

Practice Science Olympiad Exam: Designer Genes

THEORETICAL

1. In humans, brown eyes (B) are dominant over blue (b). A brown-eyed man marries a blue-eyed woman and they have three children, two of whom are brown-eyed and one of whom is blue-eyed.

****for this example, we'll consider only this one gene.

- a. If blue is recessive, what must the woman's genotype be?
 - b. Taking into account aforementioned genotype, what kind(s) of gametes (eggs) can she produce?
2. Assuming the conditions set in problem 1, if the man has brown eyes, but has a blue-eyed child what must his genotype be?
 - a. Taking into account aforementioned genotype, what kind(s) of gametes (sperm) can he produce?
 3. Fill out the following punnett square for problem 1:

	a.	b.
c.	d.	e.
f.	g.	h.

4. In a gene where both alleles code for part of a trait and phenotypes can be a mixture of two traits, this phenomenon is called?
5. Name an example of a human gene which shows incomplete dominance.
6. What disease does the sickle cell anemia disorder prevent if both alleles are present (Ss) or the person has sickle cell anemia (ss)?
7. A man and woman living in a tropical area where malaria is prevalent have some children. The genotypes of these children are ss, Ss, SS, ss, Ss, Ss, and SS.
 - a. What must the genotype of both parents be to have these children?
 - b. Which of their kids would most likely be able to live to adulthood and reproduce?
8. What type of genetic inheritance is shown in human blood types?
9. What are the possible alleles for the human blood types?
10. Suppose a person with type A blood and a person with type B blood get married.
 - a. First, what possible genotypes can a person be if that person has type A blood?
 - b. What possible genotype(s) can a person be if that person has type B blood?
11. What chromosomes are the genes for colorblindness and hemophilia located on?
12. What type of genetic inheritance is displayed by hemophilia?

MOLECULAR

13. What does DNA stand for?
14. What is the shape of DNA and who discovered this shape?
15. What are the 4 nucleotides found in DNA? Which ones are purines and which ones are pyrimidines?

16. What nucleotide does Adenine pair up with and how many hydrogen bonds are found between them?
17. What nucleotide does cytosine pair up with and how many hydrogen bonds are found between them?
18. What is the “backbone” of DNA made from and what type of bonds does the element share with the adjacent sugars?
19. What is the protein called that connect two chromatids to form a chromosome?
20. What protein does DNA strands wrap around when coiling, and how many times does it wrap around the protein?
21. Explain how DNA is replicated; include the terms helicase, leading strand, lagging strand, 3’end, 5’end, DNA polymerase 1, RNA primase, DNA polymerase 3, and DNA ligase if possible.
22. Explain the process of DNA transcription; include elements of RNA modification in your explanation.
23. What does RNA stand for? Give 3 differences between DNA and RNA.
24. What type of RNA is created after DNA transcription?
25. What are a set of 3 nucleotides located on an RNA strand called? What is the “start” one?
26. Where does translation occur?
27. Explain the process of translation.
28. Name and explain two different types of mutations that occur in a DNA sequence.
29. Which of the bonding examples below is NOT possible?

(A) a DNA adenine to a DNA thymine

(B) a DNA adenine to an RNA thymine

(C) a DNA guanine to an RNA cytosine

(D) a DNA adenine to an RNA uracil

(E) a DNA guanine to a DNA cytosine

30. Which of the following replaces guanine in RNA?

(A) adenine

(B) thymine

(C) cytosine

(D) uracil

(E) none of the above

31. Which of the following statements is true about mutations?

(A) Rates tend to be very high in most populations.

(B) Generally Lethal

(C) irreversible

(D) Only certain gene locations are affected.

(E) source of genetic variation

32. For the DNA strand 58-A-C-C-G-T-G-A-C-A-T-T-G-38, the correct compliment DNA would be

(A) 38-T-G-G-C-A-C-T-G-T-A-A-C-58.

(B) 58-T-G-G-C-A-C-T-G-T-A-A-C-38.

(C) 38-U-G-G-C-A-G-U-G-U-A-A-C-58.

(D) 58-A-C-C-G-U-G-A-C-A-U-U-G-38.

(E) 38-T-C-C-G-A-G-T-G-T-A-A-C-58.

33. The portion of the DNA molecule that can vary is its

(A) sugar.

(B) base.

(C) deoxyribose.

(D) ribose.

(E) phosphate.

34. An mRNA is 429 nucleotides long. The number of amino acids in the polypeptide chain formed from this mRNA is

(A) 143.

(B) 142.

(C) 141.

(D) 429.

(E) 428.

