AP Biology **Name:** **P:**

Chapter 12 Reading Guide: The Chromosomal Basis of Inheritance

How to use this reading guide: Look over the entire reading guide—read each question to prepare yourself for reading the chapter. Read the chapter carefully and thoroughly. Make sure to look at all of the figures and pictures and read their captions. Then…answer the questions posed below.

Mendelian inheritance has its physical basis in the behavior of chromosomes

1. When cytology converged with Mendel what "parallels" were seen between the behavior of chromosomes and the behavior of Mendel's "factors"?

2. What is the "chromosome theory of inheritance?"

3. Read and Study Figure 12.2 carefully.
    a. How does the behavior of "homologous chromosomes" account for Mendel's law of segregation?

    b. How does the behavior of "non-homologous chromosomes" account for Mendel's law of independent assortment?

4. Who was Thomas Hunt Morgan? Where did he work? What was he investigating?

5. What organism did he use in this research? Why was this organism a particularly good choice?

6. Define the term "wild type."
    a. Describe the notation that Morgan and his students invented to name and symbolize fruit fly genes.
    b. Use w and w^+ to explain.

7. After a year or so of breeding fruit flies, Morgan discovered a white-eyed male (a mutant—the normal eye color is red). He used this white-eyed male in a cross with a red-eyed female (P generation)
    a. What did he get in the F1 generation?

    b. What did he do with these F1s?

    c. What were the F2 ratios? What was so surprising?

    d. What did this lead him to conclude? Explain COMPLETELY!

    e. use the w and w+ symbols and the X and Y symbols to show the P generation, F1 generation, and F2 generations in Morgan's experiment.

8. How did Morgan's work support the chromosomal theory of inheritance?

Sex-linked genes exhibit unique patterns of inheritance

9. Study Figure 12.6. What are the four different chromosomal systems of sex determination?

10. Why do the X and Y chromosome behave as homologous pairs in humans?

11. If a human female is XX and a human male is XY.
    a. What gametes can each make?
    b. Given the types of gametes they can make, who determines the sex of a child? Explain completely.

12. What is SRY? How is it responsible for the anatomical development of sex?

13. What is a sex-linked gene?

14. What patterns of inheritance do sex-linked genes follow? Be specific about how daughters and sons inherit these characteristics.

15. For each of the sex-linked traits below, know…
    i. Dominant or recessive?
    ii. Definition and/or Symptoms

    a. Colorblindness

    b. Duchenne Muscular Dystrophy

    c. Hemophilia

16. Describe what happens in X-inactivation.
    a. What does it mean?
    b. What does the inactivated X become? What happens to the genes?
    c. What happens to this inactivated X during oogenesis?

17. Females are “mosaics.” What does this mean? How is it related to X-inactivation?
    a. Give 2 examples of “mosaicism.”

18. What mechanisms may be responsible for X-inactivation? List and describe ALL mechanisms.

Linked genes tend to be inherited together because they are located near each other on the same chromosome

19. What are "linked genes?" From which of Mendel's Laws do linked genes deviate? Explain why.

20. Read "How linkage affects inheritance" and study figure 12.9.
    a. What are the two characteristics being studied?

    b. What are the symbols for the wild type and mutant for each trait?

    c. What would the genotypes of the P generation be (remember what "true-breeding" means?)?

    d. What would the genotypes of the F1 be?

    e. At this point, can you tell whether the genes are linked? Explain why or why not.
    f. If the genes were NOT linked, what offspring would you expect? And in what proportions?

    g. Morgan then did a test cross – what is a test cross?

    h. In this test cross the females were_____and the males were_____.

    i. If the genes were NOT linked, what offspring would you expect? And in what proportions?

    j. How did Morgan know that the genes were linked? Explain COMPLETELY!!!

Morgan's results not only indicated that genes are linked but also indicated that there have to be other events taking place—let's investigate…Genetic Recombination!

21. Use Mendel's experiments with peas to explain the terms "parental types" and "recombinant types".

22. What does a “50% frequency of recombination” mean?
    a. What does it tell you about the genes?

23. In Morgan’s experiment there were two phenotypes that were recombinant types, gray-vestigial and black-normal. Using these two recombinants, explain why this is an example of crossing-over and not recombination as in Mendel’s peas.

24. What is a genetic map?
    a. How are crossing over and recombination frequency involved in genetic mapping?

25. What did Sturtevant hypothesize?
    a. What assumptions were involved in this hypothesis?

26. What did he predict?
    a. What was his reasoning?

27. Carefully read figure 12.11. What is a linkage map? What do scientists use the linkage map for?
    a. What are map units?

28. How are genes that are located far apart mapped? Why is this necessary?

29. What are some of the limitations of a linkage map? How does a cytogenetic map differ (and take care of some of the limitations)?

30. What will be the same regardless of which map you look at-physical, linkage or cytogenetic? What won’t be the same?

Alterations of chromosome number or structure cause some genetic disorders

31. Explain what happens in non-disjunction.
    a. What is aneuploidy?

32. Compare non-disjunction in meiosis I and meiosis II.

33. What are the differences between the following terms?
    a. Monosomic, trisomic, polyploidy and aneuploidy.

34. Name and describe the four different types of alterations in chromosome structure.

35. For each of the following disorders, know…
    i. The chromosomal abnormality that causes it
    ii. How that abnormality happens
    iii. Symptoms of the disorder

    a. Down's Syndrome

    b. Klinefelter's syndrome

    c. Turner syndrome

    d. Cri du chat

Some inheritance patterns are exceptions to the standard chromosome theory

36. What is genomic imprinting? What happens in imprinting within an individual? What happens to imprinting between generations? What genes seem to be imprinted more often?

37. How is imprinting related to methylation?

38. What is meant by the term “extranuclear” genes?
    a. Do they follow Mendelian inheritance patterns? Why or why not?

    b. Explain the “variegated” trait in plants and its relation to “extranuclear” genes.

39. How are mitochondria inherited?