

Haystack Rock Awareness Program

EDUCATOR'S GUIDE TO FIELD TRIPS

Grades 9-12



2024



163 E. Gower Street | PO Box 368 | Cannon Beach, OR 97110

Dear Group Leader,

Thank you for your interest in bringing your students to Haystack Rock. The Haystack Rock Awareness Program (HRAP) looks forward to supporting your visit! If this is your first field trip with HRAP, please review this Educator Guide carefully and let us know of any questions you may have.

Please pay **SPECIAL** attention to three items in this guide:

*** Scheduling** -- We appreciate you scheduling your visit in advance, rather than showing up unannounced. This helps us ensure that the greatest number of school groups and students can visit Haystack Rock, while minimizing our collective impact on the fragile intertidal ecosystem.

*** Safety** -- Please review our safety suggestions with both students and chaperones, before your field trip. Safety is our number one priority at Haystack Rock, and our goal is to keep people safe while also keeping Haystack Rock wildlife safe.

*** Stewardship**— Haystack Rock belongs to all of us, and we share the responsibility to keep it healthy and flourishing for future generations to enjoy. Research has shown that when students and chaperones learn good tidepool etiquette before visiting Haystack Rock, they do less unintentional damage and gain more knowledge during their visit.

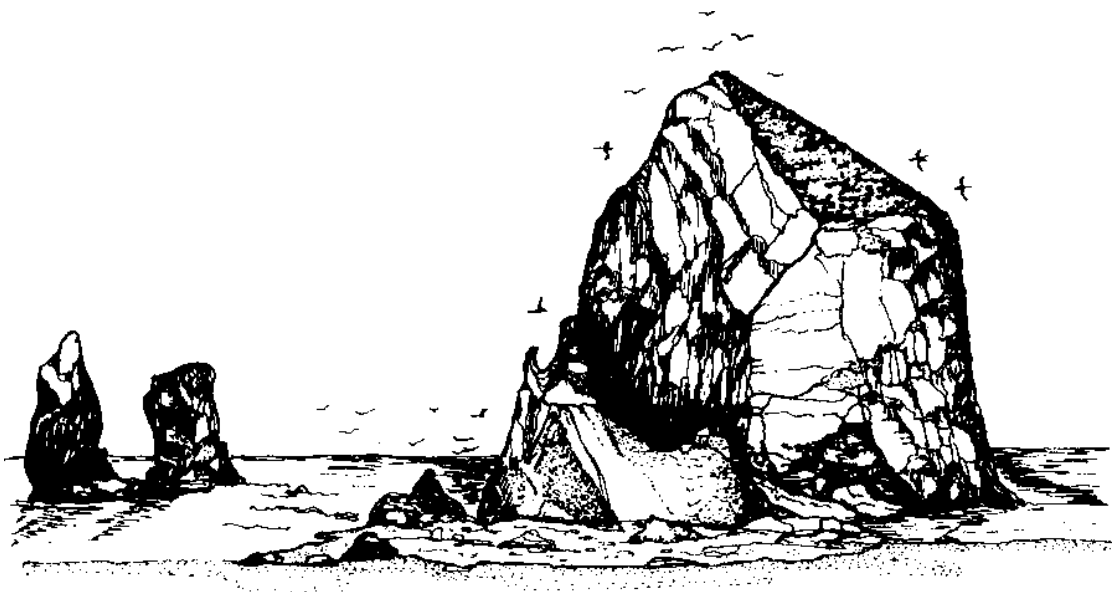
Thank you and see you at the Rock

Sincerely,

Lisa Habecker
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Haystack Rock Awareness Program

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Preparing & Planning Your Field Trip

About the Haystack Rock Awareness Program

The Haystack Rock Awareness Program (HRAP) is an environmental education program of the City of Cannon Beach. HRAP's mission is to protect, through education, the intertidal and bird ecology of the Marine Garden and Oregon Islands National Wildlife Refuge at Haystack Rock. The program provides trained staff and volunteer interpreters during the spring and summer months to educate visitors about the rocky intertidal and nesting seabird areas. In addition, HRAP coordinates field trips with visiting groups during this time. Groups are scheduled to spread out the impact and crowding of this intensely visited area. This provides a more enjoyable experience for students and helps prevent damage to the fragile Marine Garden ecosystem.

Field Trip Program

In order to accommodate as many groups as possible during low tide and minimize environmental impact, we arrange field trip activities for either 60 minutes (groups of 50 or less students) or 75 minutes (groups of over 50 students). We also limit field trips to less than 100 students (if you have several classes/groups please schedule separate field trip slots if they exceed 100 in total). HRAP's field trip program includes three educational stations for groups of 50 or less students, or 4 stations for 50 or more students. These 15-minute stations include:

- Intertidal Exploration Stations: We typically have one intertidal station on the north side and one intertidal station on the south side of Haystack Rock. Each station will focus on different aspects of the intertidal habitat. At times, only a single intertidal station will be available due to tide, weather, or ephemeral deep-water channels that may prevent access to some areas.
- Bird Observation Stations: A bird viewing station will be set up on the north or south side of Haystack Rock to view nesting seabirds. We may set up two bird viewing stations to provide views of different species and habitats (e.g., tufted puffins on the north side and black oystercatchers on the south side).
- Aquaria Investigation Station: HRAP has a collection permit which allows our program to set up temporary aquaria tanks at the Marine Garden. We will set up aquaria and provide microscopes (or stereoscopes) to offer students a closer look of intertidal animals. It is crucial to return the animals to their intertidal habitats before the tide comes in, prioritizing both animal and interpreter safety. An important note to consider is that aquaria display will only be included on days with favorable tides and weather, as access to tidepools is essential for collecting and returning tidepool organisms.

Scheduling a Field Trip to Haystack Rock

All field trips should be scheduled with the HRAP's Volunteer and Education Coordinator. The coordinator will schedule groups in the order in which request are received. We highly recommend scheduling your trip at least two months in advance and to also have alternative dates in case your first choice is already fully booked.

Choosing a Day: Before choosing a date, it is important that you consult a tide table. On the Oregon Coast there are two low tides and two high tides of varying height each day. Tides of 0.0 feet and lower are better for tidepool viewing at Haystack Rock. Understand that tide tables reflect an educated guess and weather can affect the accuracy of the tidal prediction. You can find a tide table on our website at: <https://www.haystackrockawareness.com/schedule>

Try to choose dates that allow you to arrive close to low tide. A field trip an hour before low tide is ideal, especially for younger children, as this will give your students time to explore while the water is still receding. Remember, weather conditions like big surf and strong winds can GREATLY affect both the level of the tide and the speed in which it comes in.

The walk to Haystack Rock typically takes 12 to 15 minutes. It is recommended to arrive at the parking lot at least half an hour before the scheduled start time of your field trip. This will provide ample time for organization, a restroom break, and the journey to the Rock.

Scheduling: To arrange a field trip, complete the electronic form available on our website at <https://www.haystackrockawareness.com/field-trips>. Following submission, the Volunteer and Education Coordinator will contact you in the order in which inquiries are received.

Program Fee: The City of Cannon Beach provides Haystack Rock Awareness Program services at **NO** charge, but a donation of \$1-\$2 per student is encouraged to support the continuation and improvement of our program. This is a work in progress and your input is greatly appreciated.

How To Prepare for a Field Trip

In the Classroom: We highly recommend that you use this guide to help prepare your students for their field trip at Haystack Rock.

“Before the students arrive at the seashore, they need to have as much information about the day as possible. Sensory awareness activities in the classroom, such as drawing a rock or pine cone, help students focus their attention on the sensory aspects of a living organism or a tidal pool during their field trip experience...The more the students know about the place they’re going to and the kinds of activities they will be doing, the less wild excitement you’ll have to deal with. The better prepared they are, the easier it will be to connect their experience with the concepts and attitudes you’re trying to develop” (Snively, Beach Exploration).

