRALIAN SEA LION



Australian sea lions were commercially hunted in the 1700s. They were heavily depleted and remain endangered today.

Mothers will nurse pups for 2 to 3 years if they do not have another pup.

WHY DO YOU THINK AUSTRALIAN SEA LION COLONIES HAVE SUCH DIFFERENT FEEDING STRATEGIES?

AUSTRALIAN SEA LION COLONIES HAVE UNIQUE FEEDING STRATEGIES. FOR EXAMPLE, SOME FEED ON THE OCEAN FLOOR, WHILE OTHERS FEED IN THE WATER COLUMN.

Australian sea lions eat vertebrates and invertebrates, including penguins, sharks, fish, octopus, and squid.

Australian sea lions are endemic to Australia, meaning they aren't found anywhere else in the world!

Sea Lion Puzzle

California Sea Lion



RESOURCE 1.5

Sea Lion Fact Sheet

California sea lions slow their heart rate when they dive so they can stay underwater longer.

About half of all California sea lions are born on June 15th!

CALIFORNIA SEA LIONS ARE VERY SOCIAL. WHY DO YOU THINK THEY OFTEN HAUL OUT IN LARGE NUMBERS?

CALIFORNIA SEA LIONS ARE ONE OF THE FASTEST MARINE MAMMALS AND CAN SWIM UP TO 25 MILES PER HOUR.

California sea lions eat vertebrates and invertebrates like schooling fish, octopus, and squid.

California sea lions were once hunted commercially. They have recovered and are now a species of “least concern,” but are sometimes accidentally harmed by fishing nets.

CALIFORNIA SEA LION



THE AMERICAS & CANADA

Sea Lion Puzzle

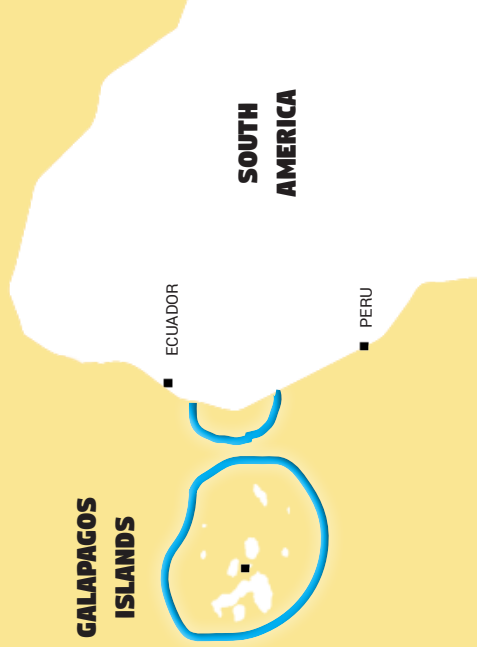
Galapagos Sea Lion



RESOURCE 1.5

Sea Lion Fact Sheet

GALAPAGOS SEA LION



Galapagos sea lions do poorly when warm waters surround the islands. Warm water is not good for fish, which means sea lions have less prey to eat.

Galapagos sea lions are endangered.

WHY MIGHT GALAPAGOS SEA LIONS WORK TOGETHER TO HUNT?

GALAPAGOS SEA LIONS WORK TOGETHER TO CATCH FAST FISH LIKE TUNA. THEY EAT LOTS OF FISH SPECIES, BUT MOSTLY SARDINES.

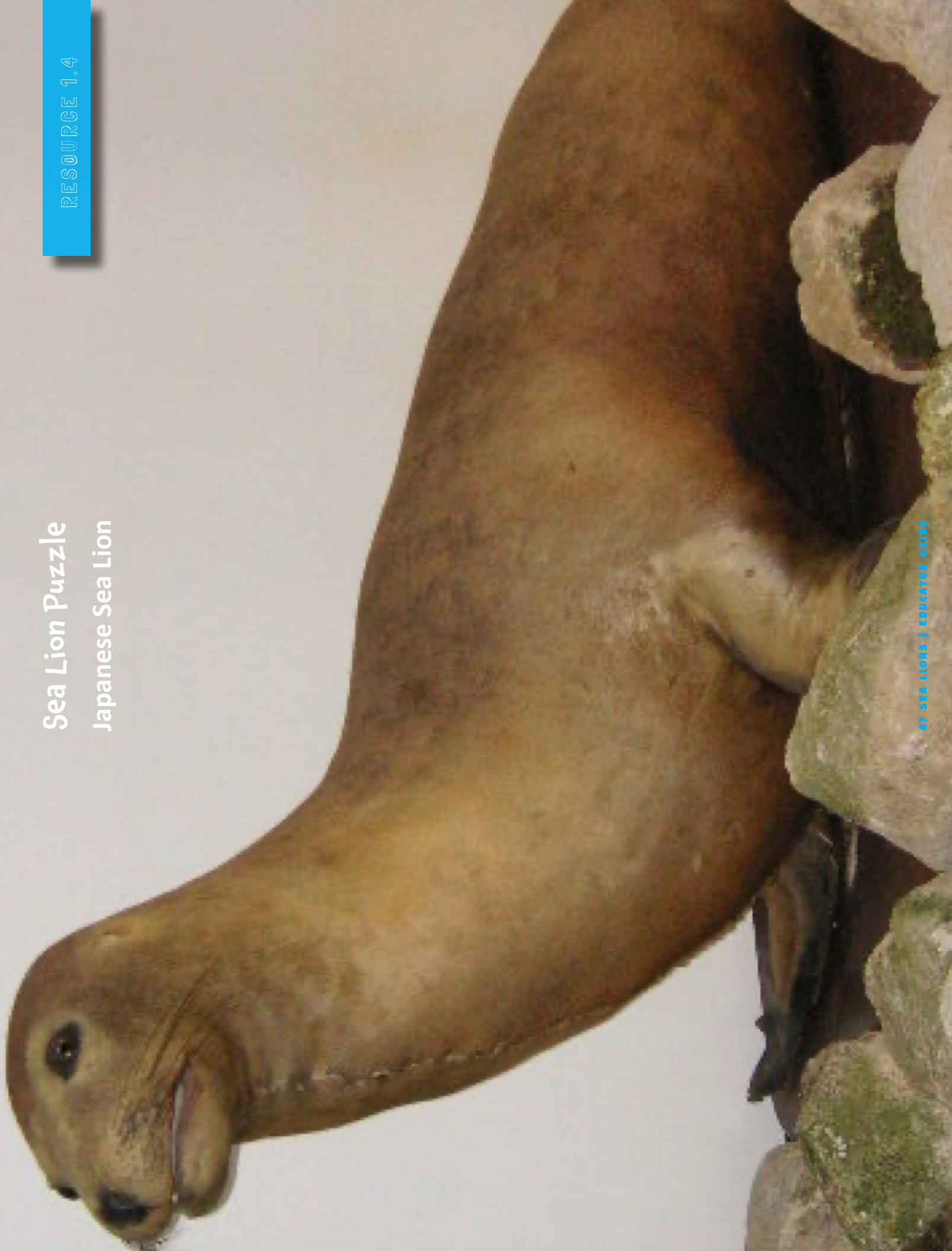
Galapagos sea lions are endemic to the Galapagos Islands, which means they aren't found anywhere else in the world!

Galapagos sea lion mothers take turns watching groups of pups on the beach so other mothers leave the hunt.

Sea Lion Puzzle

Japanese Sea Lion

RESOURCE 1.4



RESOURCE 1.5

Sea Lion Fact Sheet

JAPANESE SEA LION



JAPAN

Japanese sea lions were once harvested for medicine and to make goods. They were also captured to use in circuses.

WHY MIGHT SCIENTISTS WANT TO BRING BACK THE JAPANESE SEA LION?

SOME SCIENTISTS WANT TO BRING BACK THE JAPANESE SEA LION, OR RELOCATE SIMILAR SPECIES INTO THIS SEA LION'S PREVIOUS HABITAT.

Japanese sea lions went extinct around the early 1950s. They're one of the most recent marine mammal extinctions to occur.

Sea Lion Puzzle

New Zealand Sea Lion



RESOURCE 1.5

Sea Lion Fact Sheet



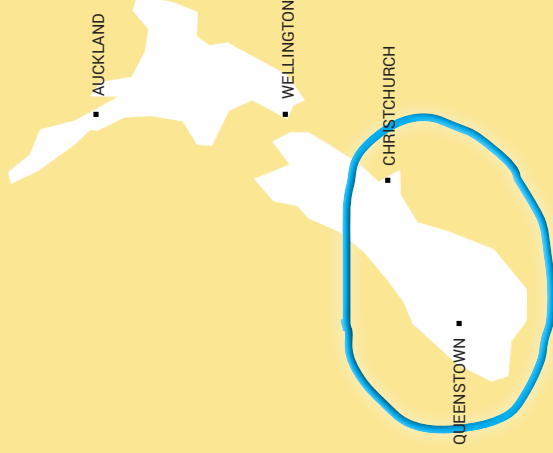
New Zealand sea lions were once hunted. Recently, breeding colonies have been impacted by bacterial infections. New Zealand sea lions are endangered.

**WHY DO YOU THINK
NEW ZEALAND SEA LION
MOTHERS MOVE THEIR
PUPS OFF THE BEACH
AFTER 6 WEEKS?**

**MOTHERS MOVE PUPS OFF
THE BEACH AND INTO NEARBY
VEGETATION WHEN THEY'RE ABOUT 6
WEEKS OLD. MOTHERS TAKE TURNS
WATCHING PUPS SO OTHERS CAN
HUNT.**

New Zealand sea lions eat vertebrates and invertebrates like fish, octopus, squid, seals, and other sea lions.

