



Rocky Shore Field Experience Teacher Resources

Grades 3-5

Thank you for your interest in the educational programs at the Marine Science Center!

This packet will provide you with information on how to incorporate a marine science field experience into your science curriculum, including background information on program content, what to expect during your visit, pre- and post-visit classroom activities and how these field experiences and activities satisfy requirements of the Massachusetts Curriculum Frameworks. For information regarding logistics and planning your visit, please see the Group Visit Registration pack.

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A. What to Expect on Your Visit

Program Description

A typical field trip to the Marine Science Center consists of three, 45-minute components:

1. *Introduction to the rocky shore/meet rocky shore organisms*

- Outreach staff will use a display to demonstrate students a rocky shore at high and low tide and will ask the students if they have ever been to such a place. Students will be asked to name the types of animals that live on the rocky shore.
- Students will hypothesize about why it might be difficult to live on the rocky shore and what kind of adaptations animals have to deal with this stressful life.
- Outreach staff will lead students in exploring our touch tanks, where they can meet and touch animals that live on the rocky shore. Teachers and chaperones are asked to enforce rules and ensure students treat animals with respect.

2. *Rocky shore field experience*

****Students must wear closed toed shoes and demonstrate good behavior in order to participate in the rocky shore activity.**

- Outreach staff will introduce students to the tools scientists use to collect data on the rocky shore and explain the activity and the rules on the rocky shore.
- Students will break into groups of 3-4 and each group will be responsible for bringing their equipment down to the rocky shore. Teachers and chaperones are asked to ensure that students form groups and gather equipment.
- On the shore, groups will start low on the shore, place their quadrat in a tide pool and collect data on the physical characteristics (temperature, salinity) and living organisms contained in the quadrat. Students will check off organisms they find in the quadrat on the provided data sheet.
- Field guides will be provided to help students identify the seaweed and invertebrates living in the tidepools.
- One teachers or chaperones should be assigned to a group, assisting students with the activity and keeping them on task, as well as enforcing rules to ensure safety.

3. *Tour of East Point*

- Outreach staff will lead students around the grounds of the Marine Science Center and to the top of East Point while discussing the history of the area, important geological features, and some current research at the MSC. Topics include:
 - Military history of East Point: bunkers, triangulation towers, submarine detection strip, Nike Missile Silo.
 - Geology of East Point: tombolo, home to first shelled fossils, rock signatures provide evidence of Pangea, igneous intrusions create sills and dikes, slant of rocks due to mountain building.
 - Nahant as a historically popular destination for tourists and scientists alike.

Included in this pack is a worksheet for students to complete using information that they learned in the classroom and tour portions of the program. This worksheet can be filled out during the program or teachers can use it as a follow-up/assessment activity, depending on teacher preference.

Special Requests

The duration and specific content of each component may be modified depending on time constraints or requests from teachers. If you have an activity in mind that is not covered here, or would like Outreach staff to place particular emphasis on a certain component of the program outlined above, please contact us prior to your visit to discuss modifications to the typical program.

Weather Cancellation Policy

In the event of inclement weather we generally leave it to the visiting group to decide to reschedule/cancel the trip. We will proceed with the program as normal in the event of rain, and encourage teachers, chaperones and students to dress appropriately if rain is in the forecast. In the event of lightning or other dangerous weather conditions we encourage teachers to reschedule, but we understand that this is not always possible and we have indoor activities that can replace the rocky shore field survey, such as invertebrate dissections and seaweed identification and pressing.

Preparing Students and Chaperones

Prior to visiting the Marine Science Center, teachers are encouraged to utilize the resources provided in this pack in order to prepare their students for the visit. This includes not only communicating with them what to bring and what to expect, but also leading activities that will introduce them to the concepts they will be learning and activities they will be doing during their visit. We hope that by providing these tools to teachers, we can work together to make a visit to the Marine Science Center more than just a one-time field experience, but an experience that can fit into a larger natural sciences curriculum.

Teachers should communicate with chaperones prior to the trip regarding what to bring and what to expect, and distribute the Teacher/Chaperone Guidelines handout, provided below.



Rocky Shore Experience Scavenger Hunt

Group Name: _____ Today's Date: _____

Group members: _____

Check off each item after completing the task!

Note the weather conditions:

Sunny ____ Partly Cloudy ____ Overcast ____ Rainy ____ Windy ____

Note the ocean conditions:

Big swells _____ Calm _____ Big waves _____ Small waves _____

Measure the Water Temperature _____ (°F) and Salinity _____ (ppt) of a tidepool.

Find on the rocky shore:

Crustaceans:

Green crab _____

Barnacles _____

Hermit crab _____

Rock crab _____

Asian shore crab _____

Springtails _____

Jonah crab _____

Amphipods _____

Molluscs:

Smooth periwinkle _____

Dog whelk _____

Common Periwinkle _____

Blue mussels _____

Echinoderms:

Common sea star _____

Other:

Sea squirts _____

Algae:

One kind of green _____

Pink crunchy algae _____

One kind of red _____

Snail on brown algae _____

One kind of brown _____

Crust algae _____

General:

Animal attached to rocks _____

Animal under a rock _____

Animal with legs _____

Animal on another animal _____

Touch in the touch tanks:

- | | |
|---------------------------------|---------------------------|
| Sea star tube feet _____ | Female crab _____ |
| Blue lobster _____ | Male crab _____ |
| Moon snail _____ | Hum to a snail _____ |
| Sieve plate of a sea star _____ | Sea star on mussels _____ |
| Five eyes of a sea star _____ | Doesn't grow shell _____ |
| Horseshoe crab _____ | Used in toothpaste _____ |
| A filter feeder _____ | An herbivore _____ |
| Floating organism _____ | A carnivore _____ |

Discover on the tour of East Point:

- | | |
|---------------------------------|--------------------------|
| Two bunker doors _____ | Two bird houses _____ |
| A man's face _____ | An experiment site _____ |
| The Boston Harbor Islands _____ | A large ship _____ |
| The city of Boston _____ | Deer Island _____ |
| Three tall towers _____ | Egg Rock _____ |
| A lighthouse _____ | Trash _____ |
| Area with ancient fossils _____ | Signs of erosion _____ |