The station sections in this guide can be used to help show the students what they will be doing the day of their field trip. In those sections there are also lessons to help prepare the students for their on-beach objectives. Any additional lessons about these topics will only enhance your students’ experience. For questions or suggestions about curriculum ideas please contact the Volunteer and Education Coordinator.

What to bring: Having the right equipment and clothing is essential to a successful field trip. It is important to convey to both students and chaperones the recommendation to wear water-resistant shoes and layered clothing that can easily adjust to varying weather conditions. Rain and wind are common year-round on the Oregon Coast, regardless of what the weather report may state or how the weather is when you get off the bus. Please encourage your students and chaperones to have the following list of items:

- * Rain coat and pants or clothes that are fast drying
- * Rubber boots or shoes that can get wet
- * 3-4 top layers on windy/cold days
- * Change of clothes
- * Lunch or snacks
- * Water
- * Sun block
- * Sunglasses or hat
- * Identification guides (optional)
- * A camera (optional)
- * Lots of questions

What NOT to bring: Please help us keep our impacts to a minimum at Haystack Rock by not bringing the following items:

- * Collecting equipment: including buckets, nets, aquaria, plastic bags, etc.
- * Sticks
- * Shovels
- * Kites

Chaperones: Adult supervision is important for safety and ensures a high-quality experience for your students. Recommended adult: student ratios are 1:4 for ages 8 and under; 1:6 for ages 9 to 12; and 1:8 for ages 13 to 18. This makes it easier for students to focus on the planned activity and questions can be more easily responded to. Please ask each of your chaperones to read and sign the *Chaperone Expectations* form enclosed. We suggest collecting these forms before exiting the bus in Cannon Beach. This form emphasizes HRAP's expectations while visiting the Marine Garden at Haystack Rock. It also allows HRAP staff and volunteer interpreters to focus on education, and reduces unintentionally harmful behavior in this protected ecosystem.

Getting Your Students to the Rock

There are three options available for parking. As previously stated, we recommend arriving at your chosen parking lot at least thirty minutes before the scheduled start time.

- **Haystack Rock Public Parking:** The nearest public parking lot is situated at the junction of Hemlock and Gower Street, right beside City Hall on 163 E. Gower St. There are three oversize parking spots available. To reach the rock, proceed westward along Gower Street from the

parking lot to reach the beach access point. Once you arrive at the beach, look south -Haystack Rock will immediately come into view. The journey to the rock takes 12 to 15 minutes on foot. Our Education and Volunteer Coordinator, will greet your group on the beach upon arrival. Before heading down, considering a restroom break might be wise – since there are no restroom facilities available on the beach. The closest public restroom is situated just across the street from the parking lot, on Hemlock Street. You can find it next to the American Legion at 1216 S Hemlock St.

- **Tolovana Beach State Recreation Site:** In the event that the Haystack Rock Public Parking area is without available spots for oversized vehicles, we recommend utilizing the parking facilities at Tolovana Beach State Recreation Site. From there, you can access the rock by following the access road down to the beach and then heading north. The rock is approximately a 25-minute walk from this spot. Our Education and Volunteer Coordinator, will greet your group on the beach upon arrival. Before heading down, considering a restroom break might be wise – since there are no restroom facilities available on the beach. Restrooms are available at the Recreation Site.
- **Drop-Off Site:** If no parking is available, you can drop off students at 1190 Pacific Drive. To reach the rock, proceed toward the beach access point. Once you arrive at the beach, head south. The journey to the rock takes 12 to 15 minutes on foot. Our Education and Volunteer Coordinator, will greet your group on the beach upon arrival

Please have your students separated into groups (3-4 depending on how many stations). HRAP will offer a quick introduction to welcome the students as well as to remind them of important tide pool etiquette. HRAP will also collect the Chaperone Expectations forms from you at this time.



Chaperone Expectations

As a chaperone on a field trip to Haystack Rock you play a vital role in helping students to learn about and preserve the fragile ecosystem at Haystack Rock. Haystack Rock is one of only seven state protected Marine Gardens along the Oregon Coast, and is part of the Oregon Islands National Wildlife Refuge (NWR). The Marine Garden encompasses a 300-yard radius around the Rock and is intended for wildlife habitat preservation, education, and exploration. The NWR at Haystack Rock begins at the high tide line (marked by the barnacle line) and is closed to public entry year-round because of the sensitive nature of nesting shorebirds and seabirds. The Haystack Rock Awareness Program needs your help to make the field trip as safe as possible for both students and wildlife, and you can do this by agreeing to the following:

1. As a chaperone and visitor to Haystack Rock, I will abide by the regulations set forth by Oregon Department of Fish and Wildlife and the U.S Fish and Wildlife Service. These regulations include:
 - **No Climbing above the high tide line (or barnacle line):** This is to protect the marine birds nesting on the offshore rocks, protect the rocks from erosion and for your safety. The marine birds are an intricate part of the coastal ecology and are protected by federal law.
 - **No Collecting:** A special permit is required to legally collect intertidal organisms in this area. Please take only pictures and memories.
2. I will follow rules set forth by the Haystack Rock Awareness Program and encourage students in my group to do the same. These rules include the following and are set in place to ensure the safety of both humans and intertidal plants and animals:
 - **Walk on sand or bare rocks:** This is to avoid crushing live animals. Wet shoes will dry, but dead animals are dead. Do not “rock hop”, especially on larger rocks. Remember, even the barnacles are alive, fragile and important to the health of the Marine Garden.
 - **Explore Gently:** poking, prodding and pulling things off rocks is a way to damage tidepool creatures and their homes. Observing animals in their natural habitat is the best way to learn about their lifestyle. Animals that are moved away from their zone/home often die. Touch plants and animals as carefully as you would touch your own eye.
 - **Keep an eye on the ocean/Do not go behind temporary closure signs:** Large wave surges or “sneaker waves” can sweep you off your feet, rip currents can whisk you out to sea, and cold ocean waves can cause hypothermia in just 20 minutes. Never turn your back on the ocean! And, when exploring around rocks, please avoid walking behind any temporary closure signs that HRAP sets up.

By signing below, I agree to follow these guidelines to help ensure student safety and preservation of this fragile area so that it remains a wonderful place to visit!

X

Stewardship & Safety

Note to Teachers

Please share the information in this section with your students as part of your educational preparation. Feel free to copy and paste this information to make your own handouts or simply print out these pages. HRAP would like all visitors to respect this ecosystem and to be safe while exploring.

Stewardship

Stewardship is the responsibility for environmental quality shared by all those whose actions affect the environment. By being stewards of our environment, we can preserve places like Haystack Rock for future enjoyment and for future generations.

How to be a Steward at Haystack Rock:

Intertidal areas are fragile ecosystems. Activities such as trampling, turning over rocks, and removing animals from their habitat can greatly damage the tidepool life. Yet we can all enjoy tidepool areas and ensure their survival by following a few simple rules.

1. **Tread Lightly – Always stay on sand or small bare rock.** It can be tricky to navigate tide pool areas without stepping on live animals. Please follow these tips to help minimize human impact while exploring in the Marine Garden:
 - a. Walk slowly and look where you place your feet. Animals in the intertidal areas are often small and camouflaged.
 - b. Look out for barnacles, mussels, anemones, snails and other creatures so you can avoid stepping on them. Teach the students what to watch out for when walking in the area.
 - c. Please follow the instructed routes between stations and please note that we generally ask visitors to walk around the Marine Garden on the sand instead of crossing through it. Please ask HRAP for directions on how to get to stations if you don't know or for the best route.
 - d. Stay out of tidepools. Small puddles are hard to avoid, but walk around large tidepools please.
 - e. Wear shoes or boots that can get wet. This helps prevent rock hopping when the tide starts to move in.

f. Avoid stepping on seaweed and algae. They provide food and hiding places for animals, and can be very slippery, making it easy for you to fall.

