See Life Trunk

CABRILLO NATIONAL MONUMENT

Objective

The See Life Trunk is designed to help students experience the vast biodiversity of earth's marine ecosystems from the comfort of their classroom. The activities, books, and DVDs in this trunk specifically target third and fourth grade students based on Next Generation Science Standards. The trunk will bring to life the meaning of biodiversity in the ocean, its role in the maintenance and function of healthy marine ecosystems, and what students can do to help protect this environment for generations to come.

What's Inside

Books:

- *In One Tidepool: Crabs, Snails and Salty Tails*
- *SEASHORE* (One Small Square series)
- *CORAL REEFS* (One Small Square series)
- *The Secrets of Kelp Forests*
- *The Secrets of the Tide Pools*
- *Shells of San Diego*

DVDs:

- Eyewitness Life
- Eyewitness Seashore
- Eyewitness Ocean
- Bill Nye the Science Guy: Ocean Life
- On the Edge of Land and Sea

Activities, Resources & Worksheets:

- Marine Bio-Bingo
- Guess Who: Intertidal
- Patterns in Nature
- See Life & Habitats
    - Classroom set of Michael Ready photographs
    - 3D-printed biomodels
- Science Sampler
- Intro to Nature Journaling
    - Creature Features
    - Baseball Cards
- Who Am I?

Beyond the Classroom Activities

- Intertidal Exploration
- 3D Cabrillo
- Bioblitz
- Beach clean-up

How to Use this Trunk

The See Life Trunk is designed to be used in a variety of ways. Most of the activities in the trunk can be adapted for any number of people for any amount of time, but some activities are better suited for entire-class participation (i.e. watching DVDs, Nature Journaling) while others are better suited for small groups (i.e. Guess Who, reading books). If desired, teachers can decide to set up stations of different activities and have groups of students rotate through them at prescribed times or allow students to explore at their own pace. Associated worksheets can be found at the back of the binder and copies can be made for each person in the class. The "beyond the classroom" activities are designed for teachers once the trunk returns to Cabrillo, as it is our hope that the learning will continue, whether on a fieldtrip to Cabrillo, in your own backyard, or elsewhere.

Next Generation Science Standards

Grade 3

http://www.nextgenscience.org/3ire-interdependent-relationships-ecosystems

Performance Expectation: 3-LS3-2
Use Evidence to support the explanation that traits can be influenced by the environment.
3-LS4-2
Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
3-LS4-3
Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
3-LS4-4
Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Constructing Explanations and Designing Solutions Engaging in Argument from Evidence	**LS2.C:** Ecosystem Dynamics, Functioning, and Resilience **LS3.B:** Variation of Traits **LS4.C:** Adaptation **LS4.D:** Biodiversity and Humans	Patterns Cause and Effect Systems and System Models Scientific Knowledge Assumes an Order of Consistency in Natural Systems

Interdisciplinary Common Core Connections:
ELA/Literacy: RI.3.1 W.3.2 W.3.8 SL.3.4

Grade 4

https://www.nextgenscience.org/topic-arrangement/4structure-function-and-information-processing

Performance Expectation: 4-LS1-1
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in Argument from Evidence	**LS1.A:** Structure and Function	Systems and System Models

Interdisciplinary Common Core Connections:
ELA/Literacy: W.4.1

Introduction to Biodiversity and Marine Ecosystems

Key Vocabulary:

- **Habitat**: the natural environment in which a plant, animal, or other organism lives
- **Ecosystem**: a community of living organisms, or group of interacting habitats, influenced by biotic and abiotic factors
- **Biotic factors**: living things and processes, such as competition, predation, and herbivory
- **Abiotic factors**: non-living things and processes, such as temperature, water availability, and pH
- **Biosphere**: a large-scale community of interacting ecosystems
- **Biodiversity**: variety of life
- **Adaptation**: driven by natural selection, species develop certain characteristics that enable them to best survive and reproduce in their environment
- **Natural Selection**: a variation in characteristics in a population of organisms leaves some individuals better suited to their environment than others; these survivors reproduce and pass on these genetic characteristics to the next generation
- **Biodiversity Hotspot**: an area of particularly high biodiversity
- **Endemic Species**: species found in only one area of the world
- **Trophic Cascade**: when a change in one organism in the food web affects all of the other organisms it is associated with
- **Coastal Upwelling**: the process by which the cold, nutrient-rich water of the deep rises to replace the warmer water at the surface; it is a driver of productivity and biodiversity in temperate oceans
- **Tides**: the rise and fall of water throughout the day due to the gravitational pull on the earth by the moon and sun
- **Rocky Intertidal Zone**: the area between land and sea, composed of 3 zones that are defined by the tides and the associated biotic and abiotic factors
- **Environmental Stewards**: those who speak up for the plants and animals that do not have a voice

