**Title: Effect of the Intestinal Protein Snakeskin on the Lifespan of Fruit Flies:   
A Kaplan-Meier Survival Analysis**Maila Hallare, Iordanka Panayotova, & Anna Salazar

**Description**

In this activity, students will analyze raw data obtained from an experiment that explores the effect of overexpressing the Snakeskin (Ssk) protein on the lifespan of a population of fruit flies. This tight junction equivalent protein is expressed at higher levels than normal specifically in the gut and throughout the entire lifespan of the flies. Because aging guts are accompanied by both a mislocalization and a decrease in the expression levels of junctional proteins, including Ssk, it was hypothesized that overexpressing Ssk may lead to a healthier fly with a longer lifespan. This data will be analyzed in order to determine if there is a significant difference between the control flies in which no overexpression occurs and the experimental group in which Ssk is overexpressed. In this module, students will use Google Sheets or Microsoft Excel to perform the Kaplan-Meier survival analysis on the data. Two groups of fruit flies, the Control Group, where there is no overexpression of Ssk, and the Treatment Group, where the fruit flies are treated with a drug leading to an overexpression of Ssk, will be compared and analyzed. The goal is to determine if there is a statistically significant difference between the survival curves of the two groups. This activity involves both statistical analysis and concepts from calculus, displaying the usefulness of mathematical concepts for biological data analysis.

The raw data used in this module are obtained in the laboratory of Dr. Salazar’s from her research on overexpressing the Ssk protein and its effect on longevity.

**Biological Learning Outcomes**

* Understand the role of tight junction proteins in maintaining intestinal barrier function
* Understand that overexpression of one of these tight junction proteins may strengthen the intestinal barrier function
* Understand the importance of bacteria in the gut for the health of an organism
* Understand how model organisms such as fruit flies could be used to study longevity in humans
* Understand how intestinal barrier functions is tightly linked to health and longevity in fruit flies, fish, mammals, and humans

**Mathematical Learning Outcomes:** At the end of the activity, the students will be able to

* Understand that mathematical and/or statistical analysis must be applied to raw laboratory data in order to make conclusions on the biological observations
* Understand how survival data may be used to measure effectiveness of interventions
* Calculate survival probability
* Create Kaplan-Meier survival graph
* Calculate restricted mean survival times using concepts from calculus for finding area under a curve such as the trapezoidal rule
* Perform chi-squared hypothesis testing
* Relate the results from the fruit fly survival analysis to longevity in humans

**Handouts and Resources:** This teaching module is accompanied by

* Student handout
* Answers to biological questions for the instructor
* Excel file with the Raw Data and Data Analysis
* A short description of a leaky gut (Biological Literature) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5554468/> or <https://www.health.harvard.edu/blog/leaky-gut-what-is-it-and-what-does-it-mean-for-you-2017092212451>

**Tags** Concepts in Statistics and Calculus, Kaplan-Meier survival analysis, Hypothesis testing, Chi-square test statistics, Area under a curve.

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