2. **Explore Gently:**

a. Use eyes more than hands and leave animals in their homes.

b. Do not poke, pry, or take animals or plants off rocks. These acts are likely to kill or seriously injure animals.

c. Even though it's fun to look, please do not turn over rocks. You can accidentally crush animals and kill them when turning over and replacing rocks. For an alternative activity, if looking for crabs, observe them with your eyes hiding in mussel beds. Ask an interpreter to help you find a "crab condo".

3. **Don't Collect at Haystack Rock– The tidepool area at Haystack Rock is a protected Marine Garden; this means everything in it is protected from collection.**

Animals and plants are alive; dead material like shells are recycled and reused by tidepool animals; and small rocks provide shelter; so take only memories and pictures. Collecting is prohibited by a Oregon Department of Fish and Wildlife law.

4. **Don't Climb Haystack Rock.** All offshore rocks, reefs, and islands on the Oregon Coast are part of a National Wildlife Refuge. People can easily disturb marine birds that nest on offshore rocks and marine mammals that haul out on these rocks to rest. Birds will abandon their eggs and nests if people get too close, which leaves eggs and chicks vulnerable to predators and to the weather! Marine mammals can bite or become exhausted trying to move away from curious visitors. So please remember to stay below the barnacle line at all times, as required by U.S. Fish and Wildlife law.

Discussion Activity: Give your class a list of the rules at Haystack Rock and have them come up with reasons why that kind of behavior or activity is detrimental to the health of the ecosystem at Haystack Rock. OR have the students brainstorm additional ways they can be stewards at Haystack Rock.



What is a Marine Garden?

A Marine Garden is a type of Marine Protected Area (MPA) which is defined by the U.S. Government as “any area of the marine environment that has been reserved by Federal, State, territorial tribal or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein”. The Rocky Shores Management Strategy within Oregon’s Territorial Sea Plan (TSP) classifies 15 Marine Protected Areas actively managed in Oregon into three categories: Marine Gardens, Habitat Refuges, and Research Reserves. Haystack Rock, Cape Kiwanda, Otter Rock, Yaquina Head, Yachats State Park, Cape Perpetua, and Harris Beach State Park intertidal areas are all classified as Marine Gardens. In Oregon, this means a protected area in which it is illegal to collect any marine invertebrate (except a single mussel for fishing bait). Marine Gardens are areas set aside for educational programs and allow visitors to enjoy and learn about intertidal resources.

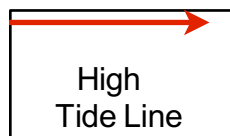
The Haystack Rock Marine Garden includes “all rocky areas, tide pools, and sand beaches situated between extreme high tide and extreme low tide lying within a 300 yard radius of the base of Haystack Rock” (2013 Oregon Sport Fishing Regulations, ODFW).

What is a National Wildlife Refuge?

National Wildlife Refuges (NWRs) are tracts of land or water set aside to conserve fish, wildlife and their habitat for future generations. The National Wildlife Refuge System is a network of over 540 refuges across the United States. The System is managed by the U.S. Fish and Wildlife Service and is considered to be a living heritage of our great country.

Haystack Rock is part of the Oregon Islands NWR which includes 1,853 rocks, reefs, islands, and two headlands. Although some NWRs allow public access, the Oregon Islands NWR is closed to public entry year-round, because of the sensitivity of nesting seabirds and other wildlife that utilize the refuge. The refuge at Haystack Rock begins above the high tide line, which is most noticeable by the top of the barnacle line (see photo below).

Above is the NWR



Below is the Marine Garden



Discussion Activity: Have your class brainstorm and list the benefits of designating protected areas like Marine Gardens and National Wildlife Refuges.

Beach Safety Tips

While the rocky shore environment is a fun place to explore, safety precautions are a must! Rocks are slippery, the ocean can be dangerous, and sneaker waves are a common occurrence. In addition, rocky shores are homes for animals and plants not well adapted to our feet and hands. Remember the following guidelines to ensure a safe trip to the tidepools for you and for the animals and plants that live there.

1. **Keep an eye on the ocean** – Large wave surges, or sneaker waves, can knock any person off their feet without warning! Sneaker waves are not predictable, but if you remember to never turn your back on the ocean you will be able to see when large waves are coming and move to a safe area.
2. **Use caution** – Running and jumping in tidepool areas is unsafe for you and for the animals that live there. Rocks that are covered with wet algae and animals are slippery. Some animals and rocks are sharp. The combination of slippery and sharp has resulted in many injuries in tidepool areas, so please walk slowly!
3. **Check local tide tables** – Know when low tide is, so you can watch for rising water when the tide is coming in. The low tide time is only a prediction, weather can affect the accuracy of this information.
4. **Be ready to get wet** – Wearing proper shoes allows you to avoid rock hopping, which is safer for you and the animals and plants that live on rocks. Wear layered clothing for unpredictable weather changes and bring a rain jacket. If you are traveling a long distance a change of clothes is a good idea just in case you get wet.
5. **Please do not play on driftwood** – It only takes four inches of water to move a five-ton log! Staying off of beached logs helps keep you from accidentally getting trapped under a log if waves move it.
6. **Please don't allow children to play in the water without adult supervision.** Undercurrents and rip currents can pull children far away from shore. There are known rip currents by Haystack Rock, so keep an eye on kids to make sure they do not go out too deep or play in unsafe areas (note: life guards are only present on Cannon Beach from June until September).

To watch beach safety commercials or for more information, go to:
www.oregonbeachsafety.org

Bird Observation Station

What is the purpose of the Bird Observation Station?

The purpose of this station is to closely observe birds, their nesting habitats, and behaviors. It will also introduce important concepts about birds, such as migration and adaptation, to the students.

What is the Bird Observation Station?

The HRAP team will set-up several telescopes so the students can view the birds in the Wildlife Refuge (see photos below). Students will also have access to binoculars to use to find birds not displayed in the scopes.

Depending on the day and the number of birds visible, your field trip program may have 1-2 bird observation stations either on the North or South side of Haystack Rock. In addition to viewing birds, the students will participate in another activities (at a table separate from the scopes). The students will gather in a group at the beginning of this station to hear the details of this activity as well as learn some fun facts about the birds of Haystack Rock.









On-Beach Objectives:

- **At the Scopes:** Observe two of the bird species, noting their interactions between individuals of the same species and their interactions with different species.
- **Non-Scope Activity:** Discuss how human activities impact bird populations, and challenge each student to take personal action to help birds of Haystack Rock.

Lessons to prepare:

Lesson 1B: Important Bird Species of the Haystack Rock National Wildlife Refuge

Lesson 1B: Important Bird Species of The Haystack Rock National Wildlife Refuge

	Common Name (<i>Scientific Name</i>)
 <p>by: Donna Lenius</p>	<p>Tufted Puffin <i>(Fratercula cirrhata)</i></p>
	<p>Pigeon Guillemot <i>(Cepphus columba)</i></p>
	<p>Common Murre <i>(Uria aalge)</i></p>
	<p>Pelagic Cormorant <i>(Phalacrocorax pelagicus)</i></p>

	Common Name (<i>Scientific Name</i>)
	<p>Western Gull <i>(Larus occidentalis)</i></p>
	<p>Black Oystercatcher <i>(Haematopus bachmani)</i></p>
	<p>Bald Eagle <i>(Haliaeetus leucocephalus)</i></p>

Aquaria Investigation Station

What is the purpose of the Aquaria Investigation Station?

