Belonging to the Phylum Echinodermata and the class Echinoidea, there are about 700 different species of sea urchins. They only live in oceans, found in the intertidal to the deep ocean among bed floors, within rocks, coral reefs, or anywhere kelp/algae is plentiful. They range in size from 3 to 10 centimeters. Common colors include black, purple, red, and brown.

Image 1-1
Aboral side of a sea urchin. The aboral area of the sea urchin is the top side. The anus, gonopores, and genital plate are located here in an area called the periproct. A sea urchin is sometimes referred to as the “hedgehog of the sea” because it resembles a hedgehog.

Image 1-2
Oral side of a sea urchin. The oral area of the sea urchin is the bottom. Located here are the mouth, teeth, gills and modified tube feet in an area called the peristome. Sea urchins are indicator species because they are sensitive to changes in their environment. Biologist monitor them to see if anything is wrong within the ocean environment.
Sea urchins have no brain and therefore have a simple nervous system. The center is a large nerve ring encircling the mouth used to power the tube feet. They have a water vascular system which aids in movement of the tube feet and releasing of sperm/eggs from the gonopores. Sea urchins are, however, sensitive to light and touch. The spines will converge toward touch points and shadows. They are nocturnal because of their sensitivity to light. Like their relative the starfish, sea urchins have a regenerative ability. If their spines become damaged or lost they can rebuild them, but only if the damage to their test isn’t too severe.

Aristotle, Greek philosopher, coined the term for the mouth of the sea urchin which many researchers use today. Said by Aristotle, "In reality the mouth-apparatus of the urchin is continuous from one end to the other, but to outward appearance it is not so, but looks like a horn lantern with the panes of horn left out." During Aristotle’s life, horn lanterns had five sides. This made for a good comparison when writing about the sea urchin.

Sea urchins are unsegmented and have a fivefold symmetry, called pentamerism. Although, from fertilization to metamorphosis the young sea urchin is bisymmetrical. The endoskeleton of the sea urchin, called the test, is globular and is composed of fused plates of calcium carbonate. The plates of the test have perforations through which five rows of tube feet are extended. The tube feet, in conjunction with the spines, allow the sea urchin to move and trap food. Surrounding the tube feet are 5 rows of rounded tubercles, to which the spines are attached by ball-joints. Each area on the test consists of 2 rows of plates, so that the test has 20 rows total. Among the tube feet and spines are tiny pedicellarines, which are small stinging structures that are used for defense and for obtaining food.

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Sea urchins feed mainly on kelp and algae, although they may eat mussels, barnacles, sea cucumbers and other invertebrates.

**Diet**

**Predators**
Known predators are sea otters, wolf eels, some birds, star fish, bacteria, and humans. Humans harvest sea urchins for their roe. It is called Uni and served as sushi in the US as well as Japan.

**Reproduction**
There are male and female sea urchins although it is difficult to distinguish between the two. One way is their location on the ocean bottom. Males choose elevated locations so that their sperm can be broadcast by sea currents. Females choose low-lying locations so that the eggs can have better protection from predators. Fertilization is external. Eggs and sperm are released through the gonopores on the aboral side of the urchin and come together to fertilize forming a larva called a pluteus. The pluteus becomes part of the plankton and do not leave the plankton until they are about 2-5 years old.

**Specimen Prep**
To get the images of the sea urchin's test I used an enzyme-based bleach to dissolve the organic material surrounding the test. I removed all of the spines from the sea urchin. I then filled a beaker with water and a couple teaspoons of the detergent Biz. I placed the sea urchin in Biz mixture for about 2 days, rotating the test as needed. Once all of the organic material dissolved I rinsed the test with plenty of water and let it air dry.

**Challenges**
The sea urchin was wet and when lit had speculars. I tried putting the specimen in water but I didn’t like the look. Some of the fine detail was lost. So I chose to shoot the specimen out of water, but I allowed it to sit out for a while to dry so it wasn’t as wet. It still had some speculars but not as many. I recommend diffusing the light with either ping pong balls or some kind of diffusing material.

I ordered the specimens live and they were shipped over night from CA. I chose live specimens because they still had color, as opposed to fixed specimens. When shipped over night they became very stressed and died within a day. I recommend having an established tropical tank set-up and ready to go for when you are working with these live specimens as they are very sensitive to their environment. As living in an area where there is no ocean my only choice was to order them from a scientific company. It is unfortunate that they died because I had hoped to photograph them living, as well as their insides. Because they had died they lost color, their spines fell over or off, and their insides had turned to mush.

**Sea Urchins in the News**

- **Sea Urchins Turning Into Cannibals**

- **Sea Urchin Genome Yields New Understanding of “Chemical Defense.”**

- **Be Green 2: Sea Urchins Battle Invasive Species**

- **After the Gold Rush**

- **Sea Urchin Body Is One Big Eye**
Photo Equipment
• Nikon D300s
• Nikon 105 mm lens
• Various mm thimble lenses
• Bellows
• Fiber optic lights
• Computer
• Tether cable

Photo Set-up
The camera was tethered to a computer. The software used to capture the images was Camera Control Pro. This helped to reduce camera vibration by not having to push the shutter button on the camera. The specimen was placed on a piece of glass on top of 2 wooden blocks and black velvet was placed underneath to add a black background to the image. The fiber optic lights were then placed around the specimen for optimum lighting. Please see the photo set-up image below.

Photographing
All images were photographed in RAW format and converted to high resolution JPEG’s for image stacking and screen display. When using a higher magnification image stacking was used because obtaining the most detail and depth of field was important. Images were taken at different depth of focuses within the specimen and put into stacking software to combine all the images into one. The software used was Zerene stacking software (http://www.zerenesystems.com/cms/stacker). Other software used for slight editing were Photoshop CS5 and Lightroom.

Resources


About the Author/Photographer
Rachael Landrie is a 4th year Biomedical Photography student at Rochester Institute of Technology in Rochester, NY. Her concentration focuses on macrophotography and photomicrography.

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