New Zealand sea lions are endemic to New Zealand, which means they aren't found anywhere else in the world!



NEW ZEALAND

Sea Lion Puzzle

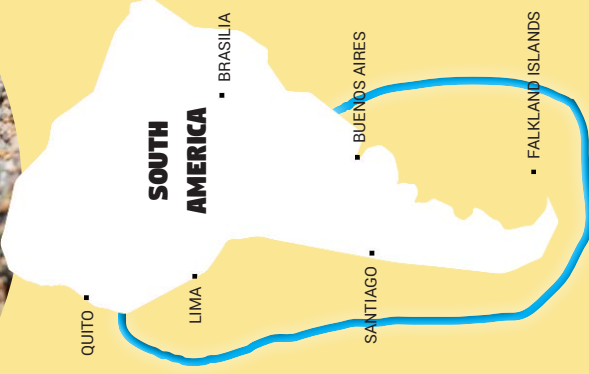
South American Sea Lion



RESOURCE 1.5

Sea Lion Fact Sheet

SOUTH AMERICAN SEA LION



South American sea lions are extinct in some places due to habitat loss. They're protected from harvesting in Argentina and the Falkland Islands.

WHY MIGHT SOUTH AMERICAN SEA LIONS HAUL OUT CLOSE TOGETHER IN LOWER TEMPERATURES AND ON SANDY BEACHES?

PUPS START TO PRACTICE SWIMMING WHEN THEY ARE ABOUT A MONTH OLD.

South American sea lions eat a variety of fish, squid, and octopus.

South American sea lions breed in the southern portion of their range and travel north for the rest of the year.

Sea Lion Puzzle

Steller Sea Lion



RESOURCE 1.5

Sea Lion Fact Sheet

Males don't eat for 1-2 months while they defend beach territories during breeding season!

Steller sea lions tend to hunt at night and dive deeper and longer as they age. They eat fish, squid, octopus, seals, sea lions, and sea otters.

WHY ARE STELLER SEA LION NUMBERS DIFFERENT ON THE EAST AND WEST SIDES OF THEIR RANGE?

STELLER SEA LION



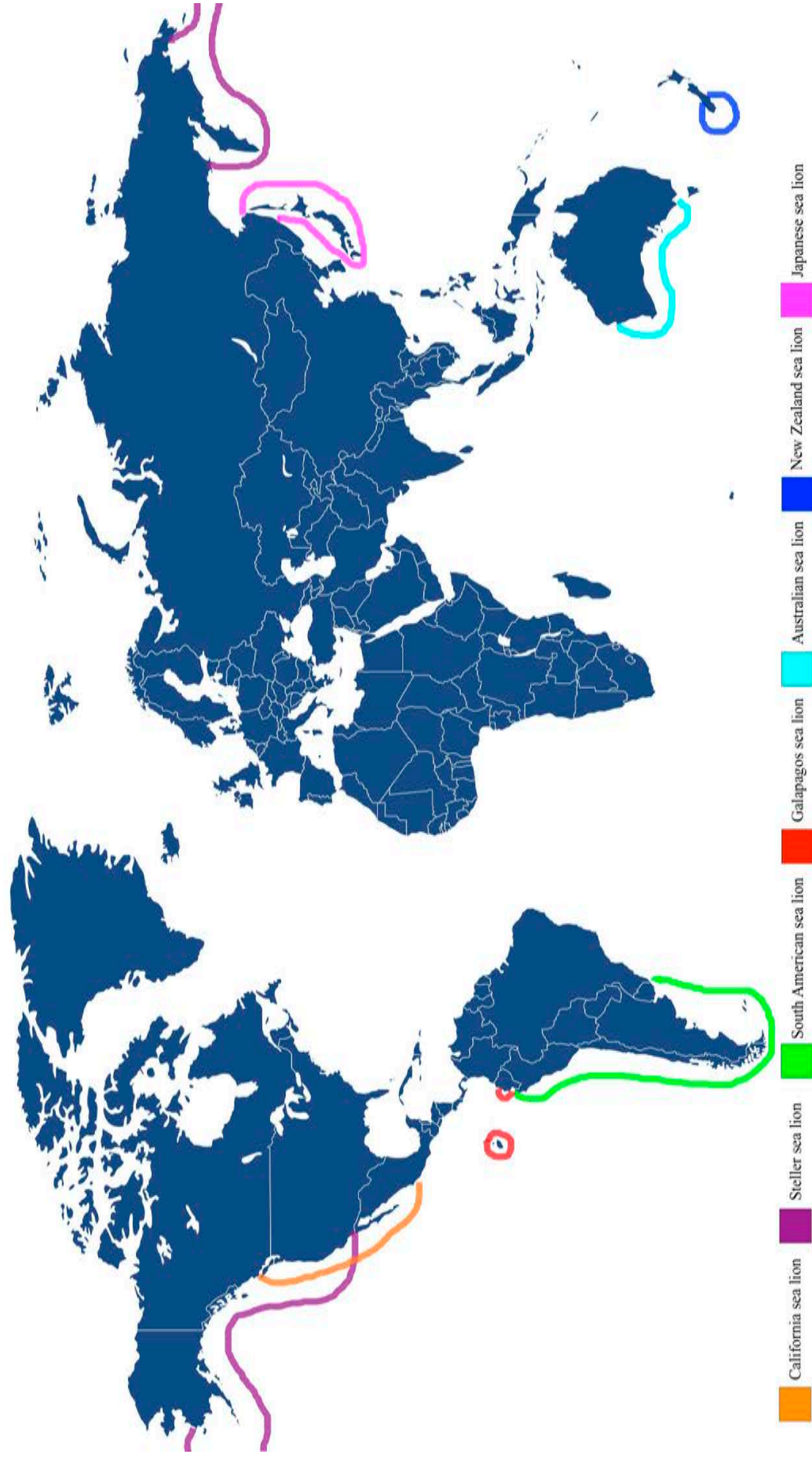
PEOPLE USED TO HUNT STELLER SEA LIONS BECAUSE THEY THOUGHT SEA LIONS STOLE FROM FISHING NETS. THE WESTERN POPULATION IS NEAR THREATENED, BUT THE EASTERN POPULATION IS NOT THREATENED.

Steller sea lions are the largest sea lion species. Males weigh up to 2,500 pounds!

Mothers spend longer and longer fishing at sea as their pups age.



Sea Lion Ranges



Field Biologist

RESOURCE 1.7





Sea Lion Adaptations



Living organisms adapt to their environment by developing a behavior or by forming a physical characteristic to help it survive.

1. How does this **adaptation** aid sea lions in successfully living in the ocean?
2. Is this a behavioral or physical **adaptation**?
3. What other animals exhibit this **adaptation**?

Sea Lion Adaptations

Continued...



Living organisms adapt to their environment by developing a behavior or by forming a physical characteristic to help it survive.

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Sea Lion Adaptations

Continued...



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Sea Lion Adaptations Continued...



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Sea Lion Adaptations Continued...



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2. Is this a behavioral or physical **adaptation**?
3. What other animals exhibit this **adaptation**?

Sea Lion Adaptations Answer Key

PAGE ONE

Adaptation: Sea Lion's streamlined, fusiform (torpedo) body shape make them hydrodynamic.

1. Ability to swim - reduces drag in the water
2. Physical
3. Penguins, seals, tuna, swordfish

PAGE TWO

Adaptation: Sea lion's sensitive whiskers help them find fish in murky waters by feeling for the movement, or wake, in the water. Their forward-facing eyes allow them to see fish in clear conditions, and their pupils can dilate for darker conditions.

1. Ability to catch fish in dark, murky conditions
2. Physical
3. Many animals have whiskers, such as cats, dogs, rats, pandas, foxes. However, walruses, seals, and sea lions are the animals that we see this **adaptation** use to track movement in water.

PAGE THREE

Adaptation: Their ability to use their flippers for thermoregulation. By holding their flipper up towards the sun, it can absorb heat which is then circulated to the rest of their body. On a sunny, windy day, they can use their flippers to help cool its body down.

1. Thermoregulation
2. Physical & Behavioral
3. Other animals that regulate their body temperature using their extremities are: elephants flapping their ears and birds flapping their wings.

PAGE FOUR

Adaptation: Sea lion's front flippers can rotate which makes them useful for swimming, as well as walking on land. Their ability to climb.

1. Walking and swimming
2. Physical
3. Guadalupe fur seals, northern fur seals, walruses, and flippers.

PAGE FIVE

Adaptation: Sea lion's deposit their body fat into a thick layer of blubber under their skin. This blubber insulates their core body to keep them warm.

1. Staying warm in the ocean or on land
2. Physical
3. Whales, walruses, seals



Engineer



RESOURCE 3.1



California Sea Lion Age Class



MALE AND FEMALE PUPS

California Sea lion Age Class Continued...



