ANSWER KEY

MULTIPLE CHOICE (1 POINT EACH)

1. Out of the possible options, which of these can be classified as a pyrimidine?
    a. Nucleotides
    b. Nucleosomes
    c. Nucleic Acids
    d. Nucleosides
    e. Nucleobases

2. Who is referred to as the father of heredity?
    a. Thomas Hunt Morgan
    b. Aristotle
    c. Hugo de Vries
    d. Gregor Mendel
    e. Carl Correns
    f. William Bateson
    g. Oswald Avery
    h. Walter Fiers

3. What happens in meiotic metaphase 1?
    a. Homologous chromosomes line up in the cleavage plate
    b. Chromatids line up in the middle of the cell
    c. Pairs of chromosomes line in up in the middle of the cell
    d. Chromatids line up in the cleavage plate
    e. Chromosomes are pulled apart by the centrosomes, leaving chromatids
    f. Chromatids are split apart by the centrosome
    g. Chromatids get split apart by the centrioles
    h. C & E
    i. D & G

4. When 2 non-homologous chromatids bond, what is it called?
    a. Non-reciprocal translocation
    b. Robertsonian translocation
    c. Reciprocal translocation
    d. Nonhomologous translocation

5. Which of these is a human monosomy?
    a. Palau Syndrome
    b. Turner Syndrome
    c. Down Syndrome
    d. Edward's Syndrome

6. Which of these are stop codons?

a. UCA
b. TGA
c. TCC
d. AUG
e. UGC

7. What is the role of the Topoisomerase?
    a. To unzip the DNA
    b. To attach the RNA primer
    c. To attach each base to its corresponding pair
    d. To unwind the DNA molecule

True of False (1 point each)

1. Tryptophan is the most commonly used amino acid. **False**
2. tRNA is created through transcription. **True**
3. Nonsense codons are another name for stop codons **True**
4. Gregor Mendel used beans for his genetic experiments. **False**
5. The original parents are called the F1 generation. **False**
6. Purines have 1 molecular ring. **False**
7. The kinetochore is the center of a chromosome **True**
8. Uracil pairs with Thymine **False**
9. The number of chromatids in a gamete is the same as the number of chromosomes in a diploid. **False**
10. Cytokinesis results is the process of creating a new nucleus. **False**
11. HUGO graphed 100% of the human genome **False**

Short Answer (2 points each)

1. What are 4 types of RNA? **Accept rRNA, mRNA, tRNA, 7SP/SRP RNA, snRNA, snoRNA, gRNA, crRNA, lncRNA, miRNA, shRNA, piRNA, siRNA, tasiRNA, rasiRNA, and basically any type of RNA.**
2. Define the law of independent assortment. **Alleles for separate traits are inherited differently from one another.**
3. Name 2 examples of aneuploidy in humans. **Having 45 or 47 chromosomes.**
4. How long did the HUGO project take? **13 years**
5. What is a somatic cell? If a cell doesn't carry DNA, is it still somatic? **A somatic cell is any cell expect gametes, even if it doesn't have any DNA.**
6. What stage of the cell cycle is needed to prepare for reproduction? **G2**
7. Name 2 examples of non-mendelian inheritance. **Co-dominance and Incomplete Dominance**
8. What is the difference between an intron and an exon? **Exons are transcribed into mRNA, introns are not.**
9. What types of antigens & antibodies does a person with blood type O have? **No antigens, both anti-A and anti- B antibodies.**

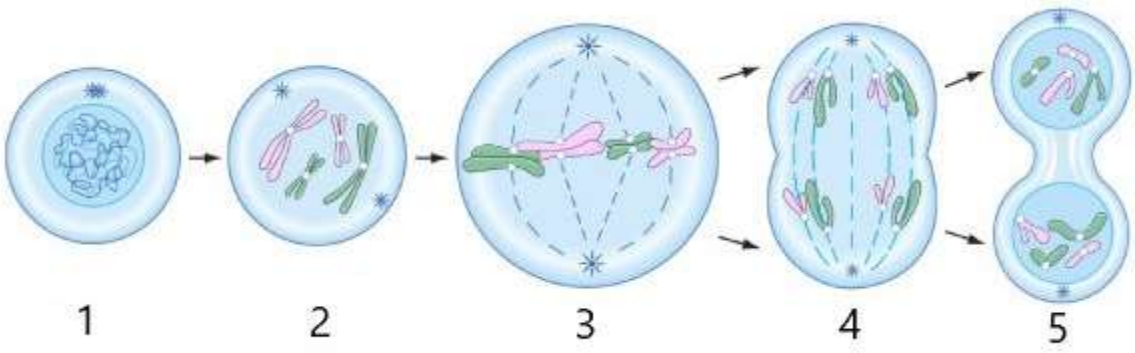
10. What is the difference between deoxyribose and ribose? **Deoxyribose has one less oxygen than ribose simply.**
11. Define epigenetics. **The study of gene expression.**

