Beach Finds Curiosity Cart

Virginia Aquarium

This activity outline was developed for use in a variety of informal venues. By design, it provides the content, pedagogy and strategy necessary for implementation by both the novice and experienced informal educator. It is expected that this outline will be adapted and improved upon by the user. We welcome your feedback!

Synopsis of the Activity

Learners will have a variety of biofacts found on beaches including egg cases, shells, tests, and bones. They will be invited to touch, ask questions and consider where these items came from, how they are associated with an organism and what the object can tell us about the organism.

Audience The main audience is the general public and school children of any age.

Setting

This activity can be conducted anywhere on an aquarium or museum floor and works nicely when located near an invertebrate touch tank or tidal pool display.

Activity Goals

- Through hands-on investigation of objects that are found on a beach, visitors will gain a better understanding of some of the organisms that inhabit local marine habitats, or marine habitats being highlighted in the activity or exhibits.
- Visitors will be able to use this experience to inform (or encourage) their next interaction with objects they might encounter in nature.
- Visitors will develop their skills in making observations and using their observations of a physical object to develop an idea and draw logical conclusions.
- Visitors will develop a sense of curiosity and wonder about the organisms that live in the ocean.

Concepts

- Hard parts of organisms that remain after it dies can provide clues about the living organisms.
- Close observation of some artifacts can provide information about the structure, function and possible adaptations of an organism.
- We can infer what animals live in a local marine habitat by observing what ends up on a beach.
- The use of observations and evidence helps scientists and other people to make scientific explanations.

Ocean Literacy Principles

1. The ocean supports a great diversity of life and ecosystems.
   d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.

Materials

- Shells, Molts, Tests, skeletons (choose mostly sturdy specimens so they can be handled by visitors)
- Pictures of the organisms shown in their habitat
- Books about shells (e.g. Eyewitness book by Alex Arthur)
- Large habitat picture to place behind you-space permitting (if there is no related display close-by)
- Paper and pencils for visitors to make a written or drawn record of questions/ideas that they have
- Hand lenses for investigating objects

Prep Section

Make sure that your artifacts are in good condition.

Procedure and Set-up

Assemble materials and display items on your table. Display enough artifacts so that they will attract attention, and reserve a few to bring out for visitors that stay longer (for comparison and deeper investigation, such as more varieties of the same item for comparison). Also reserve the photos of animals in habitats, and books about the organisms behind the scenes to bring out as the visitors get deeper into the activity. You will find the ideal number of items to display will vary with the age, number and temperament of visitors, as well as the style and inclination of you, the facilitator.

Guiding Questions

Looking at all the items

Has anyone seen any of these items before?

Yes- Which ones? Where did you see them?

No- They are all from the ocean. What do you think they might be?

Focusing on a set of items

Do any of these look familiar?

What do you think they are?

Focusing on specific items

What do you notice about this object?

Where do you think it came from?

What do you think it is?

or

Do you think it is man-made or from nature?..from a plant or an animal? What makes you think that?

In what ways do you think this could help an animal (be important for) an animal's survival?

or
What do you think an animal would use it for?
(Follow-up with the visitor about: How would the animal use that part? or Why would that function be important?)

Activity Description
Visitors will approach the cart and be invited to observe the items on the cart.
The facilitator will encourage the visitors to observe the objects more closely, compare different objects and make connections with where the items might come from and what their function is in the living organism.

Note: *The learner's experience with this subject, their interest and general personality will vary, so be flexible. Be open to their areas of interest and lines of questioning and thinking and don't hesitate to try a new approach.*

Following is a sample of how to proceed through the activity, but instead of a sample conversation there is a progression of groups of questions. The questions focus on welcoming the learner, getting the visitor to observe the object and relate it to their experiences, think about the object and how it connects with an organism, and consider some further connections. The questions below should be part of a conversation that you have with the learner, so you can start anywhere and move freely from one group to another. As you read through these questions, you may think of other ways to phrase the same idea, responses the visitor may give and questions you might use to follow-up the visitor responses.

Remember to be flexible with their interests. If someone approaches and is drawn to a particular item, don't start by asking them if they have seen any of the items, but instead, start with the item they are interested in and then move to looking at other, perhaps related, pieces (i.e., "This is really interesting. What do you notice about it? Do you see those colors on anything else? Is there anything else that looks like it?).