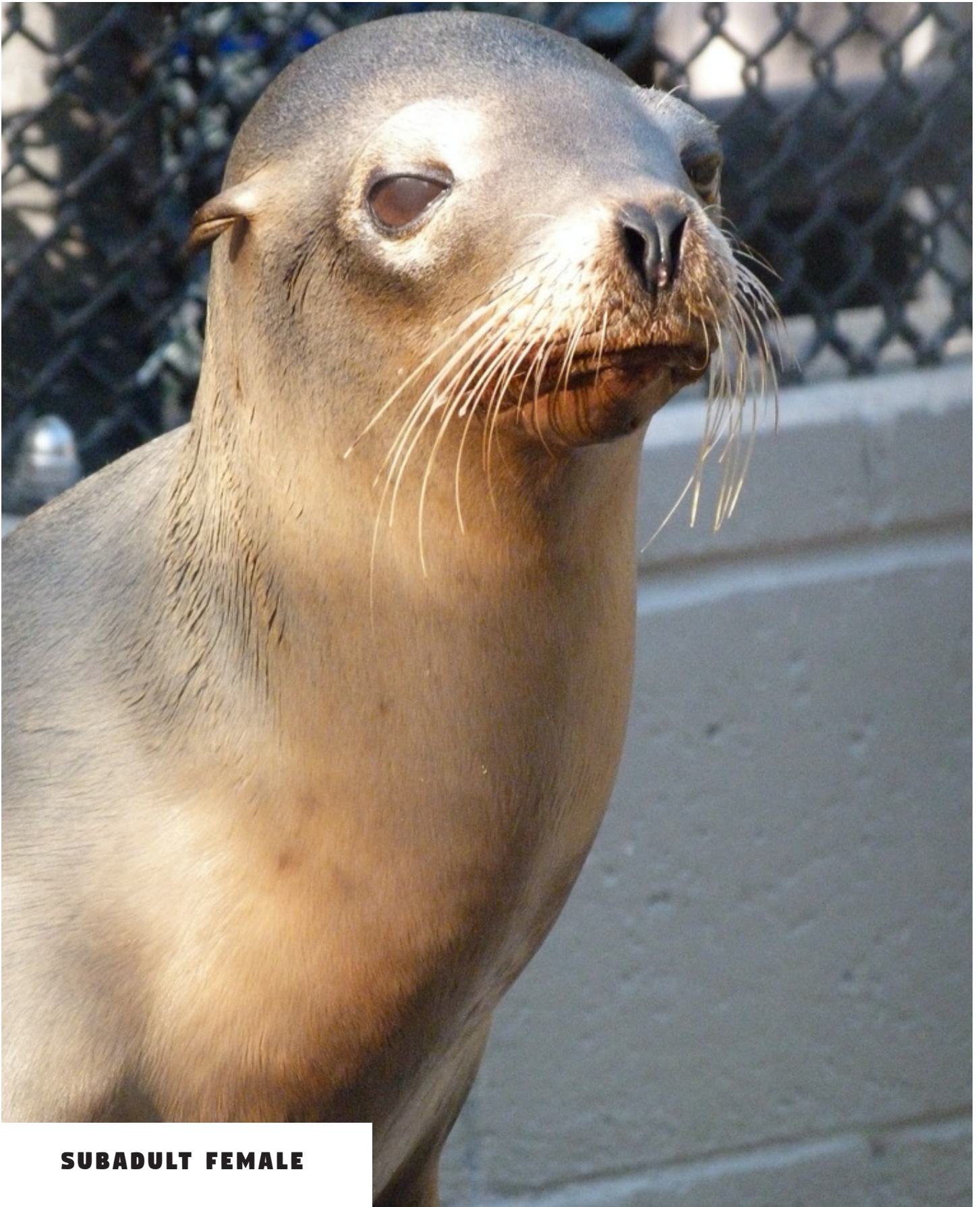
FEMALE YEARLING

California Sea lion Age Class Continued...



JUVENILE MALE

California Sea lion Age Class Continued...



SUBADULT FEMALE

California Sea Lion Age Class

Continued...



ADULT MALE



ADULT FEMALE

California Sea Lion Age Class Characteristics

Pup

California sea lion pups are less than a year old. Males and females are both about 2.6 feet long and 12-20 pounds. Pups are born with a darker brown coat that grows lighter after their first molt. Pups spend their first few weeks on the beach, where they nurse from their mothers and socialize with other pups. They start to learn to swim and hunt with their mothers once they have developed enough blubber to survive cold ocean waters.



Weaner

California sea lion weaners are typically pups older than 6 months. They spend a significant amount of time with their mothers but are weaned, which means they no longer eat their mother's milk. Instead, they eat fish and other solid foods. Pups are weaned at around 6 months old, although there is variation between mothers. Weaners are slightly larger than younger pups and have developed a thick layer of blubber to keep them warm in the ocean.



Yearling

California sea lion yearlings are between 1 and 2 years old. They are first experiencing life on their own, hunting and swimming without help from their mothers. Sometimes they are not very successful at this. Yearlings are larger than pups and there is some differentiation between the size of males and females. Yearlings can be distinguished from juveniles by the size of their teeth.



California Sea Lion Age Class Characteristics

Continued...

Juvenile

The “juvenile” category is assigned only to male California sea lions between 2-4 years old. Juveniles are not yet able to reproduce. They hunt and swim on their own, but are still perfecting these behaviors. Juvenile males lack the sagittal crest found on subadult and adult sea lions. Juveniles are distinguished from yearlings based on the size of their teeth.



Subadult

Female subadult California sea lions are between 2-5 years old while male subadults are between 4-8 years old. Subadults are in the process of reaching sexual maturity. Males are larger than females and have a partial crest, which means their sagittal crest is beginning to develop. Females are nearing their adult size as well. Subadult males are also developing a darker brown coat compared to female’s lighter brown coat. Subadults **haul out** in breeding colonies but do not engage in breeding behavior.



Adult

Female adult California sea lions are 5 years and older, weigh about 220 pounds, and are 6 feet long. They have a lighter brown pelt. Male adults are 8 years and older, weigh 700-880 pounds, and are 7-8 feet long. They have a darker brown pelt and are fully crested, which means they have a fully developed sagittal crest. Adult are sexually mature and engage in breeding behavior. Adult males fight each other for breeding territory and access to females, but do not help raise pups. Adult females birth, nurse, and raise pups before leaving breeding colonies. Both female and male California sea lions live to about 20 years old.

Marine Sanctuary Park Ranger



RESOURCE 4.1



Mother and Pup Matching Game

AUSTRALIAN
Sea Lion

CALIFORNIA
Sea Lion

STELLER
Sea Lion

SOUTH
AMERICAN
Sea Lion

GALAPAGOS
Sea Lion

JAPANESE
Sea Lion

NEW
ZEALAND
Sea Lion

01.

Mothers nurse pups for 2-3 years if they do not have another one. Mothers stay onshore with pups for about 2 weeks before taking hunting breaks.

02.

About half of all pups are born on June 15th. Pups are weaned when they are about 6 months old. Mothers stay onshore with pups for 7-10 days before taking brief fishing trips.

03.

Mothers spend 1-2 weeks on shore with pups before taking hunting breaks. Mothers spend longer and longer fishing at sea as their pups age.

04.

One mother will watch a group of pups while other mothers are on fishing trips. Mothers spend a week bonding with pups onshore before taking hunting breaks.

05.

Mothers take pups off the beach when they are around 6 weeks old and move them into nearby vegetation. Pups gather together for warmth and protection when their mothers are out hunting.

06.

Pups start to practice swimming after they are about a month old. Mothers wean their pups after a year or more.

07.

Not much is known about the behavior of these moms and pups because they went extinct before they could be researched.

Veterinarian

RESOURCE 4.3





Sea Lion Food Web



Sea Lion Food Web Answer Key Continued...

The sun is the base of the **food web**, depicted by the sun over the ocean. Energy from the sun is consumed by primary producers like phytoplankton.

Phytoplankton, the small blue organisms, are eaten by primary consumers like zooplankton.

Zooplankton, the small tan organisms, are eaten by secondary consumers like schooling fish.

Schooling fish are eaten by tertiary consumers, like tuna.

Tuna are eaten by quaternary consumers, like sea lions.

Sea lions are eaten by quinary consumer, like orcas.

Sea lion Hunting Adaptations

BLUBBER

Blubber keeps sea lions warm and streamlines their bodies.

BODY SHAPE

Sea lions have a “torpedo” shaped body that is incredibly hydrodynamic.

FRONT FLIPPERS

Sea lions’ front flippers are flexible and help propel them through the water.

WHISKERS

Sea lions’ whiskers are called “vibrissa” and can sense “trails” left behind by fish as they move through the water.

HEART RATE

Sea lions can slow their heart rate when they dive, which allows them to conserve oxygen.

LUNGS

Sea lions can collapse their lungs when they dive deep and keep air stored in their upper airway.

METABOLIC RATE

Sea lions can reduce their heart rate while they dive.

COOPERATIVE HUNTING

Some sea lions work together to trap and hunt fast prey like tuna.

ANSWER KEY:

Blubber keeps them warm so they can withstand cold ocean waters while hunting. By streamlining sea lions’ bodies, it also helps them move through the water quickly and efficiently. **Body shape** helps them move through the water quickly and efficiently. **Front flippers** help them quickly change direction underwater. **Whiskers** help them find fish in dark ocean expanses. By slowing their **heart rate** and conserving oxygen, sea lions can hold their breathe longer and remain underwater longer. Collapsible lungs help them avoid decompression sickness, while air in the upper lungs acts as a reserve to help them return to the surface. A slower **metabolic rate** means they require less oxygen while they dive.