The purpose of this station is to closely observe intertidal animals and algae, identifying both anatomical and behavioral similarities and differences that contribute to their classifications.

What is the Aquaria Investigation Station?

HRAP has a collection permit from the Oregon Department of Fish and Wildlife (ODFW) which allows our program to temporarily collect both fish and invertebrate species to put in display tanks (or aquaria) in front of the Marine Garden (see photos below). This enables students to make closer observations of intertidal organisms.

The set-up and format of this station will vary depending on the tide, number of HRAP staff and volunteers, weather and the number of student participants. On an optimum day (a very low tide and ample staff and volunteers) there will be two tables with 4 to 5 display tanks with many organisms, microscopes, and hand lenses. On a challenging day (high low tide and minimal staff and volunteers) there may only be 1 to 2 tanks with fewer organisms, and hand lenses only. HRAP staff and volunteers will determine the lay-out of this station the day of your field trip after assessing the conditions that day, but will keep in mind what is needed to complete the student's on-beach objectives. HRAP may also utilize an alternate activity in case there is not enough specimens to observe in the aquaria.





On-Beach Objectives:

- Discuss at least two different intertidal phyla that are represented in the aquaria tanks, and important anatomical features that lead to their classifications.

Lessons to prepare:

Lesson 1A: Important Intertidal Phyla

Domain: Eukaryota
Kingdom: Animalia

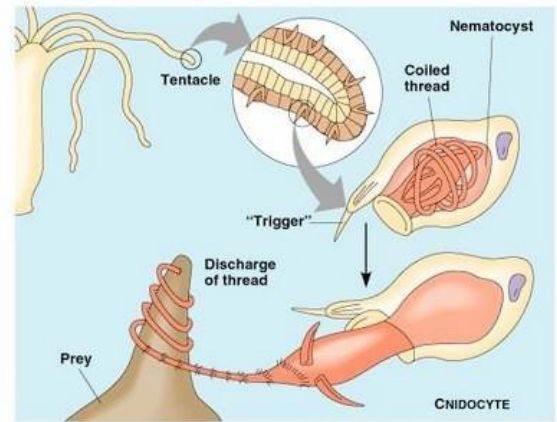
Phylum: Cnidaria

Hydrozoans, Jellyfish, Anemones, and Corals

Grade of construction: Two tissue layers
Symmetry: Radial
Type of gut: Blind gut
Type of body cavity other than gut: None
Segmentation: None
Circulatory system: None
Nervous System: Network of nerve cells
Excretion: Diffusion from cell surface

Some species at Haystack Rock:

Aggregating Anemone (*Anthopluera elegantissima*),
Wine-Glass Hydroid (*obelia sp.*)



General Descriptions: All Cnidarians have the same body plan, a cup-shaped polyp which has a ring of tentacles and a digestive tract with one opening. The tentacles which surround the mouth/anus are usually lined with several different types of nemoblast, which produce structures call nematocysts. When the tentacle comes in contact with prey, the nematocyst releases a sticky extension or sharp barb. The nematocyst may be mucus-coated to entrap the prey or it may contain a neurotoxin which stuns and/or kills the prey (refer to figure above).

Cnidarian body plan. Polyp form above and medusa form below. (Levinton, pg.286)

Class Hydrozoa

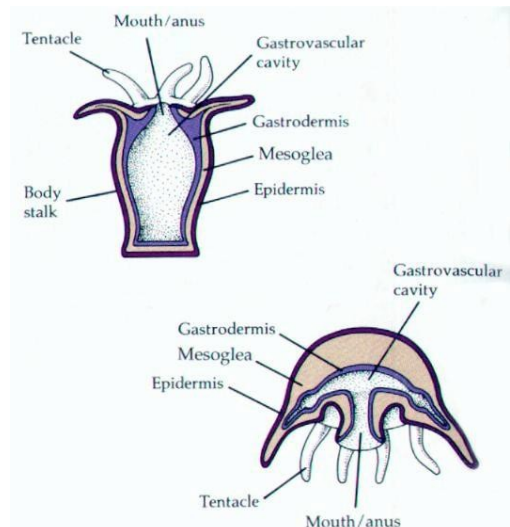
- Simplest cnidarians
- Most have a complex life cycle, with an alternation between a benthic colonial polyp stage and a planktonic medusa stage.

Class Scyphozoa

- True jellyfish
- Life cycle lacks a benthic polyp stage. Gametes mix in the water column producing embryos and then larva. The larva then metamorphose into jellyfish.
- All are carnivores

Class Anthozoa

- Includes anemones, corals, and sea fans
- Life cycle lacks a medusa stage. Embryos develop into a swimming planula larvae which settles and metamorphoses into the polyp stage.



Domain: Eukaryota

Kingdom: Animalia

Phylum: Porifera

Sponges

Grade of construction: Cellular, with no distinct tissues or organs

Symmetry: Usually asymmetrical but sometimes radial

Type of gut: None

Type of body cavity other than gut: None

Segmentation: None

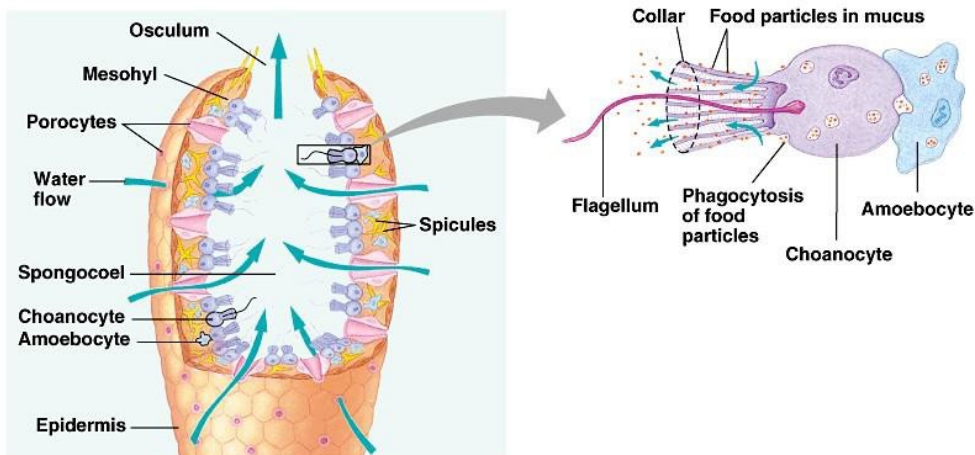
Circulatory system: none

Nervous System: None

Excretion: Diffusion from cell surface

Some species at Haystack Rock: Red Encrusting Sponge (*Ophlitspongia pennata*), Purple Encrusting Sponge (*Haliclona permollis*)

General Descriptions: Sponges have an internal space which is made up of a series of pores, canals, and chambers. Because they lack developed tissue layers and organs, they instead have several different specialized cells that perform specific functions. Collar cells, or choanocytes, line the chambers and are flagellated to beat water into the sponge's system. Food particles in the water are trapped on the flagellae and engulfed by the collar cells. Another cell type, the amoebocytes, are responsible for the transport of digested food to other cells in the sponge and for transport of waste products out. When water is expelled from the sponge it is pushed out through a single opening called the osculum. Sponges can grow quite large, some as individuals and other as colonies. Both secrete a fibrous protein called spongin, between the two main cell layers for structural support. Many sponges also secrete siliceous or calcareous needle-like spicules in an interlocked network.



