Connected Experience: Marine Invertebrate Adaptations

GRADE LEVELS	3rd- 12th Grade with NGSS for 3rd grade
SUBJECTS	Life Sciences, Patterns
DURATION	Pre-Visit: 30 minutes, Aquarium/Tide pool: 45 minutes, Post-Visit: 30
SETTING	Classroom and Aquarium or Outdoor Tide Pool

Summary

This "connected experience" allows students to connect their classroom learning to field trip learning, and back again. Students begin by thinking about a specific ecosystem, and what adaptations an animal might need to survive there. They then observe invertebrates in an outdoor, or aquarium setting to look for evidence of how the organism uses its body parts to survive.

Objectives

In this lesson, students will:

1. identify patterns within organisms and the environments in which they live
2. construct an argument from evidence on how an animal is specially adapted to live in its ecosystem.
3. build curiosity for the natural world through exploring a new environment.

Materials

- Marine Invertebrate Cards (part of this lesson)
- invertebrate scavenger hunt worksheets
- clipboards with pencils (for field trip)
- cameras (optional – 1 per student group)
- local field guide (optional)

Teacher Tips: This scavenger hunt may be used in an aquarium or an outdoor tide pool. If you choose to go outside, consider having students wear sunscreen, and rain boots. Additionally, you may want to bring trash bags, and have students collect any litter that they find in order to leave a healthier habitat behind.

Teacher Prep

1. Scout out the aquarium or tide pool so you know where students can find invertebrates. If going outside, use a tide log to find out what time low tide is on the day of your field trip, and plan to scout at a similar tidal level.
2. Find or take a picture of the environment where students will be exploring. If it's an aquarium, get a picture of the natural habitat where the animals come from.
3. Print 1 scavenger hunt per student.
4. Print out Marine Invertebrate cards (1 set per small group of students)
5. Draw the table on the board, but leave the boxes blank.
6. If using cameras, charge the batteries before the field trip.

Classroom Activity - Before Your Field Trip

Introduction

Let students know that you will be learning about how scientists construct knowledge of an ecosystem, or how animals and plants living in a general area interact with each other, and their physical environment.

Show a picture of the near-shore environment that you are studying. Begin by having students brainstorm what animals live in near-shore environments. How do they think animals might be specially adapted to survive there?

- One way is to start by having students think about what the animals need to do to avoid getting washed away in waves (i.e. a body structure that helps them hang on to rocks, or bury themselves in the sand).
- Think about how they might survive if the water wasn't there for a period of time (i.e. only live in nooks and crannies where water gathers, or somehow hold onto water).
- For young students, you can begin with having them brainstorm what keeps them alive (food, shelter, etc.).

What to do

1. Let the students know that they will be going on a field trip to study marine invertebrates, and their adaptations for living in a specific ecosystem. During the trip they will have a fun ocean scavenger hunt. To prepare for the trip, students will begin by doing an activity to help prepare them for types of animals that they might see.
2. Split your class into small groups, and let them know that they will be looking at pictures of animals found in the near shore environment. Pass out the Marine Invertebrate cards. Give them a chance to look over the cards, and talk about whether or not the animals' body structures are what they were expecting of an animal that could survive in that environment.
3. Let your students know that scientists classify (split animals up into groups) that are related to each other. Give each group a copy of the Marine Invertebrate cards and have them sort the animals into groups that they think are related to one another based on structures they observe. To do this, students will look for patterns, similarities and differences between animals.

   Teacher Tip: Explain to students that this is just a trial- when scientists are learning about a new area or animal, they are often making their best guesses based on what evidence they find, then they re-assess based on new evidence and ideas. Often this happens when scientists talk with each other, and listen to diverse ideas.

4. Have students compare their sorting with another group. How was their thinking similar or different to the other group? Where there any different patterns that they noticed? Did someone else's thoughts or ideas shift your own ideas?
5. Pass out the Field Journals to students so they can take notes as you begin to talk more about their scientific classifications. Then begin to give clues as to which animals fit in specific categories. As you give clues they can rearrange their guesses if needs be. Encourage students to take notes, and ask questions during this exercise. Students may

make predictions on what they think the animals will be doing to survive in their environment.