TEACHER/CHAPERONE GUIDELINES

Thank you for your interest in our educational programs at the Marine Science Center! Your visit will be filled with hands-on activities both inside and outside, and as a teacher/chaperone, we ask that you keep students safe and on-task. Our instructors will give directions and information to the students, so please help us by following and enforcing these guidelines:

- At least one teacher/chaperone must always accompany students to the restrooms.
- While on the rocky shore, teachers/chaperones should be assigned to particular groups of students, or at least spread out so that there are adults on the low tide areas and the high tide areas.
- There is no climbing on the high rocks and no swimming at any time. Students should not be in any water above the ankle.
- As necessary, remind students to be respectful of animals, handle them carefully, and observe any areas designated as no-touch zones.
- Students who do not have appropriate footwear for the rocky intertidal may be asked to stay on the beach with a teacher/chaperone during that activity.
- Shoes must be worn at all times during the visit, even on the lawn.
- We do not allow electronics other than cameras out during our programs. Students may take pictures with a phone, but we advise them not to bring them onto the rocky shore.
- Nothing should be removed from the Marine Science Center except worksheets, and nothing should be left behind. We will provide trash bags for lunchtime, and there are recycling bins available as well.
- We know you are curious and smart too! But please allow students to answer questions and figure things out on their own to the greatest extent possible. Having said that, please maintain order and focus in your group, and facilitate the student completion of tasks when they are stuck.

Thank you for your cooperation

FIELD TRIP ETIQUETTE

Preparing Students

Before your outdoor field trip, brainstorm with students about how everyone should conduct themselves. Below are some general themes to guide your discussion. If desired, the teacher can document the rules on a board or flip-chart paper.

Established rules of the site

- Challenge students to think about who lives in the habitat they are exploring?
- How should students behave to ensure they respect these inhabitants?
- What rules are in place to protect these inhabitants?
- General discussion on proper handling/respect of living things

School rules

- Students should conduct themselves as they would in school
- Reminders about any field-trip specific rules
- Students are responsible for representing their school via good behavior

Safety

- Ask students to brainstorm any dangers or hazards at the field trip site
- How should students avoid these dangers?
- What rules are in place to avoid dangers or respond to potential hazards?

Logistics

- Allow students to ask questions about field trip logistics. This will help to avoid distraction during the field trip.
- Give them all the details such as: how long is the bus ride, what will we be doing, is there a gift shop, when will we eat lunch?
- Discuss what students should wear/bring, and what they should not. Send home a handout with this information before the field trip.

If the students don't think of everything while brainstorming, be sure to mention these general rules regarding visiting coastal habitats:

- Remind students that they shouldn't take anything home and to be sure not to leave behind any equipment, personal belongings or trash.
- Its ok to get your feet wet, but no one should be more than ankle deep in the water.
- On the rocky beach, no one should climb on high rocks above where seaweed grows.

Preparing Chaperones

Invite chaperones to attend the in-class discussion of field trip etiquette and even the pre-visit educational activities that you do to prepare students for the field trip. The more information that the chaperones are familiar with, the more they can help students get the most out of the experience. Share resources with chaperones such as the field trip etiquette document, a schedule of activities for the day, procedures for activities, what to bring handout, site map or website where they can find out more information about the site.

WHAT TO BRING

- The weather in Nahant is usually a bit cooler and windier than on the “mainland”. Layers of clothing, a change of clothing, and/or rain gear is highly recommended. A hat is advisable.
- Though swimming is not permitted, feet WILL get wet while tidepooling, so rubber-soled shoes such as boots, water shoes, or old sneakers are recommended. Participants wearing slip-on sandals, flip flops, Crocs, Texas, or heels may be denied participation in tidepooling.
- Participants should bring sunscreen and/or hand sanitizer, as they will not be provided.
- Each person should bring an ample supply of water, there is a water fountain to refill water bottles, but no water bottles/drinks/cups will be provided.
- Participants may bring snacks and lunch to eat onsite during designated breaks only.
- With the exception of cameras, all electronic devices must be out of sight at all times.

B. Classroom Resources

Background Information for Teachers

This section of the packet provides details regarding the type of information students will learn during a typical field experience at the Marine Science Center. This information is provided in order to help teachers prepare their students for the visit, as well as plan/implement pre and post extension activities to ensure students get the most out of a Marine Science Center visit.

The Rocky Shore

The rocky **intertidal** is a zone of rocky coastline that falls between high tide and low tide. The rise and fall of the tides creates an area that is covered by water part of the day and exposed to air for part of the day. Below the rocky shore is the **subtidal** zone, which is always submerged in water, and above the rocky shore are uplands, which waves rarely reach. These rocky shores generally occur in relatively exposed waters, and are generally comprised of bedrock and other large glacial rocks and cobble.

These rocks provide a hard substrate for a variety of **sessile** (non-moving) organisms to settle. Additionally, many mobile organisms dwell in the cracks, crevices and **tidepools** left behind as the water retreats to the low tide line. Due to the habitat provided by the rocks, the tide pools, and the foundations species living here, the rocky shore hosts variety of life that is much more apparent at first glance compared to the sandy beach. **Invertebrates** and seaweeds (red, green and brown) dominate life on the rocky shore. Large, brown seaweeds form dense canopies that trap water and provide relief from the stressful conditions experienced by organisms during low tide. Cooperation between organisms is important for survival in this stressful environment.

The rocky shore has several distinct zones that are defined by elevation relative to the water's edge and distinct geologic features. These include a low, mid, and high zone, and the splash zone above. The intertidal is not uniform. These distinct zones are submerged in water and exposed to air for different lengths of time, resulting in increasing physical stress associated with higher tidal elevations. This physical stress includes drastic changes in **temperature, salinity, dissolved oxygen** levels, and **pH** in high tidepools during low tide when they are separated from the flow of seawater. Additionally, organisms living directly on the rocks outside of tidepools must deal with **desiccation** stress due to emersion. Organisms have adapted to these stressors by developing high tolerances for changes in these **abiotic** conditions. For instance, a periwinkle in a high tide pool is able to survive in temperatures ranging from below freezing to over 90 degrees F, and salinities ranging from 15 to 45ppt. Wave action is another abiotic stressor on the rocky shore. Large waves can dislodge organisms from the rocks, washing them into deeper waters, or to the uplands beyond the intertidal. As a result many intertidal organisms have adaptations that allow them stick to rocks such as tube feet in sea stars and byssal threads in mussels.

