

Weeks 5-9

Exercise 3: The Origins of Genetics: Mendel (1865) *Experiments in Plant Hybridization*

Run-down of the assignment:

Week 5

Before class:

Read Sections 1-9 of Mendel (1865) *Experiments in Plant Hybridization* at MendelWeb (<http://www.netSPACE.org/MendelWeb/Mendel.html>).

Use the questions on the next few pages to help guide your reading. Also make use of the MendelWeb Notes (<http://www.netSPACE.org/MendelWeb/MWNNotes.html>) and *The Cartoon Guide to Genetics*, pages 1 -55 (required course book). Both summarize the main points of Mendel's paper.

Answer questions 1 through 8 about Mendel's classic paper in genetics (pp. 3-3 to 3-4 below).

Your type-written responses are due at the start of lab.

In-class assignment:

Mendel's Paper: We will go over Mendel's paper in class. We will specifically go over some of the questions below.

GCK: You will be introduced to the Genetics Construction Kit (GCK). (*Refer to File: Exercise 3 GCK program.*) This wonderful program lets you quickly simulate genetic experiments that would actually take weeks or more to conduct. They provide realistic data which means that the data is sometimes not 'perfect' so you will need to conduct a statistical test to be certain that your conclusions are supported by the data. We will be using the Chi Square test, which is briefly described in an appendix to this manual.

After Class:

Answer questions 9-22 below. Submit your type-written responses by Friday, 5 p.m.

Continue to work on the GCK assignment.

Week 6

Before Class: Complete the GCK Pre-lab Questions. Your type-written responses are due at the start of lab.

In-class assignment:

Enzymes Poster Session (see course schedule)

GCK: You will also work on Bio 220's GCK#1, with time to ask questions and receive on-the-spot assistance.

When you work on your problem, try to explain to yourself, or your partner, why you are doing each cross. What do you predict will be the offspring ratios? Why? Do the statistics support your hypothesis? What does a ***p* value** of less than 0.05 really mean anyway? Be sure that you understand what a *p* value is and how to use it properly.

After Class:

Answer the GCK#1 Content Questions. Submit your type-written responses by Friday, 5 p.m.

Week 7**In-class assignment:**

Mitosis and Meiosis: You will be doing a mitosis and meiosis demonstration. While you work on this try to think about how it applies to the GCK problem. Specifically ask yourself, what happens during mitosis and during meiosis to different alleles that are on homologous chromosomes? *Refer to File: Exercise 3 Mitosis and Meiosis* .

GCK: You will also work on Bio 220's GCK#2, with time to ask questions and receive on-the-spot assistance.

After Class:

Answer the GCK#2 Content Questions. Submit your type-written responses by Friday, 5 p.m.

The Origins of Genetics:
Mendel (1865) *Experiments in Plant Hybridization*

Reading Scientific Research Papers

As noted in the Syllabus, a goal of this course is to further develop your ability to read original research articles, particularly in biology. Reading a scientific article is different than reading a magazine article or even your textbook. Research papers are written for scientific colleagues and therefore assume a certain level of background knowledge. Consequently, you must often read a scientific paper several times and refer to other helpful resources (such as

textbooks) to fully understand the article.

When reading a scientific paper, you should ask yourself the following questions¹:

- Why was the study undertaken?
- What specific questions were asked?
- What specific approaches were taken to address each question?
- What were the major findings of the study?
- What contributions does this study make toward answering the original question?
- What questions remain unanswered (either because the study was inconclusive or because it raised new questions)?

Mendel's Classic Paper in Genetics

To practice reading scientific articles, we will examine Mendel's classic 1865 article which ultimately gave rise to the field of genetics. To assist your reading of this paper, the *MendelWeb* site (see below) has links to a Notes page that includes helpful summaries and to a glossary of terms.

To get you started, below are specific questions to consider as you read Mendel's paper (also refer to other resources, such as the MendelWeb Notes and the *Cartoon Guide to Genetics*). *Be sure to answer these questions fully, before we meet to discuss the paper in lab.*

Assigned Reading:

- Mendel, G. 1865. *Experiments in Plant Hybridization*. [Focus on parts 1 - 9]. At *MendelWeb* (<http://www.netspace.org/MendelWeb/Mendel.html>)

Helpful supplemental Readings:

- MendelWeb Notes (<http://www.netspace.org/MendelWeb/MWNNotes.html>)
- *The Cartoon Guide to Genetics*, pages 1 -55.

Introductory Remarks²

1. What was Mendel's objective in undertaking his "experiments in plant hybridization"? (**Hint:** Examine the second paragraph of this section and the first paragraph of "Division and Arrangement of the Experiments.")
2. William Bateson, the geneticist who edited the English translation of this paper, credits Mendel's success to his "conception of three primary necessities". What were the distinctive features of Mendel's experimental design that enabled his success while his predecessors had failed? (**Hint:** Examine the third paragraph of this section and page 36 of *The Cartoon Guide to Genetics*)

Selection of the Experimental Plants

Adapted from Jan Pechenik's *A Short Guide to Writing about Biology*

The subheadings correspond to Mendel's paper.

3. Mendel correctly points out the importance of an ideal experimental system for the question being investigated. What features of an experimental organism did Mendel distinguish as essential for his hybridization experiments?
4. Mendel notes that pea plants (genus *Pisum*) fulfill the above requirements and have several additional advantages. What are they?
5. Why did Mendel perform a two year trial experiment with his 34 varieties of peas?

Division and Arrangement of the Experiments

6. Mendel selected only seven of the available contrasting traits for detailed analysis. Why were these chosen over the others?
7. Rather than perform a single cross with individuals varying in these seven contrasting traits, how did Mendel modify his study to more easily determine patterns of inheritance?
8. How did Mendel perform his “experiments in plant hybridization”? Why did he perform “reciprocal crossings”?

The Forms of the Hybrids

9. What did Mendel generally observe when examining the (F₁) hybrids?
10. How did he interpret these results?

The First Generation From the Hybrids

11. What did Mendel generally observe when examining the (F₂) generation bred from the hybrids?
12. How did he interpret these results?
13. Rewrite the last paragraph of this section in your own words.

The Second Generation From the Hybrids

14. What did Mendel generally observe when examining the (F₃) generation bred from the second (F₂) generation?
15. How did he interpret these results?
16. In the penultimate (next-to-last) paragraph of this section, Mendel notes that unlike in experiments 1, 2, and 6, where the ratio of dominant to recessive characters was almost 2 to 1, in the other experiments, the ratio varied “more or less.” Why did it vary from the 2 to 1 ratio that Mendel “fixed with certainty”?

The Offspring of Hybrids in Which Several Differentiating Characters are Associated

17. How did the experiments described in this section differ from those above?
18. What did Mendel generally observe in these experiments?
19. How did he interpret these results?

The Reproductive Cells of the Hybrids

20. How did the experiments described in this section differ from those above?
21. What did Mendel generally observe in these experiments?
22. How did he interpret these results?