



## Marine Conservation Science & Policy: Intertidal Zone

### Grade Level:

4<sup>th</sup>- 12<sup>th</sup>

### Subject Area

Science

Biology

### Duration

1.5 Hrs

### Benchmarks:

#### Body of Knowledge

Life Science

Nature of Science

#### Big Idea

Organization and Development of Living Organisms.

The Practice of Science

#### Standards

##### SC.1.L.17.1

Recognize that all plants and animals, including humans, need the basic necessities of air, water, food and space.

##### SC.4.L.17.2

Trace the flow of energy from the Sun as it is transferred along the food chain through the producers and the consumers.

##### SC.7.L.17.1

Explain and illustrate the roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.

##### SC912.L.17.9

Use a food web to identify and distinguish producers, consumers and decomposers.

### Focus Question

What is the intertidal zone? What organisms live in this habitat and what challenges do they face? What is a food chain and what organisms of the intertidal zone are interconnected?

### Objectives

Students will explore the intertidal zone and discover some of the unique qualities of this ecosystem. Students will learn to:

- Identify the four subzones of the intertidal zone.
- Identify some of the organisms that live in this habitat and the challenges they face.
- Describe a food chain and elaborate one found in the intertidal zone.

This will be a project-based activity in which students will discuss the interconnectedness of organisms and the habitats in which they live.

### Background

The rhythmic rise and fall of the ocean surface is due mostly to the pull exerted on the water by the moon's gravity. This daily flooding and draining exposes a unique habitat along the coasts called the intertidal zone. The intertidal zone, also known as the littoral zone, is the area along the shore of marine environments that is exposed to the air in low tide and flooded by the seawater during high tide.

The intertidal zone can be divided into four subzones, including the spray zone, the high tide zone, the middle tide zone, and the low tide zone. The spray zone, or supratidal zone, is more of a terrestrial environment, as it lies above the spring high tide line and is only flooded during storm surges or other extreme weather events. While this zone receives waves splash and wind-blown spray, organisms here must be able to cope with exposure to air, heat, freshwater from rain, and predators like sea gulls. Some organisms that make this zone their habitat include barnacles, as well as land crabs, sea gulls, possibly even raccoons and seals.

Just lower than the spray zone, the high intertidal zone, as the name implies, is only flooded during high tide, and is exposed to the air for the longest amounts of time. This exposure means that marine organisms risk **desiccation**, or loss of water, and must adapt by hiding or clamming up, which means sealing off their shell to conserve moisture. Marine organisms that have adapted to withstand this exposure include red, brown and green algae, hermit crabs, limpets, and some snails and whelks.

The middle intertidal zone, also called the lower mid-littoral zone, is generally submerged, except for brief periods during low tide. Organisms that thrive in this zone have adapted to the turbulence of the daily tidal rhythms, and include sea stars, snails, barnacles, anemones, crabs, sea lettuce, and mussels.

The low intertidal zone is usually underwater, only exposed to the air when the tide is unusually low. Organisms that live in this zone are not well adapted to long periods of dryness

## Vocabulary:

### **Intertidal Zone:**

The area along the coastal shores that are exposed and flooded alternately by the ocean tides.

### **Spray Zone:**

The area just above the tide line that still receives splash from wind and waves.

### **High Intertidal Zone:**

The shore area only flooded by high tide, exposing its marine organisms to the elements.

### **Desiccation:**

Drying out or loss of water.

### **Middle Intertidal Zone:**

The shore area generally submerged but still exposed daily during low tide.

### **Low Intertidal Zone:**

The shore area is only exposed during extreme low tides, hosting organisms that are not well adapted to dryness or extreme temperatures.

### **Food Chain:**

A group of organisms linked in the order of the food they eat, starting with primary producers and continuing through consumers and eventually to decomposers.

### **Food Web:**

The natural overlapping interconnections between food chains in an ecosystem.

### **Primary Producers:**

Organisms that use photosynthesis to convert energy from the sun into nutrients, forming the base of most food chains.

### **Consumers:**

Organisms that need to eat other organisms for nutrients, these can be divided into herbivores, carnivores, and omnivores.

### **Decomposers:**

Organisms that consume organic material, including dead tissues and wastes, breaking down nutrients and returning them to producers.

## Background

or extreme temperatures. Some organisms that may be found in this zone include abalone, sea urchins, sea stars, brown seaweed, sea cucumber, sponges, shrimp, surf grass, tubeworms, and some small octopus species.

