

Radiolaria Cell Measurement Lab

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This virtual lab utilizes the website <https://www.virtualmicroscope.org/collections>. Using a slide of Radiolaria collected from the West Indies, students will measure individual specimens and practice calculating the mean and standard deviation of a data set. Students can use college library databases to increase their background knowledge of Radiolaria. The students then write a lab report based on their measurements and background information on these little-studied organisms.

Keywords: Radiolaria, online microscopy, inquiry-based learning

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Introduction

Radiolarians are little studied in biology courses, but they are fascinating indeed. These marine protozoans are predominantly single-celled with elaborate silica skeletons or tests, but some are colonial and “naked”. In living specimens you may notice axopodia, which are thin projections of protoplasm through holes in the test, which they use to catch their prey. Some species have dinoflagellate endosymbionts that imbue the tests with a golden-brown color (Yuasa et al. 2016).

Radiolarians originated in the Cambrian period, which was almost 500 million years ago (Smalley 1963). The siliceous tests of many species allow them to be well-preserved in the fossil record giving an indication of past life and biodiversity. Siliceous ooze, found in the ocean, is made up of 30% organic material, much of which are radiolarians and diatoms. Although many species have gone extinct, there are extant species that are continually being

discovered (Tetard et al 2015, Toklu-Aliçlı and Balkis 2007). Researching these organisms can expose students to a range of geographic and geologic history. For example, Vishnevskaya et al. (2014) display a map of the Arctic with the sampling sites from which they obtained Radiolaria from the Cretaceous time period. Vishnevskaya et al. (2017) later found new Radiolaria with intricate tests from Jurassic sediments. Kršinić and Kršinić, (2012) appear to have the most comprehensive illustrations of Radiolaria, many of which look similar to the ones in this exercise.

In this lab, students use sample specimens from the Virtual Microscope collection <https://www.virtualmicroscope.org/collections> to make observations about the diversity of Radiolarian species. They perform simple measurements in the online platform and then use Excel to statistical analyses on these protozoans. For this lab exercise students are required to write a full lab report, allowing them to practice both their scientific writing skills and their library research skills.

Student Outline

Objectives

- Use an online exercise to measure radiolarians.
- Make an Excel spreadsheet with statistical data.
- Understand how Radiolaria fit into the Tree of Life.

Introduction

Methods and Data Collection

Part A: Identifying and Measuring Radiolaria specimens

Go to this website: <https://www.virtualmicroscope.org/collections> then go to Cabinet of Curiosities, and find the specimen Radiolaria - West Indies. Click on the microscope icon to view the specimen (fig. 1).

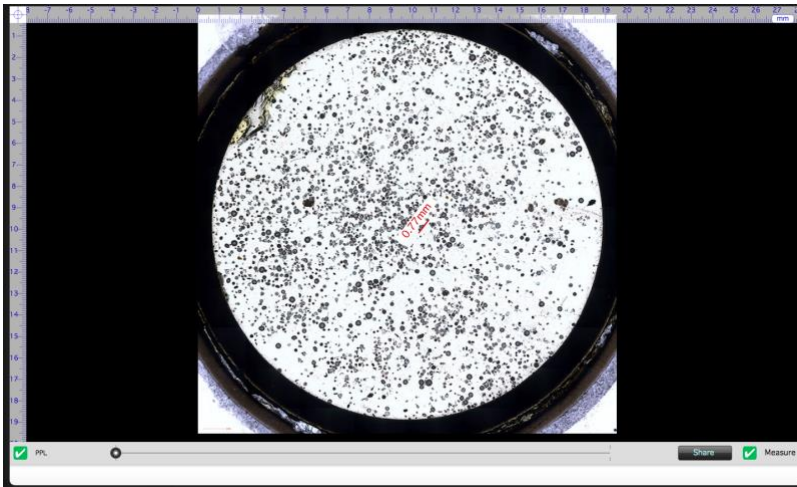


Figure 1. Radiolarians at low magnification.

Zoom in on a section of the radiolarian----(black button on left) randomly pick out and measure the length and width of 20 radiolarians (click measure tool). Open up Excel, and enter your measurements (fig. 2).

