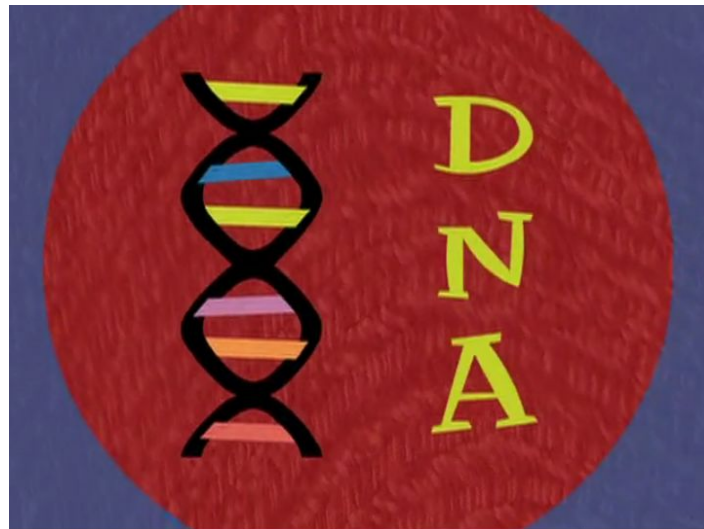




## HEREDITY - Menomonie High Invitational 2021



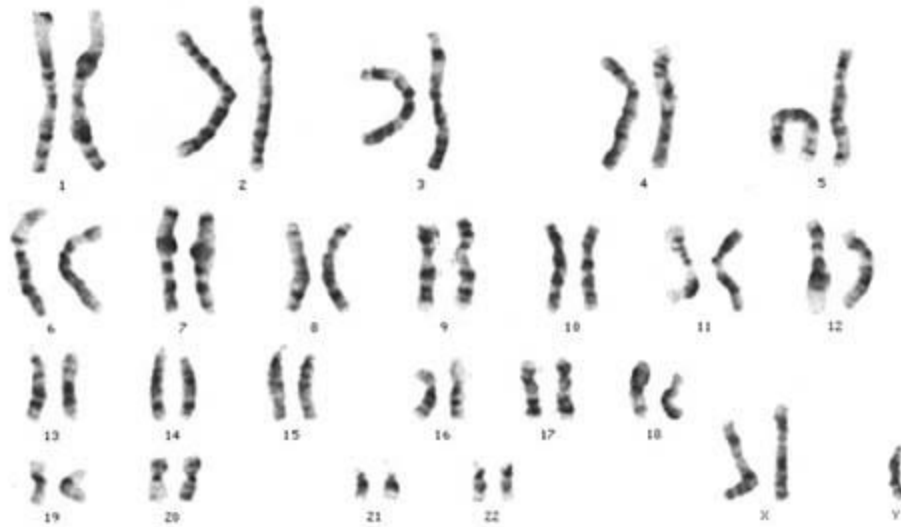
Team Number: \_\_\_\_\_

Score: \_\_\_\_/72

### Rules:

- You will have **50 minutes** to complete the test.
- The **only** materials allowed during testing are:
  - one 8.5" x 11" sheet of paper containing information on both sides without annotations or labels
  - two non-programmable calculators
- There is **no penalty** for **guessing**.
- Be sure to **answer** each question as **completely as possible**. Partially correct answers may earn **partial credit**.
- **Point values** for each question will be indicated by brackets "{ }" around a number at the end of each question.
- **Good luck!**

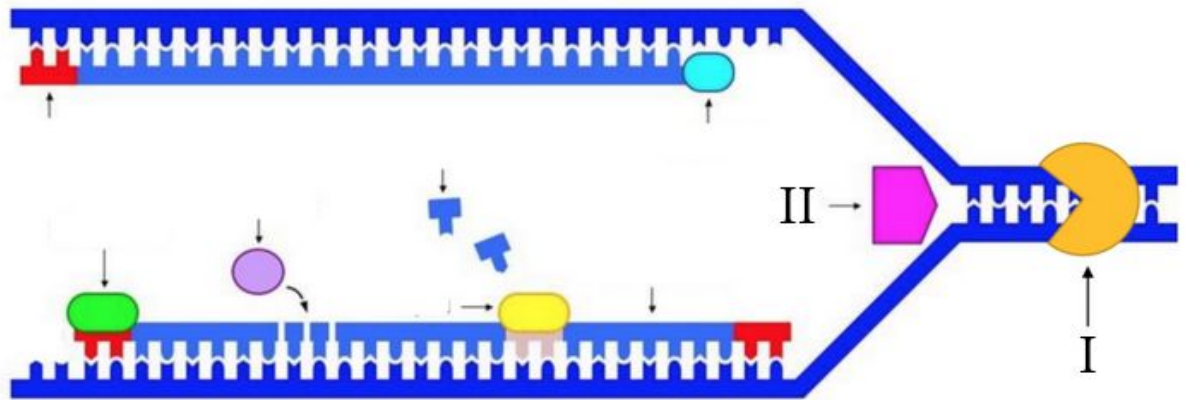
- In the holland lop rabbit, grey is dominant to white. Two rabbits are crossed -- one is white and the other is grey. Their offspring is white. What can be concluded about the **genotype** of the parents?
  - The parents are homozygous recessive and heterozygous
  - The parents are homozygous dominant and heterozygous
  - The parents are both homozygous recessive
  - The parents are both homozygous dominant
- Two individuals which are heterozygous for two different traits are crossed. What would the resulting phenotypic ratio be for this cross?
  - 1:2:1
  - 9:3:3:1
  - 1:2:1:2:4:2:1:2:1
  - 3:1
- Define "ploidy".
  - The number of sets of chromosomes in a cell
  - Another term for chromosomal abnormalities
  - The number of dominant alleles an organism has
  - The number of recessive alleles an organism has