In addition to abiotic stressors, **biotic** stressors include competition and predation. Isolated tidepools contain limited quantities of food and oxygen, leading to competition for these

essential resources. Space is at a premium on rocky shores, and organisms compete for a spot on the rocks to settle. Competition is so intense that organisms even settle on top of one another. Like land plants, seaweeds that grow on other seaweeds are known as epiphytes. Sessile animals such as mussels, barnacles and tunicates settle on each other as well as on larger organisms such as crabs and snails, and are referred to as epibionts.

Intertidal organisms are subject to predation from both land and sea. At high tide large subtidal crabs and fish can venture into the intertidal for a snack. Similarly, at low tide, terrestrial predators such as seabirds, rodents and raccoons might make a meal out of tidepool creatures.

Despite all these challenges and stressors facing organisms in the rocky intertidal, the cold, nutrient-rich waters of the temperate coastal climates in which these habitats occur, allow the rocks to support a large diversity of life.

History of East Point

Nahant has been a popular destination for recreation, science and military defense for years. Nahant is a special type of peninsula known as a tombolo, which means it is nearly an island, only connected to the mainland via a small strait or sandbar. Historically Nahant was a popular vacation destination among affluent Bostonians. In the 1800s hotels and summer vacation homes dominated the town. East Point, the current site of the Marine Science Center was home to several hotels.

After several fires eliminated the hotels from the site, the military established a presence on East Point, during WWII, due strategic location of Nahant, extending out into Boston Harbor. Remnants of the military presence can still be seen at East Point, including 3 underground bunkers once used for protection and artillery storage, 3 triangulation towers previously used for detecting invading enemies and the infrastructure of a primitive submarine detection device. Post-WWII the military presence persisted with the construction of a Nike Missile Silo.

In 1967, Northeastern University established a marine science lab at East Point with the goals of marine science research, education, and community outreach.

Geology of East Point

East Point, Nahant is well known as an important geological study site due to the unique rocks that make up its terrain, some of which can be found no where else in New England. One reason that the rocks here fascinate geologists is that some rocks in Nahant provide evidence for the theory of Pangea. Using techniques such as Stable Isotope Analysis and Radiocarbon Dating, scientists have shown that rocks in Nahant have the same signatures as rocks in Northern Africa. This indicates that when the African continent split from North America, rocks from Africa were left behind in Nahant.

The sheer cliffs in Nahant also provide visual illustrations of some key geological concepts. The cliffs at East Point are all tilted at a North facing 45 degree angle, evidence that these

rocks were involved in Mountain Building as Africa crashed into North America due to the movement to continental plates.

The rocks that form of the cliffs of East Point have a base of sedimentary rock such as limestone (grey/white) and siltstone (grey, green and black). This rock is around 580 million years old. Around 400 to 500 million years ago, hot molten rock beneath the earth, known as magma, rose to the surface. As it rose, the magma fractured and displaced the sedimentary rock, filling in the cracks it created. These “igneous intrusions” form distinct colored stripes and sections on the rocks at East Point. A horizontal intrusion is known as a sill and a vertical intrusion is known as a dike.

Furthermore, Nahant is home to some very special fossils, which give geologists and paleontologists clues as to what kind of animals inhabited this area millions of years ago. Notably, the rocks here are home to the oldest fossils of shelled organisms (ancestors of modern Mollusks).

CONNECTIONS TO MASSACHUSETTS CURRICULUM FRAMEWORKS (Grade 3rd-5th)

	Classroom	Rocky Shore	Touch Tank	Tour	Pre / Post Activity
Science and Technology/Engineering					
<i>Earth and Space Sciences</i>					
<ul style="list-style-type: none"> 3-ESS2-1- Use graphs and tables of local weather data to describe and predict typical weather during a particular season in an area 		•			•
<ul style="list-style-type: none"> 3-ESS2-2. Obtain and summarize information about the climate of different regions of the world to illustrate that typical weather conditions over a year vary by region 		•		•	
<ul style="list-style-type: none"> 4-ESS1-1. Use evidence from a given landscape that includes simple landforms and rock layers to support a claim about the role of erosion or deposition in the formation of the landscape over long periods of time 		•		•	•
<ul style="list-style-type: none"> 4-ESS2-1. Make observations and collect data to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering and moved around through erosion by water, ice, wind, and vegetation 		•	•	•	•
<ul style="list-style-type: none"> 4-ESS3-2. Evaluate different solutions to reduce the impacts of a natural event such as an earthquake, blizzard, or flood on humans. 				•	
<ul style="list-style-type: none"> 5-ESS1-2. Use a model to communicate Earth’s relationship to the Sun, Moon, and other stars that explain (a) why people on Earth experience day and night, (b) patterns in daily changes in length and direction of shadows over a day, and (c) changes in the apparent position of the Sun, Moon, and stars at different times during a day, over a month, and over a year. 					
<ul style="list-style-type: none"> 5-ESS2-1- Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation 	•	•	•	•	•
<ul style="list-style-type: none"> 5-ESS2-2- Describe and graph the relative amounts of salt water in the ocean; fresh water in lakes, rivers, and ground water; and fresh water frozen in glaciers and polar ice caps to provide evidence about the availability of freshwater in Earth’s biosphere 	•	•		•	
<ul style="list-style-type: none"> 5-ESS3-1- Obtain and combine information about ways communities reduce human impact on the Earth’s resources and environment by changing agricultural, industrial, or community practices. 		•	•	•	•
<i>Life Science</i>					
<ul style="list-style-type: none"> 3-LS1-1- Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen 		•	•		•
<ul style="list-style-type: none"> 3-LS3-1. Provide evidence, including through the analysis of data, that plants and animals have traits inherited from parents and that variation of these traits exist in a group of similar organisms. 	•	•	•		•