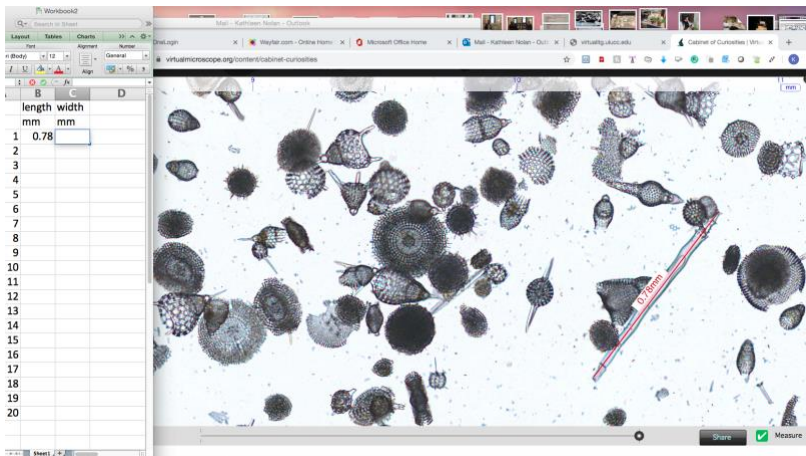


Figure 2: Excel spreadsheet adjacent to the magnified radiolarians.

Notice that the sample appears to include many different species based on the variation in morphology seen in individual specimens (figs. 3 and 4).

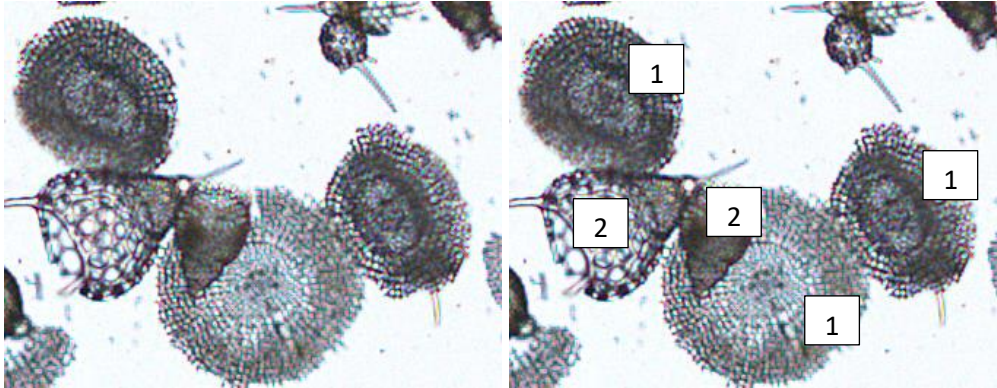


Fig. 3: Multiple species of radiolarians in a single frame can be classified into species types based on morphology



Figure 4. Three species of radiolarians from <https://www.virtualmicroscope.org/collections>

How many species are in your sub-sample? Take into consideration that they might have been preserved in different planes---for example, a round dinner plate would look like a straight line if photographed from the side. Write down your observations.

Part B: Data calculations

Once you have measured 20 individual specimens, find the minimum (MIN), maximum (MAX), averages (AVERAGE) and then calculate the standard deviation (STDEV) of your length and width data. The formulas for these are: =MIN(column letter and row number of your first value:column letter and row number of final value). Example: Type =MIN(B2:B22) into a cell below your data. When you press "enter" the value will be calculated and will appear in the cell. The bar at the top of the page will contain the formula. Follow this same format for maximum =MAX(B2:B22), average =AVERAGE(B2:B22) and standard deviation =STDEV(B2:B22).

Part C: Writing your lab report

You will write a lab report on this lab and turn it into Assignments on Canvas.

For your **Introduction**, look up what radiolarians are. Type the definition (in your own words, as best as possible). Write down your source of information. Also, go to your school library and open up databases. Find a research article about radiolarians, and include some of the data (statistics) from the article in this introduction

Results---include some screen shots in your report showing what you saw.

Your **Results** are your Excel spread sheet and descriptions of what you saw.

Be as detailed as possible. Also, look at one other specimen in the Cabinet of Curiosities and describe it.

Your **Discussion** would include any further research you could do on these organisms!!

Materials

A computer with Internet access.

Notes for the Instructor

This exercise works really well as an online introduction to Protista.

Students should search the literature for information about the Radiolaria, and, if directed, additional protists such as foraminifera and the diatoms. They should write a lab report that has an abstract that includes information about the types of Radiolaria they measured (at least three), and interesting information about Radiolaria that they gleaned from the literature. This could include information about the symbiosis that occurs in some radiolarians with dinoflagellates, the use of radiolarians to discern information about geology, and others. They should write a Materials and Methods section that describes how they used the virtual microscope site above.

For additional pictures of radiolarians see: <http://earthsci.org/expeditions/microfossils/microfossils.html#radi>

For additional information on microfossils, see: <https://ucmp.berkeley.edu/fosrec/Lipps1.html>

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<http://earthsci.org/expeditions/microfossils/microfossils.html#radi>

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Acknowledgments

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Kathleen Nolan has been an Instructor at St. Francis College since 1995 where she teaches a variety of biology courses.

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