Biodiversity – what is it? Broken down, "bio" is the Latin root for "life" and "diversity" means "variety." Together, biodiversity simply means the variety of life on this planet. Why do we care about it? High biodiversity leads to healthy **ecosystems**. Each individual plant or animal within an ecosystem has an

important job to do in order to keep the community functioning. For example, fungi in the soil provide the nutrients plants need to grow and reproduce. These plants create the oxygen that animals breathe, and some provide food for these animals. The animals help the plants by pollinating them or spreading their seeds. When the animals poop, they provide nutrients for the soil and the cycle starts over again. Another important aspect of biodiversity is **adaptation**. Some plants and animals are better suited to their environment than others because of the different characteristics they have evolved over time. These include things such as shells, poisons, and stingers for protection, sharp teeth, and keen senses for predation. Plants and animals have developed and refined these characteristics to survive, reproduce, and perform their essential jobs in the environment they find themselves in today.

As you can see, healthy ecosystems create a healthy planet. The same processes still happen in ecosystems with low biodiversity, but these systems are more susceptible to disasters such as storms or disease. For instance, if an organism gets removed because of a disease, it can no longer perform its job. In areas with high biodiversity, another organism can usually take its place and compensate for the loss, so the effects aren't as great. In places with low biodiversity, however, there are no other organisms to compensate, and so the effects of the loss of one species can be catastrophic for the entire system. This phenomenon is known as a **trophic cascade**, where a change in one organism in the food web affects all of the other organisms it is associated with.

In the same way that biodiversity is important for our terrestrial ecosystems, it is also extremely important for marine systems, which are themselves home to a great variety of life. Due to a process known as **coastal upwelling**, where the nutrient-rich waters of the deep rise to replace warmer surface waters, California's coast is characterized by low temperatures and high nutrients. Cold water can be bad news for tourists but great news for many marine organisms, especially kelp. Giant Kelp provides habitat for some of the greatest variety of life in the world, such as the Point Loma Kelp Forest located just off the coast of Cabrillo National

Monument. A healthy kelp forest such as this supports life from microscopic plankton to gray whales, and even absorbs a lot of the carbon dioxide from our atmosphere.

Another area of high marine biodiversity is the rocky intertidal, or tidepools, which are easily accessible from many places in San Diego and is the primary focus of the activities in this trunk. **Tides** are defined as the rise and fall of water throughout the day due to the gravitational pull of the moon and sun. Because of our location on the globe, San Diego sees mixed semi-diurnal tides – two high tides and two low tides per day. This pattern causes an extremely variable habitat in the **rocky intertidal zone**, or the area between land and sea, where marine plants and animals are often exposed to long periods of dryness and heat during low tides. The intertidal has three zones within it: high, middle, and low. Each are characterized by different factors, both living and non-living. **Biotic** (living) factors include things like predation and competition among organisms, while **abiotic** (non-living) factors include things such as temperature and water availability.

The high zone is defined by having little water and a lot of sun most of the time. Organisms in this zone must be adapted to withstand desiccation**,** or drying out, and thus have features such as hard outer shells to keep water in. The low zone**,** on the other hand, is usually submerged underwater throughout the day, except for during the times of the lowest tides. Instead of desiccation stress, the plants and animals in this zone must withstand a higher rate of predation and high wave action. Animals in the low zone often have defenses such as ink or camouflage and seaweeds are strong and hearty to withstand these stressors. Finally, the middle zone is somewhere in between. This zone is often submerged for part of the day and dry for the other part, so it comes with a variety of stressors for the organisms that live there. All told, the plants and animals that have adapted to live in this extremely variable environment account for a very high amount of biodiversity.

At Cabrillo National Monument, it is our mission to preserve and protect the plants and animals within our terrestrial and marine ecosystems for future

generations to enjoy. We use educational tools, such as this traveling trunk, to spread our mission and create the next generation of **environmental stewards** – those who speak up for the plants and animals that do not have a voice. Environmental stewardship is especially important here in San Diego, as we are in what is known as a **biodiversity hotspot**, or area of particularly high biodiversity. San Diego also has a high rate of **endemic species**, or those not found anywhere else in the world. Due to the high rate of urbanization and population growth in Southern California, this high biodiversity is in jeopardy. It is our hope that by empowering the next generation of environmental stewards, we can preserve these special and endemic species in our San Diego home for many years to come.