Many of the following questions are framed "What do you think…" This is so that the visitor can share and investigate the idea with you. With a question such as "What happens if this is left on the beach?" there are only a few responses that the visitor can give and they may be worried about providing the correct answer.

<u>*Initial contact*</u>
Has anyone seen any of these items before?
Yes-Where did you see them?
No- I found these on the beach. How do you think they got there?

OR Do any of these look familiar?
What do you think they are?

OR (if visitor is focused on a specific item) Have you seen this before?
What do you notice about it?

General observations of a specific item

What do you notice about this object?
Where do you think it came from?
What do you think it is? What clues can you find to help you figure it out?
Do you think it is man-made or from nature?..from a plant or an animal? What makes you think that? What clues can you find to help you come up with your ideas?
What do you think would happen to this item if it remained on the beach longer?

Comparisons with other items on your table

All of these are from organisms living in the ocean.
How do you think this part might help an animal survive? What clues or evidence can you use to help figure it out?
Are there any other items that might serve the same purpose?
Do you think any of these other items came from the same organism? What makes you think that?
Do you think you could sort the items into groups that have something in common with each other?(Give it a try).

Connections with the living organism and other visuals

If this is part of an animal, do you think it is on the inside of the animal or on the outside? What makes you think that?
Let's look at a photo of the animal and see if we can find that part.
What do you think an animal would use this part for? What makes you think that?
Here is a photo of where it lives. Does that support the idea that you had? What clues or evidence can you find to support your ideas?
If this is part of a plant, what do you think its function is?
Let's take a look at a photo and see what we can figure out. What clues or evidence can help us come up with an explanation?

Conversation- generating questions

What artifact is most interesting to you? Why?
What questions do you have about any of these items?
How about challenging some of the other visitors here by doing a mystery sort and having the others try to figure out how you sorted them?
If you were the facilitator at this table, which artifacts would you put out for the visitors and why?
Are we missing some artifacts that you think would be great to display here? (Have visitors look in a book to choose other artifacts they are interested in.)
What do you think will happen to this item if it were to remain on the beach longer? What makes you think that?
What kinds of things have you found on beaches near here? Have you visited other beaches? How did the things you found on that beach differ from these things?

Relationship to the beach

Why do you think that only certain hard parts are found beaches? (What factors might influence which shells you find on beach?)
Which of these things do you think you could likely find together on the beach? Why do you think you often find them together?
or
Here are a few things that you would find on the same beach. (make a collection) Why do you think you often can find them together?

Notes About Facilitating this Activity:

How long will the interaction last?

Since this is an informal interaction the length of time that a visitor stays can vary greatly. It will be influenced by their interest, the interest of someone else in their party, time pressures at the science center (i.e., another program beginning soon). If a visitor has seen and talked with you about many things, you can direct them to a related exhibit to look for one of the organisms whose parts you have been observing. If they are interested in the items at the table for a long time, be willing to look at the items with them and continue the discussion.

Pacing

Pacing will depend on the individual, but be patient after you have asked a question and allow them time to observe the objects and generate a response. Silence and pauses are ok and with any age can provide an opportunity for them to initiate the next part of the interaction.

Scaling

These questions are meant for use with an audience of ages 8 -12 year olds. For this age group it is generally necessary to take them through observing and generating ideas about what an item is and then comparing and developing ideas about where objects are from and their function in the living organism. Encourage the learners to use evidence in their explanations and model how to do this for them.

Older Audiences

If you are working with a group of older learners, adjust your language and manner, be more straightforward and more overtly challenging of their ideas, and start them with idea-generating questions (what do you think this is from? What do you think that organism would use this part for?). Older audiences will generally make observations and use the observations as evidence in their explanations. Many adult learners will tend to ask more questions to get information about the objects; it is ok to answer some of these questions, but still encourage them to think about where the object is from and to voice their observations and ideas. Engage them in a conversation about what they know about the objects and what more they would be interested in knowing about them.