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Domain: Eukaryota

Kingdom: Animalia

Phylum: Arthropoda

Invertebrates with jointed appendages (crabs, shrimps, insects, barnacles, isopods)

Grade of construction: Organs derived from three tissue layers

Symmetry: Bilateral

Type of gut: Complete with anus

Type of body cavity other than gut: Coelom

Segmentation: Present

Circulatory system: Usually open to large coelomic cavity

Nervous System: Brain, with nerve cords and bundles (ganglia)

Excretion: Excretory organs

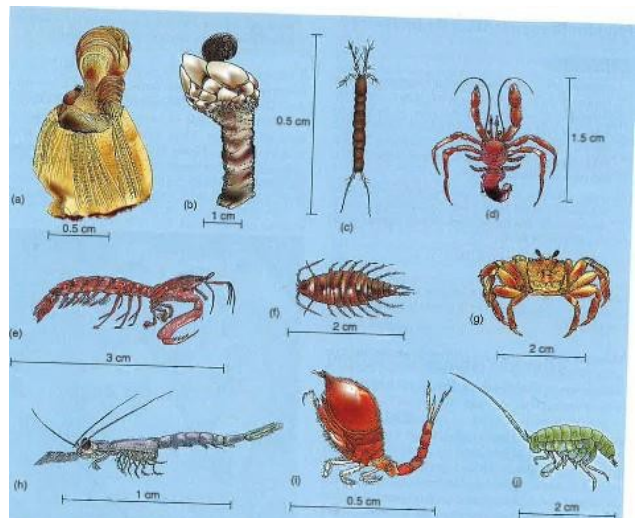
Some species at Haystack Rock: Acorn Barnacle (*Balanus glandula*), Hermit Crab (*Pagurus sp.*), Pacific Mole Crab (*Emerita analoga*), Purple Shore Crab (*Hemigrapsus nudus*)

General Description: All arthropods have a flexible external skeleton made up of the polysaccharide chitin. In many species, like crabs, this exoskeleton is calcified. This skeleton is jointed which allows for more flexibility at the limbs. Muscles are inserted into the interior of this skeleton. Their exoskeletal limbs are therefore operated and moved by a series of lever systems making movement precise. Because the animal's soft tissues continue to grow inside a rigid shell, it must periodically molt its external skeleton in order to grow. All arthropods also have segmented bodies that usually consist of a main cephalothorax (head-trunk) region and a multi-segmented abdomen.

Subphylum Crustacea

- Largest marine arthropod group.
- Examples: Barnacles, copepods, isopods, hermit crabs, and other true crabs.
- Members of this subphylum are characterized by:
 1. A head with two pairs of antennae, which are densely covered with taste and smell receptors.
 2. Three pairs of specialized mouthpart appendages, which process food before it enters the mouth.
 3. A trunk with several specialized appendages for feeding, walking, and/or swimming.
- There are 50,000 species of Crustacea that represent a wide range of body shapes and life habits. Acorn Barnacles, for example, are sessile filter feeders that live in an enclosure of calcium carbonate plates, while Dungeness Crabs are mobile carnivores, using their claws to seize, crush, and tear apart prey.

Diversity of Crustacea (Levinton, pg. 299)



Domain: Eukaryota
Kingdom: Animalia

Phylum: Mollusca

Shelled Invertebrates (mostly): Chitons, Snails, Nudibranchs, Octopods, Squids

Grade of construction: Organs derived from three tissue layers

Symmetry: Bilateral

Type of gut: Complete, with anus

Type of body cavity other than gut: Coelom

Segmentation: None

Circulatory system: Usually open to large coelomic cavity

Nervous System: Brain, with nerve cords and bundles (ganglia) ; Brain very well developed in squids and relatives.

Excretion: Excretory organs

Some species at Haystack Rock: Mossy Chiton (*Mopalia muscosa*), Shield Limpet (*Lottia pelta*), Frilled Dogwinkle (*Nucella lamellosa*), Opalescent Nudibranch (*Hermisenda crassicornis*)

General Description: The general body shape of a mollusk is comprised of a head-foot complex. All mollusks have a mantle which secures all of its inner organs. In many mollusk species, the mantle secretes calcium carbonate forming a protective shell. Mollusks use gills, which are suspended in the mantle cavity, to breath and in some cases for suspension feeding.

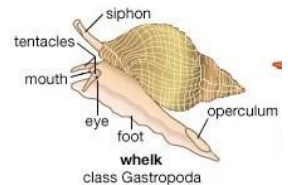
Class Bivalvia (clams, mussels, oysters)

- Bivalves are distinguished by two shells or valves connected by a hinge.
- The foot of the bivalve can be powerful, allowing the animal to burrow in sediment, or it can be reduced. The mussel's foot, for instance, is reduced and merely used to secrete byssal threads that glue it to the hard substrate.



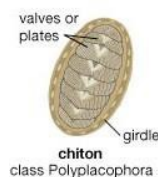
Class Gastropoda (snails)

- Gastropods are distinguished by a flattened foot
- The mantle is protected by either a cap-shaped shell or a coiled shell. Nudibranchs, however, do not have a shell like usual snails. That is why they are known as sea slugs.
- All gastropods feed with a mouth apparatus known as a radula. A radula is a row or rows of teeth, which move back and forth over food to scrape it off or to drill into it.



Class Polyplacophora (chitons)

- Chitons have a flattened foot that can adhere to hard substrates by suction.
- Their dorsal mantle is covered by eight articulated plates.
- They use a radula, much like the gastropod's, to scrape microalgae and seaweed from rocks.



Class Cephalopoda (squids and octopus)

- Cephalopods are distinguished by their elaborate nervous and muscular coordination.
- Many have an internal shell remnant often called a beak. Their foot is also modified into a water-squirting funnel.
- Unlike other mollusks they have grasping arms used to seize prey.

Domain: Eukaryota
Kingdom: Animalia

Phylum: Echinodermata

Animals with Fivefold Symmetry (Sea Stars, Urchins, Sea Cucumbers)

Grade of construction: Organs derived from three tissues layers

Symmetry: Radial, sometimes combined with bilateral

Type of gut: Blind sac with very reduced anus, or complete with anus

Type of body cavity other than gut: Coelom

Segmentation: None

Circulatory system: Usually open to large coelomic cavity

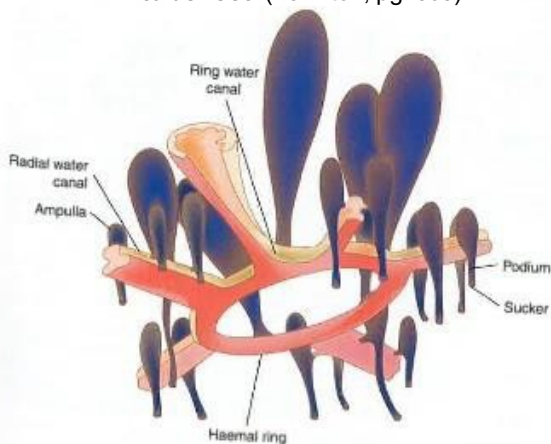
Nervous System: Major nerves extending from nerve ring, no brain

Excretion: Diffusion

Some species at Haystack Rock: Ochre Star (*Pisaster ochraceus*), Sunflower Star (*Pycnopodia helianthoides*)

General Description: Among invertebrates possessing organ grade complexity, echinoderms are unique in that their adult stages are radially symmetrical and their structure are often repeated in multiples of five (e.g. the arms of sea stars). Echinoderms have a tough leathery skin that encloses an internal skeleton of interlocking calcium carbonate plates called ossicles. In sea urchins the ossicles form a ball which encloses soft tissues, including a digestive system and reproductive system. In sea stars, the ossicles are less fused, giving the animal flexibility. Specialized ossicles, known as pedicellariae, are located on the outer surface of sea stars and urchins. These pedicellariae can pinch and protect against predators or fouling organisms, such as barnacles. Echinoderms use a water vascular system to move and to feed. Water is exchanged across a sieve plate known as a madreporite, which is located on the dorsal side of the animal. The water entering the madreporite travels through a network of canals which can create increases of pressure or suction in various parts of the water vascular system (see photo below). Tube feet used for locomotion and to connect with the outside world are connected to this system. Each tube foot is an ampulla, which looks and works much like a rubber medicine dropper.