To Learn More

Biodiversity:

http://www.nationalgeographic.org/encyclopedia/biodiversity/

http://thekidshouldseethis.com/post/why-is-biodiversity-so-important-ted-ed

San Diego as a biodiversity hotspot:

https://interwork.sdsu.edu/fire/resources/overview_bioderversity.htm

Marine habitats and conservation:

http://oceanservice.noaa.gov/facts/

Common marine organisms in California:

https://www.montereybayaquarium.org/animal-guide

Activity 1: Marine Bio-Bingo

The goal of this activity is to guide student learning and engagement while watching the provided DVDs. The Bingo board is intentionally designed to be open-ended so that students will think a little deeper about the information presented.

Materials/Set-up:

Each student will need one Bingo sheet per DVD watched. This activity works for any DVD provided in the trunk, and teachers can choose to play more than one. Each DVD runs for 20-30 minutes.

Background/Rules:

This activity works as any other Bingo activity does, and it is desired that students write or draw the organism in the box. This is not only so that students can remember these organisms at the end of the game, but to show a defining characteristic of biodiversity – that the same descriptors can be used to describe vastly different organisms, and similar organisms can be described in a variety of ways. It is possible that at the end of the game, no two students in the class have the same organism written down in a given box. This should prompt a discussion that compares and contrasts the different organisms the students learned about in the DVD to reinforce the concepts of biodiversity and adaptation.

Throughout the course of the game, students may see an organism that could fit into a number of boxes on the Bingo board, however, they must choose only one. Students may not use the same organism to mark off multiple boxes. For example, "sea snail" may fit into the "something that crawls" box and the "something smaller than you" box, but students must choose only one box and fill in the other with a different organism later on.

Procedure:

1. Hand out Bingo sheets to each student.

2. Define the rules of the game described above. Teachers can decide whether they want to play "5 in a row," "X marks the spot," "blackout" (preferred), another variation of the game, and/or incentivize a prize.
3. Play the DVD of choice and let students fill out the board as the movie progresses.
4. At the end of the DVD, allow students to compare their board with those around them. Then, prompt a discussion based on the questions below.

Discussion Questions:

1. Did you and those around you have the same things written/drawn in the boxes on your board? Why or why not?
2. Was it easy or difficult to fill the boxes on your board? If it was easy, explain how this relates to biodiversity. If it was difficult, explain why.
3. Look at what you wrote in the "something that doesn't belong" box. What can you do to ensure that that item doesn't end up in the ocean? (If you didn't have anything written, think of what you *could have* written to answer the question).
4. What is one thing that you learned that you didn't know before?

Activity 2: Intertidal Guess Who

Southern California's temperate oceans support some of the greatest biodiversity in the world. The purpose of this game is to highlight this biodiversity while looking closer at life that students may have never seen before.

Materials/Set up:

To set up the game, clip the 24 clothespin pieces to the black letter holder in any order, but all of the blue pieces should be together and all of the green pieces should be together. The binder clips can be used to hold each person's larger card, but are optional. After setup, one person's side of the game should look like this:

Background:

About the plants and animals in the game (24 total):

- **Owl Limpet (*Lottia gigantea)*:** Commonly found on rocky faces throughout the high and middle intertidal zones, Owl Limpets are approximately 10 cm (4 inches) or greater in length. They have a lumpy, low profile shell that is mottled white, brown, and black coloring.

- **Hopkin's Rose Nudibranch (*Okenia rosacea)*:** Commonly found in the middle to low intertidal zone from Oregon to Baja California, the Hopkin's Rose Nudibranch can grow as long as 2.5 cm (1 inch). The Hopkin's Rose Nudibranch is bright pink and has long tentacle-like structures, like the stinging tentacles of anemones, to deter predators.
- **Gooseneck Barnacle (*Pollicipies polymerus*):** Gooseneck Barnacles are common in the middle intertidal of the rocky shore. Goosenecks average about the size of your finger, but can be as long as 13.8 cm (6 inches). True to their name, these barnacles have a fleshy, chalk-white stalk that resembles the neck of a goose.
- **Moray Eel (*Gymnothorax mordax*):** Commonly found in shallow waters and near rocky reefs all over the world, the Moray Eel is actually a fish. This carnivore can grow up to 4.6 m (15 feet) and is known to live as long as thirty years. These eels secrete a protective mucus from their skin, giving them their distinct yellow-green color.
- **Seagrass (*Phyllospadix scouleri)*:** Commonly found in the low tidal zone from Southern Alaska to the tip of Baja California, Seagrass is a true flowering and pollinating plant. It is dark green and can be found at depths up to 12-15 m (40-50 feet). Seagrass grows in dense meadows connected by a root-like system of rhizomes, creating important habitat for a variety of organisms.
- **Striped Shore Crab (*Pachygrapsus crassipes)*:** Usually found throughout the mid to high intertidal zone from southern Oregon to Baja California, the Striped Shore Crab can grow up to 4.8 cm (2 inches). Striped Shore Crabs normally live in rock crevices, tide pools, and mussel beds. These crabs get their name from the colorful stripes on their backs.
- **Starburst Sea Anemone (*Anthopleura sola)*:** The Starburst Sea Anemone is mostly found in low tidal zones along the coasts of Southern California and Central America. These sea anemones can grow up to 23 cm (10 inches) long. They are mostly green and blue and resemble an upside-down jellyfish.