Comprehensive Questions

1. Transcribe the following DNA strands into RNA strands (1 point each)
   i. 5' ATGCGAAATTTC 3'
      UACGCUUUAAAG
   ii. 3' AAACTGATCGTG 5'
      CACGAUCAGUUU
   iii. 5' ATGGATTAGCCA 3'
      UACCUAAUCGGU

2. Using your previous answers from #1, translate each of these into amino acids. (1 point each)
   I. **TYR-ALA-LEU-LYS**
   II. **HIS-ASP-GLN-PHE**
   III. **TYR-LEU-ILE-GLY**

3. Label each stage of cell cycle. (0.5 points each)



1-Interphase 2-Prophase 3-Metaphase 4-Anaphase 5-Telophase

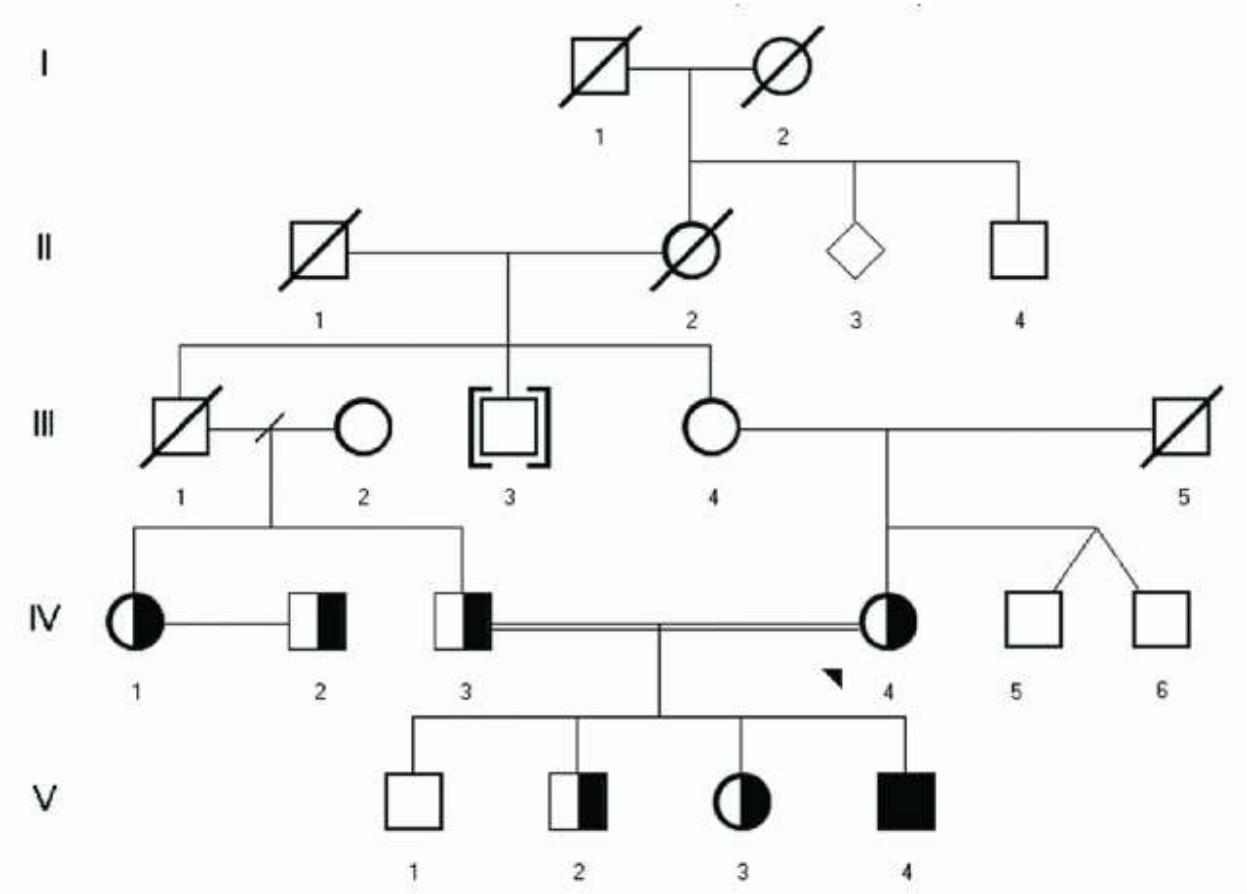
4. Jaiden wants to know what blood type she has. Her mom's blood type is B, and she also knows Jaiden's grandpa's, which is O. Her dad has forgotten his blood type, but he knows that both of his parents have AB as their blood type. What are the chances that Jaiden's blood type is A? (5 points)

