

Lab 21. Models of Inheritance: Which Model of Inheritance Best Explains How a Specific Trait Is Inherited in Fruit Flies?

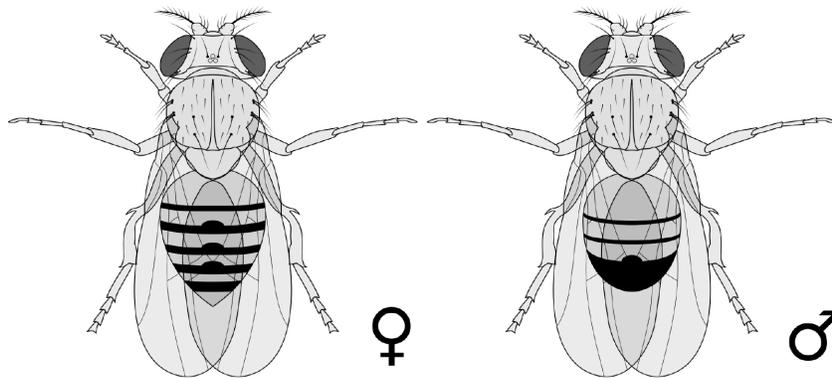
Introduction

The principles of Mendelian genetics encompass several different models of inheritance. These models include dominant-recessive, incomplete dominance, codominance, multiple allele, and sex-linked. All these models share two key ideas. First, inherited genes determine specific traits and alternative versions of a gene (called alleles) are responsible for the variation we see in traits. Second, an organism inherits two alleles for each trait, one from each parent. What makes these models different from each other is in the nature of the interactions that occur between alleles, the number of types of alleles that are associated with a gene, or which chromosome carries the gene for a trait.

The dominant-recessive model of inheritance suggests that when an individual inherits two alleles and the two alleles differ, then one is fully expressed and determines the nature of a trait (this version of the gene is called the dominant allele) while the other one has no noticeable effect (this version of the gene is called the recessive allele). The incomplete dominance model of inheritance suggests that the interaction that occurs between two different alleles results in a hybrid with an appearance somewhere between the phenotypes of the two parental varieties. The codominance model of inheritance is similar to the incomplete dominance model, but in the codominance model both alleles affect the phenotype of the individual in separate and distinguishable ways. The multiple allele model of inheritance simply means that there are more than two versions of a gene for a given trait within a population, and each allele can be either dominant, recessive, incomplete dominant, or codominant to the other alleles. Finally, the sex-linked model of inheritance only applies to genes located on the sex chromosomes. Females and males differ in the number of genes they inherit when the gene is found on the sex chromosome; one gender inherits two copies of the gene and the other gender inherits only one.

In this investigation, you will use what you have learned about these different models of inheritance to determine how fruit flies inherit a specific trait. Fruit flies are very common. Most fruit flies have six legs, two wings, and two antennae (see the figure below). Most fruit flies also have an orange-yellow body and red eyes. Scientists call flies with these traits the “wild type.” Every once in a while, however, you might see a fruit fly with body and/or eyes that are different colors, such as black or yellow body and sepia (brown) or white eyes.

Male and female fruit flies



Your Task

Pick two fruit fly traits (e.g., eye color, body color, wing shape). Then you will need to determine which model of inheritance (dominant-recessive, incomplete dominance, codominance, multiple allele, or sex-linked) best explains the inheritance pattern of these two specific traits in fruit flies. To accomplish this goal, you will use an online simulation that allows you to “order” fruit flies with specific traits from a supply company and then “breed” them to see how a trait is passed down from parent to offspring.

The guiding question of this investigation is, **Which model of inheritance best explains how a specific trait is inherited in fruit flies?**

Materials

You will use an online simulation called *Drosophila* to conduct your investigation. You can access the simulation by going to the following website: www.sciencecourseware.org/vcise/drosophila.

Safety Precautions

1. Use caution when working with electrical equipment. Keep away from water sources in that they can cause shorts, fires, and shock hazards. Use only GFI-protected circuits.
2. Wash hands with soap and water after completing this lab.
3. Follow all normal lab safety rules.

Getting Started

Your teacher will show you how to use the *Drosophila* online simulation and the types of traits you will be able to investigate before you begin designing your investigation. To answer the guiding question, you will need to determine what type of data you will need to collect using the online simulation, how you will collect these data, and how you will analyze the data. To determine *what type of data you will need to collect*, think about the following questions:

- What types of flies will you need to work with during your investigation (e.g., males or females, flies with a specific eye color, flies with a specific wing shape)?
- What type of measurements or observations will you need to record during your investigation?
- How will you determine which model of inheritance is the best explanation for a particular trait?

To determine *how you will collect your data*, think about the following questions:

- How many times will you need to breed the flies?
- How many generations of flies will you need to follow?
- How often will you collect data and when will you do it?
- How will you keep track of the data you collect and how will you organize the data?

To determine *how you will analyze your data*, think about the following questions:

- How will you determine if the results of your cross tests match your predictions? (Hint: Your teacher will show you how to use a statistical method called a chi-square test to help determine if your observations match your prediction once you have collected all your data.)
- What type of graph could you create to help make sense of your data?

Investigation Proposal Required? Yes No

Connections to Crosscutting Concepts and to the Nature of Science and Scientific Inquiry

As you work through your investigation, be sure to think about

- the importance of uncovering causes for patterns observed in nature,
- how scientists develop and use explanatory models to make sense of their observations, and
- the nature of theories and laws in science.

Argumentation Session

Once your group has finished collecting and analyzing your data, prepare a whiteboard that you can use to share your initial argument. Your whiteboard should include all the information shown in the figure to the right.

To share your argument with others, we will be using a round-robin format. This means that one member of your group will stay at your lab station to share your group's argument while the other members

Argument presentation on a whiteboard

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence:

of your group go to the other lab stations one at a time to listen to and critique the arguments developed by your classmates.

The goal of the argumentation session is not to convince others that your argument is the best one; rather, the goal is to identify errors or instances of faulty reasoning in the arguments so these mistakes can be fixed. You will therefore need to evaluate the content of the claim, the quality of the evidence used to support the claim, and the strength of the justification of the evidence included in each argument that you see. In order to critique an argument, you will need more information than what is included on the whiteboard. You might, therefore, need to ask the presenter one or more follow-up questions, such as:

- How did you use the simulation to collect your data?
- What did you do to analyze your data? Why did you decide to do it that way? Did you check your calculations?
- Is that the only way to interpret the results of your analysis? How do you know that your interpretation of your analysis is appropriate?
- Why did your group decide to present your evidence in that manner?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those alternative ideas?
- How confident are you that your claim is valid? What could you do to increase your confidence?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your original argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most valid or acceptable answer to the research question!

Report

Once you have completed your research, you will need to prepare an investigation report that consists of three sections that provides answers to the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in two pages or less. This report must be typed, and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!