	Defining Body Parts	Examples
Cnidarians (many stingers)	Have stinging structures, breathes directly through their skin, radial symmetry	Jellyfish, Anemone, Coral, Sea Pen
Echinoderms (spiny skinned)	have many "tube feet", radial symmetry generally in "fives"	Sea Cucumber, Sea Star, Urchin, Sea Apple
Arthropods (jointed limbs)	Exoskeleton, jointed limbs, molts when growing	Hermit Crab, Crab, Shrimp, Prawn
Mollusks (soft, legless body)	Typically has a hard shell, soft body, some have tentacles (different than legs)	Scallop, Snail, Chiton, Octopus, Mussel

6. Explain that knowing how animals are classified can help us understand how to look up information about the different animals. For example, many field guides that scientists use are organized by this classification system. So, if you want to look something up, you can use this system to understand how it might work.
7. To reflect on this exercise you may use the sentence frame "At first I thought… then I …."

On the Field Trip

1. Remind students that the goal of this field trip is to try to understand how specific animals interact with the ecosystem, both the living and non-living components. In the previous activity students had brainstormed adaptations that animals might have to help them survive in this environment. Now, we are going to observe the real animals to see how those adaptations might work.
2. Introduce students to the area that they are exploring, and go over any ground rules that you need, emphasizing safety for people, and animals. Set boundaries of where they can explore. If you have pre-determined tide pools, or aquarium tanks you want your students to explore, assign them to that area.

   Teacher Tip for the Outdoors: For safety's sake, always face the ocean when exploring tide pools and beware of areas with unexpected waves that can sweep you off the rocks. (look, but don't touch; avoid stepping on, or poking animals, move slowly and carefully because rocks can be slippery).
3. Allow students at least 45 minutes to complete the scavenger hunt. This will allow for a little bit of "messing around time," which can be important in getting students settled enough to observe. If you are using cameras pass them out so students can document what they see.
4. Encourage students to sit/ kneel at a tide pool or tank. It is important to get close, and to be still so that they can observe the natural behavior of an animal. Encourage adult chaperones to help students look closer by asking questions such as:
   - Why do you think it is doing that?
   - How does its color help it survive?

- What else do you notice about its environment?
- What do you think would happen if…?
- How are those animals similar or different…?
- Can you say more about that? Did you all hear what this student had to say? What do you think about his/her idea?

5. Remind your students to fill out all parts of the field journal and to use what they learned in class before the visit to help them answer the questions.
6. Students can also try looking up specific animals in a field guide if you brought them with you.
7. If you have time, let the students visit each other's tanks or tide pools, and see how they are similar or different to their own. This is also a great time to notice patterns that exist across all of the different tide pool environments.

   Teacher Tip: If you are outdoors, encourage students to notice human impacts on the environment, and have them pick up litter that they see so the environment can be left better than when you came.

Back at School

1. Review student discoveries from the scavenger hunt. Have students choose one of the marine invertebrates they found on their scavenger hunt and write about how they think their animal was suited to survive in its environment.

   - How did it interact with other animals of its same kind, or of different kinds?
   - How did it move through, and/or hide in its environment?
   - What patterns did they notice about the animal (locations or distribution throughout the tide pool, etc.).
   - I noticed … and it made me think that….
   - One thing that surprised me…
   - I think this animal is important to the ecosystem because…

2. In class or as a homework assignment, have students research answers to their questions. If students have a hard time coming up with a question, choose a topic from the list below.

   - Habitat
   - Special Adaptations
   - Diet
   - Predators
   - Conservation status

3. Have students create reports, or posters that showcase their invertebrate and give short presentations to explain how they think their invertebrate's adaptation help it survive in its home ecosystem.

Extensions

- This observation process can also work well in a school garden, or other outdoor environment. Additionally, it can be repeated over time to refine student ideas.

- Pair this activity up with one of your activities on food webs. Other Academy activities that will also work well are: Sustainable Fishing, and Pollution in Our Watershed.

Student Vocabulary

- adaptation: any structure or behavior of an organism that improves its chances for survival
- arthropod [**ahr**-thr*uh*-pod]: an animal with jointed legs, segmented body and an exoskeleton, when growing it molts (sheds old skeleton); includes the insects, crustaceans and arachnids
- biodiversity: the variety of life found in particular habitat or ecosystem
- cnidarian [nahy-**dair**-ee-*uh* n]: an animal with radially symmetrical body with a saclike internal cavity, and including the jellyfishes, hydras, sea anemones, and corals
- echinoderm [ih-**kahy**-n*uh*-durm]: radially symmetrical animal, often with spiny skin. They include starfishes, sea urchins, and sea cucumbers
- invertebrate: an animal that lacks a backbone or spinal column
- mollusk [**mol**-*uh* sk]: a legless invertebrate animal, typically with a soft body, and no legs

Teacher Background

Our world is filled with an amazing diversity of creatures, and ecosystems! Many of these are hidden from human eyes because they are in the ocean. Visiting an aquarium, or tide pool is a great way to connect with these important ecosystems. Tide pools, coral reefs and kelp forests are very diverse with high numbers of plant and animal species. Diversity in these places can be comparable to diversity in rain forests (California Water Monitoring Council, 2013). Additionally, healthy near shore ecosystems can provide shoreline stability, healthy fisheries, and beautiful places to explore.

