Designer Genes

Captains Tryouts 2019

SCIENCE OLYMPIAD

Exploring the World of Science

Name:

Grade:

Points: ___/85

Fill in the blanks with the word, phrase, or response that correctly and appropriately answers the question or defines the phrase.

1. _____ A portion of a DNA that serves as the basic unit of heredity.
2. _____ Different variation of a gene.
3. _____ The location of a gene along a chromosome.
4. _____ DNA is tightly coiled around proteins called
5. _____ Austrian monk who made important discoveries in genetics by studying pea plants.
6. _____ A SSyy x ssYY cross will lead to what phenotypic ratio? (Assume complete dominance)
7. _____ A type of mutation that occurs when the addition or loss of DNA bases changes a gene's reading frame.
8. _____A mutation that does not change the sequence of amino acids.
9. _____ Probability of offspring being tall in a Tt x tt cross. T=tall, t=short. (Assume complete dominance)
10. _____ "Blending" of dominant and recessive traits.
11. _____ Law that states that genes for different traits are inherited independently of one another.
12. _____ What is the most important gene in human sex determination?
13. _____ Which human sex is more likely to inherit X-linked recessive genetic disorders?
14. _____ Women who are heterozygous for an X-linked recessive allele are called
15. _____ DNA stands for (spelling counts)
16. _____ What 5 elements are present in DNA?
17. _____ What type of bond exists between adjacent DNA nucleotides and forms the DNA backbone?

18. _____ Humans receive all of their mitochondrial DNA from their

19. _____ DNA replication occurs during this phase of the cell cycle.

20. _____ RNAs that act as enzymes are known as

21. _____ The 2 main types of regulatory RNA are

22. _____ When mRNA is being translated by multiple ribosomes, mRNA and ribosomes together form a

23. _____ The process of adding a 3' poly-A tail to an mRNA transcript.

24. _____ Introns are removed by a protein-and-RNA complex called the

25. _____ Crossing over occurs in which phase in meiosis?

Answer the following questions.

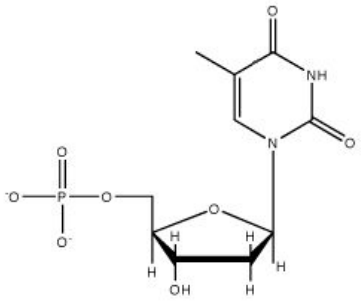
26. a.) If a father is unaffected by colorblindness and mother is colorblind, what is the probability that the son is colorblind? Draw a diagram to support your answer.

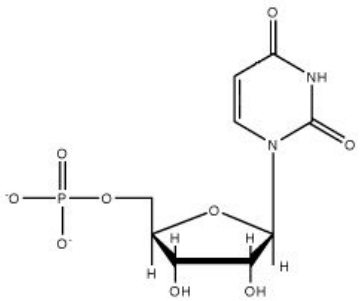
    b.) If a daughter carries the colorblind allele, do we know which parent she received that allele from? Explain.

27. What is the difference between a holoenzyme and an apoenzyme?

28. What is the difference between epistasis and dominance?

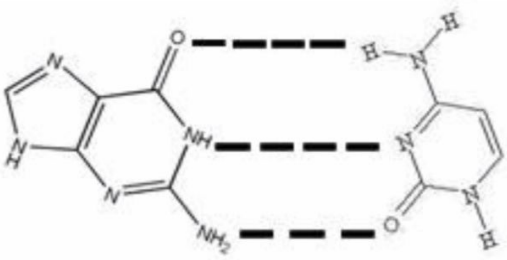
29. Label which molecule is DNA and which molecule is RNA. Explain how you know by referring to specific differences in their molecular structures.

