1. What is the term for the observable characteristics of an organism?

A. Genotype

B. Phenotype

C. Allele

D. Genome

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2. In humans, free earlobes (F) are dominant over attached earlobes (f). What is the probability that two heterozygous parents will have a child with attached earlobes?

A. 0%

B. 25%

C. 50%

D. 75%

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3. Which of the following represents a heterozygous genotype?

A. AA

B. aa

C. Aa

D. A

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4. A red flower (RR) is crossed with a white flower (WW) and produces pink flowers (RW). What type of inheritance is this?

A. Complete dominance

B. Incomplete dominance

C. Codominance

D. Polygenic inheritance

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5. A man with normal vision and a woman who is a carrier for color blindness have a son. What is the chance that he is color blind?

A. 0%

B. 25%

C. 50%

D. 100%

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6. What phase of the cell cycle involves the duplication of DNA?

A. G1 phase
B. S phase
C. G2 phase
D. M phase

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7. During which stage of mitosis do the sister chromatids separate?

A. Prophase
B. Metaphase
C. Anaphase
D. Telophase

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8. Which of the following occurs during meiosis but not mitosis?

A. DNA replication
B. Separation of chromatids
C. Synapsis and crossing over
D. Cytokinesis

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9. How many cells are produced at the end of meiosis, and how do they compare to the parent cell?

A. 2 identical cells
B. 2 non-identical cells
C. 4 identical cells
D. 4 non-identical cells

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10. What is the total number of chromosomes in a normal human somatic cell?

A. 23
B. 46
C. 44
D. 92

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11. A karyotype shows an extra chromosome 21. What condition does this indicate?

A. Turner Syndrome

B. Klinefelter Syndrome
C. Down Syndrome
D. Edward Syndrome

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12. Which of the following statements about homologous chromosomes is correct?
A. They are identical copies of the same chromosome.
B. They come from the same parent.
C. They contain the same genes in the same order
D. They never pair up during meiosis.

1. Explain how Mendel's laws of inheritance apply to a dihybrid cross. Provide an example with a Punnett square.
2. A child has type AB blood. What are the possible genotypes of their parents? Justify your answer using genetic principles.
3. Compare and contrast complete dominance, incomplete dominance, and codominance with examples.
4. Explain the role of test crosses in determining unknown genotypes. When are they useful?
5. How do sex-linked traits differ from autosomal traits? Use hemophilia or color blindness as an example.
6. Describe the process of gene linkage and its impact on Mendelian ratios.
7. Explain how crossing over contributes to genetic variation. At what stage of meiosis does it occur?
8. A couple are both carriers for cystic fibrosis. What is the probability their child will have the disease? Show work.
9. Describe one genetic disorder caused by a mutation. Explain the effect at the DNA and protein level.
10. Use a Punnett square to predict offspring outcomes for a monohybrid cross involving Tay-Sachs disease.
11. What is epistasis? Provide an example and explain its genetic mechanism.

12. How can mitochondrial inheritance affect heredity patterns? Why is this considered non-Mendelian?
13. Discuss the ethical implications of gene editing technologies like CRISPR on inherited traits.
15. Compare and contrast mitosis and meiosis in terms of processes, outcomes, and biological significance.
16. Explain how errors in meiosis can lead to chromosomal abnormalities such as trisomy 21.
17. Describe the role of cyclins and CDKs in regulating the cell cycle.
18. What is apoptosis? Why is it important in development and disease prevention?
19. Analyze a diagram showing stages of mitosis. Identify each stage and key events.
20. A diploid cell has 16 chromosomes. How many chromosomes are in each daughter cell after mitosis? Meiosis?
21. Describe how meiosis increases genetic variation through independent assortment and recombination.
22. What are the key differences in gamete production between males and females in humans?
23. Explain why cancer can be described as uncontrolled cell division. What cellular mechanisms fail?
24. Interpret a karyotype showing nondisjunction. Identify the syndrome and explain how it occurred.
25. Describe the significance of synapsis and tetrad formation in meiosis.
26. How can environmental factors influence the rate of mitosis in cells?
27. Explain the difference between chromatin, chromosomes, and chromatids in terms of structure and function.
28. How does a mutation in the DNA sequence affect protein synthesis? Include transcription and translation.
29. Describe the process of DNA replication, including key enzymes involved.
30. Compare prokaryotic and eukaryotic chromosomes in terms of structure and number.

31. How can gel electrophoresis be used to analyze DNA fragments? What determines their movement?
32. Outline the steps of the polymerase chain reaction (PCR) and explain its importance in biotechnology.
33. Describe how karyotyping can be used for prenatal diagnosis of genetic conditions.