Videographer

RESOURCE 5.4





Commercial Fishing Interactions

Bycatch

Sometimes, sea lions are caught in commercial fishing nets accidentally. This may happen because they are trying to hunt fish that are already caught in fishing nets, or because they accidentally swim into these nets without seeing them. If sea lions cannot reach the surface because they are caught in a fishing net, they cannot breathe and will not survive.

Prey Competition

Many commercial fisheries target the same species that sea lions hunt, such as sardines. As commercial fishing boats pursue these species, they leave less of these fish for sea lion consumption. Boats following sustainable fishing practices leave behind enough fish for sea lions and other marine predators to eat, but boats that follow unsustainable practices may not.

Noise Pollution

Fishing boats are loud and disruptive when they move through the water. These noises can scare away sea lions, which forces them to use more energy to swim away. Excess noise can also frighten away sea lions' prey, making it difficult for them to find food and forcing them to swim deeper and farther to hunt.

Entanglement

Commercial fishing gear can end up in the ocean because it falls overboard on accident, rough conditions knock it off the boat, or crew toss it into the water because it is broken. Sea lions can become entangled in this discarded fishing gear. If they are unable to free themselves, they can get cuts from the material digging into their skin as they grow. These cuts can get infected and the sea lion can die. Sea lions also spend extra energy swimming when they are also dragging along a fishing gear entanglement.

Shooting Sea Lions

Although it happens less frequently as people become better educated about sea lions, there are still people that view sea lions as fishing competition. Certain people believe sea lions steal fish from their nets, or are reducing fish populations in the area by hunting them, leaving less fish for commercial fishing boats. Sometimes, people will shoot a sea lion when they see one because the person thinks they are protecting their nets and/or improving their chances of catching fish in the future.

Fisheries Observer





Human Interaction Case Study

Human-Caused Injuries

In 2009, 19 sea lions were rescued suffering from gunshots. Sadly, those are only the seals and sea lions the Center knows about and it is most likely that countless others that don't strand on a beach just die at sea.

"Unfortunately, our latest gunshot wounded patient, Silent Knight, is only the latest in a long line of **marine mammal** gunshot patients rescued by The Marine Mammal Center," said Dr. Jeff Boehm, executive director at The Marine Mammal Center. "In 1992 we began keeping records on human interactions with **marine mammals** and since then, volunteers and staff have rescued nearly 500 **marine mammals** (primarily sea lions) that had been shot. We even came to the rescue of a poor sea lion that had been shot in the neck with an arrow from a crossbow."

California sea lions are hurt by humans more than other **marine mammals** because they outnumber all other **pinnipeds** and **marine mammals** combined. The U.S. Marine Mammal Protection Act (MMPA) protects all **marine mammals**, including cetaceans (whales, dolphins, and porpoises), **pinnipeds** (seals and sea lions), sirenians (manatees and dugongs), sea otters, and polar bears within the waters of the United States. The Act makes it illegal to "take" **marine mammals** without a permit. This means people may not harass, feed, hunt, capture, collect, or kill any **marine mammal** or part of a **marine mammal**. The Act also formalized the **marine mammal** health and stranding response program to improve the response of stranding and unusual mortality events. The National Oceanic Atmospheric Administration (NOAA) website gives the complete text of the Act.

Marine Science Research plays a key role at The Marine Mammal Center. The Center regularly conducts and contributes to a long list of cutting-edge research projects that are published peer-reviewed journals. You can read just a few of the many groundbreaking studies the Center has helped publish regarding Negative Human Interaction (gunshots, entanglements, harassment and boat strikes) as well as papers about toxic algae poisoning, cancer and pathogens.

Human Interaction Case Study

Continued...

Oil Spills

Oil in or on the water is extremely dangerous to wildlife. For instance, when an animal lands in an area affected by oil, it will try to preen or clean itself and ingest the toxic petroleum product, causing severe damage to internal organs. Ingesting oil will greatly disrupt the reproductive process, and animals that have survived oil spills may suffer the long term effects of breeding problems and may produce deformed offspring.

From the Oiled Wildlife Care Network: There are different effects on different classes of **marine mammals**. Heavily furred animals, such as sea otters and fur seals, are more severely affected by oiling because these species rely on their thick haircoat to maintain warmth and buoyancy. The fur traps a thin layer of air adjacent to the animal's skin (in a similar fashion to birds), and this air layer prevents the skin of the animal from coming into contact with the cold ocean water. When exposed to oil, the alignment of the hair is altered; the air layer is destroyed; and **mammals** rapidly become hypothermic.

For **marine mammals** without heavy haircoats (such as other species of seals, sea lions, dolphins and whales), problems associated with hypothermia are less of a concern because their thick blubber protects them from the cold, with the exception of juveniles that have not yet developed this protective layer. However, problems associated with fume inhalation, skin exposure, and ingestion are still concerns for these species, as they are in birds and fur-bearing **marine mammals**.

There are cumulative impacts to sensitive shoreline organisms (such as clams, crabs, macro invertebrates) which die or bio-accumulate the toxic components of petroleum products. This toxicity moves up the food chain, negatively impacting reproduction, shortening life span and leading to mortality of larger animals (birds and **mammals**) that may prey on these organisms.

If you find oiled wildlife in your area, please call 1-877-UCD-OWCN (1-877-823-6926) and report it immediately. Do not attempt to rescue the wildlife yourself and keep pets away from the area. Untrained individuals who attempt to rescue wildlife may cause more harm than good and may injure themselves in the process. If oiled animals are scared back into the water by pets or people, their chances of survival decrease dramatically.

The Marine Mammal Center is a member of the Oiled Wildlife Care Network, which coordinates all oil spill response in the state of California. Our hospital is a primary facility for oiled seals and sea lions, and our staff and volunteers are specially trained to assist if called upon during an oil spill event. The Marine Mammal Center has, in the past, assisted agencies by rescuing **marine mammals** and birds caught in the toxic goo.

Human Interaction Case Study

Continued...

Entanglement

Entanglement is a worldwide issue that results in the injury or death of thousands of **marine mammals**. The sources of the items that entangle these animals range from fishing gear to marine debris, otherwise known as ocean trash. **Marine mammals** such as whales, dolphins, seals, and sea lions become entangled while swimming or when hauled out on a beach.

Entangled animals may become restricted in their ability to move their flippers which can affect their ability to swim and may cause them to drown or starve. Heavy gear makes animals particularly susceptible to drowning. When animals' ability to swim is impaired, this makes them more susceptible to boat strikes or predation. They may also suffer from physical injuries due to the entangled item cutting into their blubber, especially if they become entangled before fully grown.

Although the problem of ocean trash can seem overwhelming, there are some simple things you can do every day to minimize your impact on the ocean. If you think it isn't worth the time and energy, remember the animals who make the ocean their home. After all, everything we do, not only affects them, it filters down to us - we eat the same food and we swim in the same water - and the ocean is the planet's biggest life source. When fishing or boating, do not leave gear or trash behind and consider participating community clean-ups.

If you see an entangled animal, keep your distance from it, note the GPS coordinates, and report it to your local responder via the national entanglement response and stranding network. Please do not attempt to free an animal on your own and wait for trained personnel to arrive.

Human Interaction Case Study

Continued...

Commercial Fishing

Commercial fishing is catching fish for profit and typically involves fishing from wild populations. Fisheries provide a large amount of food to many countries around the world. Interactions between **marine mammals** and fisheries can include bycatch, **marine mammal** depredation, and the removal of **marine mammal's** prey by fisheries.

Bycatch is the accidental capture of a species that was not the fishing target. This can include turtles, sea birds, or **marine mammals** such as dolphins, sea lions, or whales. Modern fishing methods involve large nets that are undetectable and inescapable for bycatch which results in death or injuries. There are efforts to reduce bycatch by working with fisheries to develop new fishing gear that can allow the unintended animals to escape.

California sea lions are easily viewed in the wild, which puts them at high risk for habituation to humans. Habituation is when there is a decrease in an animal's response to humans after being exposed to them and they become used to their presence. Trying to feed them is illegal because it can alter their behavior and habituate them to people and ships. It is important that they do not learn to associate humans with food because this can cause them to change their hunting practices and go after bait on fishing gear. Sometimes they become victim to retaliation, such as shooting, by irritated fisherman or boaters.

There's a limit to the fish in the sea. Humans are removing fish from the oceans at a rate faster than fish can reproduce. This results in a decrease in populations and limits the amount of fish for **marine mammals**. Better equipment, technology, and the need to make more money have made it easier to catch fish with less effort. These developments have resulted in a loss of 90% of the ocean's large predatory fish. The state of global fisheries threatens is threatening food supplies, economies, and recreation in all parts of the world. By supporting sustainable fisheries, we can help reduce the amount of sea lion's affected by commercial fisheries. Monterey Bay Aquarium's Seafood Watch program helps people choose sustainable seafood, which is fish that caught or farmed in ways that support a healthy ocean for current and future generations. By following their recommendations, we can ensure that there are enough fish left for the predators of the ocean, such as sea lions.