This activity will explore diversity of marine invertebrates. Each of these animals are important to ecology, some as the base of the food chain, while others are top carnivores. Energy produced in rocky intertidal habitats can also be exported to the open ocean or onto land when terrestrial predators eat tide pool animals (California Water Monitoring Council, 2013).

Although many people think of animals as only those that have backbones such as fish, birds, reptiles, and mammals, over 95% of the world's animals are invertebrates, which lack backbones. These are things such as insects, arachnids, and sponges. Invertebrates were the first animals on the planet, with fossil evidence showing their existence for at least 600 million years. Vertebrates evolved from these animals. There is tremendous invertebrate diversity, but for the purpose of this activity, we will focus on four types of marine invertebrates that can be seen in most aquariums and tide pools: Cnidarians, Mollusks, Echinoderms, and Arthropods. (Commonwealth Scientific and Industrial Research Organization, 2008).

Cnidarians include jellyfish, corals, sea anemones, and hydroids. These animals obtain their food by using stinging structures in their tentacles to capture prey. Cnidarians have what is called an incomplete digestive tract with only one opening to both take in food and expel waste. Cnidarians are able to absorb oxygen from the water around them directly through their skin and expel carbon dioxide

the same way (National Zoo, 2015).

Echinoderms include sea stars, brittle stars, sea cucumbers, and sea urchins. All echinoderms have a water vascular system with fluid-filled tube feet, which help them move, feed, and respire. They can be spotted easily because of their 5-point radial symmetry. (National Zoo, 2015)

Arthropods includes crustaceans, arachnids, centipedes, millipedes, and insects. Crustaceans respire with gills that obtain oxygen from the water around them. Crustaceans use many feeding strategies including filter feeding, scavenging, and hunting. They all have a complete digestive tract with two openings. (National Zoo, 2015)

Mollusks are extremely diverse and includes clams, snails, squids, and octopuses. Mollusks have a soft body that sometimes has tentacles, but they have never have articulated legs. Mollusks capture food in a variety of ways including filter feeding like clams, scraping algae off rocks like limpets, and stunning prey with poison like cone snails. Like arthropods, mollusks have a complete digestive system with two openings. (National Zoo, 2015)

References

California Water Monitoring Council. Retrieved March 13, 2015 from www.mywaterquality.ca.gov/eco_health/ocean/tide_pools/why.shtml

Commonwealth Scientific and Industrial Research Organization. *Insects and their Allies.* Retrieved March 11, 2008 from http://www.ento.csiro.au/education/what_invertebrates.html.

Invertebrate Video Clips. Retrieved March 13, 2015 from http://www.kidport.com/RefLIb/science/Animals/AnimalIndexInv.htm

National Zoo. *Invertebrates: The Silent Majority.* Retrieved March 15, 2015. http://nationalzoo.si.edu/animals/invertebrates/facts/

Correlated California Content Standards

Grade 3

3. Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept: (b.) Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.

Grade 5

4. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will: (a.) Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.

Next Generation Science Standards

The items listed below indicate how the **activity** supports the three dimensions of the Next Generation Science Standards: www.nextgenscience.org/.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence 3-5: Construct and/or support an argument with evidence, data, and/or a model.	**LS3.B: Variation of Traits:** Different organisms vary in how they look and function because they have different inherited information. The environment also affects the traits that an organism develops. **LS4.B: Natural Selection:** Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.	**Patterns** 3-5: students identify similarities and differences in order to sort and classify natural objects.

Related Performance Expectations

The materials/lessons/activities outlined here are just one step toward reaching the Performance Expectations listed below. Additional supporting materials/ lessons/ activities will be required.

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment. [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]
www.nextgenscience.org/3ivt-inheritance-variation-traits-life-cycles-traits

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]
www.nextgenscience.org/3ls4-biological-evolution-unity-diversity