Water Vascular system and operation of tube feet. (Levinton, pg. 303)



Sea Stars (class Asteroidea)

- All sea stars have a central disk area from which several arms radiate. As long as part of this central disk is intact the sea star is able to survive and regenerate missing limbs.
- Most all sea stars are carnivores, and many, like the Ochre Star, feed by extruding their stomach and digesting prey outside of their body.

Domain: Eukaryota

Kingdom: Animalia

Phylum: Bryozoa

Moss Animals

Grade of construction: Organs derived from three tissue layers

Symmetry: Bilateral

Type of gut: Complete

Type of body cavity other than gut: Coelom, usually reduced

Segmentation: none

Circulatory system: none

Nervous System: single ganglion with nerves branching throughout zooid

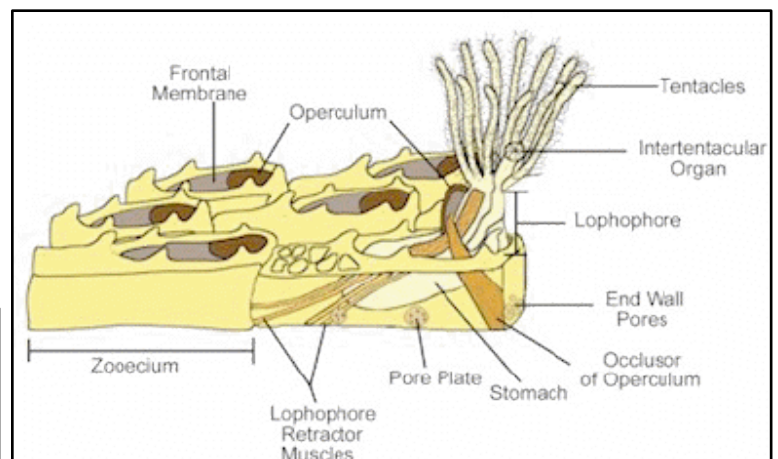
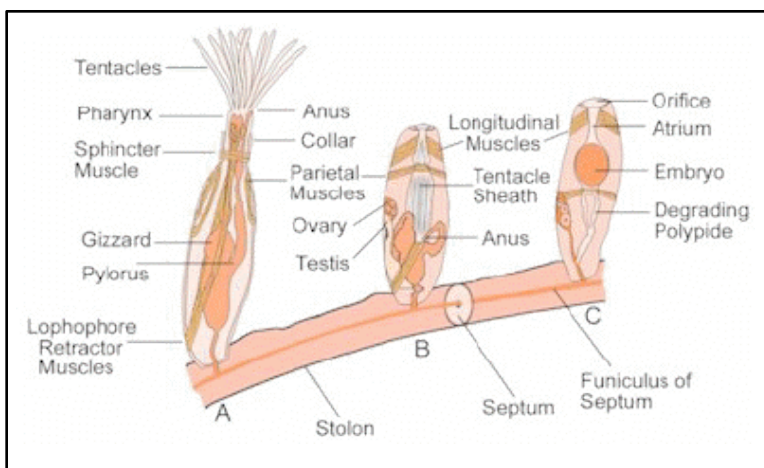
Excretion: no special structures

Some species at Haystack Rock: Kelp Encrusting Bryozoan (*Membranipora membranacea*), Branched-spine Bryozoan (*Flustrellidra corniculata*)

General Description: Bryozoans are colonial invertebrates that grow as sheets or as erect colonies on hard surfaces. The colonies are composed of individuals called zooids, which are less than 1 mm in diameter. A colonial nervous system allows for coordination between zooids. The feeding zooids consume suspended matter using a looped feeding structure called a lophophore. Cilia on the lophophore create a current that draws suspended food particles to the lophophore and into the mouth. Other specialized zooids, known as avicularia, are interspersed among feeding zooids and are equipped with beaklike structures which pinch away fouling organisms.

Non-calcifying or arborescent Bryozoan (below)

Zooids in arborescent colonies live attached to a common stolon. Their body walls are composed of chitin. (Barnes,1980)



Encrusting Bryozoan (above)

In encrusting bryozoans, zooids are housed in a calcified structure called a zooecium and the lophophore emerges from a pore in this calcified enclosure. (Barnes,1980)

Domain: Eukaryota

Kingdom: Protista/Chromista

Phylums: Chlorophyta, Ochrophyta, Rhodophyta

Macroalgae or Seaweeds

General Description: Like plants, seaweeds are primary producers requiring essential nutrients, like nitrogen and phosphorus, and sunlight to do photosynthesis. Unlike plants, however, seaweeds gather nutrients from the seawater surrounding them, therefore they lack a root system. An individual seaweed is known as a thallus and can range in morphologies. Some forms are tar-like crusts while others are erect filamentous branches. The thallus is held to the substrate by a holdfast. Connected to the holdfast is the stipe, which is usually tubular and flexible allowing the thallus to bend over in strong currents. On top of the stipe is the blade or frond. This tissue is specialized for light capture. Many seaweed species also have floats filled with gas called pneumatocysts, which keep the thallus suspended upward toward the sunlight while in seawater.

Green Seaweeds (Chlorophyta)

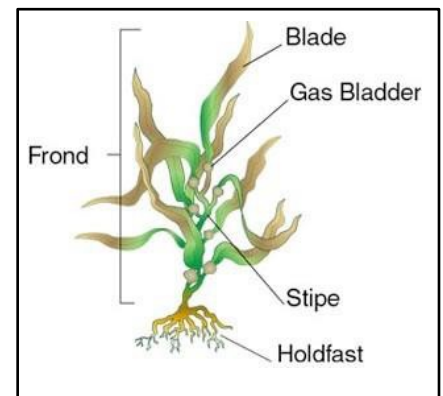
- Some species at Haystack Rock: Sea lettuce (*Ulva lactuca*), Spongy Cushion (*Codium setchelli*), Sea Staghorn (*Codium fragile*)
- May have been the ancestors of higher plants. Green seaweeds have photosynthetic pigments similar to higher plants. They also have starch as a storage product.
- *Ulva* species are commonly found along the shore; their delicate leafy morphology is very susceptible to grazing by snails and other herbivores. *Ulva* species have relatively few compounds that deter feeding therefore it is an important primary food source in places like the rocky intertidal.

Red Seaweeds (Rhodophyta)

- Some species at Haystack Rock: Nori (*Porphyra sp.*), Nail Brush Seaweed (*Endocladia muricata*), Iridescent Seaweed (*Mazzaella splendens*)
- The photosynthetic pigment phycoerythrin gives red seaweeds their color. In many species this pigment masks the green chlorophyll. Often the phycoerythrin pigment is bleached by the sun, causing the seaweeds to be a variety of colors.
- Most diverse group of seaweeds. They are also capable of surviving at far greater depths than other seaweeds.
- Red seaweeds often grow rapidly and many species contain Carrageenan, a gel-forming polysaccharide used in the production of some food.