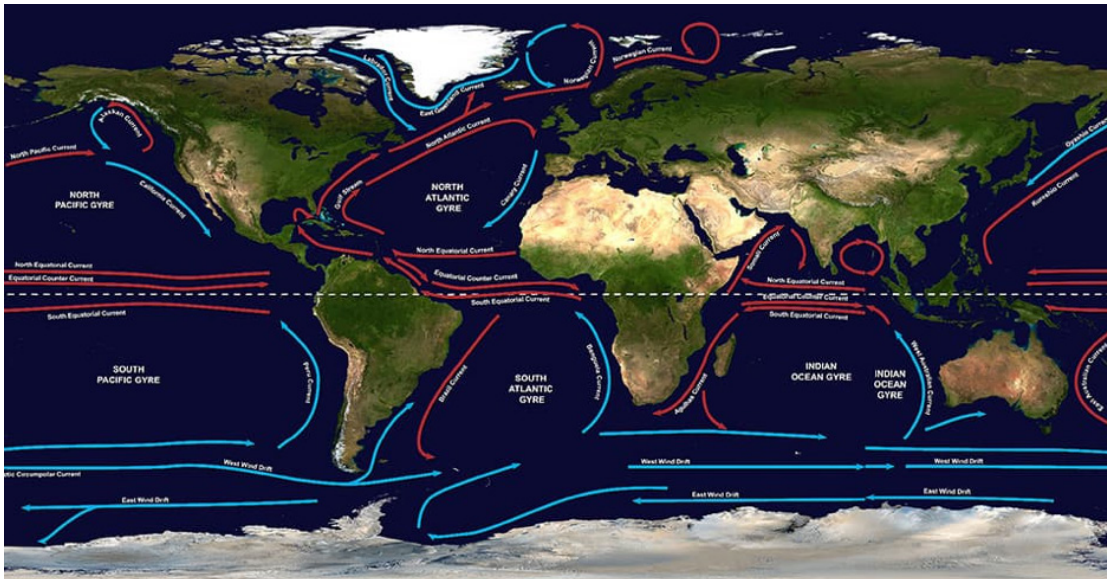
Human Interaction Case Study

Continued...

Plastic Pollution

Trash ends up in the ocean due to rain washing it into waterways that lead to the ocean, as well as wind patterns picking up garbage on land and carrying it to the ocean. 90% of the trash found in the ocean is plastic and the large amounts of trash are having an impact on marine life and marine ecosystems. The most common types of plastic in the ocean are styrofoam, microbeads from soaps, fibers from clothing, bottles, straws, bags, feminine care products, balloons, and cigarette butts. When the large pieces of plastic garbage enter the ocean through waterways, the air, and sewers, they get broken into smaller pieces by waves. This results in a soup of small plastic particles, called microplastics. These smaller pieces can be mistaken as food and are ingested by marine life. Ingesting plastic can lead to suffocation, starvation, and death. Small pieces of plastic even end up in the seafood that humans eat. As fish eat plastic, the toxins in plastic can accumulate and the toxins work their way up the food chain to their predators.

Marine mammals that live in areas unpopulated by humans are still susceptible to plastic pollution due to the gyres of the ocean. A gyre is a large vortex created by rotating ocean currents. Gyres move plastic waste and debris and can accumulate them in unpopulated areas of the ocean. There are five major gyres as shown below:



Regardless of where you live in the world, the amount of plastic you use can impact marine life. Although the problem of ocean trash can seem overwhelming, there are some simple things you can do every day to minimize your impact on the ocean. If you think it isn't worth the time and energy, remember the animals who make the ocean their home. After all, everything we do, not only affects them, it filters down to us - we eat the same food and we swim in the same water - and the ocean is the planet's biggest life source.

Rescue Team





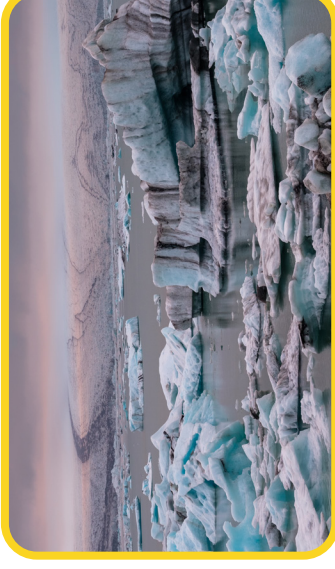
Climate Change Outcomes



Rising Sea Levels

Many species of seals and sea lions rely on beaches to rest, give birth and nurse their pups.

Warming water temperatures, as well as melting land ice, have contributed to rising sea levels around the world. In turn, **marine mammals** are losing an important habitat on beaches. For sea lions, as the water invades their breeding beaches, it makes the pups more prone to exposure to large storm surges and increases the likelihood of young pups being separated from their mothers during their first month of life. Rising sea levels also limits natural **haul out** space for sea lions which can increase their encroachment into areas developed by humans. Their movement into developed areas can lead to an increase in human interaction and habituation which can directly harm them.



Warming Water Temperatures

Just as humans have preferred temperature ranges, so do many of the animals that call the ocean home. While **marine mammals** have been shown to be quite resilient to changing ocean conditions, the food that seals, sea lions, whales and dolphins depend on has been shown to change locations due to warming water. In the presence of warm water, schooling fish such as sardines and anchovies, favorites for California sea lions, tend to dive deeper and further offshore to find colder water. This extra distance means that sea lions must spend more energy traveling and hunting than before. In 2015, we saw that record warm water temperatures in California resulted in thousands of sick sea lions on the beach as mothers left their pups early due to the harder foraging environment and pups struggled to dive deeper and farther in search of food.

Climate Change Outcomes Continued...



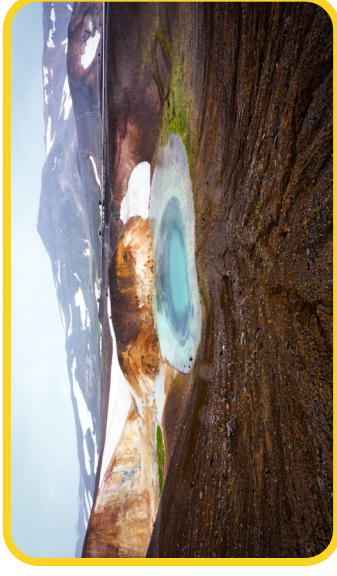
Harmful Algae Blooms

Particular types of plankton have been shown to behave differently due to changing water temperatures or ocean acidity. As water temperatures continue to warm, and the ocean becomes more acidic, we anticipate seeing more harmful algal blooms. One particular diatom, *Pseudonitzschia australis*, responsible for producing a toxin called Domoic acid toxicosis, is one that could have dramatic effects on **marine mammal** populations. This toxin accumulates up the food chain and can cause seizures, disorientation and brain damage at animals that feed at the top of the food chain. In 2015, with record warm water temperatures, the largest algal bloom in history was observed off the west coast of the United States and resulted in over 200 sea lions suffering from domoic acid toxicosis and also shutting down fisheries, such as Dungeness crab and razor clams, to human consumption.



Extreme Weather Events

Climate change increases the intensity and frequency of extreme weather events. The number and strength of heat waves, heavy downpours, and major hurricanes has increased in the United States, according to The National Climate Assessment. The combination of warmer sea surface temperatures and sea level rise can intensify hurricane impacts, making them cause more damage to the coastal habitats that sea lions rely on. Sea lions **haul out** on beaches, rocks, docks, and piers to thermoregulate, breed, rest, and forage. These are all areas that can be impacted by harsh weather events.



