

Questions

1.

- a. When mating/crossing a white pure-breeding elephant, with a black pure-breeding elephant, Jen expected offspring that were entirely white. Why? Explain by showing genotypes of parents and progeny.
- i. Due to complete dominance, Jen would expect entirely white progeny if the white trait is the dominant factor. Since the black trait is homozygous recessive, the elephant progeny would need to be completely recessive in order to portray that characteristic. This will be demonstrated in the following table where the white pure-breeding elephant (WW) will be crossed with a black pure-breeding elephant (ww).

	W	W
w	Ww	Ww
w	Ww	Ww

- ii. Therefore, according to the table, all the progeny will be entirely white.
- b. If, instead, the progeny were gray, give a possible explanation.
- i. If the progeny are gray, it could be due to incomplete dominance because the parents are homozygous white and homozygous black. Therefore, when they are crossed, the progeny would be heterozygous, indicating that it has both white and black traits because the phenotype of the heterozygote is not dominant unless it is between two homozygotes. Thus, since both are dominant, incomplete dominance would result allowing the two traits to share dominance and produce a gray offspring.

- c. If, instead, Jen mated two heterozygous white elephants, what would be the expected phenotypes if this trait followed basic Mendelian genetics? Explain your answer.
- i. If Jen mated two heterozygous white elephants (Ww), the following would result:

	W	w
W	WW	Ww
w	Ww	ww

The expected phenotypes would be 1:2:1 with 1 homozygous dominant white elephant, 2 heterozygous white elephants, and 1 homozygous recessive black elephant. This ultimately results in 3 white elephants and 1 black elephant.

- d. What explanation would be given if the progeny from such a cross in c. gave all white elephants.
- i. If the two heterozygous white elephant progeny from c were crossed, the only way to get all white elephants would be if the homozygous recessive genotypes were either not viable and/or lethal.
2. For each of the following, give a brief description:
- a. Pleiotrophy

- i. Pleiotrophy occurs when a gene affects multiple, seemingly unrelated traits. In humans, Pleiotrophy is known as phenylketonuria (PKU), which is a recessive genetic defect that is only shown when the carrier is homozygous recessive for the trait. This disease has been known to cause mental retardation, a small head size, and lighter colored hair.
- b. Expressivity
 - i. Expressivity is the level or degree that a gene or allele is expressed. For example, if two individuals have the same genotype for a trait like brown hair, they won't necessarily express the same phenotype depending on how the gene or allele is being expressed due to things like environmental factors. Therefore, one individual could have light brown hair while the other individual has more of a darker brown hair color.
- c. Sex-limited trait
 - i. Sex-limited traits are those that are only expressed in one sex. The most common example of sex-limited traits are the female's ability to produce milk from her breasts.
- d. Multiple alleles
 - i. Multiple alleles occur when genes have more than 2 alleles since the genes normally only have 2 alleles.
- e. In-complete penetrance
 - i. Penetrance has been defined as the proportion of individuals that display the expected phenotype from its respective genotype. Since the genotype phenotype correlation is not perfect; therefore, if the genotype is AA and no A phenotype is expressed, then the gene exhibits in-complete penetrance.

3.

- a. Why would you suspect that a trait is X-linked?
 - i. X-linked traits are often hidden in females since they have a pair of X chromosomes, while males have XY. Therefore, the X-linked trait is gender biased because it is usually more prominent in males. Also, when looking at the trait from generation to generation, if the trait is present in a few of the females but many males, then the trait must be passed down on the X chromosome.
- b. Why would you suspect that a trait is Y-linked?
 - i. The Y-linked traits are only found in males since they carry the Y chromosome. Therefore, the trait is often passed down from father to son. The trait can be determined to be Y-linked by looking from generation to generation to see if the trait is only present in males.
- c. Draw a Punnett square to show how a daughter could inherit red/green color blindness.

	X^C	X^c
X^C	$X^C X^C$	$X^C X^c$
Y	$X^C Y$	$X^c Y$

- i. X^C represents normal vision, X^c represents colorblind trait, and the Y indicates the father. Therefore, a carrier ($X^C X^c$) was crossed with a

colorblind father (X^cY). Therefore, there is a 25% chance that a daughter could be colorblind.

4. A person with blood type B (whose parents were types O and AB respectively) mates with a person with type AB.
- What are the expected blood types (phenotypes) and their proportions in their children?
 - The expected blood types are $\frac{1}{4}$ type AB, $\frac{1}{2}$ type B, and $\frac{1}{4}$ type A.
 - What are the expected genotypes at this locus and their proportions in their children?
 - The expected genotypes and their proportions are as follows in the table:

	I^B	I^O
I^A	$I^A I^B$	$I^A I^O$
I^B	$I^B I^B$	$I^B I^O$

They are $\frac{1}{4}$ type AB ($I^A I^B$), $\frac{1}{2}$ type B ($I^B I^B$, and $I^B I^O$), and $\frac{1}{4}$ type A ($I^A I^O$).

- Pretend that instead of being codominant, A, B, and O were sequentially dominant, with A dominant over B and B dominant over O. What would the phenotypes and their proportions be in children from such a mating?
 - If A is dominant over B, and B is dominant over O, then the proportions in their children would be $\frac{1}{2}$ type A, and $\frac{1}{2}$ type B.

- 5.
- Describe in detail what is meant by a quantitative trait? Give an example and include in your answer how it differs from a "Mendelian trait."
 - A quantitative trait occurs through interactions and additive effects of many genes. It differs from Mendelian traits in that, a Mendelian trait is specified by one gene and can determine traits such as eye color; whereas a quantitative trait is specified by multiple genes. Since multiple genes are required for quantitative traits, the effects cannot be separated into different categories; however, a couple examples are height and weight determination.
 - What is meant by the term "heritability"?
 - The term heritability describes the part of the phenotypic variation in a population that is related to or caused by genetic factors.
 - Sketch the variation of leaf size you might see in trees in a forest. Assume that leaf size is a quantitative trait.

at.