Younger Learners

For younger learners, you will need to make adjustments as well. They will be able to make good observations and will generate ideas and questions. You may have to take

them through more observing questions to have them focus on and notice more details about the objects. Be especially patient after you have asked a question and allow them time to observe the objects and generate a response.

Related Activities/Extensions/Modifications
Direct visitors to other touch tank, tide pool, animal, or artifact displays in the ISEI. Ask visitors to make observations of other objects, and perhaps compare them to the objects they have just seen.

Additional Resources
Eyewitness: Shell by Alex Arthur. 2000. DK Children Publishers.

Local field guides are also helpful.

Background Much of this will be specific to the biofacts that you are using. Below is some information that can get you started.

Invertebrate describes any animal without a spinal column. The group includes 97% of all animal species. They are classified into over 30 phyla, from simple organisms such as sponges and flatworms to complex animals such as arthropods and molluscs.
Below are some common groups and an example member:

- Porifera — sponges
- Cnidarians — jellyfish
- Platyhelminthes — flatworms
- Nematoda — roundworms
- Annelida — earthworms
- Echinodermata — starfish, sea urchins, sea cucumbers
- Mollusca — squid, snails
- Arthropoda — ticks, spiders, grasshoppers, lobsters, crabs
- Bryozoa — moss animals, sea mats (occasionally resemble corals)

A whelk is a large marine gastropod (snail) found in temperate waters. Whelks are sometimes confused with conches. While both are gastropods, the shells of whelks are more slender. Whelks are scavengers and carnivores, equipped with an extensible proboscis that is tipped with a file-like radula. The radula is used to bore holes through the shells of clams, crabs and lobsters. They also have a large, muscular foot with which they hold their victims. Like other mollusks, whelks have a mantle, a thin layer of tissue located between the body and the shell that creates the shell. Whelks build their hard shells from the calcium carbonate they extract from the seas. The shells can grow up to 9.5 inches (24 cm) long.

A channeled whelk (left) and a knobbed whelk.

Whelk shells are generally light gray to tan, often having brown and white streaks. The shells coil dextrally (right-handed, or in a clockwise direction) and have a long siphonal canal. The shell shape of individual specimens may vary widely in both coloration and sculpture.The Knobbed whelk, *Busycon carica*, is the largest species, ranging up to 16 in. (40.6 cm). They have tubercles (or spines) along the shoulder. Knobbed whelks eat clams. They open the clam with their hard shell and insert their long proboscis. Today the Knobbed whelk is a common predator of the intertidal mudflats and can be found offshore to 26 fathoms (48 m). The Channeled whelk is slightly smaller than the Knobbed whelk and has a smooth shell with channels following the swirls at the top of the shell.

Bivalves are molluscs belonging to the class **Bivalvia**. They typically have two-part shells, with both parts being more or less symmetrical. The class has 30,000 species, including scallops, clams, oysters and mussels. Bivalves are exclusively aquatic; they include both marine and freshwater forms. Bivalves lack a radula and feed by siphoning and filtering small particles from water. Some bivalves are epifaunal: that is, they attach themselves to surfaces in the water, by means of a byssus or organic cementation. Others are infaunal: they bury themselves in sand or other sediments. These forms typically have a strong digging foot. Some bivalves can swim. Bivalves are filter feeding mollusks that feed using their gills. They have an open circulatory system that covers the organs with blood. Nephridia remove the excreted waste. Bivalves are laterally compressed and have two shells.

Clams are shelled marine or freshwater mollusks belonging to the class Bivalvia (Kingdom Animalia, Phylum Mollusca[1]). The term "clam" has no taxonomic significance in biology, but in general use clam refers to a bivalve (a mollusk whose body is protected by two symmetrical shells) that is not an oyster, mussel, or a scallop, and that has a more-or-less oval shape, or alternately, to a freshwater mussel (Merriam-Webster Dictionary.). Clams are invertebrates, with shells divided into two pieces called valves. These pieces are joined with a hinge joint, and with two adductor muscles that open and close the shells. Clams have a heart, blood vessels, and kidneys. An exception to the oval shape is the razor clam, which has an elongate shell suggesting a straight razor. Some quahogs on the Eastern American Coast may be 200 years old.