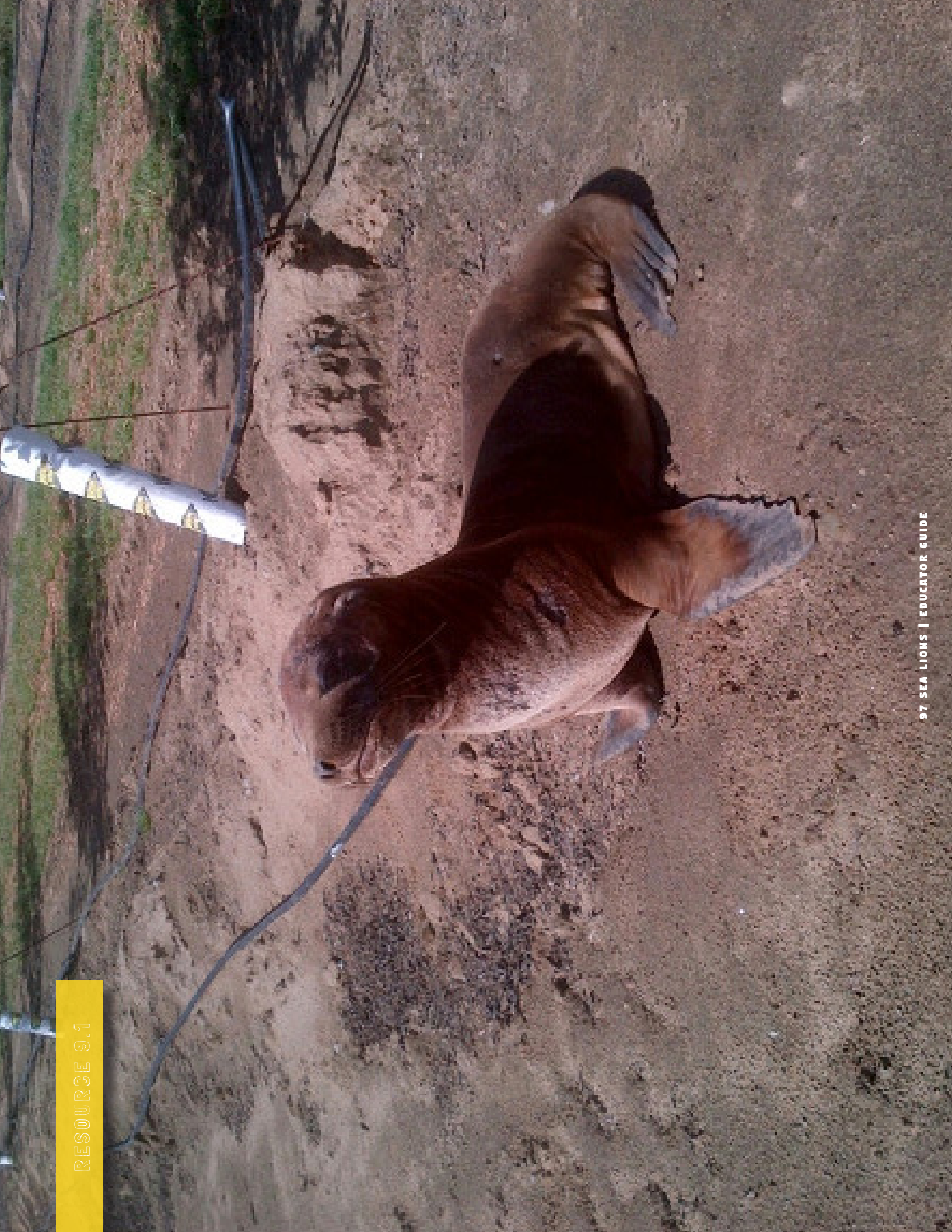
Ocean Acidification

The ocean absorbs about 30% of the carbon dioxide (CO₂) released into the atmosphere. Levels of CO₂ in the ocean increase as levels of CO₂ increase in the atmosphere, which causes an ongoing decrease in the pH of the ocean. The increase in acidity limits the availability of calcium carbonate minerals for shelled animals (crabs, coral, etc.) to build their calcium shells. This decreases the food availability for animals higher up in the food chain which can result in the collapse of the ocean **food web**. Ocean acidification's domino effect has the potential to put every ocean habitat and animal at risk.

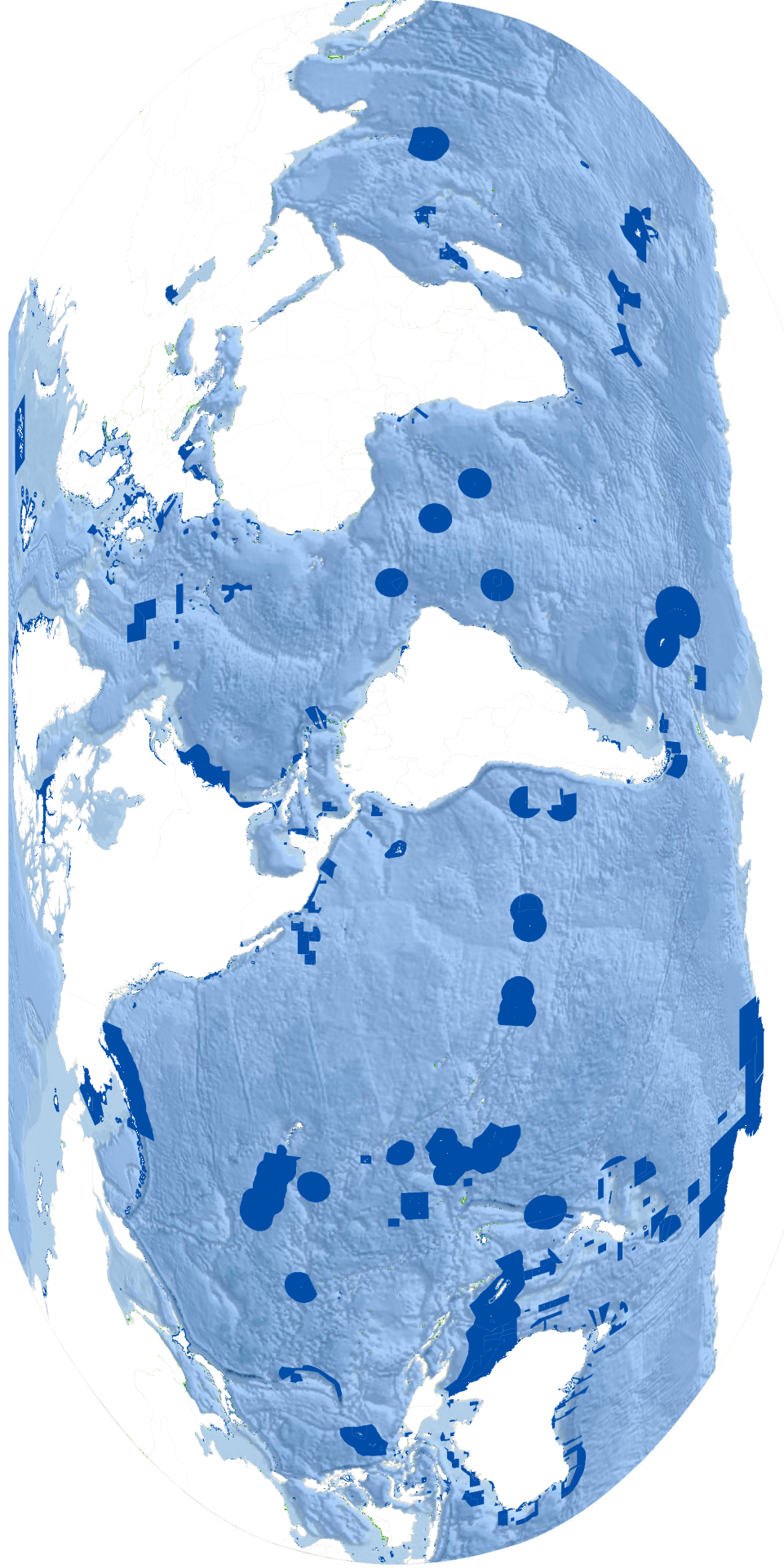
Marine Science Educator



RESOURCE 9.1



Official MPA Map



Source: UNEP-WCMC and IUCN (2019). Protected Planet: The World Database on Protected Areas (WDPA) [On-line], December 2019, Cambridge, UK: UNEP-WCMC. Available at www.protectedplanet.net

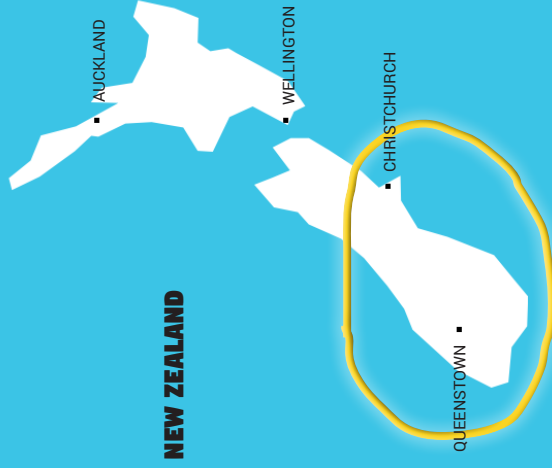


7.63% of the global ocean covered by protected areas
2.57% of the global ocean covered by no-take protected areas



Marine Protected Area Case Studies

NEW ZEALAND SEA LION



New Zealand Sea Lion

New Zealand sea lions mostly live and breed on remote islands south of New Zealand. There, fishing boats catch fish in areas where New Zealand sea lion mothers hunt while pregnant and nursing pups. Fishing boats go after some of the same species New Zealand sea lions eat. Sometimes sea lions are accidentally caught by fishing boats, but there is new technology that will hopefully make this happen less. Although there isn't much human interaction on these remote islands, sea lion

disease outbreaks have killed a lot of pups. A new breeding colony for New Zealand sea lions is slowly starting on Stewart Island, which is close to New Zealand and a place where humans live too. People on Stewart Island use the ocean to feed themselves and to earn a living by taking tourists on fishing trips. Most of the land on Stewart Island is already covered by a national park that people use for hiking and backpacking.

Marine Protected Area Case Studies Continued...

CALIFORNIA SEA LION



THE AMERICAS & CANADA

California Sea Lion

California sea lions are found from Canada to Mexico. They breed mainly on offshore islands. Each year, many California sea lions become stranded on beaches as malnourished pups. They are severely underweight because of **maternal separation**, diseases, not enough food, and changing ocean conditions. Hundreds of California Sea Lions are also affected every year by domoic acid toxicosis. This condition is caused by

harmful algal blooms and gives sea lions seizures. Many groups rehabilitate California sea lions and do research to understand the diseases that hurt them. This has helped the California sea lion population grow steadily over the years, so they are no longer threatened.

Marine Protected Area Case Studies Continued...



