

Objectives for Unit Six: 9 & 10

Cell Division (Mitosis, Meiosis) & Regulation of Cell Division; Cancer

You should be able to:

1. Describe the advantages & disadvantages of sexual and asexual reproduction.
2. Compare the role of mitosis in a single-celled organism to that in a multi-celled one.
3. Compare the genetic information found in one of your body cells to that found in other body cells.
4. Explain why DNA needs to be replicated prior to cell division.
5. Describe asexual reproduction (binary fission) in prokaryotes (use your text; we may not discuss this much).
6. Describe the relationship between DNA, genes, chromatin, sister chromatids, and chromosome.
7. Identify the different stages of the cell cycle and label them on a circular diagram (pie chart). Explain where mitosis fits into the cell cycle.
8. Describe what takes place during each stage of Interphase.
 - a. G1
 - b. S
 - c. G2
9. Describe the events during each phase of Mitosis.
 - a. Prophase/Prometaphase (we'll just group these together)
 - b. Metaphase
 - c. Anaphase
 - d. Telophase
10. Describe and compare the process of cytokinesis in plant and animal cells.
11. Explain how the spindle helps elongate the cell and move the chromosomes to the poles.
12. Explain the purpose of a checkpoint and identify what the cell is checking for at the G1, G2 and M checkpoints.
13. Explain the relationship between cancer and control of cell division.
14. LAB: **Calculate** the time needed for completion of Interphase and each stage of Mitosis by counting cells in each phase in a sample of cells.
15. Identify (in pictures) the different phases of mitosis plus interphase.
16. Summarize the experiment performed on minnows with black spot disease that support the concept that sexually reproducing organisms are protected against parasites because of their increased variation resulting from sexual reproduction. (If we watch the "Why Sex" video segment)
17. Give examples of asexual reproduction in animals.
18. Distinguish between the following terms:
 - a. Diploid and Haploid
 - b. Gonads and Gametes
 - c. Somatic cells and Sex (germ) cells
 - d. Autosomal chromosomes and Sex chromosomes
 - e. Chromatin and Chromosomes
 - f. Sister Chromatids and Chromosomes
 - g. Chromosomes and Homologous Chromosomes
19. Explain why meiosis is needed and used for gamete production in animals but not in plants.
20. Tell the ploidy (N or 2N) of cells in at the end of mitosis, meiosis I, and meiosis II. Given a species' diploid number, predict the number of chromosomes in its somatic cells and gametes. (See the binder practice sheet)
21. Identify in pictures and discuss the events of the following phases of Meiosis.
 - a. Interphase I
 - b. Meiosis I (Prophase I, Metaphase I, Anaphase I, Telophase I)
 - c. Interphase II (how is it different from interphase I?)
 - d. Meiosis II (Prophase II, Metaphase II, Anaphase II, Telophase II)
22. Identify when and where Meiosis occurs in animals and plants (See your life cycle diagrams).
23. Compare and contrast oogenesis and spermatogenesis.
24. Describe and diagram independent assortment and tell its impact on gametes.
25. Diagram and describe crossing over and tell its impact on gametes.
26. Identify several human disorders caused by nondisjunction, such as Down syndrome, Klinefelter Syndrome, and Turner Syndrome.
27. Compare and contrast mitosis and meiosis. Pay particular attention to how the phases of Meiosis I are different from the corresponding phases of Mitosis (e.g. compare prophase to prophase I)
28. Explain how meiosis, mutations, crossing over, independent assortment, and fertilization all play a vital role in introducing variation into a population.

29. The cell cycle is regulated by the combination of cyclins and Cdks (cyclin-dependent kinases). Explain the role of cyclins and Cdks in regulation of the cell cycle. You can use MFP or PDGF as an example.
30. Explain two external factors that also regulate cell division.
31. Discuss the role of growth factors in stimulating cell division.
32. LAB: Using *Sordaria* to determine the map distance between a gene and the centromere.
 - a. Label a diagram of the *Sordaria* life cycle.
 - b. Explain why we know the genotype of each spore with regard to spore color.
 - c. Diagram the cross over events (or lack of) that cause various spore patterns in the *Sordaria* asci (4:4,2:2:2:2, and 2:4:2).
 - d. Explain the relationship between distance between the gene and it's centromere and recombination frequency.
 - e. Count asci spore patterns and use this data to **calculate** the map distance between the gene for spore color and the centromere. (Why do you divide by 2 when doing this calculation?)
 - f. Given a published map distance **calculate** the Chi-square statistic to evaluate how well experimental data agrees.
 - g. Compare the translocation that results in the Philadelphia chromosome and leukemia with the crossing over that occurs in *Sordaria*.
 - h. Design an experiment to evaluate the effect of some environmental factor (light, pH, humidity, space, etc.) has on the crossover frequency in *Sordaria*.
33. Explain and apply the Chi-square statistical method to results obtained from experiments comparing rates of mitosis under varying conditions (such as with Lectin and caffeine).
 - Properly state a null hypothesis.
 - Calculate expected values.
 - Calculate the chi-square statistic for observed results and expected values and evaluate it using a table of Chi-square values.
34. Explain the controversies of using HeLa cells for research.
35. Each chapter has some multiple choice questions and a few other additional questions at its end. Give these a try. You might see them again!

Some Examples of Calculation and paragraph questions: These might be the actual questions.

36. Given cell counts in several fields of view of cells in the various stages of mitosis and interphase, **calculate** the amount of time each phase requires in the cell cycle and/or in mitosis.
37. Given a species' diploid number of chromosomes for a species, **calculate** the number of chromosomal combinations that are possible with independent assortment and with random fertilization.
38. **Design an experiment to test the effect of an environmental variable (say the presence of lectin or caffeine) on the rate of mitosis. **Calculate** the Chi-square statistic and use it to evaluate the null and experimental hypotheses. (Guaranteed to be a question on your test!)
39. Several human disorders occur as a result of defects in the meiotic process. **Identify** ONE such chromosomal abnormality; what effects does it have on the phenotype of the people with the disorder? **Describe** how this abnormality could result from a defect in meiosis.
40. **Explain** how the reduction and rearrangement of chromosomes are accomplished in meiosis.
41. Production of offspring by parthenogenesis or cloning bypasses the typical meiotic process. **Describe** either parthenogenesis or cloning and **compare** the genomes of the offspring with those of the parents.
42. Information transfer is fundamental to all living organisms. Explain in detail how the genetic material in one eukaryotic cell is distributed to two identical daughter cells once it has been copied.
43. The survival of organisms depends on regulatory mechanisms at various levels. Explain how the cell cycle is regulated.
44. Indicate when and how each of the following occurs in meiosis. Discuss an advantage or disadvantage associated with each
 - a. Crossing over
 - b. Nondisjunction
45. Compare and contrast the origin and maturation of the male and female gametes in mammals.