   ANSWER: 25%

   How to solve it: Using the information given, we know the mom's blood type is definitely i^B (or BO, as we're going to use A, B, and O for simplicity from now on). For the dad, there is 3 possibilities. He can either have the genotype AB (50%), AA(25%), or BB(25%). If the dad has the genotype of AB, the chances of an A blood type is 50% (mom chance of O) x 50% (dad AB chance) x 50% (chance of A dad). If the genotype is BB, the chance is 0%, as there is no

chance the father will contribute the gene for A. If the genotype is AA, the chances of an A blood type is 50% (mom chance of 0) x 25% (chance of AA blood type) x 100% (chance of A given by dad). Adding up all 3 of these percentages will get you the total probability of Jaiden's blood type, which is 12.5% + 0% + 12.5%, or 25% of A.

Look at the following image for questions 5-10. (1 point each)

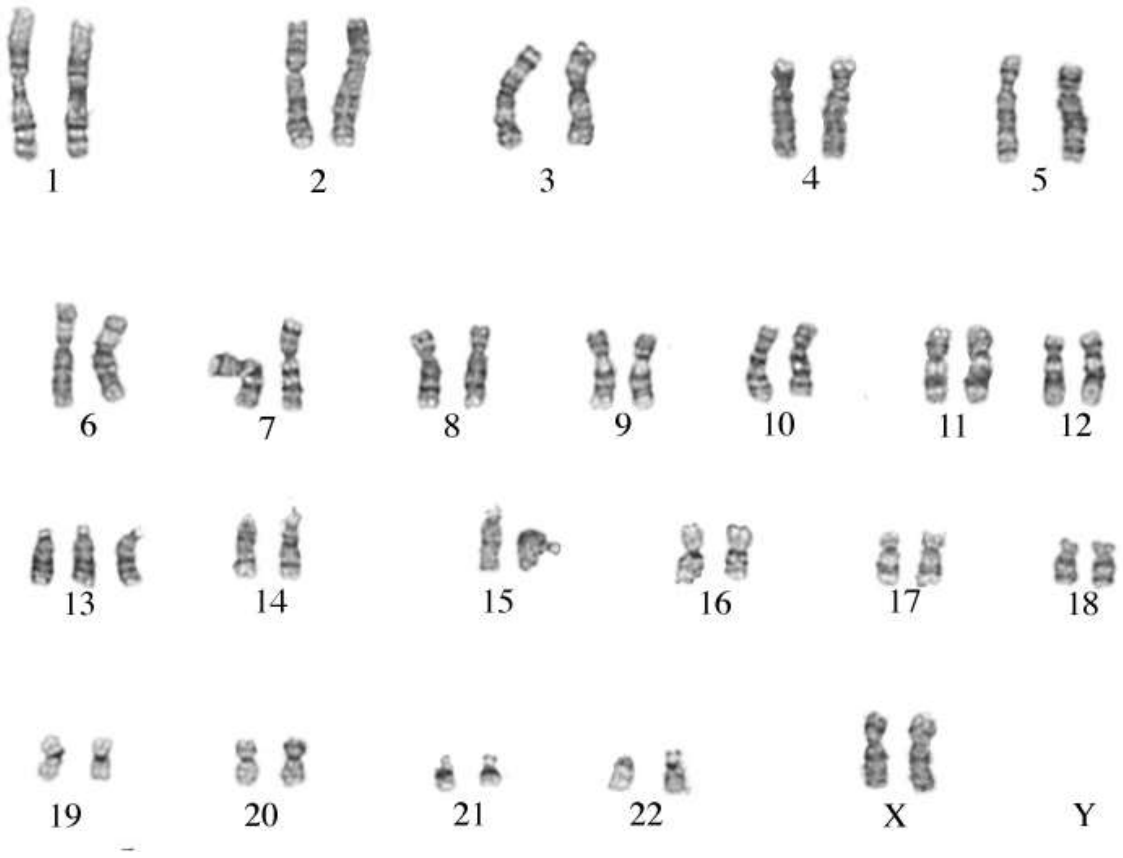


5. What is the relationship between IV 3 and IV 4? **Consanguineous marriage (accept marriage between family members)**
6. What is the relationship between IV 5 and IV 6? **Fraternal or non-identical twins**
7. How many females are present in this family? **7**
8. How many males are present in this family? **13**
9. What do the brackets around III 3 mean? **Adoption**
10. Why is II 3 a different shape? **No gender is specified.**