STELLER SEA LION

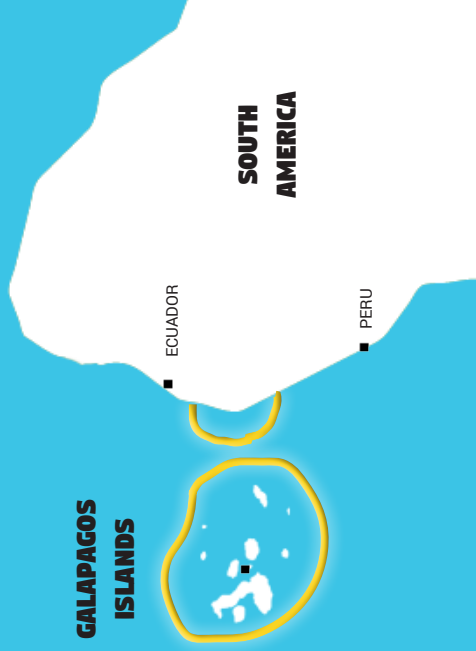
Steller Sea Lion

Steller sea lions breed and live in the North Pacific Ocean from Japan to California. Steller Sea Lions used to be hunted for meat, fur, and oil and were killed because fishers thought these sea lions stole from their nets. All Steller sea lions were once considered threatened, but thanks to the protection of the Endangered Species Act, the population living near the

U.S. and Canada is doing much better. Steller sea lions are endangered in Russia, but there are no laws to protect them there. Steller sea lions that live along Russia and the Northwestern Pacific Ocean are not recovering like the other population of steller sea lions.

Marine Protected Area Case Studies Continued...

GALAPAGOS SEA LION

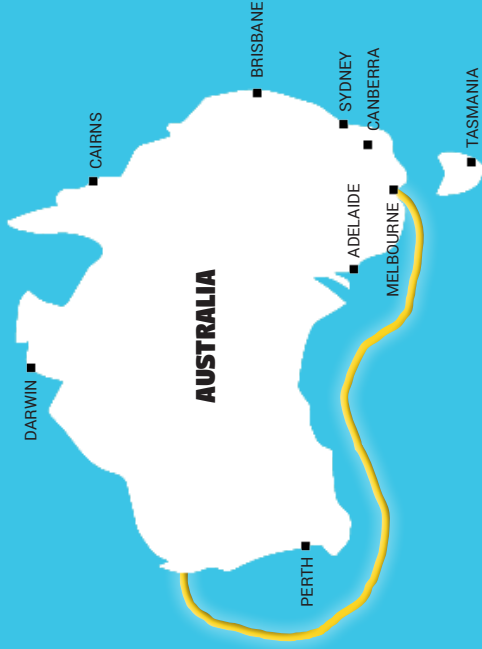


Galapagos Sea Lion

Galápagos sea lions are only found on the Galapagos Islands. They are hurt by warming ocean temperatures that happen every few years due to El Niño. The warm water brought by El Niño makes food harder to find, and many sea lions die when this happens. Galápagos sea lions are also exposed to new diseases, entanglement,

and habitat loss as local human populations grow. Galapagos sea lion numbers have decreased in the last 30 years, while more and more people visit the Galapagos Islands every year.

Marine Protected Area Case Studies Continued...



AUSTRALIAN SEA LION

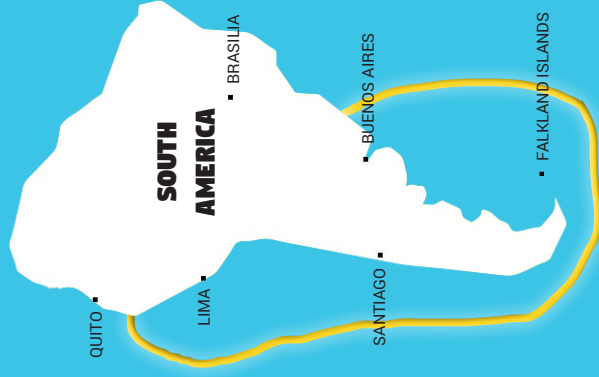
Australian Sea Lion

Australian sea lions are only found along the Southern Coast of Australia. There is a high pup mortality rate, which means many pups do not live to adulthood. This may be caused by aggressive adult sea lions and food shortages. Entanglement in shark fishing nets and crayfish pots is another large threat to Australian sea

lions. Recently, fish farms have been established near **haul outs** and feeding areas. Australian sea lions may be harmed by these farms and more interactions with humans.

Marine Protected Area Case Studies Continued...

SOUTH AMERICAN SEA LION



South American Sea Lion

South American sea lions are found from Peru to Chile to Brazil. They breed in the southern portion of this range and travel north for the rest of the year. South American sea lions were once hunted commercially, but today are protected from harvesting in Argentina

and the Falkland Islands. Human development in key breeding and **haul out** areas has wiped out South American sea lions from some areas.



Marine Protected Area Case Studies Continued...

JAPANESE SEA LION



Japanese Sea Lion

Japanese sea lions were once found in the Sea of Japan. The Japanese sea lion went extinct by the early 1950's, and is one of the most recent **mammal** extinctions to occur. Japanese sea lions were harvested for medicine and goods and also captured for entertainment in circuses.

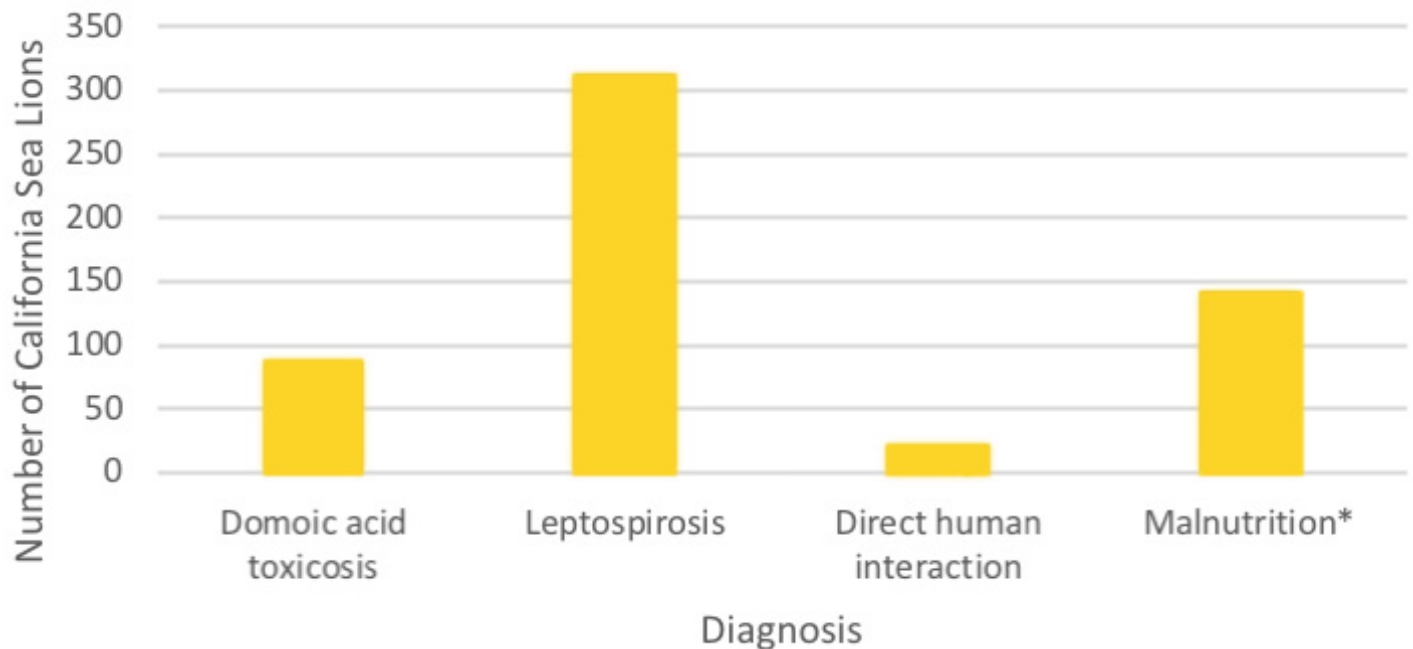
Today, South Korea, Russia and China are working to bring back Japanese sea lions from extinction. Scientists are hoping to recreate the Japanese Sea lion, or plan to relocate similar species like the Californian Sea Lion into previous habitat of the Japanese sea lion.





Patient Diagnosis Graph

California Sea Lion Diagnoses at
The Marine Mammal Center (2018)



* We don't always know why an animal has malnutrition. It can happen because of other issues or because of direct or indirect human interaction.

Begin by answering questions A and B:

- a. What was the most common diagnosis for California sea lions at The Marine Mammal Center in 2018?
- b. What other information do you see on the graph?

Thinking of your particular diagnosis, answer the following questions:

1. How do you think an animal would get this injury or illness?
2. How might humans contribute to this illness or injury?
3. What might be happening out in the ocean that would cause this injury or illness?
4. How would you help an animal recover from this illness or injury?

Patient Diagnosis Graph

Continued...

Domoic Acid Toxicosis

Domoic acid toxicosis occurs when animals consume food that had been contaminated with domoic acid. Domoic acid is released by toxic algae blooms, which are often associated with warmer ocean waters. Domoic acid bioaccumulates, or accumulates in greater quantities as it is consumed by organisms going up the food chain. Domoic acid shrinks the hippocampus in sea lions, which causes them to experience disorientation and seizures. The **symptoms** of domoic acid are seizures, disorientation, head bobbing, and strange behavior, such as traveling a long distance from the beach and other typical sea lion habitat. Domoic acid toxicosis is treated by feeding patients uncontaminated fish and giving them ample fluids, which flushes the toxins out of their bodies. Patients are also given anti-seizure medications.

Leptospirosis

Leptospirosis is a bacterial infection affecting sea lion's kidneys. The **symptoms** of leptospirosis are holding the flippers over the abdomen and drinking water. These **symptoms** are often enough to correctly **diagnose** a sea lion with leptospirosis, but urine samples can also aid in diagnosing. Leptospirosis is treated with antibiotics and fluids.