The **Blue Mussel** (*Mytilus edulis*) is an edible bivalve. It is commonly farmed and harvested for food throughout the world. Blue mussels are part of an ongoing long term environmental monitoring program in Prince William Sound, Alaska, the area affected by the Exxon Valdez oil spill. The study examines hydrocarbon signatures in order to aid a better understanding of ecosystem recovery following the spill. Blue mussels live in intertidal areas attached to rocks and other substrates by strong thread-like structures called byssal threads which are secreted by byssal glands located in the foot. Shell smooth with a sculpturing of concentric lines but no radiating ribs. They are purple, blue or sometimes brown in color. Blue Mussels are preyed upon by starfish such as *Asterias vulgaris*; small mussels are also eaten by the Dogwhelk (*Nucella lapillus*).

Oysters are filter-feeders that draw water in over their gills through the beating of cilia. Suspended food plankton and particles are trapped in the mucus of the gills and transported to the mouth, where they will be eaten, digested and expelled as feces or pseudofeces. Feeding activity is greatest in oysters when water temperatures are above 50°F (~10°C). Healthy oysters consume algae and other water-borne nutrients, each one filtering up to five liters of water per hour. Scientists believe that the Chesapeake Bay's once-flourishing oyster populations historically filtered the estuary's entire water volume of excess nutrients every three or four days. Today that process would take almost a year, and sediment, nutrients, and algae can cause problems in local waters. Oysters filter these pollutants, and either eat them or shape them into small packets that are deposited on the bottom where they are harmless.

- Oysters breathe much like fish, using both gills and mantle. The mantle is lined with many small, thin-walled blood vessels which extract oxygen from the water and expel carbon dioxide. A small, three-chambered heart, lying under the abductor muscle, pumps colorless blood, with its supply of oxygen, to all parts of the body. At the same time a pair of kidneys located on the underside of the muscle purify the blood of any waste products it has collected.

- There is no way of determining male oysters from females by examining their shells. While oysters have separate sexes, they may change sex one or more times during their life span. The gonads, organs responsible for producing both eggs and sperm, surround the digestive organs and are made up of sex cells, branching tubules and connective tissue.

As a keystone species, oysters provide habitat for an extensive array of marine life. The native oyster usually inhabits water depths of between 8 and 25 feet. The hard surfaces of oyster shells and the nooks between the shells provide places where a host of small animals can live. Hundreds of animals such as anemones, barnacles, and hooked mussels use oyster reefs as habitat. Many of these animals serve as food for larger animals, including striped bass, black drum and croakers. An oyster reef, with its many convolutions, can encompass 50 times the surface area of an equally extensive flat bottom. The oyster contributes to improved water quality through its filter feeding capacity. An oyster's mature shape often depends on the type of bottom to which it originally attached. It orients itself with its outer, flared shell tilted upward. One valve is cupped and the other is flat. The submerged shell opens periodically to permit the oyster to feed. Oysters usually mature by one year of age. They are protandric, which means that during their first year they spawn as males (releasing sperm into the water). As they grow larger over the next two or three years and develop greater energy reserves, they release eggs, as females. Bay oysters are usually prepared to spawn by the end of June. An increase in water temperature prompts a few initial oysters to spawn. This triggers a spawning 'chain reaction', which clouds the water with millions of eggs and sperm. A single female oyster can produce up to 100 million eggs annually. The eggs become fertilized in the water and develop into larvae, which eventually find suitable sites on which to settle, such as another oyster's shell. Attached oyster larvae are called 'spat'. Spat are oysters 25 mm or less in length.

Echinoderms (Phylum **Echinodermata**, from the Greek for *spiny skin*) are a phylum of marine animals found at all depths. This phylum appeared in the early Cambrian Period and contains about 7,000 living species and 13,000 extinct ones. Five or six classes (six counting Concentricycloidea) are alive today:

- Asteroidea (asteroids, starfish, or sea stars): about 1,500 species that capture prey for their own food.
- Concentricycloidea (sea daisies), notable for their unique water vascular system; two species; recently merged into Asteroidea.
- Crinoidea (crinoids, feather stars or sea lilies): about 600 species that are suspension feeders.
- Echinoidea (echinoids, sea urchins and sand dollars): notable for their movable spines; about 1,000 species.
- Holothuroidea (sea cucumbers): elongated animals resembling slugs; about 1,000 species.
- Ophiuroidea (brittle stars and basket stars), the physically largest of echinoderms; about 1,500 species.

