

GENETICS
Problem set #1
Mitosis/Meiosis

The following problem set is designed primarily as a tool to help you test your understanding of the distribution of chromosomes during mitosis and meiosis. It is not graded and is not mandatory, although it will undoubtedly confirm your understanding of important genetics concepts. Problem set answers will be posted on the website Thursday January 28th, until the time of exam 1. Students who have completed the problem set are welcome to check their answers. The key is NOT to be used unless you have done the problem set.

** Some questions may imply that all cells undergo both mitosis and meiosis. Remember only 2n germ cells (spermatogonia, oogonia) undergo meiosis.

1. Sketch a mitotic cell (such as a liver cell) with $n=4$ chromosomes as it might appear at metaphase. Assume this cell has a metacentric large chromosome, an acrocentric small chromosome, a telocentric small chromosome, and a submetacentric medium-sized chromosome.

2. Show the same cell as a primary spermatocyte at Metaphase I of meiosis.

3. **A cell has $2n=12$ chromosomes.
 - a. How many chromatids are present during:
 1. G_1 of interphase
 2. G_2 of interphase.

 - b. How many tetrads/bivalents are present during:
 1. Metaphse I
 2. Metaphase II

 - c. How many chromatids are present during:
 1. Metaphase I of meiosis
 2. Metaphase II of meiosis

 - d. How many chromosomes are present in the new cells that result from:
 1. Meiosis
 2. Mitosis

4. A horse has $2n = 64$ chromosomes and a donkey has $2n = 62$ chromosomes. Female horses and male donkeys can mate. The offspring is a mule. How many chromosomes does a mule have? Mules are sterile (unable to mate with each other and produce viable offspring). Give a possible explanation, including what you know about production of gametes. (Use sketches to help you see what would happen in meiosis)

5. *Drosophila melanogaster* (fruit flies) have $n = 4$ chromosomes.

a. How many unique combinations of maternal and paternal chromosomes are possible in egg and sperm as the result of independent assortment? (gametic combinations)

b. How many unique zygotes can be formed can be formed following union of the gametes described above? (zygotic combinations)

c. What other mechanism (besides independent assortment) contributes to genetic variation in the gametes/zygotes?

6. Interpreting the following cartoon, is cell engaged in meiosis or mitosis? Give a full explanation of your answer.



6. p53 is known as a master cell cycle control gene/protein.

a. Why?

b. What is the actual evidence that p53 is extremely important in cell cycle control.