11. An isolated population in a remote island was examined for a certain gene by a university. They discovered that 32 people out of the 2453 people expressed the gene, while the rest did not. This gene

is believed to be recessive, and the population is being assumed to be in a Hardy-Weinberg equilibrium. Around how much of the population has the gene? (5 points) **560 people.**

Use the following image to answer questions 12-16 (1 point each)



12. What gender is the specimen shown? **Female**
13. Does this specimen have aneuploidy? **Yes**
14. Look at chromosome 7. Name any problems associated with this chromosome if are present. **N/A**
15. Look at chromosome 15. Name any problems associated with this chromosome if any are any present. **Deletion of the q arm.**
16. Are there any other noticeable disorders? Name them if so. **Yes, Palau Syndrome**

17. A couple is having a baby, so they come to you as their counselor in order to figure out what their baby will be like. This is what they told you.
    I. The dad has a history of red-green colorblindness (x-linked recessive) in his pap's family, as his papa had it, but he is unsure he has it. The mom knows for a fact that she carries Hemophilia A (x-linked recessive) but doesn't seem to suffer from it.
    The baby has no chance of red-green colorblindness, since the dad can only contract it if the mom has it. The mom though, gives the baby a 50% chance of Hemophilia, as the baby will contract it if it's a boy, but it won't if it's a girl. **Hemophilia A is a threat, while red-green colorblindness is not.**

II. Both parents are carriers for cystic fibrosis, but none of them suffer from it.
From this, we can assume this cystic fibrosis is a recessive allele. This gives the baby only a 25% chance of contracting, as a cross between heterozygous carriers will lead to a 3 dominant: 1 recessive phenotype ratio. Cystic fibrosis is not a major threat to the baby.

III. The dad knows his parent's blood types (O and AB) but seemed to forget his. The mom knows her blood type is AB.
The dad either has blood type A or B, with a genotype of AO or BO (for simplicity I'm using this A instead of I^A and so on). If you cross AO and AB, the chances are 50% A, 25% B, and 25% AB. For the other cross of BO and AB, there's a 50% of B, 25% of A, and a 25% of AB. This means that the chances of A and B are both 37.5, and AB has only a 25%. Since none of these traits are above 50%, accept only responses stating none of them.

IV. The dad suffers from Marfan Syndrome, even though he's heterozygous. The mom's family never encountered it.
From this, you can assume that Marfan Syndrome is dominant, since someone heterozygous is suffering from it. With a cross like this, there is a 50% the allele will appear in the baby, as he phenotype ratio is 2:2 for a case like this. Marian Syndrome is a major threat to the baby.

V. The mom has a history of down syndrome in her family, but she doesn't seem to have it.
Down syndrome is nonheritable, as it is cause by nondisjunction.

Now, out of all of these traits, which traits does the baby has 50% or more of inheriting and is therefore considered a threat? Make sure to show your work. (2 points for each part. 1 point for the correct answers, another for work shown. Give 1 point only for problem V for correct answer.) **The baby has a high chance of inheriting Hemophilia A and Marfan syndrome. All other traits are either nonexistent or a minor threat.**

You are the discoverer of a new species of wildflower which carries 4 alleles for its color, white, pink, blue, and some which never bloom. When they crosspollinated, you found that the whites when cross-pollinated with each other create only blue and white, the pinks created only pinks and blues, and the blues created only blues. When you cross-pollinated white and pink, you found that the flower never bloomed, or was blue.

18. Solve a possible cross between a non-blooming flower **(PO)** and a blue **(bb)** flower. Label each of the letters you use. List the genotype ratio. (2 points, one for Punnett square, the other for the correct ratio)

	Pink	Orange
b	Pb	Ob
b	Pb	Ob

2:2

19. What type of dominance is present in this example? (1 point) **Codominance**

20. Dan was given the task of finding the cross of tUU x Ttuu. T is a recessive X-linked and U is autosomal dominant. Here is Dan's work. Is he right? If not, explain what he did wrong. (4 points. 2 for getting the right answer, 2 for explaining well)

Daniel is incorrect, as the sex-linked allele of t should only be present in half of the children, not all of them, as half of the children won't have 2 X chromosomes. For the top row, Dan should have put the allele t in only the first 2 slots, not all 4.

	tU	tU	tU	tU
Tu	TtUu	TtUu	TtUu	TtUu
tu	ttUu	ttUu	ttUu	ttUu
Tu	TtUu	TtUu	TtUu	TtUu
tu	ttUu	ttUu	ttUu	ttUu