	Classroom	Rocky Shore	Touch Tank	Tour	Pre / Post Activity
<i>Life Science (continued)</i>					
<ul style="list-style-type: none"> 3-LS3-2. Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. Give examples of characteristics of living organisms that are influenced by both inheritance and the environment. 		•	•		•
<ul style="list-style-type: none"> 3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. 	•	•	•		•
<ul style="list-style-type: none"> 3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. 	•	•	•	•	•
<ul style="list-style-type: none"> 3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce 	•	•			•
<ul style="list-style-type: none"> 3-LS4-5 (MA). Provide evidence to support a claim that the survival of a population is dependent upon reproduction 		•	•		•
<ul style="list-style-type: none"> 4-LS1-1. Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction. 	•	•	•		•
<ul style="list-style-type: none"> 5-LS1-1. Ask testable questions about the process by which plants use air, water, and energy from sunlight to produce sugars and plant materials needed for growth and reproduction 	•	•	•		•
<ul style="list-style-type: none"> 5-LS2-1. Develop a model to describe the movement of matter among producers, consumers, decomposers, and the air, water, and soil in the environment to show that plants produce sugars and plant materials, that animals can eat plants or other animals for food, and that some organisms, including fungi and bacteria, break down dead organisms and recycle some materials back to the air and soil 	•	•	•		•
<i>Physical Science</i>					
<ul style="list-style-type: none"> 5-PS2-1. Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward Earth's center. 	•				
<ul style="list-style-type: none"> 5-PS3-1. Use a model to describe that the food animals digest (a) contains energy that was once energy from the Sun, and (b) provides energy and nutrients for life processes, including body repair, growth, motion, body warmth, and reproduction. 	•	•	•		•
English Language Arts					
<i>Reading Standards for Informational Texts</i>					
<ul style="list-style-type: none"> RI.1 (3-5)- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text 		•	•	•	
<ul style="list-style-type: none"> RI.3 (3-5)- Explain events, ideas, procedures, or concepts in a historical, scientific, or technical text, including what happened and why, based on scientific information in the text 		•	•		•

	Classroom	Rocky Shore	Touch Tank	Tour	Pre / Post Activity
<i>Reading Standards for Informational Texts (continued)</i>					
<ul style="list-style-type: none"> RI.4 (3-5)- Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a 3-5 grade level topic or subject area 		•			•
<ul style="list-style-type: none"> RI.7 (3-5)- Interpret information presented orally, visually, or quantitatively, and explain how the information contributes to an understanding of the text in which it appears 		•			•
<i>Writing Standards</i>					
<ul style="list-style-type: none"> W.2 (3-5)- Write informative/explanatory texts to examine a topic and convey ideas and information clearly 					•
<ul style="list-style-type: none"> W.7 (3-5)- Conduct short research projects that build knowledge through investigation of different aspects of a topic 		•			•
<ul style="list-style-type: none"> W.10 (3-5)- Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences 	•	•			•
<i>Speaking and Listening Standards</i>					
<ul style="list-style-type: none"> SL.1 (3-5). Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade level topics and texts, building on others’ ideas and expressing their own clearly. 	•	•	•	•	•
<ul style="list-style-type: none"> SL.2 (3-5). Determine the main ideas and supporting details of / Paraphrase / Summarize a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. 	•	•	•	•	•
<ul style="list-style-type: none"> SL.3 (3-5). Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. 	•	•	•	•	•
<ul style="list-style-type: none"> SL.4 (3-5). Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes 	•	•	•	•	•
Mathematics					
<i>Operations and Algebraic Thinking</i>					
<ul style="list-style-type: none"> 3.OA-1. Interpret products of whole numbers 	•	•			
<ul style="list-style-type: none"> 3.OA-2. Interpret whole-number quotients of whole numbers 	•				
<ul style="list-style-type: none"> 3.OA-7. Fluently multiply and divide within 100 	•	•			
History and Social Science					
<ul style="list-style-type: none"> 3.1 On a map of the United States, locate the New England states (Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, Maine) and the Atlantic Ocean. On a map of Massachusetts, locate major cities and towns, Cape Ann, Cape Cod, the Connecticut River, the 				•	

<i>History and Social Science (continued)</i>	Classroom	Rocky Shore	Touch Tank	Tour	Pre / Post Activity
Merrimack River, the Charles River, and the Berkshire Hills.					
<ul style="list-style-type: none"> 3.9 Identify historic buildings, monuments, or sites in the area and explain their purpose and significance. 				•	
<ul style="list-style-type: none"> 3.11 Identify when the students' own town or city was founded, and describe the different groups of people who have settled in the community since its founding. 				•	
<ul style="list-style-type: none"> 3.12 Explain how objects or artifacts of everyday life in the past tell us how ordinary people lived and how everyday life has changed. Draw on the services of the local historical society and local museums as needed. 				•	
<ul style="list-style-type: none"> 3.14 Give examples of tax-supported facilities and services provided by their local government, such as public schools, parks, recreational facilities, police and fire departments, and libraries. 				•	
Comprehensive Health					
<ul style="list-style-type: none"> 13.1 Describe types of natural resources and their connection with health 				•	
<ul style="list-style-type: none"> 13.2 Describe how business, industry, and individuals can work cooperatively to solve ecological health problems, such as conserving natural resources and decreasing pollution 		•	•	•	

Extension Activities

These in-school activities are designed to either prepare students for, or debrief students after their field experience. While some activities are particularly suited for either before or after, some are more flexible and can be conducted anytime as teachers see fit. All activities satisfy requirements of the Massachusetts Curriculum Frameworks.

Activity 1: Introduction to the rocky shore and Nahant

Materials:

Slide presentation (provided)

Map of Nahant (provided)

Rocky shore vocab list (provided)

Duration: 1 class period

Learning Objectives: Build on prior knowledge to learn what lives on the rocky shore, and the physical factors that influence life in this habitat.

Instructions:

- This activity introduces students to the field-trip site and prepares them for the trip, including an explanation of the activities on the trip, vocabulary and field-trip etiquette/safety.
- Teacher displays an image of a rocky shore and asks students if they have ever been to such a place. Students will be invited to share their experiences of the rocky shore in a group discussion. Discussion will continue as teacher presents the rocky shore Slide show and introduces students to vocabulary associated with the rocky shore.
- Teacher will pose questions such as
 - What kind of organisms live on the rocky shore?
 - What might make it hard or stressful to live on the rocky shore?
 - What kind of adaptations might organisms have to survive here?
- After the discussion of the rocky shore, teacher will show students a map of Nahant as an example of a rocky shore location. Teacher will lead a discussion about Nahant and the upcoming field trip.

Activity 2: Introduction to taxonomic classification

Materials:

Variety of seashells

Field guides (books and/or online)

Duration: 1 class period

Learning Objectives: Classify animals based on shared characteristics

Instructions:

- Students will be organized into groups of 4 to classify different types of shells based on characteristics observed. Groups will share and discuss their classification schemes with the whole group. The teacher will then show students how to use a field guide to identify organisms, shells in particular. Students will use the field guides to identify the types of shells they have been given.

