

Epigenetic Effects of Diet on Fruit Fly Lifespan (student version)

(Adapted and modified from the Billingsley, J., & Carlson, K. (2012) The American Biology Teacher. 72, 231-234).

*Do our genes exclusively control us, or are other factors at play? You are going to use inquiry-based methods to understand a complex biological concept and design an experiment testing whether dietary supplements affect the lifespan of *Drosophila melanogaster* over multiple generations.*

Background:

Please read through the following:

<http://learn.genetics.utah.edu/content/epigenetics/nutrition/>

<http://www.nature.com/scitable/topicpage/epistasis-gene-interaction-and-phenotype-effects-460> (Scitable)

<http://www.livescience.com/16618-inherited-genome-longevity.html>

<http://www.livescience.com/21902-diet-epigenetics-grandchildren.html>

<http://www.myhealthnewsdaily.com/1970-ten-tips-eat-healthy.html>

<http://advances.nutrition.org/content/1/1/8.full> Epigenetics: A New Bridge between Nutrition and Health^{1,2} (lists of foods, nutrients that may be epigenetic).

(there are additional links at the end of this lab).

Learning Objectives:

LO 3.1 The student is able to construct scientific explanations that use the structures and mechanisms of DNA and RNA to support the claim that DNA and, in some cases, that RNA are the primary sources of heritable information. [See **SP 6.5**]

LO 3.12 The student is able to construct a representation that connects the process of meiosis to the passage of traits from parent to offspring. [See **SP 1.1, 7.2**]

LO 3.16 The student is able to explain how the inheritance patterns of many traits cannot be accounted for by Mendelian genetics. [See **SP 6.3**]

LO 3.17 The student is able to describe representations of an appropriate example of inheritance patterns that cannot be explained by Mendel's model of the inheritance of traits. [See **SP 1.2**]

LO 3.18 The student is able to describe the connection between the regulation of gene expression and observed differences between different kinds of organisms. [See **SP 7.1**]

LO 3.19 The student is able to describe the connection between the regulation of gene expression and observed differences between individuals in a population. [See **SP 7.1**]

LO 3.20 The student is able to explain how the regulation of gene expression is essential for the processes and structures that support efficient cell function. [See **SP 6.2**]

LO 3.21 The student can use representations to describe how gene regulation influences cell products and function. [See **SP 1.4**]

LO 3.23 The student can use representations to describe mechanisms of the regulation of gene expression. [See **SP 1.4**]

Designing and Conducting the Group Investigation

The background information should have raised several questions about factors that relate to the effect of nutritional supplements on the epigenetics on life span of organism, in your lab group discuss the following:

1. Design an experiment to investigate your own lab group question to determine the effect of a nutritional supplement that may change the life span of a fruit fly. (a basic procedure follows this section

When identifying your design, be sure to address the following questions:

- What is the essential question being addressed?
- What assumptions are made about the questions being addressed?
- Can those assumptions be easily verified?
- Will the measurement(s) provide the necessary data to answer the question under study?
- Did you include a control in your experiment?

2. Make a hypothesis/prediction about how the supplement will affect lifespan rates. Be sure to explain your hypothesis.

3. Conduct your experiment(s) and record data and any answers to your questions in your lab notebooks or as instructed by your teacher. You must have approval to start your experiment. Write down any additional questions that arose during this study that might lead to *other* investigations that you can conduct.

Materials and Methods:

Wild-type fruit flies

75-mL plastic vials with foam plugs.

An incubator with a temperature range of 24–26°C A photoperiod of 12 hours light and 12 hours dark to be maintained for the duration of the experiment.

food medium in the amount of 15 mL was added to each vial.(fly food)

Control vials contained 100% plain medium, and experimental vials contained 10% of the additive.

Fleischmann's brand baker's yeast in the amount of 0.1 mg was added to the top of the food medium in each vial.

For the lifespan experiment, 10 females and 10 males from stock bottles were added to each vial (three replicates were set up for each treatment).

Fruit flies were allowed to mate for 96 hours, and then the parents were removed and placed into new culture vials containing the specified food additive.

Newly emerged flies were allowed to grow and reproduce for three generations.

Flies were transferred to new food media weekly and dead flies were recorded.

Do a statistical analysis

Safety Precautions:

Follow general laboratory safety procedures. Wear proper footwear, safety goggles or glasses, a laboratory coat, and gloves. Use proper pipetting techniques, and use pipette pumps, syringes, or rubber bulbs. Never pipette by mouth! Dispose of any broken glass in the proper container. Since the concentrations of the reactive materials in this laboratory are food and nutrient based they can be rinsed down a standard laboratory drain. The concentrations used here are generally deemed to be safe by all chemical standards, but recall that any compound has the potentiality of being detrimental to living things and the environment. When you develop your individual investigations you must always consider the toxicity of materials used.

Analyzing Results

- 1.** Was there any life span difference between the control group and the treated group?
- 2.** Think of a way you can effectively communicate your results to other lab groups.
- 3.** Based on data collected from different lab groups, which supplements had the greatest effects (or least) over the 3 generations? Explain why some supplements might have had opposite.
- 4.** Create a data table and graph to represent your results.

Evaluating Results

- 1.** Was your initial hypothesis about the effect of your supplement supported by the data you collected? Why or why not?
- 2.** What were some challenges you had in performing your experiment? Did you make any incorrect assumptions about the effect of nutritional supplements on the life span of a fruit fly?
- 3.** Were you able to perform without difficulty the mathematical routines required to analyze your data? Which calculations, if any, were challenging or required help from your classmates or teacher?

Lab Write up Rubric:
(TBD)

Additional information, videos and associated materials:

<http://www.pbs.org/wgbh/nova/genes/> A Ghost in your genes

<http://www.pbs.org/wgbh/nova/body/epigenetics.html>

<http://www.pbs.org/wgbh/nova/body/epigenetic-mice.html>

<http://www.pbs.org/wgbh/nova/body/jirtle-epigenetics.html>

<http://www.pbs.org/wgbh/nova/body/epigenetic-therapy.html>

<http://www.pbs.org/wgbh/nova/body/rnai.html>