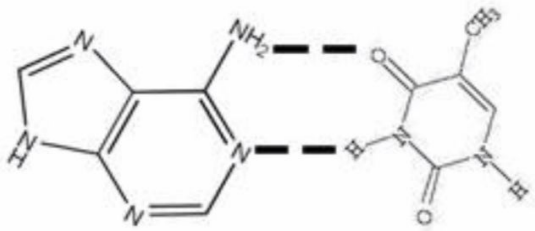




30. a.) Label the following diagram with the following terms (Not all will be used) :

Adenine (A)
Cytosine (C)
Thymine (T)
Uracil (U)
Guanine (G)
Hydrogen Bond (HB)
Phosphodiester Bond (PD)
Ionic Bond (ID)
Histone (H)
Primase (P)



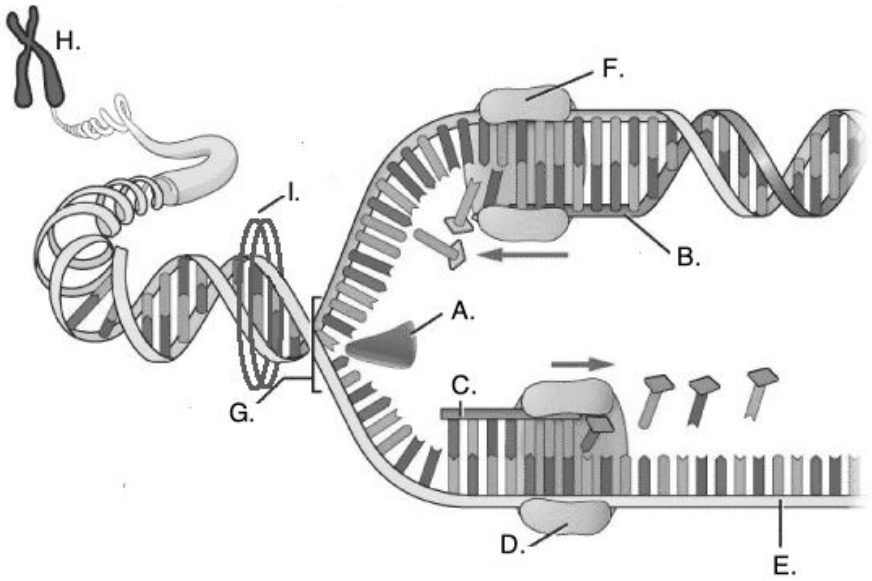


b.) Circle the Pyrimidines in the diagram.

31. a. The process of DNA → mRNA is known as: _____

b. The process of mRNA → protein is known as: _____

Questions 32- 39 refer to the following diagram.



32. What process does the diagram depict?

33. a. Identify H:

b. What is it composed of?

34. a. Identify A:

b. What is its role in this process?

35. a. Which one is the lagging strand (B or C):

b. What is the name of the fragments formed on the lagging strand?

36. a. What is the name of enzyme F and D?

b. F is adding nucleotides from 5'→3' or 3'→5'?

37. What is structure G commonly known as?

38. a. Identify I:

b. What is its role in this process?

39. a. Is E the template strand or the coding strand?

b. True or False: The coding strand is called the antisense strand.

40. List the phases of mitosis in order.

    a. In which phase does microtubules of the spindle attach to the kinetochore?

    b. In which phase does the spindle fibers depolymerize?

    c. In which phase are cohesin proteins cleaved?

Questions 41-43 refer to the following diagram.

41. What is the following diagram called?

42. Is this person male or female?

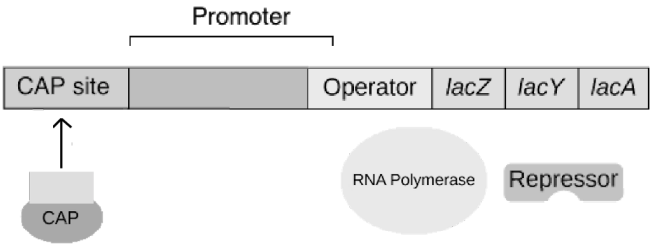
43. a.) What is the common name of the chromosomal disorder this person has?

    b.) What are some symptoms of this disorder?

    c.) This disorder is caused by an error in cell division when chromosomes do not separate normally. What is this error called?