Activity 3: Weather Observations

Materials:

Thermometer
Weather data sheet (provided)
Cloud Types Chart (provided)
Beaufort Scale Chart (provided)

Duration: 1 class period

Learning Objectives: Recognize how weather impacts living organisms, practice field sampling procedures

Instructions:

- Teacher will lead a discussion on weather and how it impacts all the living things on our planet. When scientists collect data in nature, they need to consider how the weather might impact the natural world which they are studying. Teacher will introduce several tools that scientists use to study the weather and how they work. Teachers will lead students outside to use the tools to make and record observations about the weather. This activity prepares students for weather data they will collect during a field experience at the Marine Science Center.

Activity 4: Rocky shore memory game

Materials:

Printed pictures of rocky shore organisms/objects (provided)
Printed names of rocky shore organisms/terms (provided)

Duration: 10-20 minutes

Learning Objectives: Review recently learned vocabulary

Instructions:

- Pairs of students will be given an envelope containing the vocabulary terms addressed in the Slide presentation and images representing those terms. Students will work together to sort the images with the correct term.

Activity 5: Research a rocky shore organism

Materials:

Research materials (books and/or online)
Presentation materials (posters and/or electronic)

Duration: 1-2 class periods

Learning Objectives: Become familiar with rocky shore species, practice research skills

Instructions:

- Students (on their own or in pairs) will choose a rocky shore organism to research. Students should focus on the specific habitat or niche of the organism, how it grows, eats and reproduces and special adaptations that allows it to live on the rocky shore.
- Students will present information on their organism to the class.

Activity 6: Construct a field guide

Materials:

Field guide template (provided)

Learning Objectives: Become familiar with rocky shore organisms and classification methods

Duration: 1-2 class periods

Instructions:

- Using information learned from previous activities, field trip or research (activity 4) students will create field guide pages for selected rocky shore organisms.
- Depending on grade level and time constraints, all pages can be combined into one field guide for the entire class, or smaller groups of students can collaborate to create a field guide among their group.

Activity 7: Name that organism!

Materials:

Rocky shore organism photos (provided in field guide, be sure to remove names first!)

Duration: 10-15 minutes

Learning Objectives: Use prior knowledge to identify organisms

Instructions:

- In this assessment activity, ten images of rocky shore organisms will be displayed one at a time to the whole group. Students are given 3 minutes to individually use their field guide to identify and record the displayed organisms.

Activity 8: Construct a food web

Materials:

Pictures of rocky shore organisms
Food web worksheet and template (provided)
Yarn
Poster or board on which to construct food web

Duration: 1 class period

Learning Objectives: Identify feeding relationships and how energy is transferred between organisms.

Instructions:

- Students will use the knowledge they have gained from NUMSC visit and classroom activities to construct a food web with pictures of organisms, identifying organisms at different feeding levels (consumers, producers etc.)
- Depending on age level, students can make one food web as a group using poster and yarn, or use the worksheet and template provided to create their own food web.

Rocky Shore Vocabulary List

Intertidal

Tidepool

Evaporation

Salinity

Temperature

Tide

Adaptation

Quadrat

Cloud types

Beaufort scale

Invertebrate

Rocky Shore Vocab List – Definitions

Intertidal – the area on a beach between the low tide line and the high tide line, which is covered by water at high tide and exposed to air at low tide.

Tidepool – a pool of water that is left behind and/or trapped by the rocks as water falls to the low tide line. These pools provide a place of refuge for organisms that are exposed to air during low tide.

Evaporation – the process by which water changes phase, becoming a gas or vapor. This process requires heat energy. Example: when the sun heats up the water in a tidepool, the water evaporates.

Salinity – the content of dissolved salts contained in a solution; saltiness.

Temperature – a measure of hot and cold; also a measure of how fast the atoms and molecules in a substance are moving: higher temperature=faster, lower temperature=slower.

Tide – the rise and fall of sea levels caused by the gravitational forces exerted by the moon and sun and the rotation of the Earth.

Adaptation – an adjustment or modification of the traits of an organism to make them more suited to survive in a particular environment.

Quadrat – a square constructed out of PVC or other materials that is used by scientists to count the number of organisms in a habitat. It would be very time consuming to count all the organisms in a habitat, so instead scientists can count the number of organisms in the quadrat, and use this number to estimate the density (#per area) of the organisms.

Cloud types:

- **Stratus** – thin flat layer in the sky, can occur at any level, Ex. Altostratus are mid-level stratus clouds.
- **Cirrus** – wisps that look like curls of hair, usually located high in the sky.
- **Cumulous** – large puffy heap of clouds
- **Nimbus** – dark rain clouds

Beaufort scale – a measure of wind speed on a scale of 1-12, based on observed conditions on land or at sea.

Invertebrate – an animal that lacks a vertebral column. 97% of all animal species on earth are invertebrates. Examples include: worms, insects, jellyfish, sea stars, squid

Rocky Shore Species List

Phylum	Subphylum /Class	Common name	Scientific name
Cnidaria		Frilled Anemone	<i>Metridium senile</i>
		Hydroid	Various
Mollusca	Gastropoda	Smooth periwinkle	<i>Littorina obtusata</i>
		Common periwinkle	<i>Littorina littorea</i>
		Rough periwinkle	<i>Littorina saxatilis</i>
		Atlantic dog whelk	<i>Nucella lapillus</i>
		Slipper snail	<i>Crepidula fornicata</i>
		Limpet	<i>Tectura testudinalis</i>
		Nudibranch	<i>Aeolidia Papillosa</i>
	Bivalvia	Blue mussel	<i>Mytilus edulis</i>
Echinodermata		Forbes sea star	<i>Asterias forbesi</i>
		Northern sea star	<i>Asterias vulgaris</i>
		Blood star	<i>Henricia sanguinolenta</i>
		Green sea urchin	<i>Strongylocentrotus drobachiensis</i>
Arthropoda	Crustacea	Shrimp	Various
		Green crab	<i>Carcinus maenas</i>
		Rock crab	<i>Cancer irroratus</i>
		Jonah crab	<i>Cancer borealis</i>
		Asian shore crab	<i>Hemigrapsus sanguineus</i>
		Spider crab	<i>Libinia emarginata</i>
		Long-clawed hermit crab	<i>Pagurus longicarpus</i>
		Acorn barnacle	<i>Semibalanus balanoides</i>
		Amphipod	Various
	Hexopoda	Springtails	<i>Anurida maritima</i>
Chordata		Sheath tunicate	<i>Botrylloides violaceus</i>
Porifera		Sponges	Various
Bryozoa		Bryozoans (lacy crust)	<i>Membranipora</i> spp.
Rodophyta		Irish moss	<i>Chondrus crispus</i>