Echinodermata is the largest animal phylum to lack any freshwater or terrestrial representatives. Echinoderms evolved from animals with bilateral symmetry; later forms were lopsided. Echinoderms' larvae are ciliated free-swimming organisms that organize in a bilaterally symmetric fashion that makes them look like embryonic chordates. Later, the left side of the body grows at the expense of the right side, which is eventually absorbed. The left side then grows in a pentaradially symmetric fashion, in which the body is arranged in five parts around a central axis. All echinoderms exhibit fivefold radial symmetry in portions of their body at some stage of life, even if they have secondary bilateral symmetry. They also have a mesodermal endoskeleton made of tiny calcified plates and spines, that forms a rigid support contained within tissues of the organism; some groups have modified spines called pedicellariae that keep the animal free of debris. Echinoderms possess a hydraulic water vascular system, a network of fluid-filled canals that function in locomotion, feeding, and gas exchange. They also possess an open and reduced circulatory system, and have a complete digestive tube (tubular gut). They have a simple radial nervous system that consists of a modified nerve net (interconnected neurons with no central organs); nerve rings with radiating nerves around the mouth extending into each arm; the branches of these nerves coordinate the movements of the animal. No echinoderm has a brain, some however do have ganglia. The sexes are usually separate. Sexual reproduction typically consists of releasing eggs and sperm into the water, with fertilization taking place externally. Many echinoderms have remarkable powers of regeneration: a starfish cut radially into a number of parts will, over the course of several months, regenerate into as many separate, viable starfish. A section as small as a single arm (with the commensurate central-body mass and neural tissue) will, in ideal circumstances, successfully regenerate in this way.

Sea stars are marine invertebrates belonging to phylum Echinodermata, class. Asteroidea. The names sea star and starfish are also used for the closely related brittle stars, which make up the class Ophiuroidea. They exhibit a superficially radial symmetry.

Starfish typically have five or more "arms" which radiate from an indistinct disk (pentaradial symmetry). In fact, their evolutionary ancestors are believed to have had bilateral symmetry, and sea stars do exhibit some superficial remnant of this body structure. Sea stars do not have movable skeletons, but instead possess a hydraulic water vascular system. The water vascular system has many projections called tube feet, located on the ventral face of the sea star's arms, which function in locomotion and aid with feeding. As these creatures are echinoderms and not actually fish, most marine biologists prefer to replace the term starfish with the less misleading term sea star.

Sand dollars are in the Echinoid (Echinoderms) class of marine animals. When alive, they are covered with a suit of moveable spines that encompass the entire shell. Like its close relative the sea urchin, the sand dollar has five sets of pores arranged in a petal pattern. The pores are used to move sea water into its internal water-vascular system, which allows for movement. Sand dollars live beyond mean low water on top of or just beneath the surface of sandy or muddy areas. The spines on the somewhat flattened underside of the animal allow it to burrow or to slowly creep through the sand. Fine, hair-like cilia cover the tiny spines. These cilia, in combination with a mucous coating, move food to the mouth opening which is in the center of the star shaped grooves on the underside of the animal. The anus is also located on the bottom, near the edge. Its food consists of plankton and organic particles that end up in the sandy bottom. On the ocean bottom, sand dollars are frequently found together. This is due in part to their preference of soft bottom areas, which are convenient for their reproduction. The sexes are separate and, as with most echinoids, gametes are released into the water column. The free-swimming larvae metamorphose through several stages before the test begins to form, and they become bottom dwellers. The name "sand dollar" is a reference to their round flat shape, which is similar to a large coin. Sand dollars usually eat tiny particles of food that float in the water. They hide by burying themselves under the sand. The term "sand dollar" can also refer to the skeleton or *test* left when a sand dollar dies. By the time the test washes up on the beach, it is usually missing its velvety covering of minute spines and has a somewhat bleached appearance due to its exposure to the sun.

