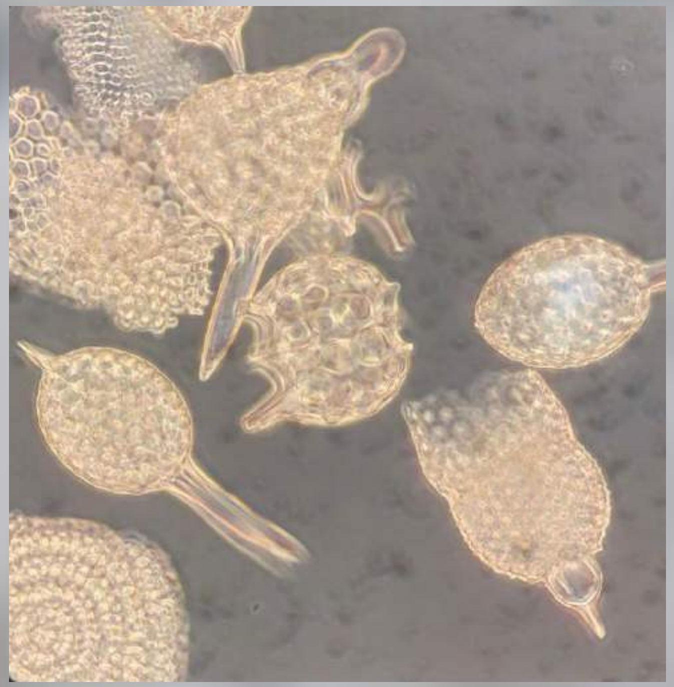
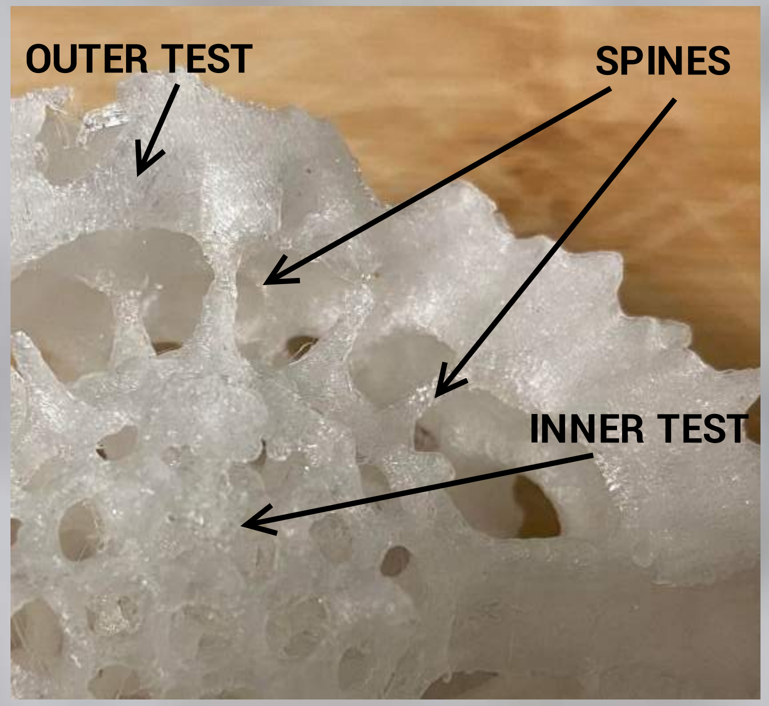


3D Visualization and Analysis of *"Cells in Glass Houses"*

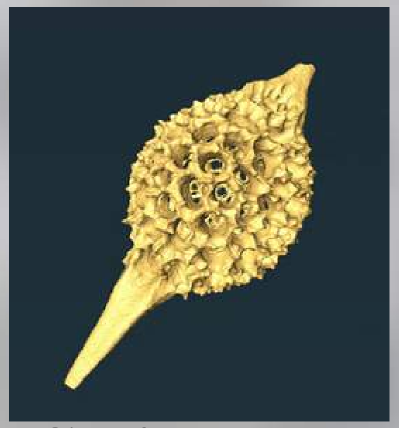
John Bean
Professor John R. Jungck

Radiolaria are single celled organisms that leave behind mystifying glass skeletons upon death. While the beauty of their intricate skeletons has served as inspiration for designers, artists, and engineers, Radiolaria offer a more practical use in the field of biostratigraphy--dating ocean sediment using fossils. Like the sediment they are found in, the skeletons of Radiolaria are layered, often structured with two or three internal skeletons, or tests. As the Radiolarian is growing, it develops external tests that are connected to the internal tests by a series of spines.