Questions 44-48 refer to the following diagram.

The *lac* operon:



44. a.) Where does the repressor bind?

b.) What does the repressor do?

45. Where does RNA polymerase bind?

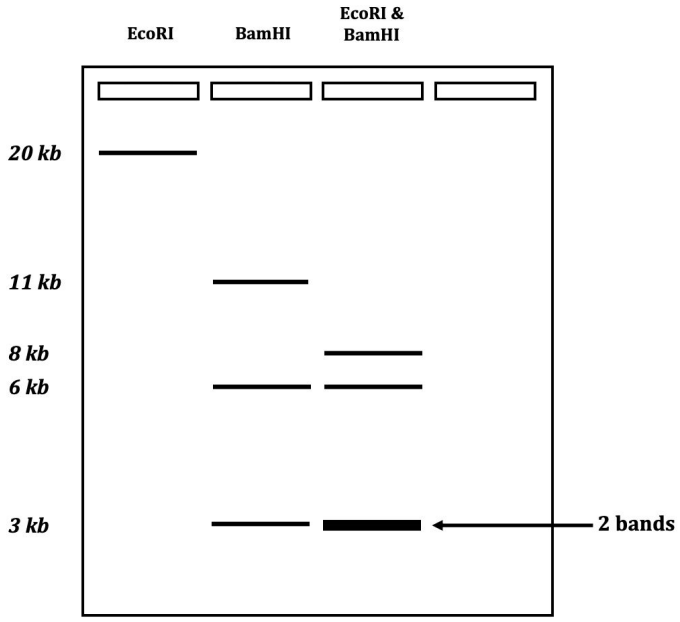
46. What does CAP stand for?

47. a.) What will happen when CAP binds onto the CAP site?

b.) Which molecule must be present for CAP to bind onto the CAP site?

48. Explain what occurs in the absence of lactose by using the terms in the diagram.

Questions 49-51 refer to the following diagram.
A single and double enzyme digest reactions were carried out for plasmid UC23 using the restriction enzymes EcoRI and BamHI.

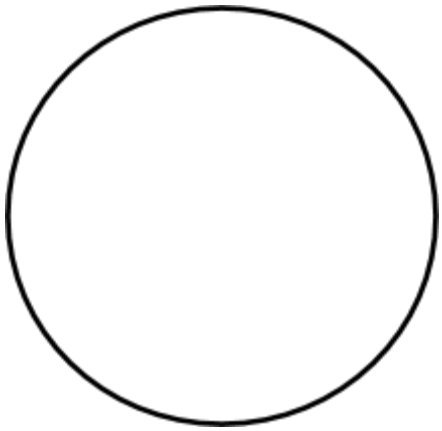


49. What is the name of the technology that produced this data?

50. Label the anode and cathode on the diagram.

51. Why do some fragments move farther than others?

52. Construct a restriction map of the pUC23 for enzymes EcoRI and BamHI.



53. Which of the following is an example of wobble?
(A) the excision of introns from mRNA
(B) the binding of a primer to DNA
(C) amino acids carried to the ribosome to form a polypeptide chain
(D) four codons all coding for the same amino acid

54. The synaptonemal complex forms during:
(A) anaphase I of meiosis
(B) prophase I of meiosis
(C) anaphase II of meiosis
(D) telophase I

55. Which of the following is an example of post-transcriptional control of gene expression?
(A) Addition of methyl groups to cytosine in DNA
(B) Binding of transcription factors to a promoter
(C) Removal of introns and alternative splicing of exons
(D) Gene amplification contributing to cancer

56. The part of a DNA molecule that is present to protect the ends of DNA from not being copied during replication is called
(A) TATA box
(B) The non-canonical bases
(C) Thymine dimers
(D) Telomeres