Ron Fonte
Exploratory 1
7/10/07

Comparison of Urchin Spines

Long Spine Red and Short Spine Purple

Sea Urchins (p. Echinoderms cl. Echinoidea) with their geodesic dome shape, over 1,000 spines and at the base of these spines are three, jawed, poisonous pedicellarias ready to protect this animal.

To be sure, the urchin's outside is protecting something very valuable on the inside. A delicious, sweet roe derived from a variety of seaweeds. Kelp is its most common food, but will eat anything including each other. In the commercial sea food "uni" world "color is king". Merchants will finish off an urchin with carrots and oranges to bring out this yellow color. They will eat anything, which is one of their secrets of success.

Theory: The spines of long spine red sea urchin and the spines of the short spine purple sea urchin look very different to the eye. They are different species; but how different are the spines on closer examination?

Method: To count the spines I divided the urchin into four quadrants with dental floss making a cross on top and bottom (across Aristotle lantern). Counting the numbers of spines within the white floss lines of the quadrant and then multiplying by four to get the total spines on the whole animal.

Volume was calculated by Archimedes principle of displacement of water. I completely submerged the urchin in water and collected the overflow in a tub thereby measuring the displaced overflow in a graduated cylinder. It would be the animal's volume in milliliters approximately equal to a cm^3 if the water was very cold.

Microscope Observations

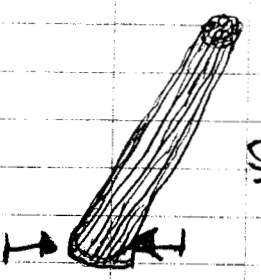
Using scope ocular of 15 x 4.5 objective, magnification of 67.6x, the red long spine and the purple short spine appear to be very similar. Built like a tapered bundle of solid straws. Magnificent example of structural strength, highly resistant to bending and breaking.

Drawings of the Spine

Tips: Measurements of the Spines taken at their widest point their base.

Scope Magnification Ocular (15X 4.5 = 67.5X

Like strands bundled, oval shape



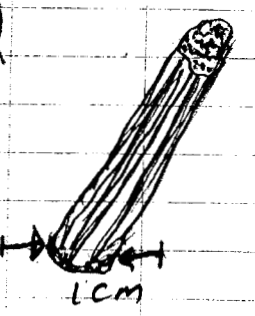
Scale 1cm / .017cm = 58.8X Magnification

Purple urchin

Tip looking down

Pacific Spine → Purple urchin Short Spine.

Solid structure



Solid

Scale 1cm / .033cm = 30.3X

Pacific Spine → Red urchin Long Spine

E Coast Sea urchin Long Spine

Hollow

1cm / .007cm = 142.9X Magnification

Hollow structure

East Coast Spine → Dark green Long Spine

Note: Nose cone black tip, Solid Calcium Arsenate? (Poison for sure)

There is a group of largely tropical sea urchins which are of special interest here They have odd spines which contain a rather potent toxin and can cause painful wounds to the unwary human who steps on one. At the tip of the spine is a small bulbous projection with glands containing the toxin. Some species also have pedicellariae with glands containing toxins. Pedicellariae deserve an entire articl

Calcareous Flowers:

Tests and Cross-Sections of Sea Urchin Spines

by Richard L. Howey, Wyoming, USA

DATA Red Long Spine – STRONGYLOCENTROTUS FRANCISCANUS
Purple Short Spine – Strongylocentrotus purpuatus

	Red	purple
Diameter of Whole Animal	10.5 cm 5.25 cm Radius	7.3 cm 3.65 Radius
Volume Whole Animal	300.3 mL	104.0 mL
Height	6.3 cm	5.0 cm
Diameter of Spines At Base	3.3 mm Average of 7 spines	1.7 mm
Total Number of Spines	988 Spines Whole Animal	940

CALCULATIONS – RATIO COMPARISONS

Red $\frac{\text{WHOLE ANIMAL DIAMETER}}{\text{TOTAL VOLUME}} = \frac{10.5\ cm}{300.3\ mL} = .04$

Purple $\frac{W.A.D}{Vol} = \frac{7.3\ cm}{104\ mL} = .07$

Red $\frac{\text{SPINE DIAMETER AT BASE}}{\text{TOTAL VOLUME}} = \frac{3.3}{300.3} = .01$

Purple $\frac{S.D.}{Vol.} = \frac{1.7}{104} = .02$

Red $\frac{\text{HEIGHT}}{Vol} = \frac{7.8}{300.3} = .03$

purple $\frac{H}{V} = \frac{4}{104} = .038$

VOL OF A SPHERE $= \frac{4}{3}\pi R^3$

Red $= \frac{4}{3}(3.14)(5.25)^3$

$= 606\ cm^3$

purple $= \frac{4}{3}(3.14)(3.65)^3$

$= 203\ cm^3$

$606\ cm^3 \approx$ 2x Real Volume Red of 300.3 mL

$203\ cm^3 \approx$ 2x Real Volume Purple of 104.0 mL

URCHIN TAKE up ½ the Room of A SPHERE of equal RADIUS – STILL PROPORTIONAL

Conclusion: Red long spine and purple short spine sea urchin spines are very similar. The red ones live below the low tide line and the purple ones live in the shallows exposed at low tides. Both urchins have approximately the same number of spines. When compared to the ratio of the whole animal's diameter, spine diameter (measured at their base and their height to their volume) are proportional and very close to the same.

A superlative example of survival is a delicate balance of form vs. function. An inspiring symphony of adaptations. When it comes to the urchin spines of the Pacific Coast, they are excellent structures that are hard to improve upon or build better to defend their delicious roe sacs.

References

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Catch in the Primary Spines of the Sea Urchin *Eucidaris tribuloides:* A Brief Review and a New Interpretation

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