- **Giant Kelp (*Macrocystis pyrifera)*:** Giant Kelp is commonly found along the coast from Santa Cruz to Mexico, and along the temperate coasts of South America, New Zealand, and Australia. Kelp can grow up to 53 m (175 feet) and up to 0.6 m (2 feet) each day! Found in various shades of brown, Giant Kelp has hollow gas-filled bladders called pneumatocysts.
- **Sea Lettuce (*Ulva californica)*:** Sea Lettuce is found globally and lives in the low and middle intertidal. Additionally, it is found deeper than 23 meters (75 feet) underwater. Sea lettuce can grow to be 8-15 cm (3-6 inches) long and can be varying shades of green.
- **Black Turban Snail (*Tegula funebralis)*:** This snail is commonly found between rocks in the middle tidal zone throughout the west coast of North America. The Black Turban Snail can typically grow about 2.5 cm (1 inch) long. These snails have a thick, dark, cone-shaped shell with a light-colored rounded tip.
- **California Spiny Lobster (*Panulirus interruptus)*:** California Spiny Lobsters are sometimes found in the middle intertidal zone but mainly live in deeper waters from Southern California to Baja California. Spiny Lobsters can grow up to 30 cm (12 inches) in length. Spiny Lobsters are often a dark red and orange color with multiple spines on their bodies.
- **Garibaldi (*Hypsypops rubicundus)*:** Commonly found in the low intertidal zone from Monterey Bay to tip of Baja California, the Garibaldi is the state marine fish of California. These fish can grow to be 36 cm (14.5 inches). As adults, they are bright orange in color and live in the kelp forest. Juveniles are found in the low intertidal zone and are bright orange with blue dots on the top of their bodies.
- **Knobby Sea Star (*Pisaster giganteus)*:** Also known as the Giant Sea Star, Knobby Sea Stars are found in the low intertidal and subtidal along the coast from British Columbia to Mexico. Knobby Sea Stars grow about 46cm (18 inches) in diameter. As their name suggests, their bodies are covered with small white knobs.

- **Bat Star (*Patiria miniata):*** Bat Stars can be found on hard surfaces in the low tide zone and subtidal along the Pacific Coast from Alaska to Baja California. They grow to be 15-20 cm (6-8 inches) in diameter, and can be brown, orange, or shades of purple. As their name suggests, they have webbing in between their arms that makes them look like bat wings.
- **Purple Sea Urchin (*Strongylocentrotus purpuratus*):** Sea Urchins are commonly found in the subtidal kelp forest from Alaska to Baja California, but can also crawl to the low intertidal zone. They hide beneath shells and under rocks to protect themselves from the sun. Sea urchins can be up to 7 cm (3 inches) in diameter, and resemble a purple pin cushion.
- **Blue-legged Hermit Crab (*Pagurus samuelis*):** The Blue-Legged Hermit Crab can be found along the Pacific Coast from British Columbia to Baja California in the rocky intertidal. This 2.5 cm (1 inch) long crustacean has 10 legs, though often only 6 are showing outside their shell. True to their name, they can be recognized by bright blue bands on their appendages.
- **California Mussels (*Mytilus californianus*):** Mussels are commonly found throughout the intertidal zone attached to hard surfaces. California Mussels live along the Pacific coast from Alaska to Baja California. These Mussels are commonly 7-12 cm (3-5 inches) long, and have a black teardrop-shaped shell.
- **Kellet's Whelk *(Kelletia kelletii*):** Commonly found from Monterey Bay to Baja California, the Kellet's Whelk commonly lives in the low intertidal zone or subtidal. It is one of the largest gastropods and can grow up to 18 cm (7 inches) in length. They have a tan spiraled shell that is often covered in algae, which camouflages the snail.
- **Two-Spot Octopus (*Octopus bimaculoides*):** The Two-Spot Octopus can be found from Central California to Baja California in the middle intertidal to depths of about 50 feet. They are usually a mottled brown color and grow to be around 1 m (3 feet) long. They are distinguished by their blue faux eye spots below their actual eyes, which confuse both predators and prey.