(red algae)		False Irish moss	<i>Mastocarpus stellatus</i>
		Dulse	<i>Palmaria palmata</i>
		Coralline algae	<i>Corallina officianalis</i>
		Filamentous red algae	Various
		Red stain algae	<i>Hildenbrandia rubre</i>
Heterokontophyta (brown algae)		Rockweed	<i>Fucus vesiculosus</i>
		Knotted wrack	<i>Ascophyllum nodosum</i>
		Common kelp	<i>Laminaria saccharina</i>
		Brown crust	<i>Ralfsia verucosa</i>
Chlorophyta (green algae)		Sea lettuce	<i>Ulva lactuca</i>
		Gutweed	<i>Ulva intestinalis</i>
		Dead man's fingers	<i>Codium fragile subsp. tomentosoides</i>
		Filamentous green algae	Various



WEATHER OBSERVATIONS

Today's Date: _____

Group members: _____

Weather (circle one)

Sunny Partly Cloudy Mostly Cloudy Overcast Rainy

Use the chart to identify the cloud types in the sky and write them here:

Estimate the wind speed (circle one)

<5 mph 1-5 mph 6-10 mph 11-20 mph > 20 mph

Estimate the wind speed using the Beaufort scale (circle one)

0 1 2 3 4 5 6 7 8 9 10 11 12

Air temperature _____ °F *(sit thermometer in shade for at least 30 seconds)*



CREATE A ROCKY SHORE FOOD WEB

Name: _____ Date: _____

Instructions:

1. Use the list of living things below and pyramid to make a diagram showing who eats whom on the rocky shore.
2. Work together with your classmates and use resources like textbooks or the Internet to determine if each living thing is a Producer or Consumer and what it eats or gets eaten by.
3. Write the name or draw a picture of each rocky shore critter on the food web pyramid.
4. Next draw arrows up the food web from who gets eaten, to who eats it

Example: snail → crab, because the crab eats the snail.

****Remember that since this is a food web, not a food chain, organisms can eat more than one and get eaten by more than one thing, allowing for many arrows****

Living things on the rocky shore

Snail

Crab

Sea gull

Barnacle

Fish

Sea urchin

Phytoplankton

Seaweed

Sea star

Blue mussel

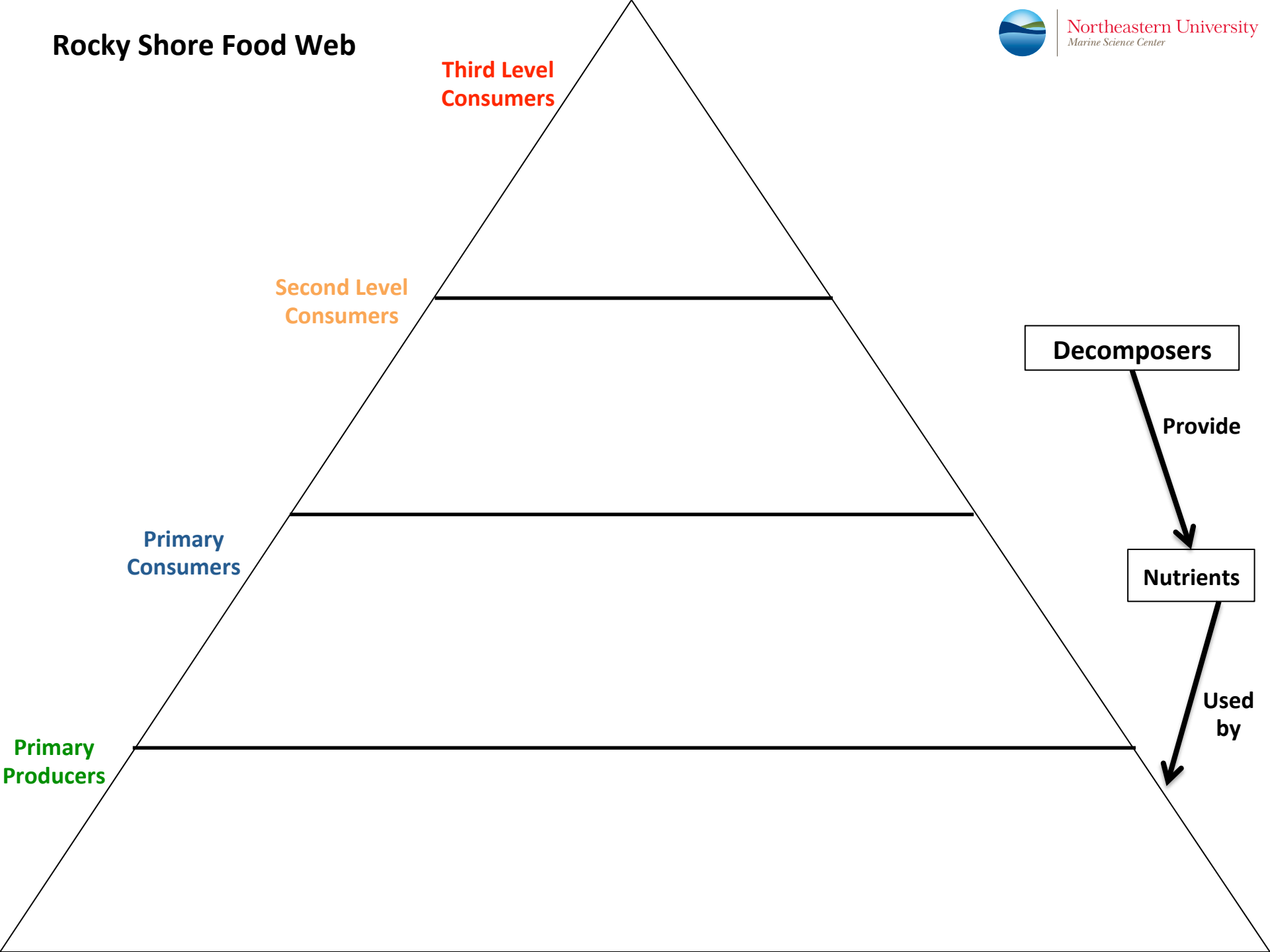
Zooplankton

Seal

Why do the arrows point from something that gets eaten to something that eats it? What does the predator/herbivore get from its prey?

