## Unit 2 Review ANSWER KEY

1. Define the following terms:
a. Meiosis is cellular division that results in daughter cells with half of the number of chromosomes as the parent cell.
b. Recombination is when homologous chromosomes intertwine and exchange corresponding segments (e.g. same loci) of genetic information during prophase. The resulting gene combinations are different than parental chromosomes (a.k.a. crossing over).
c. Independent assortment is when the maternal and paternal homologous chromosomes are randomly distributed during anaphase (can yield $2^{23}$
[ $8,388,608]$ different ways to arrange chromosome pairs.)
d. Mutation is described as random changes in the DNA sequence as the sister chromatid is being formed (e.g. deletion, insertion, duplication, insertion). e. Gregor Mendel (1822-1884) was an Austrian monk who studied the inheritance patterns of pea plants and is known to be the "grandfather" of genetics.
f. Punnett square is a diagram that is used to predict the probabilities of the phenotype and/or genotype of offspring.
g. Codominance is when more than 1 allele is expressed (e.g. blood type).
h. Sex-linked refers to when the allele for trait is on the " $X$ " or " $Y$ " sex chromosome (e.g. red/green color blindness).
i. Incomplete dominance is when heterozygotes are intermediate phenotypes between the homozygotes (Snap dragon flower color. Dominant homozygotes = red, heterozygotes $=$ pink, recessive homozygotes $=$ white $)$.
j. Complete dominance is when both genotypes are present and the dominant allele completely masks the recessive allele when heterozygous (e.g. widow's peak is dominant over strait hair line).
k. Polygenetic inheritance is when phenotypic traits vary by degrees (e.g. height).
I. Pleiotropy is when a single gene contributes to multiple phenotypic traits.
m . Autosome is a chromosome that is not a sex chromosome. In humans, this is pairs 1-22.
n . Sex chromosome is the chromosome responsible for determining the sex of an individual. In humans, the sex chromosomes are known as "x" and "y."
o. Somatic cell is the cell that forms the body of an organism.
p. Gamete/Sex cell is the sperm or egg cell.
q. Haploid is the number of chromosomes in a gamete/sex cell (abbreviated as "n").
r. Diploid is the number of chromosomes in a somatic cell (abbreviated as " 2 n ").
s . Triploid means having 3 times the number of chromosomes in a cell.
t. Pedigree/Family tree is a diagram that shows the biological relationship between organisms.

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2. What is the total number of chromosomes that the average person has in a somatic cell? 46
3. What is the total number of chromosomes that the average person has in a sex cell? $\underline{23}$
4. How many pairs of chromosomes does the average person have in a somatic cell? 23 pairs
5. What is a human's diploid number $(2 n) ? 2 n=46$
6. What is a human's haploid number $(\mathrm{n}) ? \mathrm{n}=23$
7. Is a human somatic cell diploid or haploid? diploid
8. Is a human gamete/sex cell diploid or haploid? haploid
9. What is the total number of autosomes that a human somatic cell has? 44
10. What is the total number of sex chromosomes that a human somatic cell has? $\underline{2}$
11. How many pairs of autosomes does a human somatic cell have? 22 pairs
12. What is the total number of sex chromosomes in a human gamete? 1
13. What is the total number of autosomes in a human gamete? $\underline{22}$

Use the following information to answer questions 14 and 15: Three alleles control the $A B O$ blood types. $I^{A}$ and $I^{B}$ are codominant genes, so the combination of $I^{A} I^{B}$ produces the AB blood type. The third allele $\mathrm{I}^{\circ}$ is recessive to the other two alleles.