- **Wooly Sculpin (*Clinocottus analis*):** The Woolly Sculpin is common in the low and mid intertidal zones from Northern California to Baja California. These intertidal fish are typically 7-12 cm (3-5 inches) long. They live along the sea floor and are mottled brown, white, and black in color to blend in with their sandy, rocky environment.
- **Conspicuous Chiton (*Stenoplax conspicua*):** The Conspicuous Chiton is commonly found on the rocks in the middle to low intertidal zone from Santa Barbara to Baja California. Chitons have 8 shell-like plates to protect them from predators. On average, these chitons grow to be about 10.5 cm (4 inches) long. Like snails, they have a tooth-like structure known as a radula to scrape algae off the rocks.
- **Feather Boa Kelp (*Egregia menziesii):*** Feather Boa Kelp is commonly found in the mid to low intertidal zones along the Pacific coast from Alaska to Mexico. This alga is usually dark brown and olive green and can grow to 10 m (32 feet) long. As their name suggests, Feather Boa Kelp has long, feather-shaped blades.
- **Dead Man's Fingers (*Codium fragile)*:** Dead Man's Fingers is a marine plant that can be found in the low and middle intertidal zones throughout the Pacific Coast. This alga grows in dense clumps, and individual "fingers" can grow up to 40 cm (16 inches) long. It is a dark green color with a spongy texture, hence its other common name, Sponge Weed.
- **Opaleye (*Girella nigricans)*:** Opaleye are commonly found in shallow waters off the southern coast of California and northern Mexico. Juveniles are found in the intertidal and grow to 5-10 cm (2-4 inches) before moving to the subtidal as larger adults. Opaleye have small white spots on their backs and bright blue-green eyes.

Procedure:

1. This is a two-player game (though there can be teams) – blue versus green.
2. Each participant will randomly choose a larger card from the pile, hiding it from the other player. This is the organism that their opponent is trying to guess.
3. Participants will take turns asking specific yes/no questions to determine the organism on the other persons' card. This game works via process of elimination, where players eliminate potential organisms from their board based on the answers to their questions. For example:
    a. Player 1 asks Player 2, "Is your organism a plant?"
    b. Player 2 answers, "Yes."
    c. Based on this information, Player 1 can eliminate all of the animals from their board.
    d. Now, it's Player 2's turn to ask a question.
    e. Continue in this fashion until one of the players guesses the other's organism. They can make a guess at any point in time during the game.
4. The first person to guess their opponent's organism wins. Teachers can choose to offer a prize or incentive for winning.

Activity 3: Patterns in Nature

This activity is designed to highlight the diversity of both marine and terrestrial organisms by looking at the patterns they exhibit. Students will think critically about why these patterns exist and how they might relate to each other.

Materials/Setup:

Provided in the trunk are 46 individual 3x5 patterns cards. In an area where students can easily get up and move around, pass one out to each student. No other materials are necessary.

While this activity is not specific to marine ecosystems, teachers can choose to use only the marine-related cards if desired.

Background:

Patterns are everywhere in nature. Patterns can be seen in plants and animals from the way they grow, the shape they become, the color and shapes on them, and much more. These patterns are not random, however, and have developed over evolutionary time as adaptations to survive. For example, some animals exhibit color patterns to camouflage in their environment, while others have patterns to warn predators that they are dangerous and should not be eaten. Some animals exhibit patterns to make them stand out and attract mates. Some things grow in groups or colonies that create patterns. Plants may grow in a certain way that allow them to best absorb sunlight and perform photosynthesis. Sedentary animals, such as corals, may grow into specific shapes that allow them to best capture food. But patterns don't always involve living things. There are many patterns that exist because of non-living processes, such as the cracks in rocks or ripples in water. Many of these patterns are repeated throughout the natural world, and are often predictable enough to be modeled mathematically.

Procedure:

1. Give the students about a minute to look at their card and determine what kind of pattern is illustrated.

2. Instruct students to find a partner or group of people with a pattern(s) that relates to theirs in some way.
3. Facilitate a short discussion based on the questions below. The discussion can be done as a large group or in smaller groups of 2-4 pairs.
4. Repeat steps 2 and 3, asking students to find a new partner based on the same card. Continue for as many rounds as you have time.

Discussion Questions:

1. What kind of pattern do you have? Why does it exist? How did it form?
2. What kind of pattern does your partner have? How do your cards relate to each other?
3. Can you think of anything else in nature that has a similar pattern?

Activity 4: See Life & Habitats

Based on the provided classroom set of See Life photographs by Cabrillo artist Michael Ready (www.michaelready.com) and 3D printed biomodels of various intertidal organisms, this activity will allow students to see real, wild creatures up close. At the completion of this activity, students will have the opportunity to compare and contrast their drawings to the drawings by their peers and understand that some organisms are better suited to certain environments than others.

Materials:

1. Classroom set of Michael Ready photos and 3D printed models
2. Art supplies of your choice i.e. paints, colored pencils, markers, etc.