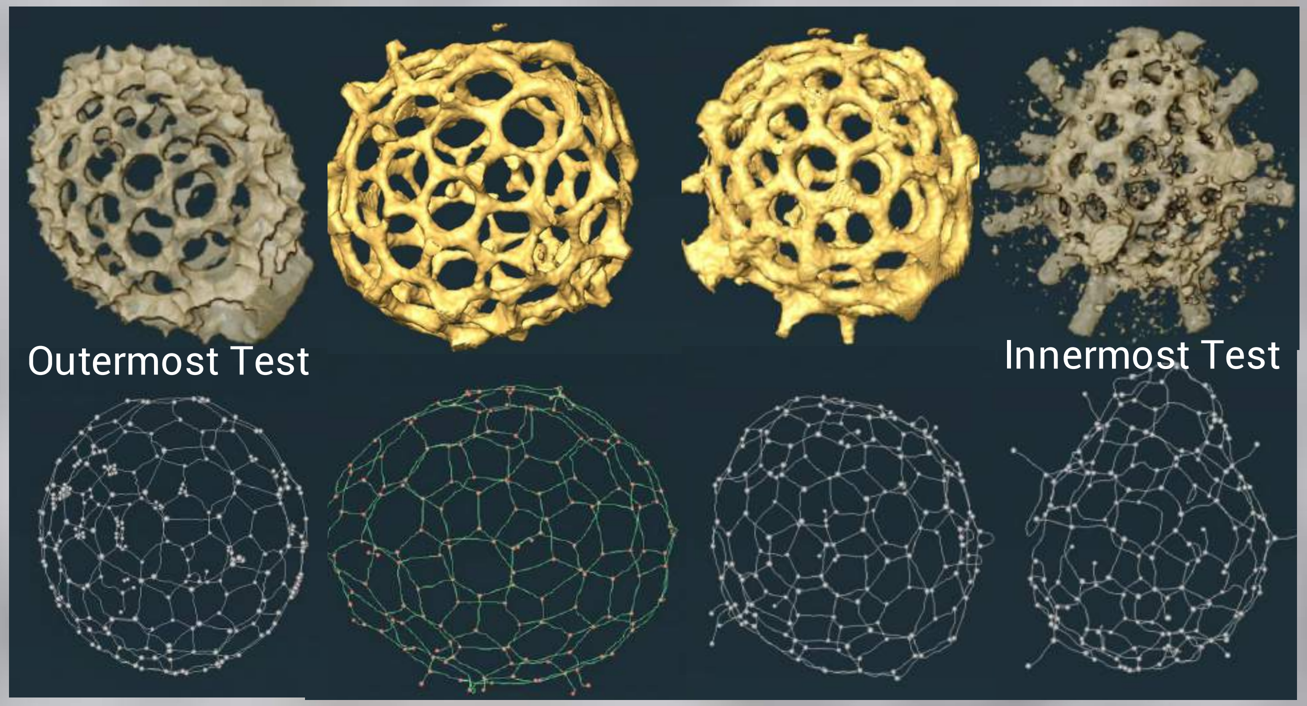


Using Amira to Analyze Skeleton Structure

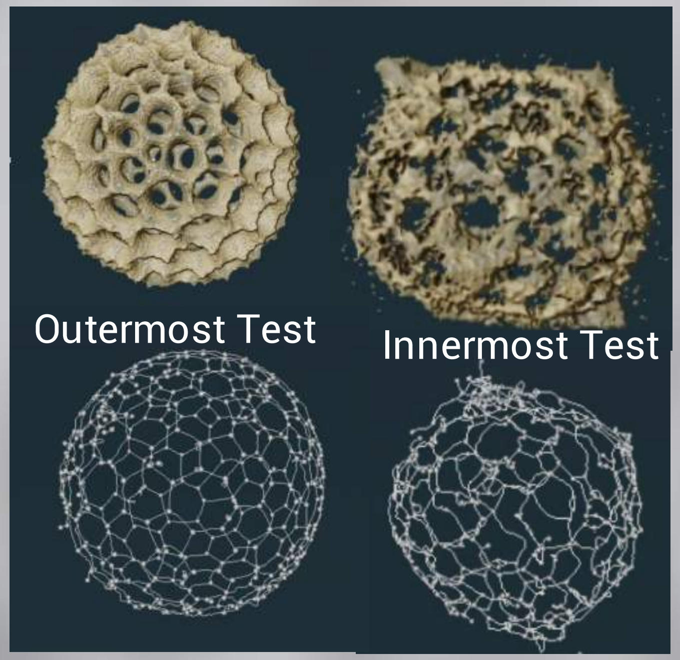
Amira is an image processing and analysis program that features a powerful *Skeletonization* tool. This enabled me to digitally dissect Radiolaria and gather topological data (vertices, edges, and faces) on their tests, and allowed me to gather data on tests that were far too small to count by hand. So far I have analyzed three different species of Radiolarian: a *Stylotractus, Heliodiscus,* and an *Unidentified Spherical Radiolarian.*

