

Intertidal Station Support Sheet: K - 2nd

Objective:

Discuss characteristics and behaviors that intertidal animals, plants, and algae use to survive.

The purpose of this station is to support student-guided free exploration.

Before they Explore:

- It is important to spend two minutes or less reminding the students about etiquette. Point out a barnacle rock or closed anemone that looks like a rock!
- Tell them that today they are explorers investigating the mysterious intertidal. How can all these sea creatures be without water!? Pay close attention to individual animals and how they survive.

While Exploring:

- Listen to the observations they are making. Let the students guide your interpretation and answer any questions that arise.

After Exploring:

- Have the students re-group after 8-10 minutes of exploring.
- Have them share their observations. Add any information that you think is important for the students to take home.
- Connect all their observations by defining the word “adaptation”. For example, “The anemone’s behavior of closing-up and the anemone’s tentacles are all adaptations. Adaptations are structures, functions, or behaviors of organisms which enables them to survive and thrive in their environment. Intertidal animals need these special adaptations to survive without water twice a day.”

Other important concepts:

- All living things need: water, air (oxygen), food, shelter, a place to raise/have their young, and space to roam.
- Surviving in the intertidal requires: staying wet, holding on, sensing surroundings, feeding, and breathing. All intertidal organisms have unique ways (adaptations) to do these things.

Tools to Utilize:

- Laminated sheets
- Field guides

Intertidal Station Support Sheet: 3rd - 5th

Objective:

Discuss important adaptations of intertidal organisms while considering what is needed to survive in their environment and how organisms interact with each other.

The purpose of this station is to support student-guided free exploration.

Before they Explore:

- It is important to spend two minutes or less reminding the students about etiquette. Point out a barnacle rock or closed anemone that looks like a rock!
- Tell them that today they are explorers investigating the mysterious intertidal. How can all these sea creatures survive without water!? Lets explore and observe to figure out how.

While Exploring:

- Listen to the observations they are making. Let the students guide your interpretation and answer any questions that arise.
- Highlight ways organisms survive and how they interact with one another (prey/predator relations, space and food competition).

After Exploring:

- Have the students re-group after 8-10 minutes of exploring.
 - Have them share their observations.
 - **Explain that** Surviving in the intertidal requires: staying wet, holding on, sensing surroundings, feeding, and breathing. All intertidal organisms have unique ways (adaptations) to do these things. Have the students define adaptation. (Adaptations are structures, functions, or behaviors of organisms which enable them to survive and thrive in their environment).
 - Another important concept to introduce is how structure and function are important to adaptation and survival. Organisms evolve structures to function better in their environment. Body structure is an easy example of this.
- Some animals are **bilaterally symmetrical** (humans, fish) while others are **radially symmetrical** (anemone, sea star).

- How is radial symmetry an adaptation? Why is it important for slow moving and sessile organisms to have this type of body plan? Why does an anemone need tentacles all around its mouth?
- **Answer:** They need to be able to capture food and sense stimuli regardless of the direction it is coming from. Feeding and sensing their surroundings are important requirements to survive in the intertidal and radial symmetry helps anemones and sea stars do this better. In other words the structure of their bodies help them function better and survive in their environment.

Tools to Utilize:

- Laminated sheets
- Field guides

Intertidal Station Support Sheet: 6th - 8th

Objective:

Discuss how individual organisms and populations interact in the intertidal ecosystem, and how changes in populations are related to resources.

The purpose of this station is to support student-guided free exploration.

Before they Explore:

- It is important to spend two minutes or less reminding the students about etiquette. Point out a barnacle rock or closed anemone that looks like a rock!
- Tell them that today they are Marine Biologists exploring how individuals and populations of intertidal organisms interact.
 - **Terminology:** Individuals of one species make up a population. Populations of species make up a community.

While Exploring:

- Listen to the observations they are making. Let the students guide your interpretation and answer any questions that arise.

After Exploring:

- Have the students re-group after about 8-10 minutes of exploring.
- Have them share their observations by asking if anyone observed an:
 1. **Interspecific Interaction** (interaction between individuals of different species) ie competition for space or food, predation, herbivory (animal who eats plants or algae), or symbiosis.
 2. **Intraspecific Interaction** (interaction between individuals of the same species) ie competition for space or food, reproduction etc.
- These interactions control community structure (how many species there are, which species there are, and how many individuals there are of each species).
- If sea star predation is mentioned explain how the interaction of sea stars and their prey species (mussels) is pivotal in the structure of the community. Mussels are excellent space competitors and the predation of the Ochre

Star keeps the mussel population in check, allowing space for other species to live.

3. **Resources** (Competition within and between species centers around the limiting resources of space and food).
 - Competitive success depends upon which organism is more efficient at getting food and/or occupying space.
 - Competition for fixed resources, such as territories, often involves various forms of aggression (Aggregating anemones using specialized tentacles to fight neighboring colonies is a good example of this).

Tools to Utilize:

- **Laminated sheets**
- **Field guides**

Intertidal Station Support Sheet: High School

Objective:

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.

The purpose of this station is to support student-guided free exploration.

Before they explore:

- It is important to spend two minutes or less reminding the students about etiquette. Point out a barnacle rock or closed anemone that looks like a rock!
- Tell them that today they are Marine Biologists who wonder what controls the biodiversity of the intertidal ecosystem.
 - **Terminology:** Biodiversity is how many species there are, which species there are, and how many individuals there are of that species.

While Exploring:

- Listen to the observations they are making. Let the students guide your interpretation and answer any questions that arise.
- Highlight any important biological interactions or characteristics of the intertidal zone that relate to the 5 key concepts below.

After Exploring:

- Have the students re-group after 8-10 minutes of exploring.
 - Ask if any of the students have a hypothesis about what controls the biodiversity in the intertidal ecosystem based on what they observed. Gather multiple hypotheses from different students.
 - Connect and point out the hypotheses mentioned that relate to the following factors that control the biodiversity of the intertidal ecosystem:
1. **Disturbances:** Marine populations suffer extensively from storms, continuous wave action, unstable sediment. Disturbances like these opens up space in the community. The frequency of disturbance regulates long-term biodiversity in an area. If disturbance is very low, then a competitive dominant species will

win and species diversity will equal one species. If disturbance is too extreme than all species, even the competitively dominant one, will be eliminated.

2. Interactions: How individuals of the same species interact with each other and how individuals interact with other species is important in determining biodiversity. Some interactions include: competition for space and food, predation, herbivory, symbiosis, and reproduction.

- Predation is one of the most important interactions in determining biodiversity. Predation works the same way as disturbance. If there are no predators competitively dominant species (like the mussel) will displace competitively inferior species (like the barnacle or anemone). As predation increases, resources and space will open up allowing more competing species to co-exist.

An intermediate level of both disturbance and predation maximizes biodiversity.

3. Biotic Factors: Living organisms which affect other organisms. This includes: competition between organisms for space and food, predation, and herbivory.

4. Abiotic Factors: Non-living characteristics of an ecosystem that affect organisms. This includes: heat stress, shortage of oxygen, and wave shock.

5. Zonation: The distinct pattern of the rocky intertidal results from preferential larval settlement and adult movement, differential physiological tolerance, and biological interactions such as competition and predation. **The upper limit of an intertidal species is regulated by abiotic factors** (drying out, heat stress, lack of oxygen), and **the lower limit is regulated by biotic factors** (competition and predation).

- Intertidal Zones are:

Splash Zone

High Tide Zone

Mid-tide Zone

Low Tide Zone

Tools to Utilize:

- Laminated sheets
- Field guides