# BACK BAY SCIENCE CENTER

## Intertidal Population Sampling

## ACTIVITY: BETWEEN A ROCK AND A HARD PLACE

**TIME:** 40-50 minutes
**GRADE LEVEL:** 7th-12th
**GROUP SIZE:** 8-10

**Activity at a Glance: Students will conduct quadrat surveys of the intertidal animals of our touch tanks to determine the "health of this ecosystem". They will learn the basics of how scientists conduct quantitative surveys of large areas while in the feild.**

## NEXT GENERATION SCIENCE STANDARDS:

### PERFORMANCE EXPECTATIONS

**MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.**
**HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data**<br>• Analyze and interpret data to provide evidence for phenomena (MS-LS2-1)<br>**Using Mathematics and Computational Thinking**<br>• Use mathematical representations of phenomena or design solutions to support and revise explanations (HS-LS2-2)<br>----------<br>Connections to Nature of Science<br>**Scientific Knowledge is Open to Revision in Light of New Evidence**<br>Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence | **LS2.A: Interdependent Relationships in Ecosystems**<br>• Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors (MS-LS2-1)<br>• In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources, access to which consequently constrains their growth and reproduction (MS-LS2-1)<br>• Growth of organisms and population increases are limited by access to resources (MS-LS2-1)<br>• Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. The fundamental tension affects the abundance (number of individuals) of species in any given ecosystem (HS-LS2-2)<br>**LS2.C: Ecosystem Dynamics, Functioning, and Resilience**<br>A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability (HS-LS2-2) | **Cause and Effect**<br>• Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)<br>**Scale, Proportion, and Quantity**<br>• Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale (HS-LS2-2) |

**Ocean Literacy Principle 5: The ocean supports a great diversity of life and ecosystems.**
**D-** Ocean biology provides many unique example of life cycles, adaptations, and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land.
**F-** Ocean ecosystems are defined by environmental factors and the community of organisms living there. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, nutrients, pressure, substrate, and circulation. A few regions of the ocean support the most abundant life on Earth, while most of the ocean does not support much life.
**H-** Tides, waves, predation, substrate, and/or other factors cause vertical zonation patterns along the coast; density, pressure, and light levels cause vertical zonation patterns in the open ocean. Zonation patterns influence organisms' distribution and diversity.

## BACKGROUND INFORMATION

Amidst a small outcropping of rocks dotting the coastal shoreline is the diverse ecosystem known as the Rocky Intertidal. Plants and animals that live here have to contend with a dramatically changing habitat four times every day. Closer observation of a rock's vertical profile reveals specific microhabitats, based on zonation. These microhabitats and the availability of water have impacted feeding and reproductive adaptations. Because of their accessibility, beauty and diversity, these ecosystems have been impacted by humans.

Tide pool communities have to be able to withstand the constant changes in the tidal changes of the ocean. These changes occur minute to minute as the tides flow in and out. There are also seasonal changes, as well as periodic high intensity 'scouring' that can occur during severe storms. Each species has to solve the problem of finding a home, and then keeping a home. Mussels have evolved byssal threads to attach to an anchoring substrate, barnacles 'glue', while sea stars use a water vascular system and suction for their tube feet. Fish do not attach at all, and clams burrow into the sand. Most of the mollusks have evolved hard shells to withstand the force of pounding waves, with the squishy bodied sea hares being obvious exceptions.

An entire tide pool community can exist in one or two rocks along the shore. Depending on the size of the rock, it may be completely inundated for part of the day. Larger rocks can have a spray or splash zone at their highest elevation which remains dry except for the incidental spray of the waves. Depending on their proximity to the shore, some tide pools may become completely exposed during low tide. Animals such as the anemones have evolved a flexible, flower-like morphology that allows them to 'close up' to protect themselves from the desiccating rays of sun, opening up when the tide comes in.

Animals living in tide pools have adapted to the changing water levels. The tides bring floating plankton and also stir up detritus (waste) that has settled. Very little is wasted within a Tide pool Food Web. Scavenging species such as shrimp and scallops feed on detritus. Barnacles that have attached their heads to a solid substrate extend their feathery feet to 'filter feed' and catch passing food. Sea stars are able to maneuver the inundated bottoms of the rocks and scale up to the zone where mussels live. Chitons living in the dry zone of the rock use a rasp-like radula to scrape off algae. Mutualism is also seen in Tide pool communities. The anemone, with its stinging nematocysts and the sculpin, increase opportunities to lure in food and avoid predation.

The changing water level also impacts reproduction. Asexual reproduction is a common adaptation amongst marine organisms. The simultaneous release of gametes in water allows the eggs and sperm to float together and start the next generation, even though the parents are not side by side. This is imperative, considering that so many species have 'anchored' themselves, are not mobile or in proximity to each other.

The attraction of visiting a Tide pool is wide-spread. Humans can see an amazing and changing ecosystem without any elaborate equipment or long hikes. While this is a delight for the humans, it has become a disaster for the Tide pool community. It is common to see children and adults walking away from Tide pools carrying buckets filled with their new-found treasures. This is having a devastating impact, world-wide. Species do not live outside their habitat, and this also limits the gene pool within the habitat. The danger doesn't stop with collecting: Humans bring both visible and invisible threats. We can see the remnants of beach litter, as well as debris that has travelled from upstream. What is not visible is the chemical pollution caused by the cigarette butts, nitrates from fertilizers and phosphates from cleansers. The increasing acidification of the ocean is dissolving the shells of mollusks and crustaceans. In California, many tide pools are beginning to be safeguarded by the California Coastal Commission as Marine Protected Areas. Activities such as fishing and collecting are limited in these designated areas.

## Resources:

http://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf
http://www.dfg.ca.gov/mlpa/
http://www.mpa.gov/
http://oceanservice.noaa.gov/topics/oceans/mpa/
http://www.ocmarineprotection.org/mpa_sites_and_regulations.php
http://www.ocparks.com/tidepools/tidepool.htm - Crystal Cove

## TEACHER GUIDE – Rocky Intertidal

## Intertidal Population Sampling

## OBJECTIVES:

Students will be able to:

- Analyze and interpret population sampling data to provide evidence for the effects of the availability of resources to the tidepool organisms and populations
- Use graphs to support and revise explanations based on evidence about rocky intertidal population and biodiversity at different scales

## MATERIALS:

Quadrats
BBSC Touch tank with intertidal organisms
*Rocky Intertidal Data Sheet* Worksheet
*Rocky Intertidal Field Guide*
Large map of Upper Newport Bay Ecological Reserve

## KEY TERMS:

Acidification Adaptation Asexual Reproduction Byssal Threads Chemical Pollution Debris Detritus Ecosystem Exposure Filter Feeding Food Web Gamete Gene Pool Intertidal Zone Inundation Microhabitat Mollusks Morphology Mutualism Niche Nematocyst Plankton Predation Radula Scavenger Simultaneous Spray Substrate Tube Feet Zonation