Setup:

Prepare for this activity by either placing the photographs and biomodels in different areas around the room or giving one to each student. This activity can be done as a whole class or in smaller groups.

Background:

About the photographs: the SEE LIFE Collection is a unique project highlighting the stunning and diverse ecosystems and animals that call Cabrillo National Monument home. Cabrillo Artist-in-Residence Michael Ready masterfully captures the morphology of his subjects while building an awareness for the biodiversity of the region. These select images include some of the commonly occurring and easily discovered species, and others that are rarely seen due to their small size, ephemeral existence, or natural behavior. Merging the worlds of science and art, SEE LIFE challenges viewers to take a closer look and garner a deeper appreciation for the diverse world that surrounds them. To learn more, please visit www.michaelready.com.

Procedure:

Students will observe one of the photos and draw their own version of that creature in the habitat they believe it would be found in. Students will rotate

through multiple photos, illustrating each one. This is a more-or-less silent, individual activity.

At the end, students should have the opportunity to share their illustrations with the class or in small groups, and especially should compare their drawings to those by other students who drew the same creature. Teachers should facilitate a discussion about biodiversity based on the guided discussion below.

Discussion Questions:

1. Where do you suspect this creature lives?
2. What features does it have that allows it to survive in this habitat?
3. Based on the different drawings by different students on the same creature, are there variations that exist among individuals that may help some survive better than others?
4. What is one way that you can help ensure your creature and its habitat survives into the future?

Activity 5: Science Sampler

The purpose of this activity is to get an idea of what it is like to be an intertidal scientist. Students will work in small groups to identify species and record data. While this activity is designed for a classroom, the same method, as well as the tools used, is used for real field work.

Materials:

- Canvas photos of the intertidal
- Quadrat
- Tidepool guides to identify organisms
- Data sheets for each group
- Something to write with and write on

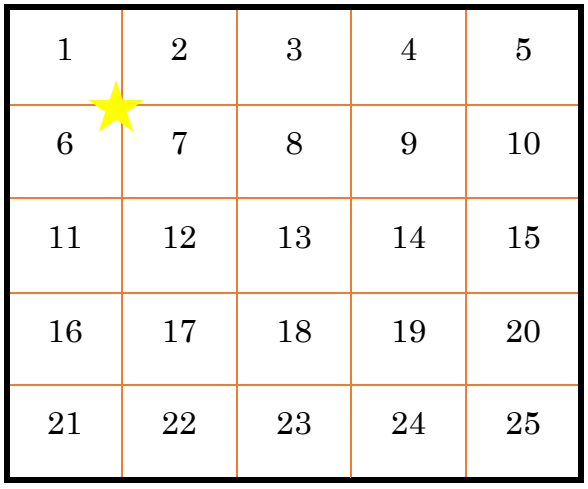
Background:

One of the fundamental questions scientists ask is, "is this habitat healthy?" To answer this question, they must look at the health of individual organisms as well as the size of populations and overall biodiversity. One way to do this is to go into the field and identify every species and count how many individuals within each species there are. As you can imagine, this would be very hard work that would take a very long time. Therefore, this method is nearly impossible in most areas. Instead, scientists take a smaller sample of the area and use math and statistics to estimate the total population size and biodiversity in the habitat.

In the intertidal zone, scientists use a tool called a **quadrat** (a square usually made of PVC pipe) to take a small sample of a known size. The quadrat is set down in a random spot, and scientists count the number of different species as well as the number of individuals of the same species within the square. This is done multiple times in different places to get the most accurate picture of the biodiversity in a given area.

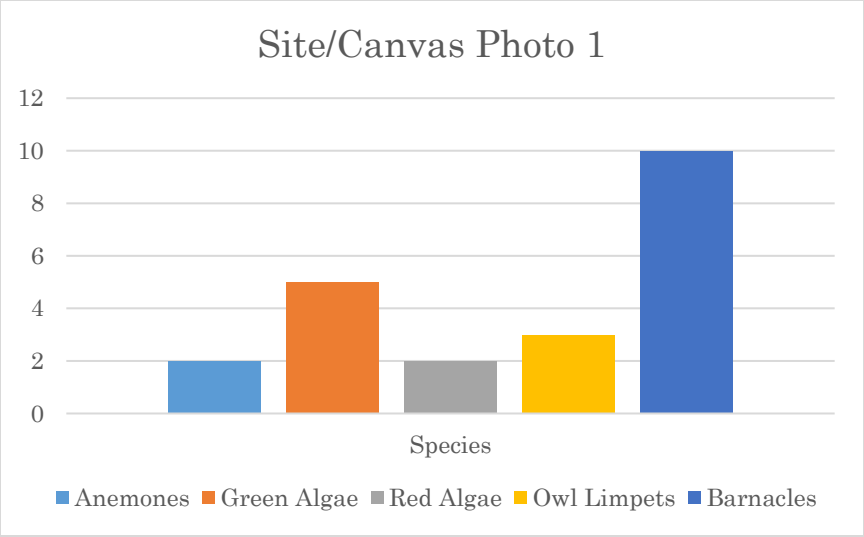
Procedure:

1. Break into small groups. Within each group, decide who is the "recorder" and who are the "identifiers." The recorder will be in charge of filling out the data sheet, while the identifiers will be referencing the intertidal guide to identify species.
2. Lay the canvas photo down on a flat area.
3. Set the quadrat down on a random area of the photo.
4. Beginning with the top left square in the quadrat (#1), identify each species at the bottom right intersection of the two strings (star) using the provided intertidal guide. Using the key on the data sheet, record your findings in Row 1, Column 1.



Example quadrat with corresponding plot numbers

5. Move right to plot #2, and so on as you would when reading. Fill in the data sheet as you go, working until you finish the entire quadrat.
6. When you've completed these counts, and if time permits, move the quadrat to another area of the photo and repeat steps 4 and 5.
7. Graph the data (optional). Create a bar chart depicting the total number of different species and the number of individuals within each species. An example of a completed bar graph would look like this:



Discussion Questions:

1. Where in the intertidal may each photo have been taken?
2. What are the defining characteristics of these organisms that allow them to survive here?
3. What abiotic (non-living) and biotic (living) factors do these organisms have to deal with in this environment?
4. From our data, what might we say about biodiversity in this area?
5. Why is it important for scientists to conduct studies like this?

Activity 6: Intro to Nature Journaling

Nature journaling is an important part of any scientists' work, as it highlights the first step in the scientific method – observation. Nature journaling brings together science, art, and writing to help students and scientists alike learn more about the world around them. This activity is designed as an introduction to nature journaling, and while it is specifically designed for groups that cannot leave the classroom, the practice of nature journaling can be done anywhere. At the completion of this activity, students should be able to take the concepts learned here with them into any nature setting to continue the practice on their own.

Materials/Setup:

1. Each student should create a Nature Journal based on the template provided in the "worksheets" tab of the binder. The template contains only three (3) pages. For more, simply add as many pages as you would like of blank printer paper to the center of the booklet.
2. Students will be observing organisms via the provided "Creature Features" and baseball cards. Set up the activity by either placing these creatures around the room or passing one out to each student.

Background:

Nature journals are a tool used by many scientists who observe plants and animals in the field. These journals serve as a record of the things they have observed and provide a way to take a little piece of nature home with them without *actually* taking a piece of nature home. These journals are used to identify plants and animals in the field and note any behaviors or other organisms they may be associated with. A good nature journal contains a few key components:

1. A table of contents so the user can easily access the information they need.
2. Page numbers for each page.
3. The date of observation.

4. A label for the organism being observed, including both the common name and the **Latin name**.
    a. A note on common names and Latin Names: while both names are important, we use Latin names in science. This is because common names are language or region-specific, while Latin names are the same across the globe. For example, while we may commonly call it an Owl Limpet here in San Diego, it may be something different in another country. But, the Latin name *Lottia gigantea* is recognized everywhere. Latin names are **binomial** (meaning two names), with the genus first and capitalized and the species second and lower case. The phrase together (both genus and species) should be italicized if typed and underlined if handwritten.
    b. If, in the field, you don't know the exact common name or Latin name, make your best guess but describe and draw the organism as best as you can so you can look it up later.
5. A drawing of the organism, in as much detail as possible. It may be beneficial to include a couple of drawings from different perspectives, though it is not mandatory. It is also beneficial to use colored pencils or something else to provide color, though, again, it is not mandatory.
6. A short description of the organism, including its color, size, behavior, where it was found, and any other additional information.

<u>Procedure:</u>

Using the provided "Creature Features" have students observe and record in their nature journal as many animals as they can in the time provided. Teachers can allot as much time as they would like for this activity, and students can go at their own pace. If enough time is provided, students can also use the resources provided at the bottom of the Creature Feature page to find out more information. This should be an ongoing activity, and students should take these journals with

them to observe plants and animals in their own schoolyard, home, or any other nature setting they may find themselves in.

Discussion Questions:

1. Where would you have to go to find this plant or animal in nature?
2. What adaptations do these organisms have that allow them to survive in that environment?
3. In what ways would nature journaling in the field be different than in the classroom?
4. Where could you go to continue adding to your nature journal?

