Within our Caribbean waters there exists high biodiversity; numerous invertebrates and vertebrates. Much of this diversity is created by animals in the following groups: arthropods, cnidarians, echinoderms, molluscs, and reptiles. Each of these animals have unique characteristics that distinguish them from other marine organisms. Some of these include:

- Some reptiles and arthropods, through a process called ecdysis, molt their exoskeleton or old skin which allows them to grow.
- Some molluscs such as the octopus use camouflage to hide from predators.
- Some cnidarians such as jellyfish use stinging cells called cnidocytes/cnidoblasts to inject venom into prey or as a defense mechanism. Thus they are considered venomous.
- Some echinoderms such as brittle stars and sea cucumbers are detritivores, consuming decaying material on the ocean floor.
All of these organisms together with the non-living components such as the air and water comprise an Ecosystem\(^\text{10}\). Our oceans make up one ecosystem, but there are many others, such as salt ponds which can be found in the Virgin Islands. Salt ponds contain various organisms and plants called Halophytes\(^\text{14}\). One such Halophyte\(^\text{16}\) is called a mangrove of which there are four species found in the Virgin Islands; Red, Black, White, and the Buttonwood. The red mangrove is considered an Ecosystem Engineer\(^\text{11}\) as it helps to create a hospitable environment for other species of mangroves to grow. Mangroves also exhibit a pattern of Zonation\(^\text{27}\) where red mangroves are found close to the water whereas white mangroves are found further inland. The red mangrove has a distinct Propagule\(^\text{22}\) that floats in the water and settles on the shore where it can become a new mangrove tree. Not only is the red mangrove important for the ecosystem, but humans also benefit from them. Ecosystem Services\(^\text{12}\) from the red mangrove include: 1) Buffering the shoreline from storms and 2) Water filtration.

**Background Information**

- Propagules of a red mangrove tree.
- Red mangrove tree. Notice the prop roots.
- Black mangrove tree. Notice the roots above ground.
- White mangrove tree. Notice the signature white flowers.

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Biological / Life Sciences & Human Impacts

Lesson 1

Background Information

The last ecosystem that deserves mention here would be sea grass beds where sea turtles can be found. All four species of sea turtles (Green, Leatherback, Hawksbill, and Loggerhead) are considered **Endangered** and if the current threats they face are not eliminated, these sea turtles could become **Extinct**. Green sea turtles mostly consume sea grass whereas the hawksbill sea turtle consumes coral polyps as well as sponges. Because some sponges harbor toxins, the hawksbill can also sequester some of those toxins which explains why their meat can be considered **Poisonous**. At UVI, our researchers attach **Global Positioning System** tags on captured Green and Hawksbill sea turtles to help monitor their movement patterns within and outside of Brewers Bay.

We’ve discussed ecosystems in some detail though it is important to note some of the impacts that each of these ecosystems face. **Coastal Development** which entails any form of infrastructure or building development that occurs along our coastlines. The concern with **Coastal Development** is that if caution is not exercised, any loose sediment or dirt can become unearthed in the process and eventually end up in the ocean. While this sediment contains nutrients that can be partially ok for corals, an excess of dirt in the water can create conditions that unfavorable for many organisms. **Marine Debris** such as plastics can also enter the water and cause harm to organisms. Sea turtles might mistake a plastic bag for a jellyfish, consume it, and could choke and die. **Marine Debris** can also include lost fishing gear such as fish traps which can unintentionally capture fish and other marine life. It is our responsibility to be protectors of our environment and its **Natural Resources**. You can help by **Recycling** your plastics therefore preventing them from entering our oceans; turn plastic bottles into planters or bird feeders.
Biological / Life Sciences & Human Impacts

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Background Information

Corals are living organisms that are important animals in the ocean ecosystem. They provide habitat for many marine organisms such as fish. Corals have tiny finger-like projections on their surface called polyps which allows the coral to feed. Also on the surface of the coral are algae organisms called zooxanthellae which allows the coral to also turn sunlight into energy, similar to plants. Most corals are found in the Tropics where the weather is warm and optimal for their growth. However, any changes in ocean temperature as has been seen with Climate Change, could stress out the corals and cause them to become bleached, leaving behind only the pale white coral skeleton. To help, when you go snorkeling, do not touch corals; only observe them. Keep nature alive by doing your part as an ecosystem protector.

A close-up image of coral polyps.  
A coral that is bleaching. The colored parts of the coral are still alive.

Corals are important ecosystems by providing habitat for many marine organisms such as fish. They also grow very slowly, and can thus be well over thousands of years old. Make sure that while you snorkel, you do not step on or touch corals.
Biological / Life Sciences &
Human Impacts