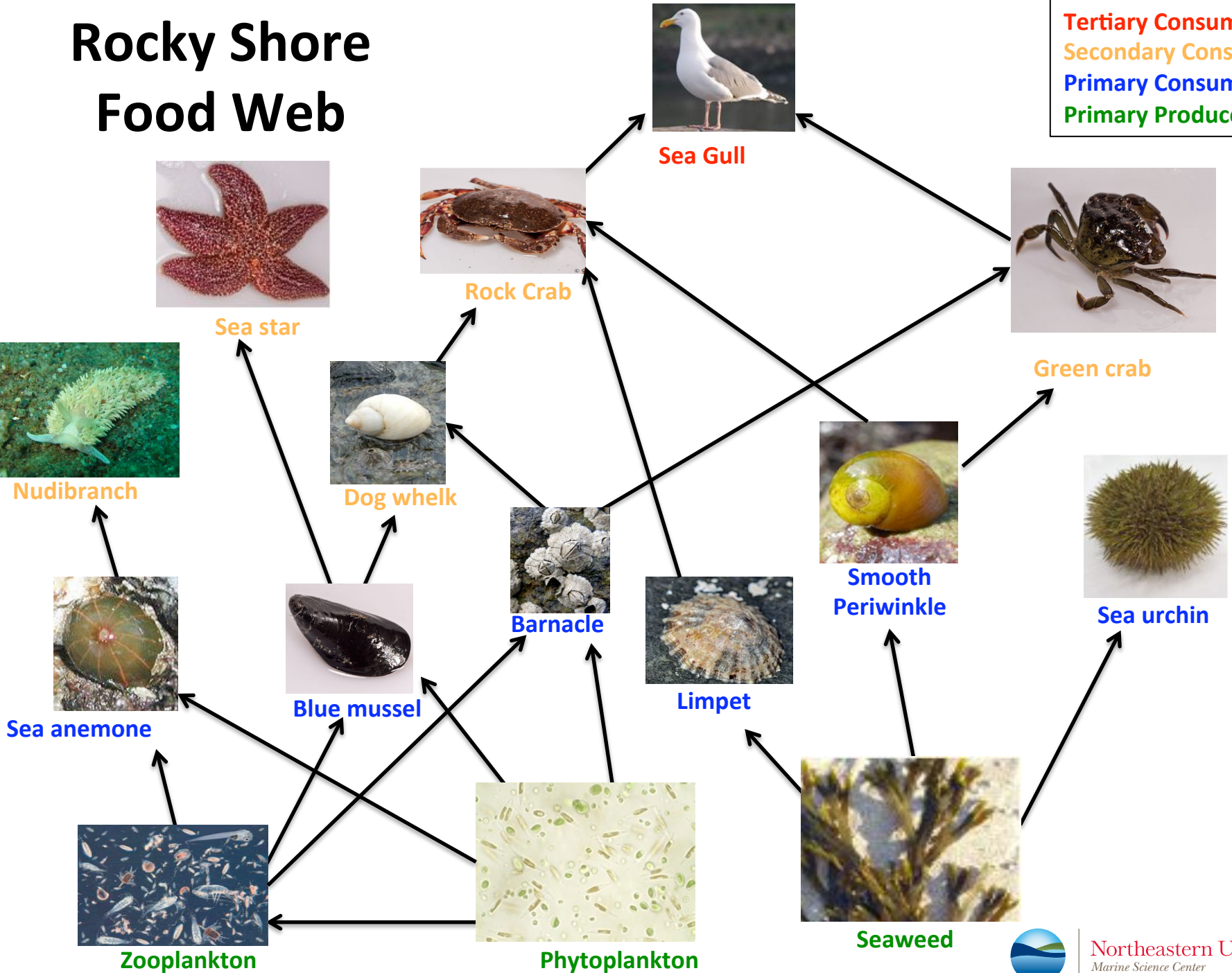
Arrow=_____

Rocky Shore Food Web



Rocky Shore Food Web

Tertiary Consumers
Secondary Consumers
Primary Consumers
Primary Producers





Construct a Field Guide

Organism Name: _____










Habitat: _____

Interesting fact about this organism: _____

Draw the organism or paste a picture of the organism in this box:

A Guide to the Rocky Intertidal: **Arthropods**











 <p>Asian Shore Crab</p>	 <p>Green Crab</p>	 <p>Hermit Crab</p>	 <p>Jonah Crab</p>	 <p>Barnacle</p>
 <p>Rock Crab</p>	 <p>American Lobster</p>	 <p>Spider Crab</p>	 <p>Shrimp</p>	 <p>Amphipod</p>

Arthropods

A Guide to the Rocky Intertidal: **Mollusks**















 <p>Rough Periwinkle</p>	 <p>Common Periwinkle</p>	 <p>Blue Mussel</p>	 <p>Lady Slipper Snail</p>	 <p>Nudibranch</p>
 <p>Smooth Periwinkle</p>	 <p>Dog Whelk</p>	 <p>Limpet</p>	 <p>Moon Snail</p>	

Mollusks











A Guide to the Rocky Intertidal: **Algae**



					
Dulse	Red Stain Algae	Filamentous Red Algae	Coralline algae	Irish Moss	Kelp
					
Dead Man's Fingers	Gut Weed	Filamentous Green Algae	Sea Lettuce	Rockweed	Knotted Wrack

A Guide to the Rocky Intertidal: **Echinoderms, etc.**



				
Common Sea Star	Blood Star	Green Sea Urchin	Crust Bryozoan	Hydroid
				
Tunicate	Springtails	Anemone	Cormorant	Rock Gunnel

Cloud Types

Cirra-means 'high-level'

Cirrostratus clouds are more like a thin veil high in the sky

Cirrocumulus clouds are layered with little lumps

Cirrus clouds are thin and wispy and made of ice crystals

Alto-means 'mid-level'