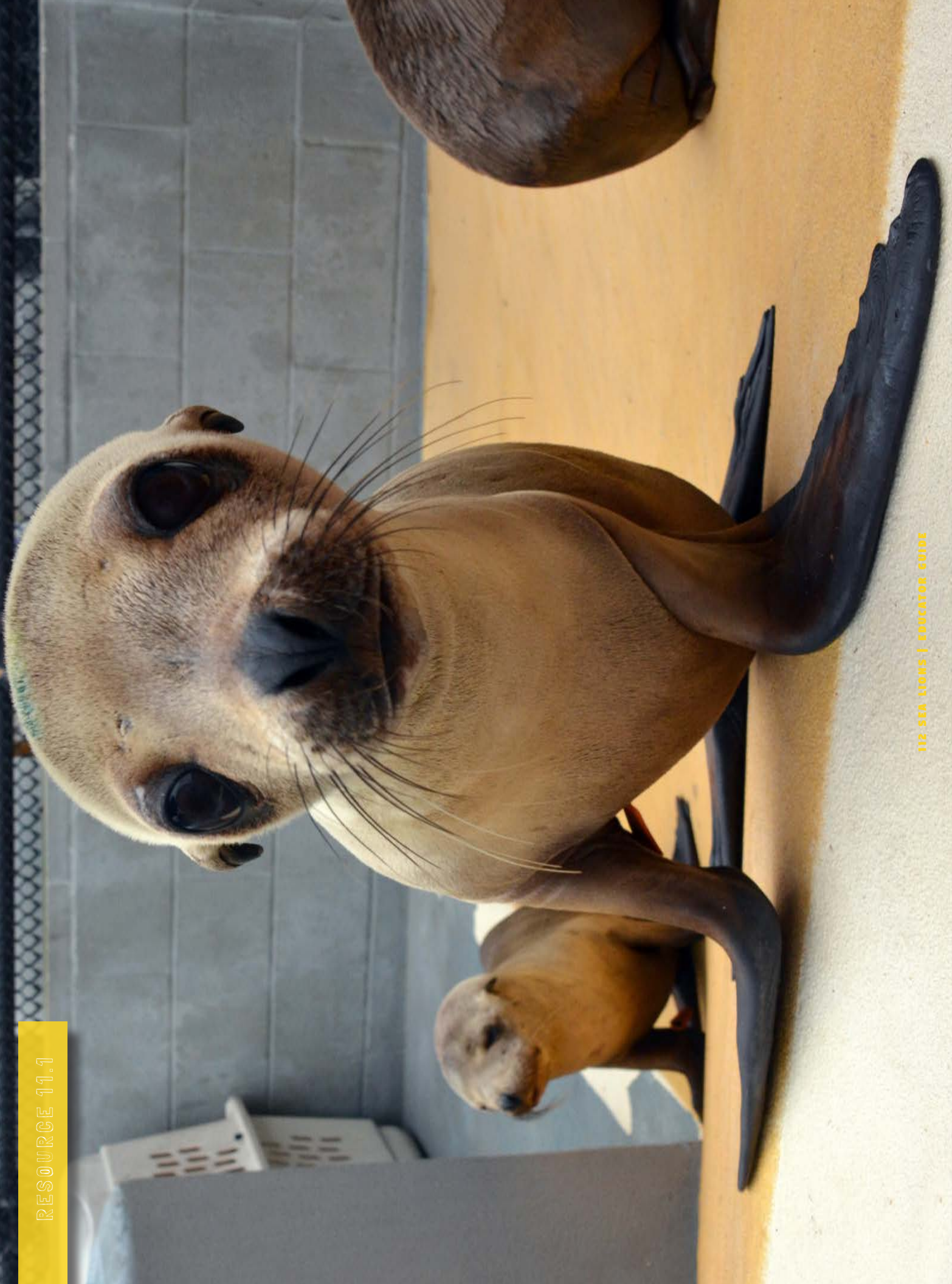
Human Interaction

Human interaction can include a variety of direct and indirect human behaviors. Some sea lions suffer due to indirect human interactions, such as plastic entanglement or ingestion of ocean trash. Other animals are harmed by direct interactions including gunshot wounds. **Symptoms** vary, but include intestinal blockages, lacerations, and other traumas. Treatment also varies depending on the diagnosis, but can include surgery to remove entanglements or consumed debris, as well as sutures and antibiotics to treat trauma.

Malnutrition

Malnutrition occurs when an animal is underweight and hasn't been receiving proper nutrition. It can result from **maternal separation** (when a pup is separated from its mother), an inability to hunt independently (this occurs when yearlings first try to hunt on their own), or as a side effect of other **diagnoses**. The **symptoms** of malnutrition are low body weight and lack of blubber. Malnutrition is treated by feeding the patient formula or fish, even teaching it how to catch and eat fish if needed.





Community-based Science Project

At the dock

What is your research question?

What is a hypothesis that could answer this research question?

In the bay

What data do you need to test this hypothesis?

How and who will collect this data?

Out to sea

How will you analyze this data?

Who will analyze it? (Trained scientists, community members, students?)

Ripple effect

How will your research benefit people and/or sea lion conservation?

How will you share these benefits with the public?





Solution Sheet

Ocean Issues	Ocean Solutions
Plastic Pollution	
Human Interactions	
Climate Change	
Habitat Loss	
Fishing	

Ocean Issues Case Studies

Direct Human Interaction

Unfortunately, sometimes humans directly have a negative effect on **marine mammals** by hurting an animal, disturbing their feeding, or separating a mom from their pup. This can happen when people get too close to or touch a **marine mammal** on the beach, but also occurs when a dog is off leash at the beach. It is illegal to feed or harass wild **marine mammals**

Plastic Pollution

90% of the trash found in the ocean is plastic and the large amounts of trash are having an impact on marine life and marine ecosystems. Large pieces, such as a plastic bag, often get wrapped around and entangle a **marine mammal** in it. When the large pieces of plastic garbage enter the ocean through waterways, the air, and sewers, they get broken into smaller pieces by waves. This results in a soup of small plastic particles. These smaller pieces can be mistaken as food and are ingested by marine life.

Climate Change

The burning of fossil fuels like coal, oil, and natural gas release a gas called Carbon Dioxide (CO₂). CO₂ acts like a heat-trapping blanket in the atmosphere, raising the temperature of the land, air and water. As CO₂ increases in the atmosphere, the ocean absorbs the excess CO₂, causing a shift in the pH of the ocean to become more acidic. The warmer water expands and high temperatures cause ice to melt, resulting in sea level rise.

Indirect Human Interaction

There are many ways that humans affect marine life as a result of other actions. A few of those ways are through coastal development and shipping goods. Coastal development is when homes or businesses are built near beaches. This increases traffic near oceans and decreases habitat for seals to haul-out. Shipping goods by using boats can result in a **mammal** being hit by a boat and interfere with **marine mammals'** communication due to their loud noises.

Overfishing

There's a limit to the fish in the sea. Humans are removing fish from the ocean at a rate faster than fish can reproduce. This results in a decrease in populations and limits the amount of fish for **marine mammals**, such as sea lions. Better equipment, technology, and the need to make more money have made it easier to catch fish with less effort. These developments have resulted in a loss of 90% of the ocean's large predatory fish. The state of global fisheries threatens is threatening food supplies, economies, and recreation in all parts of the world.

Bycatch

Bycatch is the accidental capture of a species that was not the fishing target. This can include turtles, sea birds, or **marine mammals** such as dolphins, sea lions, or whales. Modern fishing methods involve large nets that are undetectable and inescapable for bycatch which results in death or injuries. There are efforts to reduce bycatch by working with fisheries to develop new fishing gear that can allow the unintended animals to escape.

Volunteer

RESOURCE 12.5



CAUTION
SLIPPERY
WHEN WET





INDEX

Credit of Involvement

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ADDITIONAL RESOURCES

The Marine Mammal Center

<https://www.marinemammalcenter.org>

NOAA

<https://www.noaa.gov>

Australian Marine Conservation Society

<https://www.marineconservation.org.au>

Australian Marine Parks

<https://parksaustralia.gov.au>

Take 3 for the Sea

<https://www.take3.org/>

Head of Bight

<http://headofbight.com.au>

EDUCATION RESOURCES

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Resource 2.2 contributed by 5 Gyres Science to Solutions 5gyres.org

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UNEP-WCMC and IUCN (year), Protected Planet:[The World Database on Protected Areas (WDPA)/The Global Database on Protected Areas Management Effectiveness (GD-PAME)] [On-line], [Dec 2019], Cambridge, UK: UNEP-WCMC and IUCN

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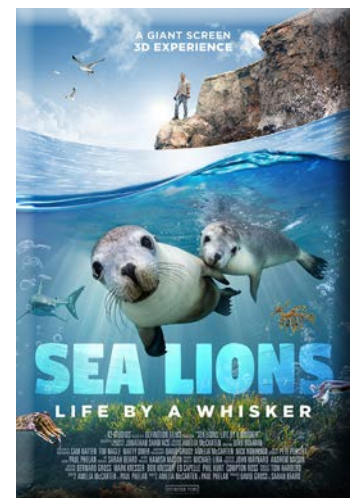
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Based on the 3D film experience 'Sea Lions: Life by a Whisker'



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BASED ON THE FILM

SEA LIONS

L I F E B Y A W H I S K E R