Glossary

1. **Arthropod**: An invertebrate animal having an exoskeleton, a segmented body, and jointed appendages.
2. **Biodiversity**: The variety of different types of life found on the Earth and the variations within species.
3. **Camouflage**: The use of any combination of materials, coloration, or illumination for concealment, either by making animals or objects hard to see or by disguising them as something else.
4. **Climate Change**: A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.
5. **Cnidarian**: A phylum of predominantly marine species with the distinct characteristic of cnidocytes (stinging cells) which they use to capture prey.
6. **Coastal Development**: An array of human activities including beachfront construction of homes, hotels, restaurants, and roads which can negatively impact the environment.
7. **Detritivore**: Organisms that obtain nutrients by consuming detritus (decomposing plant and animal parts as well as feces).
8. **Ecdysis**: The process of an arthropod molting its exoskeleton.
9. **Echinoderm**: The common name given to animals in the Phylum Echinodermata; these animals have the distinct feature of five-points or radial symmetry.
10. **Ecosystem**: A community of living organisms in conjunction with the non-living components of their environment, interacting as a system.
11. **Ecosystem Engineer**: An organism that modifies, creates, or destroys habitat and directly or indirectly modulates the availability of resources to other species, causing physical state changes in biotic or abiotic materials.
12. **Ecosystem Services**: Any positive benefit that wildlife or ecosystems provide to people.
13. **Endangered**: Any species of organism that is at risk of extinction.
14. **Extinct**: Any species of organism that no longer is in existence.
15. **Global Positioning System (GPS)**: A space-based navigation system that provides location and time information.
16. **Halophyte**: A plant that grows in waters of high salinity.
17. **Invertebrate**: Animals that neither possess nor develop a vertebral column, derived from a notochord.

18. **Marine Debris**: Any man-made, solid material that enters waterways directly through littering or indirectly via rivers, streams and storm drains.

19. **Mollusc**: A large phylum of invertebrate animals that included cephalopods (octopi) and gastropods (snails). These animals have a distinct feeding apparatus called a radula which has numerous small tooth-like structures used for scraping.

20. **Natural Resource**: Materials or substances such as minerals, forests, water, and fertile land that occur in nature and can be used for economic gain.

21. **Poisonous**: Any animal or plant that contains toxins either in its skin or organs.

22. **Propagule**: Any plant material used for the purpose of plant propagation; this can include a seed or a spore.

23. **Recycle**: The conversion of waste into reusable material.

24. **Reptile**: A cold-blooded vertebrate that is distinguished by having a dry scaly skin, and typically laying soft-shelled eggs on land.

25. **Venomous**: Animals that are capable of secreting venom or some toxin by injection either by bite or by sting.

26. **Vertebrate**: An animal of a large group distinguished by the possession of a backbone or spinal column, including mammals, birds, reptiles, amphibians, and fishes.

27. **Zonation**: A process exhibited mangroves in which those with higher salt tolerance are found closer to salt water whereas those with lower salt tolerance are found furthest inland.
## Biological / Life Sciences & Human Impacts

### Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Difficulty</th>
<th>Time Spent</th>
<th>Concepts covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch tank observations</td>
<td>Introductory</td>
<td>~ 30 minutes</td>
<td>Biodiversity, unique traits to marine organisms, invertebrates vs. vertebrates, and food webs</td>
</tr>
<tr>
<td>Fish Identification</td>
<td>Intermediate</td>
<td>~ 1 – 2 hours</td>
<td>Research methodologies, fish identification</td>
</tr>
<tr>
<td>Snorkel activity</td>
<td>Advanced</td>
<td>~ 1 hour</td>
<td>Marine species identification, human impacts to marine life</td>
</tr>
<tr>
<td>Red mangrove nursery observations</td>
<td>Introductory</td>
<td>~ 30 minutes</td>
<td>Ecological importance of red mangroves, species adaptations</td>
</tr>
<tr>
<td>Red mangrove plantings</td>
<td>Intermediate</td>
<td>~ 1 hour</td>
<td>Ecological importance of red mangroves, conditions that influence seedling growth</td>
</tr>
<tr>
<td>Sea turtle presentation</td>
<td>Introductory</td>
<td>~ 30 minutes</td>
<td>Threats to sea turtles, characteristics of the three species of sea turtles found in the V.I.</td>
</tr>
<tr>
<td>Sea turtle encounter</td>
<td>Introductory</td>
<td>~ 30 minutes</td>
<td>Current research conducted on sea turtles in the V.I.</td>
</tr>
<tr>
<td>Sea turtle survey</td>
<td>Advanced</td>
<td>~ 1-2 hours</td>
<td>Identifying sea turtles</td>
</tr>
<tr>
<td>Water quality testing</td>
<td>Advanced</td>
<td>~ 30 minutes – 1 hour</td>
<td>Environmental conditions that influence water</td>
</tr>
</tbody>
</table>

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# Biological / Life Sciences & Human Impacts

## Lesson 1

### Performance Expectations

<table>
<thead>
<tr>
<th>Elementary School (3-5)</th>
<th>Middle School (6-8)</th>
<th>High School (9-12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilize evidence to explain how unique marine animal characteristics provide advantages with survival and reproduction.</td>
<td>Analyze and interpret data that documents unique evolutionary changes in marine animals and discuss what environmental changes might have influenced them.</td>
<td>Provide an explanation for the relationships between natural resources, ecosystem sustainability, and biodiversity.</td>
</tr>
<tr>
<td>Utilize evidence to support an argument that environmental conditions such as pH, salinity, and temperature affect how well some marine species survive in their specific habitat.</td>
<td>Analyze and interpret data on the effects of marine resource availability on organism and ecosystem health.</td>
<td>Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.</td>
</tr>
<tr>
<td>Develop explanations for patterns of mutualistic and parasitic behavioral relationships amongst marine animals.</td>
<td>Evaluate evidence to justify that complex interactions within an ecosystem help to maintain relatively consistent species numbers and type; however, changing these conditions results in new ecosystem dynamics.</td>
<td>Construct an explanation for how natural selection leads to the adaptation of marine animals for their specific habitat.</td>
</tr>
</tbody>
</table>

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