General Seaweed Morphology

(Image by US Navy)



Brown Seaweeds (Ochrophyta)

- Some species at Haystack Rock: Winged Kelp (*Alaria marginata*), Rockweed (*Fucus gardneri*)
- Brown seaweeds get their color from xanthophylla and carotenes, which in many species masks chlorophyll.
- They are more morphologically diverse than green seaweeds, but usually have distinct holdfast, stipe, blades and reproductive structures.
- Brown seaweeds contain phycocolloids which help with water retention and wave shock. These colloidal agents are also utilized by humans in many foods and other products for human consumption.

Intertidal Exploration Station

What is the purpose of the Intertidal Exploration Station?

The purpose of this station is to observe intertidal organisms in their natural habitat. These observations will be discussed after exploration to introduce key ecological concepts such as adaptation and zonation.

What is the Intertidal Exploration Station?

This station focuses on free exploration, which will allow students to observe and make conclusions about the intertidal habitat and its inhabitants. HRAP will meet the group at the beginning of this station to quickly brief the students on tidepool etiquette. The students will then be led by the interpreter into the Marine Garden where the students will have time to explore. HRAP interpreters will be present to assist with finding and identifying organisms, and to answer questions. At the end of the station the group will reconvene to discuss the students' observations.





On-Beach Objectives:

- Discuss how the intertidal ecosystem changes in response to disturbances and interactions among populations, and analyze how the relationships among biotic and abiotic factors determine zonation.


Lessons to prepare:

Lesson 1I: Common Intertidal Species of the Haystack Rock Marine Garden




Lesson 2I: Community Interactions

Lesson 1I: Common Intertidal Species of The Haystack Rock Marine Garden




Fish

	Common Name (<i>Scientific Name</i>)
	<p style="text-align: center;">Tidepool Sculpin <i>(Oligocottus maculosus)</i></p>

Crabs

	Common Name (<i>Scientific Name</i>)
	<p style="text-align: center;">Hermit Crab <i>(Pagurus sp.)</i></p>
	<p style="text-align: center;">Purple Shore Crab <i>(Hemigrapsus nudus)</i></p>
	<p style="text-align: center;">Dungeness Crab <i>(Cancer magister)</i></p>



Barnacles

	Common Name (<i>Scientific Name</i>)
	<p>Acorn Barnacle <i>(Balanus glandula)</i></p>
	<p>Goose Neck Barnacle <i>(Pollicipes polymerus)</i></p>
	<p>Thatched Barnacle <i>(Semibalanus cariosus)</i></p>



Bryozoans

	Common Name (<i>Scientific Name</i>)
	<p>Branched-spine Bryozoan <i>(Flustrellidra corniculata)</i></p>


Sea Stars

	Common Name (<i>Scientific Name</i>)
	<p>Ochre Sea Star <i>(Pisaster ochraceus)</i></p>
	<p>Sunflower Sea Star <i>(Pycnopodia helianthoides)</i></p>




Sea Anemones

	Common Name (<i>Scientific Name</i>)
	<p>Giant Green Anemone <i>(Anthopleura xanthogrammica)</i></p>
 <p>by: Donna Lenius</p>	<p>Aggregating Anemone <i>(Anthopleura elegantissima)</i></p>


Hydroids




	Common Name (<i>Scientific Name</i>)
 <p>by: Lisa Habecker</p>	<p>Wine-glass Hydroid (<i>Obelia</i> sp.)</p>

Nudibranchs (sea slugs)



	Common Name (<i>Scientific Name</i>)
	<p>Sea Lemon (<i>Peltodoris nobilis</i>)</p>
 <p>HRAP</p>	<p>Opalescent Nudibranch (<i>Hermisenda crassicornis</i>)</p>
	<p>Leopard Nudibranch (<i>Diaulula sandiegensis</i>)</p>

Shelled Mollusks

	Common Name (<i>Scientific Name</i>)
 A photograph showing several dark, frilled dogwinkles (Nucella lamellosa) on a rocky surface. One shell is open, revealing a white interior.	<p>Frilled Dogwinkle (<i>Nucella lamellosa</i>)</p>
 A close-up photograph of a black turban snail (Chlorostoma funebris) with its body extended from its dark, turban-shaped shell.	<p>Black Turban Snail (<i>Chlorostoma funebris</i>)</p>
 A photograph showing a dense cluster of California mussels (Mytilus californianus) on a rocky surface. The shells are dark and have a characteristic blue-black color.	<p>California Mussel (<i>Mytilus californianus</i>)</p>
 A photograph of a mossy chiton (Mopalia muscosa) showing its characteristic eight overlapping, rounded plates.	<p>Mossy Chiton (<i>Mopalia muscosa</i>)</p>


	Common Name (<i>Scientific Name</i>)
	<p>Leather Chiton <i>(Katharina tunicata)</i></p>
	<p>Ribbed Limpet <i>(Lottia digitalis)</i></p>
	<p>Keyhole Limpet <i>(Diodora aspera)</i></p>

Sponges





	Common Name (<i>Scientific Name</i>)
 A photograph showing a bright orange-red, encrusting sponge growing on a dark, rocky substrate. The sponge has a porous, irregular texture.	<p>Red Encrusting Sponge <i>(Ophlitaspongia pennata)</i></p>
 A close-up photograph of a purple encrusting sponge. The surface is covered in numerous small, circular openings (oscula) arranged in a somewhat regular pattern.	<p>Purple Encrusting Sponge <i>(Haliclona permollis)</i></p>

Algae

Green Algae

	Common Name (<i>Scientific Name</i>)
 A photograph of sea lettuce, a green alga, growing on a sandy or rocky surface. The alga has a flat, leaf-like appearance with a central vein and a slightly wavy edge.	<p>Sea Lettuce <i>(Ulva lactuca)</i></p>

Red Algae

	Common Name (<i>Scientific Name</i>)
	<p>Nori or Laver <i>(Porphyra sp.)</i></p>
	<p>Black Pine <i>(Neorhodomela larix)</i></p>
	<p>Iridescent Seaweed <i>(Mazzaella splendens)</i></p>
	<p>Branching Coralline <i>(Calliarthron sp., Corallina sp., Bossiella sp.)</i></p>

Brown Algae

	Common Name (<i>Scientific Name</i>)
 A photograph of Pacific Rockweed (Fucus gardneri) showing its characteristic brown, leaf-like blades and a central stalk, growing on a rocky surface.	<p>Pacific Rockweed <i>(Fucus gardneri)</i></p>
 A photograph of Winged Kelp (Alaria marginata) showing its dark brown, wing-like blades and a central stalk, growing on a rocky surface.	<p>Winged Kelp <i>(Alaria marginata)</i></p>

Lesson 2I: Community Interactions

Warm-up Discussion: Have your students brainstorm different ways in which species in an ecosystem interact.

Task: Give your students the list of important vocabulary words and interactions on the following page. After they familiarize themselves with these terms, give or show them the photo on the page that follows. Discuss as a group, or describe as individuals, what types of interactions maybe occurring in this tidepool. Also brainstorm abiotic and biotic factors that may affect this ecosystem.

One of the most important abiotic factors in the intertidal ecosystem is the tide. At low tide abiotic factors such as heat, drying out (or desiccation), and shortage of water for oxygen affect survival of intertidal organisms. These factors also set how high an organism can live in the intertidal. Organisms like acorn barnacles are able to survive for very long periods of time without water, therefore they are found as high as the splash zone. In contrast, anemones dry out quickly so they must live in the mid to low intertidal zones only.