A person with type A blood has 1 allele from their mom and one allele from their dad. When you put them together to form the offspring during fertilization, there could be two different genotypes to produce type A blood:
$\left.\left.\right|^{A}\right|^{A}=$ type A blood
$\left.\left.\right|^{\mathrm{A}}\right|^{\mathrm{O}}=$ type A blood
A person with type B blood has 1 allele from their mom and one allele from their dad. When you put them together to form the offspring during fertilization, there could be two different genotypes to produce type $\mathbf{B}$ blood:
$I_{1}^{B} 1^{B}=$ type $B$ blood
$I^{B} I^{\prime}=$ type B blood

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A person with type $\mathbf{A B}$ blood has 1 allele from their mom and one allele from their dad. When you put them together to form the offspring during fertilization, there could be one different genotype to produce type AB blood:
$\left|\left.\right|^{A}\right|^{B}=$ type $A B$ blood
A person with type $\mathbf{O}$ blood has 1 allele from their mom and one allele from their dad. When you put them together to form the offspring during fertilization, there could be one genotype to produce type $\mathbf{O}$ blood:
$1^{\circ} 1^{\circ}=$ type O blood
During meiosis, when producing sperm and egg, the homologous chromosomes separate and one allele goes into each egg/sperm. You write these potential gametes along the side of the Punnett square:


Rather than drawing all that out, you can just list the potential gametes and the unions that they produce in the middle
14. A woman sues a man for child support, claiming he is the father of her illegitimate child. The woman is type A blood, the man is type B blood, and the child is type O blood. Using a Punnett square, show how it is possible for this man to be the father of this child. Can $\mathrm{A} \times \mathrm{B}$ produce an O child? Yes, these parents could potentially produce this child if both parents are heterogeneous for their blood type $\left(\left.I^{\mathrm{A}}\right|^{\mathrm{O}}\right.$ and $\left.\left.\left.\right|^{\mathrm{B}}\right|^{\circ}\right)$.


However, If they were both homogenous for their blood type or if just one parent was homozygous, then they could not produce this child.

15. A wealthy elderly couple dies together in an accident. A man comes forward, claiming that he is their long lost son and is entitled to their fortune. The couple was of blood types A and AB. The man has type O blood.
a. Could he be the heir to the fortune? No
b. Using a Punnett square, show why or why not.

Can A X AB produce an O child? No, these parents cannot produce this child.

16. Which of the following statements about polygenic inheritance is true?
A. In polygenic inheritance, one gene controls many phenotypic traits.
B. In polygenic inheritance, one phenotypic trait is controlled by multiple genes.
C. Polygenic inheritance is illustrated by height and eye color.
D. Both B and C
E. None of the above
17. If you cross a true-breeding purple flowered plant with a true-breeding white flowered plant and get pink flowers, your result is most likely an example of which of the following?
A. Codominance
B. Epistasis
C. Incomplete dominance
D. Polygenic inheritance
E. Complete dominance
18. If you conduct a dihybrid cross and get a ratio of $9: 7$, you could conclude which of the following?
A. The traits under examination are impacted by epistasis.
B. The traits under examination are polygenic.
C. The traits under examination are codominant.
D. All of the above
E. None of the above
19. In fruit flies, white eyes are x-linked recessive. If you cross a white-eyed female and a red-eyed male, what percentage of your female offspring will have white eyes?
A. $100 \%$
B. $50 \%$
C. $25 \%$
D. $0 \%$
20. Hemophilia is an $x$-linked recessive disease, otherwise known as the "royal disease." If you crossed a carrier female with a hemophiliac male, what is the likelihood that your female offspring will have hemophilia?
A. 0\%
B. $25 \%$
C. $50 \%$
D. $75 \%$
E. 100\%
21. Blood type can be either $O, A, B$, or $A B$. $A$ and $B$ are dominant to $O$, yet they are codominant to each other. If you crossed an individual with the blood type of O with A , what would the blood type be of the offspring?
A. All of the offspring would be A.
B. All of the offspring would be O.
C. Half of the offspring would be A , and half would be O .
D. Both A and C
E. None of the above
22. Red-green colorblindness is a sex-linked recessive trait. Which of the following statements is true?
A. Women carriers will not be colorblind.
B. There are more colorblind men than women.
C. Women carriers will be colorblind.
D. There are more colorblind men than women.
E. None of the above
23. Which of the following is a potential chromosomal abnormality?
A. Deletion
B. Insertion
C. Duplication
D. Insertion
E. All of the above
24. If you have an initial gene sequence of DFEBA, you conduct a controlled test cross in your F1, and you notice that your offspring have a gene sequence of DFEFEBA, then which mutation has occurred?
A. Duplication
B. Deletion
C. Inversion
D. Deletion
25. Barr bodies are believed to be which of the following?
A. Extra new copies of chromosomes
B. Inactivated $x$ chromosomes in female mammals
C. Responsible for a genetic disease
D. None of the above
26. Meiosis results in which of the following?
A. 2 haploid daughter cells
B. 2 diploid daughter cells
C. 4 haploid daughter cells
D. 4 diploid daughter cells
27. Which of the following cells undergoes meiosis?
A. Unicellular organisms
B. Sperm cells
C. Stomach cells
D. All of the above
28. Draw and label the stages of meiosis I \& II.

