

Cell Size Limits of the Six Kingdoms

Summary: I investigated, with assistance, two hypotheses regarding cells: 1) cell sizes of multicellular and unicellular organisms are similar, and 2) all Six Kingdoms have similar size cells. In total, eight separate samples spanning the Eubacteria, Archebacteria, Protista, Plantae, Fungi, and Animalia Kingdoms were viewed under a microscope that was equipped with an ocular micrometer.

Measurements of length were collected for twenty different cells from each of these samples to calculate mean values; these were used for comparisons and to make determinations. Our results indicated that cell sizes differ greatly across the Kingdoms, and the characteristic of being either unicellular or multicellular does not serve as an effective indication of cell size. These results are supported by the knowledge that typical eukaryotic cells are 10 to 100 μm in diameter, while most prokaryotic cells are only 1 to 10 μm in diameter (Raven 2011). Our data collection methods appeared to be roughly consistent with cell measurement determinations taken by others, such as the diatom phytoplankton *S. minutulus* having a diameter of $\sim 10 \mu\text{m}$ (Toporowska 2010).

Methods & Results: I obtained a microscope with an ocular micrometer and configured it for use. In order to properly translate measurements from the many different magnification levels available, I constructed the following table to obtain the correct measurements of specimens:

Ocular Lens	Objective Lens	Total Magnification	Conversion ($\mu\text{m}/\text{unit}$)
10x	4x	40x	25 μm
10x	10x	100x	10 μm
10x	45x	450x	2.2 μm
10x	100x	1000x	1 μm

Our group, consisting of four people total, retrieved two samples each of the eight available. I selected unicellular Archebacteria and Eubacteria samples, while my other lab partners selected the samples for multicellular Protista (Cladophora), unicellular Protista (Diatomstrew), multicellular Plantae (Elodea), multicellular Fungi (Penicillium), unicellular Fungi (Saccharomyces Budding), and Animalia (Buccal Smear). Using the microscope to establish the correct magnification level for each slide, I used the ocular micrometer to carefully measure the lengths and widths of 20 unique cells from each of the two samples. An average size for each individual reading was calculated by using $(\text{Length} + \text{Width} / 2)$ and was then translated from generic units into μm , using information included in the table above. Finally, after recording the sizes for 20 different cells, a mean value was calculated for each sample. This general procedure was also followed by my lab partners as well and produced the following table of data:

Kingdom – Sample Name	Mean Size
Archebacteria	$\sim 3.925 \mu\text{m}$
Eubacteria	$\sim 3.925 \mu\text{m}$
Protista – Cladophora	$\sim 223.50 \mu\text{m}$
Protista – Diatomstrew	$\sim 31.02 \mu\text{m}$
Plantae – Elodea	$\sim 32.23 \mu\text{m}$
Fungi – Penicillium	$\sim 2.64 \mu\text{m}$
Fungi – Saccharomyces Budding	$\sim 7.125 \mu\text{m}$
Animalia – Buccal Smear	$\sim 142.67 \mu\text{m}$

The results show quite clearly that cell sizes vary greatly across the Six Kingdoms. The data also shows that generalizations cannot be made about cell sizes for unicellular and multicellular organisms.

References:

Raven P., 2011. *Biology*, 9th ed., McGraw-Hill.

Toporowska, M., 2010. Winter Versus Summer Blooming of Phytoplankton in a Shallow Lake: Effect of Hypertrophic Conditions, *Polish Journal of Ecology* 58(1), pp. 3-12.