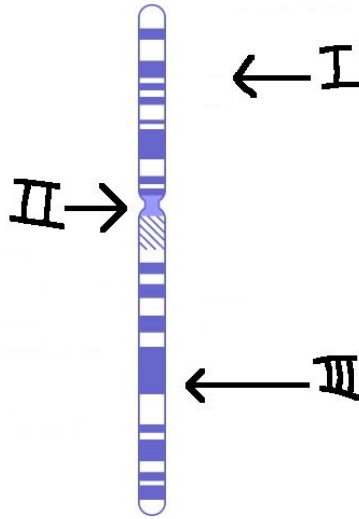
- Analyse the karyotype above.
  - This individual has a normal karyotype
  - This individual has Down syndrome
  - This individual has Klinefelter syndrome
  - This individual has Turner syndrome

5. A pedigree for a trait shows twelve individuals across three generations. Individuals of both genders are affected approximately equally by the trait, and no individuals in the second generation exhibit the trait. What mode of inheritance does this trait likely follow?
- A. Autosomal dominant
  - B. Autosomal recessive
  - C. X-linked dominant
  - D. X-linked recessive
6. Which of the following nitrogenous bases are found in RNA? Select all that apply.
- A. Adenine
  - B. Guanine
  - C. Thymine
  - D. Cytosine
  - E. Uracil
7. When in the cell cycle does replication take place?
- A. G1
  - B. G2
  - C. S
  - D. M
8. There are only 20 common amino acids, yet there are 64 possible codons. How is this possible?
- A. 44 codons remain unused, as there are only 20 that code for amino acids
  - B. Each codon codes for multiple amino acids
  - C. Each codon codes for one amino acid, but multiple codons can code for the same amino acid
  - D. The ribosome only reads part of the codon, and certain codons do not code for amino acids
9. Define crossing over.
- A. When chromosomes are assorted independently during mitosis
  - B. When nucleotides in DNA pair with the wrong base
  - C. When genes are exchanged between chromosomes in meiosis
  - D. The movement of chromosomes during mitosis
10. What is an exonuclease?
- A. A chromosome found outside the nucleus
  - B. An enzyme that separates the mRNA from DNA after transcription
  - C. An enzyme that catalyzes the end of translation
  - D. An enzyme that removes RNA primers from DNA after replication

11. If a DNA molecule is made of 17% adenine, what percentage of it is made up of thymine?
- 17%
  - 34%
  - 66%
  - 33%
12. Which of the following are characteristics of RNA? Select all that apply.
- Double-stranded
  - Possesses a phosphate-ribose backbone
  - Single-stranded
  - Circular
  - Thymine as opposed to uracil



13. The image above shows a replication fork. Which of the following accurately describe I and II?
- I - Helicase, II - DNA gyrase
  - I - DNA polymerase, II - DNA ligase
  - I - Helicase, II - RNA primase
  - I - DNA Ligase, II -DNA primase
14. What are Watson and Crick known for?
- Discovering DNA
  - Describing DNA as genetic material
  - Larceny
  - Describing the structure of DNA



15. Shown above is a chromosome. Which option accurately labels I, II, and III?
- I - Telomere, II - centromere, III - p arm
  - I - Telomere, II - centromere, III - q arm
  - I - p arm, II - centromere, III - q arm
  - I - q arm, II - centromere, III - p arm
16. What is binary fission?
- Cellular division in prokaryotes
  - Cellular division in plants
  - Another word for mitosis
  - Cellular division in fungi
17. Distinguish between codominance and incomplete dominance.
- Incomplete dominance involves the blending of traits, while in codominance both traits are expressed at the same time
  - Codominance involves the blending of traits, while in incomplete dominance both traits are expressed at the same time
  - Codominance involves the expression of two traits, while in incomplete dominance the recessive trait can be seen due to an error in the allele
  - None of the above
18. Why are karyotypes typically taken when the cell is in metaphase?
- This is the only point when the chromosomes are distinguishable
  - The stain used does not bind to DNA when it is in the form of chromatin
  - The chromosomes are more accessible during metaphase
  - There's no particular reason -- it's just convenient