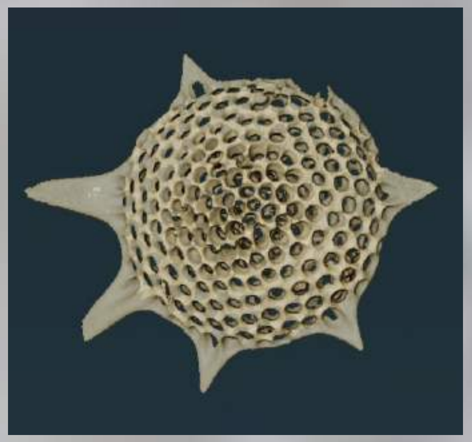


Stylotractus

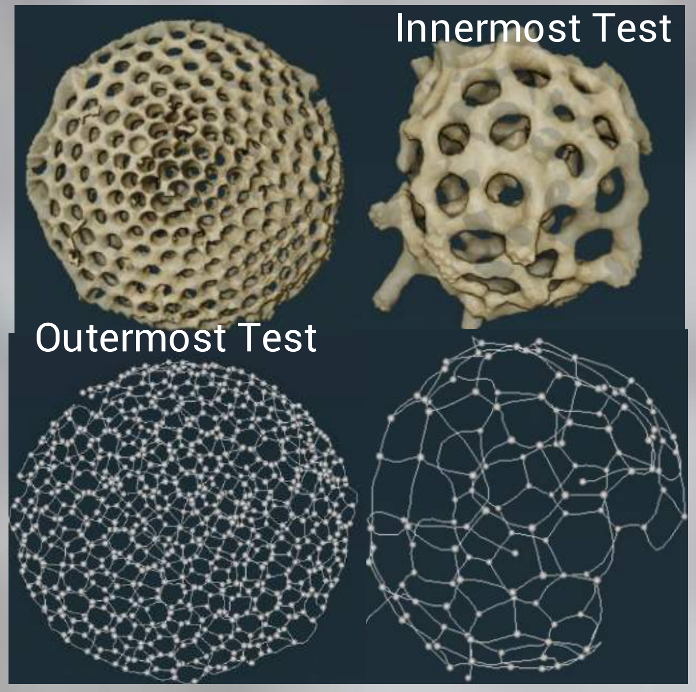


Unidentified





Heliodiscus



Skeletonization Results

Using *Amira Skeletonization* I gathered data on the *vertices* and *edges* of the Radiolaria models. I then utilized *Euler's Formula* to calculate the number of *faces* on each model.

$$F = E + 2 - V$$

Stylotractus

Test#	Vertices	Edges	Faces
Innermost	174	261	**89**
Test #2	178	258	**82**
Test #3	167	281	**86**
Outermost	165	247	**84**

Heliodiscus

Test#	Vertices	Edges	Faces
Inner	127	191	**66**
Outer	766	1176	**413**

Unidentified Spherical

Test#	Vertices	Edges	Faces
Inner	363	559	**198**
Outer	395	583	**190**

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Amira Shortcomings

While *Amira* allowed me to gather lots of information on the tests of the three Radiolaria, the *Skeletonization* process was not perfect, and I had to do some counting by hand to achieve more accurate results. To count by hand, I utilized a series of 3D printed models, including two *Stylotractus* models, and a model of the *Unidentified Spherical* Radiolarian.

Observations and Conclusions

The data I gathered through studying the *vertices*, *edges, and faces* of three species of Radiolaria gave me insight into how these organisms grow and develop. The structures of the *Stylotractus* and *Spherical* Radiolaria seem heavily influenced by their internal tests, as the three topological variables are all very similar at each test. However, the shape of the tests does not seem to be influenced nearly as much, as while both species have spherical external tests, their internal tests are vase or ellipsoid shaped. For these two species, the topology stayed fairly constant while the geometry varied extensively.

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