The **crustaceans** (**Crustacea**) are a large group of arthropods (55,000 species), usually treated as a subphylum. They include various familiar animals, such as lobsters, crabs, shrimp and barnacles. The majority are aquatic, living in either fresh water or marine environments, but a few groups have adapted to terrestrial life, such as terrestrial crabs, terrestrial hermit crabs and woodlice. The majority are motile, moving about independently, although a few taxa are parasitic and live attached to their hosts (including sea lice, fish lice, whale lice, tongue worms, and *Cymothoa exigua*), and adult barnacles live a sessile life - they are attached head-first to the substrate and cannot move independently. Crustaceans have three distinct body parts: head, thorax, and abdomen (or *pleon*), although the head and thorax may fuse to form a cephalothorax. The head bears two pairs of antennae, one pair of compound eyes and three pairs of mouthparts. The thorax and pleon bear a number of lateral appendages, including the gills, and the tail ends with a telson. In common with other arthropods, crustaceans have a stiff exoskeleton which must be shed to allow the animal to grow (ecdysis). Although a few are hermaphroditic, most crustaceans have separate sexes, which are distinguished by

appendages on the abdomen called swimmerets or, more technically, pleopods. The first (and sometimes the second) pair of pleopods are specialised in the male for sperm transfer. Many terrestrial crustaceans (such as the Christmas Island red crab) mate seasonally and return to the sea to release the eggs. Others, such as woodlice lay their eggs on land, albeit in damp conditions. In many decapods, the eggs are retained by the females until they hatch into free-swimming larvae.

The **horseshoe crab** (***Limulus polyphemus***) is a chelicerate arthropod, therefore it is more closely related to spiders and scorpions than crabs. They are most commonly found in the Gulf of Mexico and along the northern Atlantic coast of North America. A main area of annual migration is the Delaware Bay. A Japanese variant (***Tachypleus tridentatus***) is found in the Seto Inland Sea, but is considered an endangered species because of loss of habitat. There are many fish farms that raise horseshoe crabs to be sold to the public as a delicacy. They can grow up to 20 inches (51 cm), on a diet of mollusks, annelid worms, and other benthic invertebrates. In captivity, its diet should be supplemented with meaty items such as pieces of squid and shrimp (Foster and Smith, 2004). Its mouth is located in the middle of the underside of the cephalothorax. A pair of pincers (*chelicerae*) for seizing food are found on each side of the mouth. Horseshoe crabs possess five pairs of book gills located just behind their appendages that allow them to breathe underwater, and can also allow them to breathe on land for short periods of time, provided the lungs remain moist. The outer shell of these animals consists of three parts. The carapace is the smooth frontmost part of the crab which contains the eyes, the walking legs, the chelicera (pincers), the mouth, the brain, and the heart. The abdomen is the middle portion where the gills are attached as well as the genital operculum. The last section is the "telson" (caudal spine) which is used to flip itself over if stuck upside down. *Limulus* has been extensively used in research into the physiology of vision. It has two compound eyes, and each ommatidium feeds into a single nerve fibre. Horseshoe crabs can live for 20-25 years. They migrate into the shore in late spring, with the males arriving first. The females then arrive and make nests at a depth of 15-20 cm in the sand. In the nests, females deposit eggs which are subsequently fertilized by the male. Egg quantity is dependent on female body size and ranges from 15,000-64,000 eggs per female (Leschen et al. 2006). "Development begins when the first egg cover splits and new membrane, secreted by the embryo, forms a transparent spherical capsule" (Sturtevant). The larvae form and then swim for about five to seven days. After swimming they settle, and begin the first molt. This occurs approximately twenty days after the formation of the egg capsule. As young horseshoe crabs grow, they move to deeper waters, where molting continues. They reach sexual maturity in approximately eleven years and may live another 10-14 years beyond that.