Meiosis I


Meiosis II


Anaphase II


Telophase II
29. At which stage does crossing-over occur?
A. Anaphase
B. Prophase
C. Metaphase
D. Telophase
30. Meiosis is the type of cell division that produces which of the following?
A. DNA
B. Gametes
C. Zygotes
D. Chromosomes
31. If a cell with a diploid number of 48 undergoes meiosis, how many chromosomes are in each daughter cell?
A. 12
B. 24
C. 36
D. 48
32. The probability of recombination between two locations on a chromosome is related to which of the following?
A. The distance between the two locations
B. The length of the chromosome
C. The length of the loci of interest
D. None of the above
33. Fill in the missing information in the table.

|  | MEIOSIS |
| :---: | :---: |
| OVERALL FUNCTION: | Creates gametes/sex cells |
| STARTS WITH type of cell(s): | Germ cell |
| STARTS WITH number of cell(s): | 1 |
| STARTS with what ploidy? | Diploid |
| RESULTS IN types of cell(s): | Gamete/sex cell |
| RESULTS IN number of cell(s): | 4 sperm or $1 \mathrm{egg} / 3$ polar bodies |
| RESULTS with what ploidy? | Haploid |
| STAGES and give a brief DESCRIPTION of each stage | Prophase I-Chromatin condenses=chromosomes. Tetrad forms, crossing over occurs <br> Metaphase I -Tetrad are lined up in center of cell Anaphase I-Chromosomes migrate to poles of cells <br> Telophase I - results in 2 cells with a haploid duplicated chromosome set <br> Prophase II - spindle forms <br> Metaphase II - chromosomes are lined up in center of cell <br> Anaphase II-sister chromatids are pulled apart <br> Telophase II - nuclear envelope forms |

Use the following information to complete questions 34-37. A pedigree, also known as a family tree, is a drawing or diagram that demonstrates the relationship between individuals in a family. It is often used to show how traits are inherited. In the pedigrees below, a circle represents a female and a square represents a male. If an individual expresses a trait, then the circle or square is dark.

34. Is the trait (freckles) dominant or recessive? Because the parents (generation 1) do not express the trait but their offspring do (generation 2), you can conclude the trait is recessive.
35. What are the possible genotypes for an individual with freckles? FF and Ff
36. What is the genotype for an individual without freckles? ff
37. On the pedigree above, label the genotype of each individual.

38. In the pedigree chart below, determine whether the characteristic is dominant or recessive. Dominant

39. Consider the following pedigree that shows the ability to change skin color in the tree frog, Hyla versicolor.
a. Is this trait due to recessive allele or a dominant allele? Recessive
b. In the F1 generation, what is the genotype of the male indicated with an arrow? Heterozygous (Cc)