35. Which of the following is NOT consistent with Griffith's experiments?

(A) injected mixture of R-strain and live S-strain: mouse dies

(B) injected mixture of heat-killed S-strain and live R-strain: mouse lives

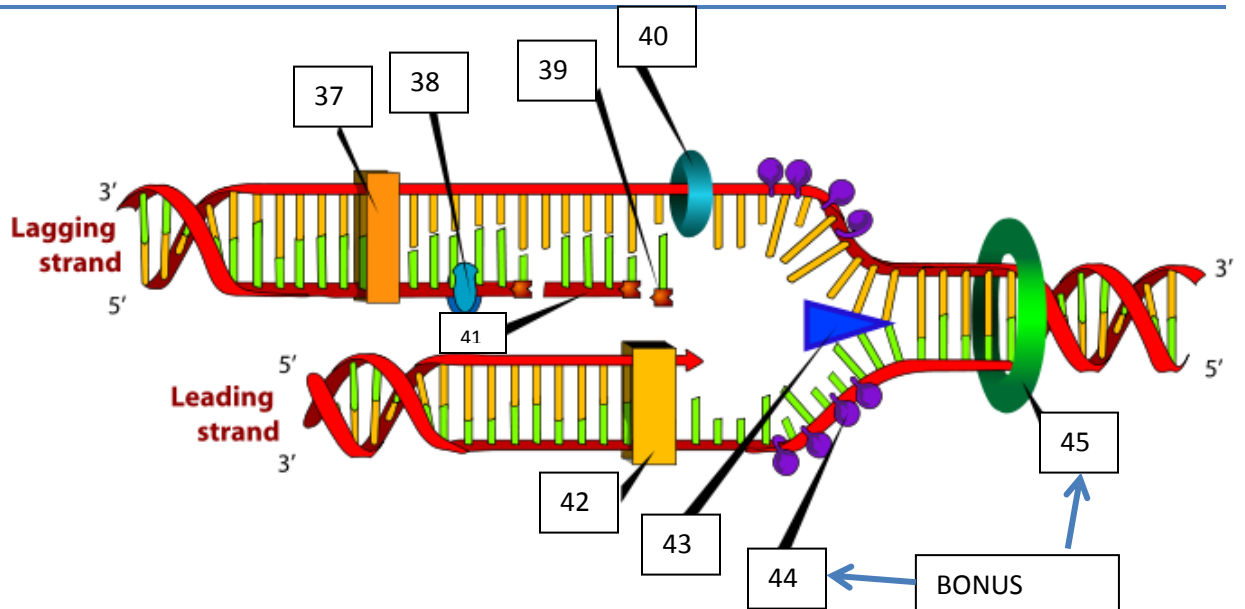
(C) injected heat-killed S-strain: mouse lives

(D) injected R-strain: mouse lives

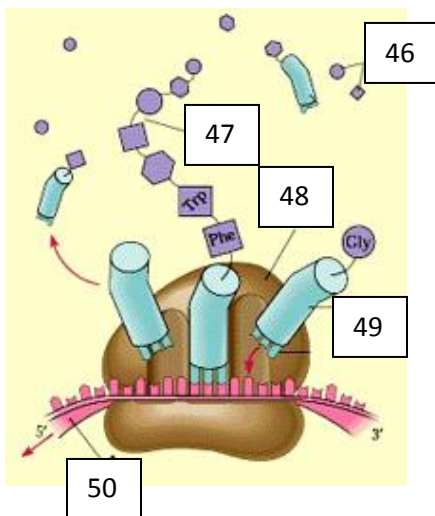
(E) injected S-strain: mouse dies

36. Which of the following is a semi-conservative process?

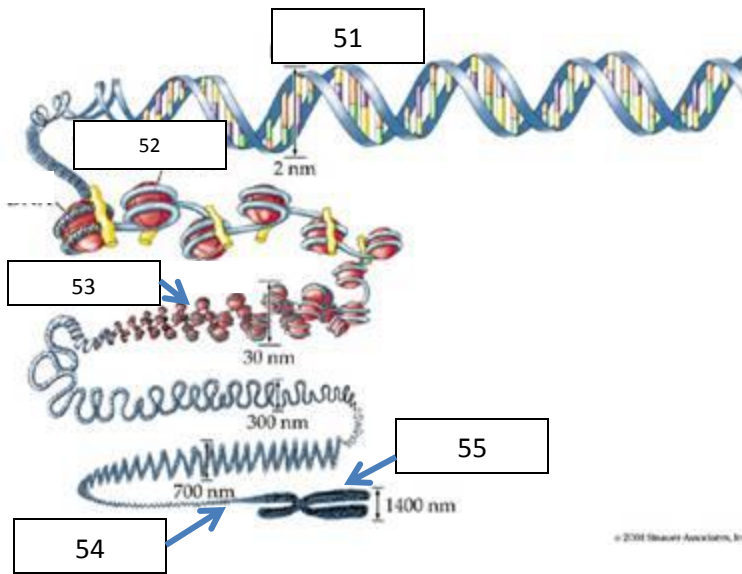
- (A) DNA replication
- (B) non-disjunction
- (C) translation
- (D) transcription
- (E) crossing over



Label the following components- 44 and 45 are bonus questions, as they are beyond the level of science olympiad



Label the following components



Label the following components

56. BONUS: Who are these two people?



ANSWER SHEET

1. A. _____

B. _____

2. A. _____

3. A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

4. _____

5. _____

6. _____

7. A. _____

B. _____

8. _____

9. _____

10. A. _____

B. _____

11. _____

12. _____

13. _____

14. _____

15. _____

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55. _____

56. _____
