Benthos – Intertidal Zone – Tutorial Script

Now let's leave the nekton world and head down to the benthic world, starting with the shallowest parts of the oceans, and the human entry point – the intertidal zone.

Remember, benthic means that an organism lives in or on the seafloor. In the intertidal zone, life is buffeted continually by tidal currents, waves, and changing environmental conditions – from high tide coverage to low tide exposure. Organisms that can survive this harsh environment must be able to combat these challenges and have found a number of clever adaptations for doing so.

To prevent dessication during low tide, animals have shells within which they can withdraw, like snails, limpets, mussels, and hermit crabs, or they have thick skins like sea stars, and giant sea anemones. Some anemones stick light-colored sediment to their tentacles then withdraw inside their bodies to prevent dry out. And some sea stars emit a thick mucus coating on their outer surface to prevent dry out.

To prevent being knocked around by high waves and currents, gastropods like abalone and limpets have strong feet that stick to rocks. Barnacles attach their shells directly to the rock. Sea urchins and boring clams carve out holes within which they nestle. Sea stars, sea urchins, and sea cucumbers have tube feet that stick strongly to rocks thanks to their water vascular system which creates high amounts of suction. Anyone who has ever tried to pry a sea star off a rock knows how strongly they can attach. Mussels attach strong byssal threads to the rocks. Kelp attach themselves with holdfasts.

To handle the large range of predators that can arrive during high tide and low tide, anemone and corals have stinging cells on their tentacles, nudibranchs eat anemones and use those same stinging cells for deterring their own predators, sea stars can regenerate lost limbs, octopus can camouflage themselves perfectly to match their surroundings and can use ink to distract predators, and sea stars and mussels and others can clamp so tightly to the rock they are nearly impossible to pull off.

To handle the difficulty of finding a mate, sessile (permanently stuck) benthic intertidal organisms will release egg and sperm into the water column at the same time, like corals do, in the hopes that they will get together in the planktonic world. Abalone and sea urchins do the same. Many organisms, such as anemones, have a second method of reproduction – cloning – which they use most of the year to expand their populations. These anemones grow buds which then migrate off their own bodies, take up residence next door, and grow into a cloned version of the parent. Barnacles have a particularly interesting method of handling the difficulty in finding mates when you're permanently attached to a rock. The males have a very long penis which can reach out of the barnacle's own exoskeleton and reach outward in a large radius probing and hunting for a ready available female.

To handle the rapid changes in temperature, salinity, pH, and oxygen levels that can occur during low tide when the rocks are exposed and freshwater, rivers, pollution, or solar heating can radically change the surroundings, organisms have shells in which they can retreat, such as barnacles. Most have adapted metabolisms that can handle these wide changes and are thus euryhaline and eurythermal. And many can lie dormant and even mostly dessicated, with no damage, for up to 12 hours.

Lastly, to handle the lack of abundant attachment sites, organisms have learned to live atop each other. Bryozoans cover the surfaces of kelp blades. Corals grow cloned colonies atop each other in branching and other ornate shapes. And as this image shows, mussel shells act as surfaces on which barnacles, bryozoans, tunicates, sponges, and sea lettuce can grow. In this picture there's a barnacle atop a bryozoan colony atop a mussel shell! As this other image shows, we have a large solitary stalked tunicate, covered by an encrusting sponge, which is itself covered by these red bryozoans.

Due to these many intertidal challenges and adaptations, the rocky intertidal shorelines typically show **vertical zonation**, which means that organisms that are uniquely adapted to survive in one of the many zones will thrive in those zones and be found only there. In fact, they will likely competitively exclude other species from those

zones. **Competitive exclusion** is a process where a favored species can outcompete other species for resources, reducing the diversity of a community. This image shows many examples of vertical zonation and competitive exclusion. **The Spray Zone** is the zone that is rarely ever covered by water, but will be exposed to wave spray during high tides on stormy days. Organisms that are most competitive in this zone can handle small amounts of seawater and plenty of above-water exposure. They are unique from other land organisms in that they can handle high amounts of salt and occasional submerging. Examples of organisms who thrive in this zone are limpets and periwinkle snails. **The High Tide Zone** sits between the Neap High Tide and the Spring High Tide. That means it will be covered at most only a few hours a day, and then only every two weeks. Organisms in this zone include, again, the limpets, the periwinkle snails, but also buckshot barnacles and chitons. **The Middle Tide Zone** is the region of the intertidal that is ALWAYS alternately covered and uncovered each day. The top of the middle tide zone is the Neap High Tide. The bottom of the middle tide zone is the Neap Low Tide. Organisms in this zone must be able to handle the most consistent alternation of wet and dry. Mussels are the most competitive at handling the top of this zone, along with sea lettuce. Abalone like the middle and lowest parts of this zone, as do acorn barnacles, gooseneck barnacles, and hermit crabs. **The Low Tide Zone** is uncovered only during the lowest low tides. It is completely uncovered during low Spring tides and never uncovered during low Neap tides. Competitive organisms in this zone can handle mostly being submerged and very limited times being exposed. These include sea urchins, most kelp, sea stars, sponges, and nudibranchs.

Let's look more closely at one of the relationships within this intertidal environment . Mussels are the favored species in the upper middle tide zone. Why? Their strong byssal threads allow them to handle high waves. Their shells prevent dessication. They are highly efficient at getting food, because they are filter feeders. They can't survive higher, because they need food source that comes from water coverage. They can't survive lower as well, because their major predator, the sea star, would feast on them and eliminate them. So mussels live as far away from seastars as possible. When tide is high, the seastars can move to the mussels, but they must return to the low tide zone before the tide retreats and leaves them exposed. The protection of the mussels depends entirely on the speed of the sea stars.

Pause now.

For more information and more detail, continue on to the next video in the series.

Benthos – Intertidal Zone
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<u>Nekton & Benthos Series:</u>
Nekton: Whales, Fish, and More
Benthos: Intertidal Zone
Benthos: Crabs, Corals, and More
Deep Sea Vent & Seep Communities

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