Although most arthropods have mandibles, the horseshoe crab is jawless. The horseshoe crab's mouth is located in the center of the body. In the female, the four large legs are all alike, and end in pincers. In the male, the first of the four large legs is modified, with a bulbuous claw that serves to lock the male to the female while she deposits the eggs and he waits to fertilize them.
Horseshoe crabs are distant relatives of spiders and are probably descended from the ancient eurypterids (sea scorpions). They evolved in the shallow seas of the Paleozoic Era

(540-248 million years ago) with other primitive arthropods like the trilobites. Horseshoe crabs are one of the oldest classes of marine arthropods, and are often referred to as "living fossils", as they have not changed much in the last 350 to 400 million years. Horseshoe crabs are extremely valuable as a species to the medical research community. Since 1964 a substance made from their blood called Limulus Amebocyte Lysate (LAL) has also been used to test for bacterial endotoxins in pharmaceuticals and for several bacterial diseases. The animals can be returned to water after extraction of a portion of their blood, so this is not necessarily a threat to the survival of horseshoe crabs. A single horseshoe crab can be worth $2,500 over its lifetime for periodically drawing its blood for this extract. The blood of horseshoe crabs is blue, which is a result of its high content in copper-based hemocyanin instead of the iron-based hemoglobin found, for example, in humans. The fact that horseshoe crabs have evolved so little over the past 300 to 400 million years is part of the reason why they are so different from most other animals.

Limulus polyphemus is not presently endangered, but harvesting and habitat destruction have reduced its numbers at some locations and caused some concern for these animals' future. Since the 1970s, the horseshoe crab population has been decreasing in some areas, owing to several factors, including the use of the crab as bait in conch trapping.

In 1995, the nonprofit Ecological Research and Development Group (ERDG) was founded with the aim of preserving the four remaining species of horseshoe crab. Since its inception, the ERDG has made significant contributions to horseshoe crab conservation. ERDG founder Glenn Gauvry designed a mesh bag for conch traps, to prevent other species from taking off with the bait. This has led to the amount of bait needed being decreased by approximately 50%. In the state of Virginia, these mesh bags are now mandatory in conch fishery. The Atlantic States Marine Fisheries Commission is in 2006 considering several conservation options, among them being a two-year ban on harvesting the animals affecting both Delaware and New Jersey shores of Delaware Bay. Every year, around 10% of the horseshoe crab's breeding population dies when rough surf flips the creatures onto their backs, a position from which they often cannot right themselves. In response, the ERDG (Ecological Resource and Development Group) launched a "Just Flip 'Em" campaign, in the hopes that beachgoers will simply turn the crabs back over. Conservationists have also voiced concerns about the declining population of shorebirds, such as Red Knots, which rely heavily on the horseshoe crabs' eggs for food during their Spring migration. Precipitous declines in the population of the Red Knots have been observed in recent years. Predators of horseshoe crabs, such as the currently threatened Atlantic Loggerhead Turtle, have also suffered as crab populations diminish.

Vocabulary

Invertebrate -Lacking a backbone or spinal column; not vertebrate
Shell- a hard outer covering of an animal
Test- a term specific to the shells of Echinoderms (sea urchins, sand dollars, sea stars, etc.)
Molt -To shed periodically part or all of a coat or an outer covering, such as feathers, cuticle, or skin, which is then replaced by a new growth.

Mollusk -any invertebrate of the phylum Mollusca, typically having a calcareous shell of one, two, or more pieces that wholly or partly enclose the soft, unsegmented body, including the chitons, snails, bivalves, squids, and octopuses.
Bivalve- A mollusk, such as an oyster or a clam, that has a shell consisting of two hinged valves
Echinoderm-any marine animal of the invertebrate phylum Echinodermata, having a radiating arrangement of parts and a body wall stiffened by calcareous pieces that may protrude as spines and including the sea stars, sea urchins, sea cucumbers, etc.
Crustacean- Any of various predominantly aquatic arthropods of the class Crustacea, including lobsters, crabs, shrimps, and barnacles, characteristically having a segmented body, a chitinous exoskeleton, and paired, jointed limbs.
Gastropod- Any of various mollusks of the class Gastropoda, such as the snail, slug, cowrie, or limpet, characteristically having a single, usually coiled shell or no shell at all, a ventral muscular foot for locomotion, and eyes and feelers located on a distinct head.
Classify/Classification - To arrange or organize according to class or category. The systematic grouping of organisms into categories on the basis of evolutionary or structural relationships between them; taxonomy.
Adaptation - any alteration in the structure or function of an organism or any of its parts that results from natural selection and by which the organism becomes better fitted to survive and multiply in its environment.