Altostratus clouds are flat and may thicken and lower into rain or snow

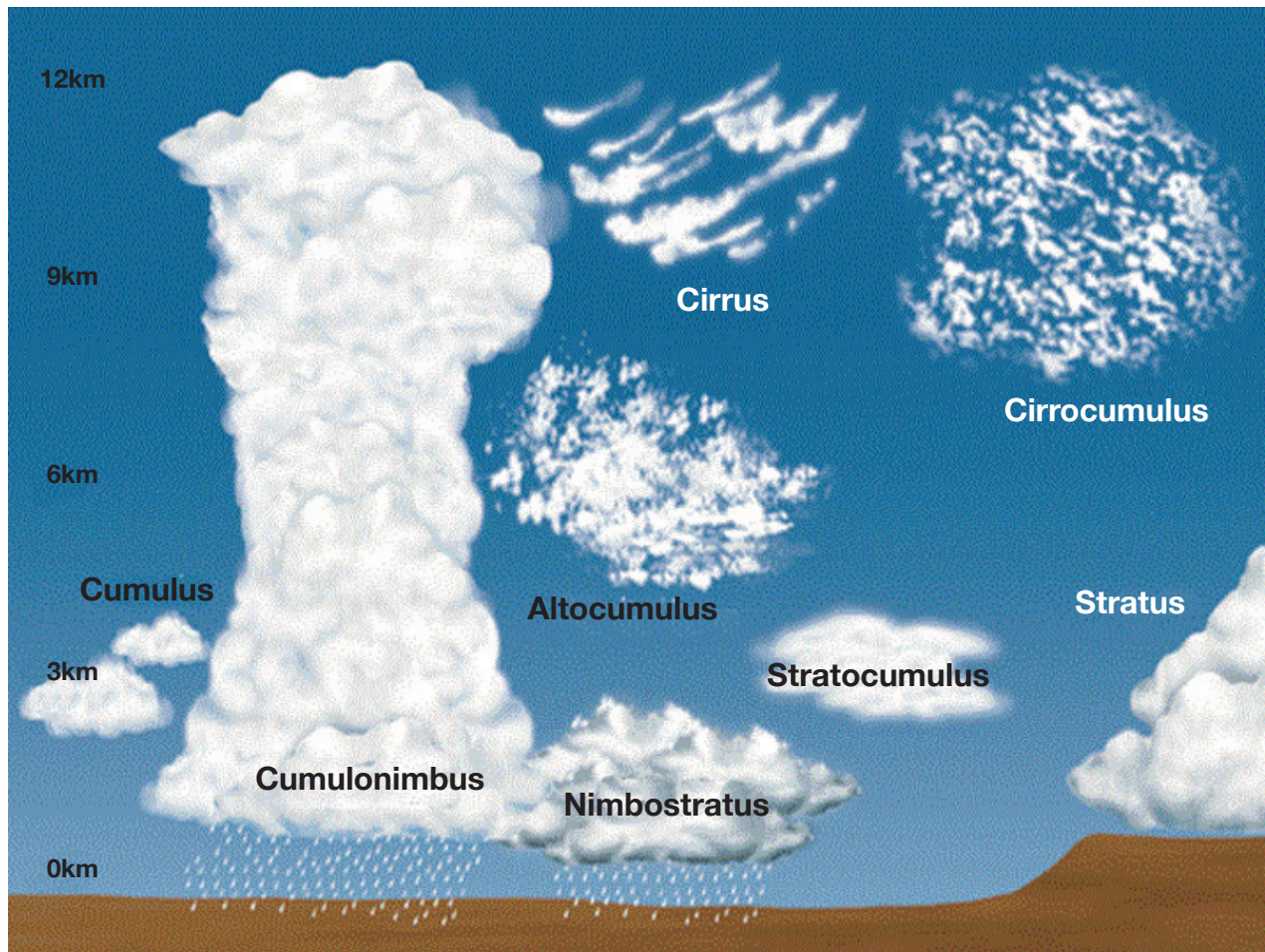
Alto cumulus clouds are heaped up and may form rows

Stratus clouds are flat and make a low grey layer of clouds make light rain

Stratocumulus clouds form a layer of cloud lumps with thick and thin areas

Nimbus-mean 'rain or snow'

Cumulonimbus clouds produce large storms



BEAUFORT SCALE		
Beufort Scale	Description	feels like/looks like:
0	Calm, wind less than 1 mph, water is flat.	Calm, smoke rises straight up
1	Light air; wind 1-3 mph, water has ripples without crests.	Smoke drifts in direction of wind
2	Light breeze; wind 4-7 mph, water has small wavelets, glassy crests, not breaking	Wind felt on skin, leaves rustle.
3	Gentle breeze; wind 8-12 mph, water has large wavelets, scattered whitecaps and crests begin to break	Leaves small twigs constantly moving, flags fluttering.
4	Moderate breeze; wind 13-17 mph, water has small waves with breaking crests, whitecaps.	Dust blowing, small branches moving.
5	Fresh breeze; wind 18-24 mph, water has moderate waves, many whitecaps, a little spray.	Medium sized branches move small trees start to sway
6	Strong breeze; wind 25-30 mph, water has many white foam crests, some airborne spray.	Large branches move, wires whistle, umbrellas are hard to use.
7	High wind; wind 31-38 mph, water heaps up, foam from breaking waves blown in streaks along wind direction, moderate airborne spray.	Whole trees moving, hard to walk against the wind..
8	Gale, wind 39-46 mph, Moderately high waves, well marked streaks foam in wind direction, considerable airborne spray	Twigs breaking off of trees, cars swerving from wind, can't walk against the wind.
9	Strong gale; wind 47-54 mph, water has high waves whose crests sometimes roll, dense foam, spray may reduce visibility	Some branches break off trees, small trees blown over, traffic cones blow over.
10	Storm; wind 55-63 mph, water has very high waves, large patches of foam make sea look white, spray reduces visibility	Trees are broken or uprooted, shingles on roofs peel off and blow away.
11	Violent storm; wind 64-72 mph, water has exceptionally high waves, very large patches of foam cover most of sea surface, poor visibility from spray.	Lots of damage to plants, many roofs damages.
12	Hurricane; wind greater than 73 mph, high waves, sea completely white, air filled with spray.	Lots of damage to plants, windows break, flying debris.



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