19. How is it possible for a gene from one organism to be inserted into another, different organism?
- A. The genetic code is universal
  - B. Genes are common between organisms
  - C. The same processes are used to make proteins, even in different organisms
  - D. It isn't possible - genes are unique to every organism
20. True/False: If one allele is dominant to another, it will always be dominant no matter what.
- A. True
  - B. False
21. True/False: Nondisjunction can occur in mitosis.
- A. True
  - B. False
22. True/False: Prokaryotic DNA is single-stranded, while eukaryotic DNA is double-stranded.
- A. True
  - B. False
23. True/False: Only one monosomy disorder is survivable (non-lethal) in humans.
- A. True
  - B. False
24. True/False: It's possible for a male to carry color blindness and not exhibit the trait.
- A. True
  - B. False
25. True/false: every gene codes for a protein.
- A. True
  - B. False
26. Fill in the blank: [ \_\_\_\_\_ ] bonds join two nitrogenous bases, linking strands of DNA together.
27. Fill in the blank: [ \_\_\_\_\_ ] is the amino acid that codes for the beginning of a protein. Answer using the full name of the amino acid.
28. Fill in the blank: The 't' in tRNA stands for [ \_\_\_\_\_ ].
29. Fill in the blank: The [ \_\_\_\_\_ ] sequence codes for the end of transcription.
30. Fill in the blank: [ \_\_\_\_\_ ] bonds connect the deoxyribose molecules of two nucleotides.

31. Construct a punnett square to represent a cross between an individual with an  $I^A I^B$  and an  $I^A i$  genotype. What percentage of their offspring will have type B blood? {1}

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32. In the black garden ant (*Lasius niger*) wings are recessive to no wings, represented using the letter Q. Determine the possible genotypes of the F1 generation from a cross between a heterozygous individual and a homozygous recessive individual. {1}

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33. Reginald the red panda is true breeding for both tail length (T) and ear tufts (F), where a long tail is dominant and ear tufts are recessive. Reginald has a long tail, but no ear tufts. What is his genotype? {1}

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34. Is it possible to determine the DNA sequence of a protein given its amino acid sequence? Justify your answer. {2}

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35. Define "gene". {1}

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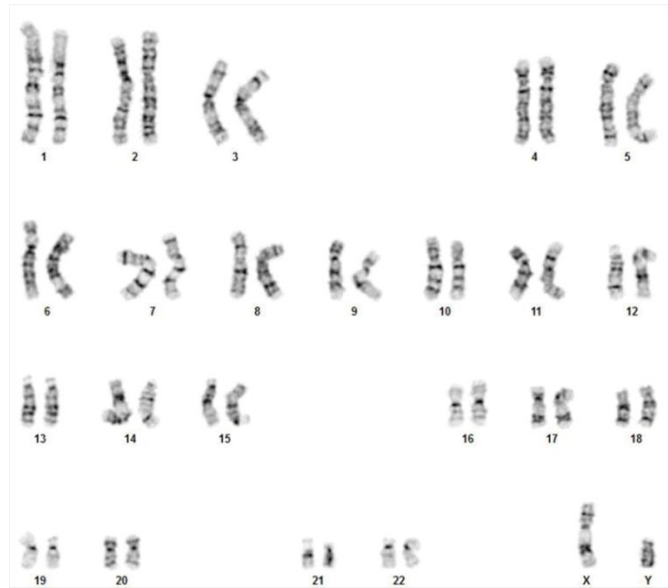
36. Compare and contrast the structure of DNA and RNA, listing two similarities and two differences. {4}

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37. Identify the sex of this individual, and analyze their karyotype for any abnormalities. {2}

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38. Describe three types of mutations. {3}

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39. Compare the structures of purines and pyrimidines. {2}

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40. Remember that in DNA, purines only bond with pyrimidines and vice versa. Using your answer to the previous question, describe the effect that this has on the DNA strand and predict what might happen if purines could only bond with purines and pyrimidines with pyrimidines. {4}

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41. Distinguish between chromatid, chromatin, and chromosomes. {3}

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42. Distinguish between the structure of prokaryotic DNA and eukaryotic DNA, listing at least three differences. {3}

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43. Name two modifications made to mRNA after transcription, and describe their purpose. {4}

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44. The TATA box is a repeating sequence of thymine and adenine nucleotides found at the beginning of most eukaryotic genes. Describe its purpose. {1}

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45. Explain how one gene can code for multiple proteins. {2}

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46. A mutation occurs to the genome in which the function of DNA ligase is altered. Predict what effect this might have on the process of replication, and justify your answer. {2}

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47. Dideoxynucleotides (ddNTPs) are modified nucleotides used in Sanger sequencing. Describe what makes them different from regular nucleotides, and why these modified nucleotides are used. {2}

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48. Describe the four levels of protein structure. {2}

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49. What process is responsible for the formation of Barr bodies? {1}

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50. A horizontal double bar links two individuals on a pedigree. What might this symbol represent?

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