Particularly along rocky shores, tide pools can form in the intertidal zones, areas of low depression that retain seawater as the tide recedes. Tide pools can range from shallow to deep, and can be found in all subzones of the intertidal zone. Because the water can evaporate, tide pools threaten inhabitants with wild changes in salinity, oxygen and temperatures, and exposure to the sweltering sun and predators. Despite the challenges, many creatures can be found in tide pools, including sea anemones, starfish, barnacles, hermit crabs, and even fish.

This zone forms an extreme environment for four particular reasons: providing only intermittently the supply of water which marine organisms need to survive; poorly adapted animals can be dislodged and washed away by the intense wave action along the shore; the high exposure to the sun causes an extreme range of temperatures from near boiling to almost freezing; and a much higher salinity as sea water left in pools evaporates leaving behind salt deposits.

While the intertidal zone poses many challenges to organisms trying to cope, it also provides many advantages to those able to adapt. The relentless wave action, though abrasive, also constantly supplies the zone with fresh nutrients and oxygen. The rocky protrusions also provide all sorts of nooks and crannies that make perfect hiding places and surfaces to cling to. These benefits also include plentiful sources of food, as the abundant sunlight also supports many algae and intertidal plants that form the base of a rich food chain.

A **food chain** is a group of organism linked in the order of the food they eat, starting with **primary producers** like plants and algae and moving up through **consumers**, including prey, predators, and ending with **decomposers**. A **food web** can connect many food chains and demonstrate the interconnections between organisms.

In the intertidal zone, the food chain begins with phytoplankton, microorganisms that use photosynthesis to create energy from the sun. These are usually consumed by zooplankton, which in turn is eaten by mussels, barnacles or other invertebrate. Barnacles are usually eaten by whelks, a type of snail that in turn is preyed upon by sea stars. While sea stars are near the very top of the food chain, they can be still be gobbled up by a sea gull or a sea otter. When the highest predator, such as a gull or a sea otter, dies, its body is consumed by decomposers, animals that break down dead tissues and wastes. Sea urchins are common intertidal zone decomposers, and as they can be eaten by sea stars, the food chain can be linked into the food web. In this manner, the food web displays not just the “who eats what”, but highlights the complex interactions and interconnectedness of all organisms and their environment.

## Supplemental Resources

“Food Web.” National Geographic Education.

<http://education.nationalgeographic.org/encyclopedia/food-web/>

“Intertidal Zone.” BBC Nature.

[http://www.bbc.co.uk/nature/habitats/Intertidal\\_zone](http://www.bbc.co.uk/nature/habitats/Intertidal_zone)

“Point Reyes Intertidal and Subtidal Zones.” National Park Service.

<http://www.nps.gov/pore/learn/nature/intertidal.htm>

## Vocabulary:

### **Intertidal Zone:**

The area along the coastal shores that are exposed and flooded alternately by the ocean tides. This zone can be divided into four subzones, including the spray zone, and the high, mid and low intertidal zones.

### **Food Chain:**

A group of organisms linked in the order of the food they eat, starting with primary producers and continuing through consumers and eventually to decomposers.

### **Food Web:**

The natural overlapping interconnections between food chains in an ecosystem

## Extension Activity:

Have students reply to the following prompt in their science journal:  
The food web is an important concept for all of us to know. Write an explanation of the food web that would help your younger brother or sister understand.

## Assessment:

Have students complete the intertidal worksheet after class. Have students write a reflection paragraph imagining what would happen if one of the links of the food web (i.e. phytoplankton) were completely eliminated. How would that affect other organisms?

## Program Partner:

## Materials

- Chalkboard or marker board or large butcher paper
- Chalk, dry erase marker or other marker, depending on above availability
- Tape
- Index cards (or similar sized pieces of paper)
- Crayons, markers, or colored pencils
- Pens or pencils
- Specimens from the intertidal zone or books, magazines or printouts, or include photos in a data show of animals from the intertidal zone if available)

## Procedure

1. Write the names of the four intertidal zones on the board or butcher paper to create four columns.
2. Divide the students into four groups and assign each group one of the four zones.
3. Have each group complete the following on the index cards:
  - 1 card describing their assigned zone including physical factors that affect the habitat (i.e. turbulence, sun exposure, etc.)
  - Several cards demonstrating some of the organisms that live in their assigned zone, each card should feature: the name of the organism, what they eat, any special features that help them adapt to the intertidal zone, and a drawing of the animal.
4. Have each group present their zone and organisms, taping their cards in the appropriate column.
5. Once all zones are presented, ask students to help connect them all to form a food web by drawing arrows from producers to consumers, prey to predator. If there is space, draw the Sun, water and bubbles (to indicate oxygen) and include them in the food web. Encourage discussion on the interconnectedness and interdependence of organisms and their environment. Where do humans fit in? What would happen if one type of organism disappeared?