Additional Resources:

Visit the Beetles Project online at:

http://beetlesproject.org/resources/for-program-leaders/field-journaling-with-students/

Beyond-the-Classroom Activities

These activities are designed to take what students learned from the trunk out of the classroom and into the real world. Whether at Cabrillo or elsewhere, we hope that students and teachers continue to explore their world and work to make it a better place.

Intertidal Exploration:

Included in this trunk are laminated guides to exploring the intertidal at Cabrillo National Monument, including some safety tips and a short scavenger hunt for some of the common plants and animals in the area. While these guides are specific to the tidepools at Cabrillo National Monument, similar organisms and rules apply to tidepool sites throughout Southern California. To obtain a permit to visit the Cabrillo tidepools on a self-guided tour, or to sign up for a Ranger-led fieldtrip to Cabrillo, visit Cabrillo Education online at: https://cabrilloeducation.org.

3D Cabrillo:

The 3D Cabrillo program is designed to blend technology and nature by creating 3D-printed biomodels of common intertidal organisms. A few examples are included in this trunk. A full library of free, downloadable, ready-to-print intertidal organisms can be accessed by visiting Cabrillo National Monument online at: https://www.nps.gov/cabr/learn/nature/3d_cabrillo_library.htm.

To create your own models, take any of the .STL files to your local library or personal 3D printer. In addition, the full curriculum can be accessed from our website, and be sure to check out **Cabrillo NPS on Youtube** for the "How It's Made – 3D Cabrillo" video.

BioBlitz:

"Bio" means "life" and "Blitz" means a sudden, energetic, and concerted effort, typically on a specific task. When combined they make "BioBlitz", a concentrated effort to discover and document as many species of plants, animals, and other organisms in a 24-hour period. This helps map the biodiversity of a given area and can be used as tool to measure impacts and changes over time. This

'snapshot' of biodiversity is a great way to connect the community with citizen science and the outdoors in a fun, interactive, and engaging way.

Conducting your own BioBlitz can take place anywhere, whether in your schoolyard, a local park, or elsewhere. This activity is designed to highlight the importance of citizen science through the app "**iNaturalist**," which can be downloaded for free on any mobile device. This app allows its users to document observations of life in their local area, including plants, animals, and insects. This information can be accessed by other iNaturalist users around the world, and when pooled together, this data can give us a better picture of our local ecosystems.

To find out more information about conducting your own BioBlitz, visit **Cabrillo NPS on YouTube** for the "How to iNaturalist" video in both English and Spanish, or find the curriculum online at:

https://www.nps.gov/cabr/learn/nature/cabrillobioblitz.htm

Beach Cleanup:

(Adapted from I Love A Clean San Diego)

As a result of littering, overflowing trash cans, and natural forces, a lot of trash finds its way into our natural environment. Once this trash is picked up by rainwater or wind, it can travel into rivers, down storm drains, and eventually make its way to the ocean. Marine debris can affect ecosystems both locally and globally as the trash moves in ocean currents. It can be extremely harmful to marine organisms that may consume or become entangled in the trash.

Furthermore, landfills are quickly filling due to the estimated 5 pounds of trash Southern Californians produce per person per day, equating to thousands of pounds per year. As a result, San Diego has recently adopted a "zero-waste" philosophy, which attempts to eliminate the use of landfills altogether by reducing consumption, reusing goods, and recycling paper, plastics, and metals. Eliminating waste will not only help to ensure that this debris doesn't end up in the natural environment, but existing natural resources aren't over-exploited, either.

We encourage students and teachers to get involved in the effort to minimize marine debris by hosting their own beach cleanup or getting involved in existing

efforts. Many organizations in San Diego host regular beach cleanups. To find out more, and learn how you and your students can get involved, visit:

- **I Love A Clean San Diego**: http://www.ilacsd.org/
- **San Diego Coast Keeper**: http://www.sdcoastkeeper.org/
- **Surfrider Foundation**: https://sandiego.surfrider.org/beach-cleanups/

However, we understand that getting students to the beach isn't always feasible. Instead, classrooms can host their own "campus cleanup," which can be just as important in ensuring that waste doesn't end up in our oceans. All you need to host a campus cleanup are trash bags, gloves, and students! Begin the activity by having a short discussion about landfills and recycling. Then, designate an area and instruct students to pick up all the trash that they see within the allotted time. Be sure to sort recyclables (paper, cardboard, metal, hard plastics) from landfill items, and instruct students to avoid handling hazardous waste (batteries, electronics, rusted metals, etc). If students do encounter hazardous waste, instruct them to inform an adult or professional rather than picking it up themselves. After the cleanup, ensure all the trash makes its way to a nearby dumpster/recycling bin. Optional: weigh the trash, sort and graph the data, and/or create an art project from your collection.