All of the interactions listed on the following page are important biotic factors in the intertidal ecosystem. The predation of the Ochre Star (*Pisaster ochraceus*) in particular is a very important influence on the community structure of the intertidal. The Ochre Star is a top predator of the intertidal and is an important keystone species. The Ochre Star feeds preferentially on mussels but will also feed on other invertebrates. Experiments have shown that if the Ochre Star is removed from an intertidal area, the mussels take over and eliminate other invertebrates and algae. Therefore, the predation of mussels by the Ochre Star actually increases the biodiversity in an area, making it an ecologically important keystone species.

Community Ecology

Community ecology is the study of how interactions between species affect community structure and organization. Community ecology is very important when studying the intertidal ecosystem.

Important Vocabulary:

Community: All organisms that inhabit a particular area. Or an assemblage of populations of different species living close enough together for potential interaction.

Community Structure: How many species there are in an ecosystem, which particular species are present, and the relative abundance of those species. Community structure is influenced by both biotic and abiotic factors.

Abiotic factors: Non-living characteristics of an ecosystem that affect organisms and the structure of their community.

Biotic factors: Living organisms which affect other organisms and the community structure of an ecosystem.

Interspecific Interactions: Interactions between individuals of different species.

Intraspecific Interactions: Interactions between individuals of the same species.

Niche: An organism's ecological role - how it "fits into" an ecosystem. If an organism's habitat is its "address," the niche is the organism's "profession" (Analogy by ecologist Eugene Odum).

Dominant Species: Species in a community that are the most abundant and therefore exert a powerful control over the occurrence and distribution of other species.

Keystone Species: Species that are not necessarily abundant in a community but exert strong control on community structure because of their pivotal ecological roles, or niches.

Types of Interactions: (Symbols + and - indicate how each interspecific interaction affects the survival and reproduction of the two species engaged in the interaction)

Competition = Species compete for a particular resource that is in short supply. The resource could be space to grow or a shared food source (-/-).

Predation = Interaction in which one species, the predator, kills and eats another species, the prey (+/-).

Herbivory = Interaction in which an herbivore eats parts of a plant or alga (+/-).

Symbiosis (parasitism, mutualism, commensalism) = A relationship between two organisms of two different species that live together in direct contact. Parasitism (+/-), Mutualism (+/+), Commensalism (+/0): one organism benefits while the other is not harmed or benefited.

What interactions are occurring in this ecosystem (at high tide and at low tide)?

What abiotic and biotic factors influence this community?





Haystack Rock Species Check List

BIRDS

- Tufted Puffin
- Pigeon Guillemot
- Common Murre
- Western Gull
- Pelagic Cormorant
- Brandt's Cormorant
- Black Oystercatcher
- Harlequin Duck
- Surf Scoter
- Black Turnstone
- Peregrine Falcon
- Bald Eagle
- Other _____

TIDE POOL CREATURES

- Crab
 - Hermit Crab
 - Purple Shore Crab
 - Lined Shore Crab
 - Dungeness Crab
 - Porcelain Crab
 - Red Rock Crab
 - Kelp Crab
 - Mole Crab
 - Other _____
- Barnacle
 - Acorn Barnacle
 - Thatched Barnacle
 - Goose Neck Barnacle
- Nudibranch (sea slug)
 - Sea Lemon
 - Shaggy Mouse
 - Opalescent
 - Other _____
- Sea Star
 - Ochre Sea Star
 - Sunflower Star
 - Other _____
- Sea Anemone
 - Giant Green Sea Anemone
 - Aggregating Sea Anemone
 -
- Other _____

- Snail
 - Frilled Dogwinkle
 - Striped Dogwinkle
 - Black Turban
- California Mussel
- Limpet
- Chiton
- Sponge

FISH

- Tidepool Sculpin
- Cling fish
- Gunnel
- Other _____

ALGAE

- Green
 - Sea Lettuce
 - Other _____
- Brown
 - Bull Kelp
 - Rockweed
 - Acidic Kelp
 - Winged Kelp
 - Ribbed Kelp
 - Kombu or *Laminaria*
 - Other _____
- Red
 - Coralline
 - Iridescent Seaweed
 - Black Pine
 - Sea Fern
 - Wild Nori or Laver
 - Other _____

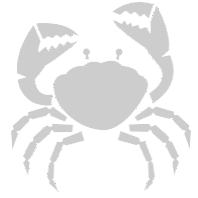
VASCULAR PLANTS

- Surf Grass
- Eel Grass

OTHER



Tidepool Safety & Etiquette



When visiting unfamiliar areas, safety precautions are a must!

Ocean beaches and intertidal areas are beautiful, but can be dangerous.

Human impact, such as trampling, overturning rocks and removing animals from the rocks, is greatly damaging to the wildlife and habitat. Please review the following tips with your group before arriving and remember: collecting, harassing wildlife and climbing at Haystack Rock are prohibited under local, state and federal regulations.

1. Check a tide book- Know the times and levels of both the high and low tides on the day of your visit. Understand that tide books reflect an educated guess and weather can affect information accuracy.

2. Arrive at least an hour before low tide- This will give you time to explore while the water is still going "out". Remember, weather conditions like big surf and strong winds can greatly affect both the level of the tide and the speed with which it comes in.

3. Adult supervision is important for safety and to ensure a high quality experience- Recommended adult:student ratios are 1:4 for ages 8 and under; 1:6 for ages 9 to 12; and 1:8 for ages 13 to 18. This makes it easier for students to focus on planned activities and questions can be responded to more easily.

4. Dress appropriately- Wear shoes that you expect to get wet and layered clothing that adapts to weather changes. Rain and wind are common all year round on the north Oregon coast, regardless of what the weather report may state.

5. Keep an eye on the ocean- Large wave surges or "sneaker waves" can sweep you off your feet, rip currents can whisk you out to sea, and cold ocean waves can cause hypothermia in just 20 minutes. *Never turn your back on the ocean!* And, when exploring around rocks, stay away from the surf line.

6. Walk on sand or bare rock to avoid crushing live animals- Wet shoes will dry, but dead animals are dead. **Do not "rock hop", especially on larger rocks. Remember, even the barnacles are alive, fragile and important to Marine Garden health.**

7. Explore gently - poking, prodding and ripping things off rocks is a sure way to damage the area and the critters. Observing animals in their natural habitat is the best way to learn about their lifestyle. Animals that are moved out of their zone often die.

8. Collecting is prohibited. Please take only pictures and memories. (You need a special permit to collect and display intertidal critters.)

9. Climbing is prohibited. This is to protect the marine birds nesting on the offshore rocks, protect the rocks from erosion and for your safety. The marine birds are an intricate part of the coastal ecology and are protected by federal law.

By following the guidelines of tidepool safety and etiquette, you will help ensure your safety and help preserve this fragile area so that it remains a wonderful place to visit!



Haystack Rock is a protected natural area, managed by the Oregon Department of Fish and Wildlife and the U.S. Fish and Wildlife Service. Everything below the average high tide line (i.e.: barnacle line), within a 300- meter radius of the Rock, is a protected Marine Garden set aside for wildlife habitat preservation and public visitation. Everything above the high tide line, including all offshore rocks and islands along the Oregon coast, is part of the Oregon Islands National Wildlife Refuge set aside for wildlife and closed to public access. To learn more, visit <https://www.haystackrockawareness.com>. **Thank you!**

Oregon Science Standards (2009)

High School

	Bird Observation Station	Aquaria Investigation Station	Intertidal Investigation Station
Interaction and Change			
(H.2L.2) Explain how ecosystems change in response to disturbance and interactions. Analyze the relationships among biotic and abiotic factors in ecosystem.			X
(H.2L.3) Describe how asexual reproduction and sexual reproduction affect genetic diversity.			X
(H.2E.4) Evaluate the impact of human activities on environmental quality and the sustainability of Earth systems. Describe how environmental factors influence resource management.	X		