Implementation Plan and Teaching Notes for Why are Cells Small? Activity

# Course and Format:

The basic activity was tested in an Introductory Biology Course for Non-Majors (30 students) in a face to face course.

Purpose:

Improve student’s quantitative literacy, mathematical skills, and critical thinking about biological organisms.

## Specific Learning Objectives:

### Biology

1) Explain the relationship of surface area to volume

2) Describe the importance of a large surface area to volume ratio in the context of a living cell

### Mathematics

1) Calculate surface area of cubes and spheres

2) Calculate volume of cubes and spheres

3) Express two values as a ratio

### Data Literacy

1) Enter data into a table

2) Interpret Tables

3) Create a graph

4) Describe the axis labels on graphs

5) Interpret graphs

# Implementation and Pedagogy:

The various levels at which biological systems could be studied, and the ways that these various levels could be observed was discussed in class. The packet **(make sure to print single sided)** was passed out and the image shown at the top of the activity was shown and discussed at the end of the class.

Students were asked to read the background for the Biology concepts and Math Concepts prior to coming to class the next day. At the beginning of the next class period, the concepts were briefly discussed before beginning the activity.

The Cube Exercise was completed by the students in groups of 2, and then as a class the answers to the questions and their predictions were discussed. These predictions were written on the white board.

The student groups worked on the Testing Predictions Activity, using either a computer or a smart phone to access the GeoGebra cube and sphere. Students were reminded to make sure they were entering the data in their tables correctly. The class then discussed their graphs and data and how the information pertained to the predictions they had made previously.

For the summative assessment, 5 questions were chosen for students to answer independently, and the self-reflection was assigned. The answers to the questions were discussed prior to leaving the class. These assessment questions were then asked again on a later unit exam.

# Time to complete: (70-75 minutes)

Set up previous day (10 minutes at end of class)

Beginning Discussion (5-10 minutes)

Cube Exercise (15 minutes)

Testing Predictions (30 minutes)

Assessment (10 Minutes)

Excel Exercise (Not completed with this course)

Conclusions and Future Plans:

Students had a good understanding of calculating ratios, entering data, and interpreting the graphs. However, the students still had trouble visualizing how the different shapes of objects could affect surface area to volume relationships. An additional activity or a video on cell shape variation would help the students to understand this better.

There are several extensions that could be explored after completing this activity in the classroom. Students could do experiments on diffusion in objects with different shapes and/or larger or smaller objects to link this activity more intimately to biological processes.

 The excel exercise was not completed with this course, since using excel was not a course learning objective for the students. The Why are Cells Small? activity can be modified in any way you deem necessary for your classroom. Feel free to add or delete portions in any section. The excel spreadsheet is included in the resource for those that want to use it.