## Worksheet Answer Key

1. Spray zone
2. High intertidal zone
3. Middle intertidal zone
4. Low intertidal zone
5. Answers will vary, may include (but are not limited to):
  - Producers- kelp, bladder wrack, spiral wrack, saw wrack
  - Consumers- sea urchins, rock crabs, sunflower stars, barnacles, hermit crabs
  - Decomposers- sea slugs, bacteria, fungi,

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## The Intertidal Zone

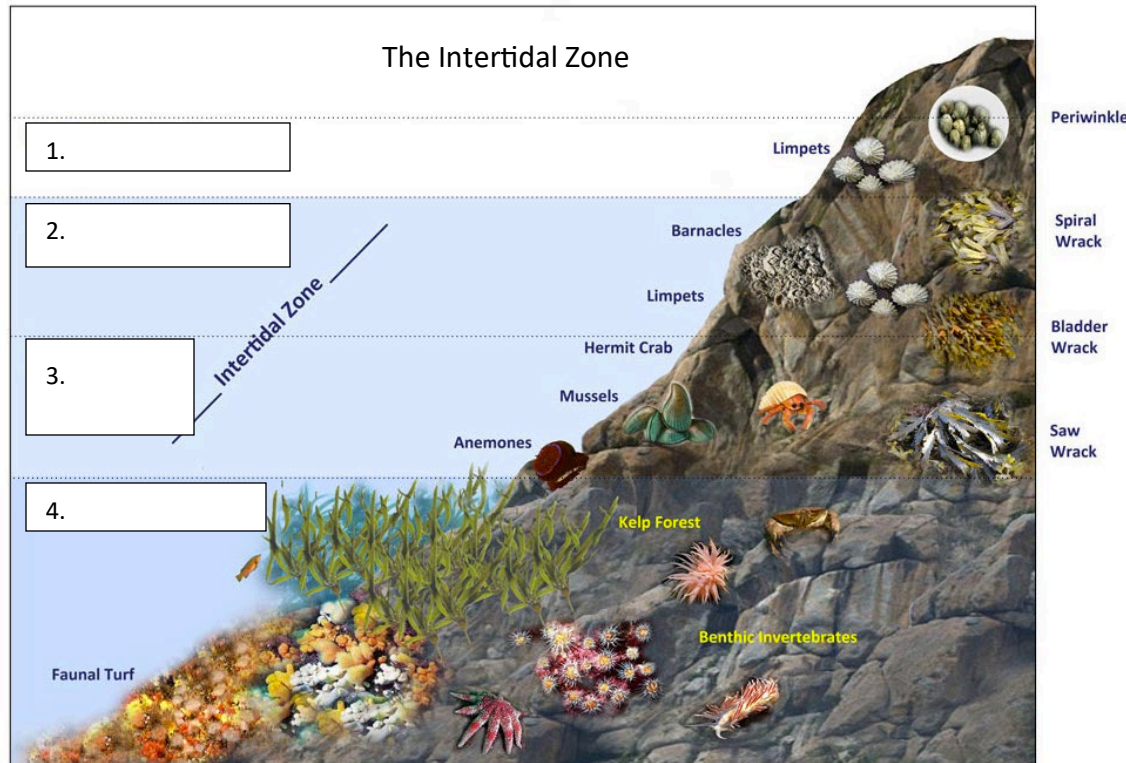
Write in the names of the subzones of the intertidal zone and match them with their description.

This zone is only flooded during high tide, exposing organisms to the sun and air for over 12 hours a day.

This zone is only dry during extreme low tides, hosting organisms that are not well adapted to air exposure.

This zone lies just above the tideline, receiving spray from wind and waves.

This zone is mostly submerged but is drained daily by the turn of low tide.



A food web is a chart that connects organisms, showing the interconnections and who eats what in an ecosystem. Most systems begin with primary producers that use photosynthesis to convert energy from the Sun and create nutrients. Consumers are organisms that need to eat other organisms for nutrients, and these can be divided into herbivores and carnivores. Decomposers are organisms that consume organic material, including dead tissues and wastes, breaking down nutrients and returning them to producers.

5. Using the above diagram and your knowledge, write one organism from the intertidal zone that fits in each category of the food web:

