

Dragon Genetics, pt. V: Lesson 6.7 Incomplete Dominance, Sex-linked, and Polygenic

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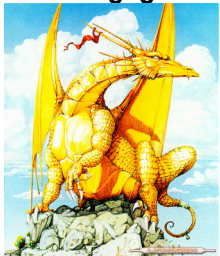
Key Terms

Incomplete dominance	Autosome	Sex chromosome
Sex-linked traits	Polygenic inheritance	

While studying dragons, explorers came across different dragons that did not seem to follow Mendel's rules. They saw dragons with traits demonstrating incomplete dominance, codominance and polygenic inheritance.



Engage



Yellow Dragonette

x



Blue drake

=



Green Offspring

How do you think it would be possible for a yellow dragon and a blue dragon to have a green dragon? Explain your thoughts.



Explore I: Incomplete Dominance

Incomplete dominance refers to offspring that appear to be a mix of the two parental varieties. It is not considered blending, due to the implication hybrid offspring would never have offspring with the original parent phenotypes. For example, cross a white snapdragon (flower) with a red snapdragon and get pink. Later crossing pink offspring will result in the return of white and red offspring.



Explain I

Refer to lesson 6.12.

1) Cross a bright green dragon with a purple dragonette.

A. Assign Symbols (alleles): = _____ and = _____

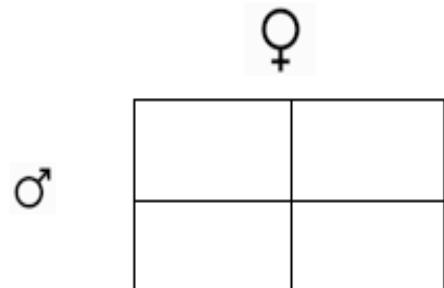
B. What phenotype will a heterozygote exhibit? _____

C. Show the cross x

D. Complete the Punnett square

E. List genotypic ratios

F. List phenotypic ratios



2) Cross two Dark olive dragons

A. Assign Symbols (alleles): $_ = _$ and $_ = _$

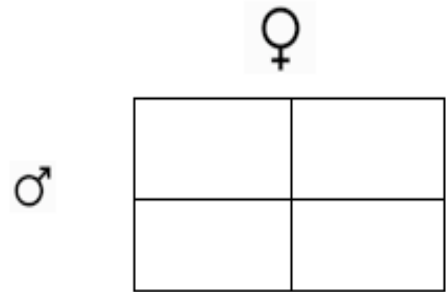
B. What phenotype will a heterozygote exhibit? $_$

C. Show the cross $_ _ \times _ _$

D. Complete the Punnett square

E. List genotypic percentages

F. List phenotypic percentages



3) In your own words, explain incomplete dominance.



Explore II: Polygenic Inheritance

In **Polygenic Inheritance** “many” genes determine a trait. When learning about eye color, we typically compare Brown eyes (B allele) to Blue eyes (b allele). What about green, hazel and light brown eyes? How do we get that genetic combination? Take a look at the dragon genome worksheet and the genes for back spikes located on the C, J, and W. All three genes can contribute to the overall number of back-spikes on a dragon. If a dragon is homozygous dominant for all three genes, the maximum number of back spikes they can have is 6. If they are homozygous recessive for all three, they can have zero back spikes.



Explain II: Write down the number of back spikes for dragons with the following genotypes:

4) CCJjww $_$

5) ccJJWW $_$

6) CcJjWw $_$

7) Mushu, a CCJJWW dragonette is crossed with a Pern drake, CcJjww. How many offspring will have each number of back spikes? *Hint: This is an example of a trihybrid cross. The best way to solve this is with three individual monohybrid crosses, one for each gene.*

$$CC \times Cc = \frac{2}{4} CC, \frac{2}{4} Cc$$

$$JJ \times JJ = \frac{4}{4} JJ$$

$$WW \times ww = \frac{4}{4} Ww$$

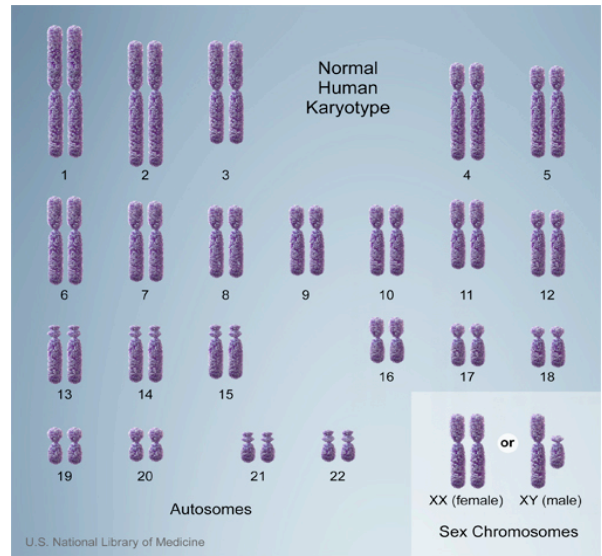
To find out how many 6 spiked offspring you need $CC \times JJ \times WW$ or $\frac{1}{2} \times \frac{4}{4} \times 0 = 0$. There are no 6 back spiked offspring. Now try find out how many have 5, 4, 3, 2, 1 or 0 back spikes. **SHOW YOUR WORK BELOW.** Remember there are multiple gene combinations to give the same number of back spikes. CCJjww is the same number as CcJjWW. Both would be four.



Explore III: Sex-linked inheritance

All genes on the sex chromosome are said to be **sex-linked**. In humans the 23rd chromosome determines the sex of an individual (XY – male with one X chromosome and XX – female with two X chromosomes). The 23rd pair of chromosomes are called **sex chromosomes**. All other chromosomes, pairs 1 -22 are considered **autosomes**. Mostly males are affected by sex-linked disorders, frequently caused by recessive alleles. A male receives a single X-linked allele from his mother (Y from father), and will have the disorder, while a female has to receive the allele from both parents to be affected.

Hemophilia and colorblindness are examples of X-linked traits in humans.



HEMOPHILIA (X-LINKED)

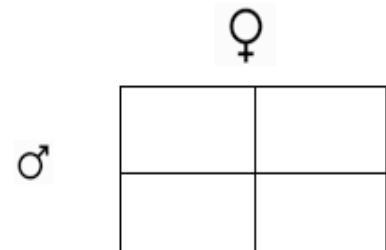
◆ Alleles, Genotypes and Phenotypes for Hemophilia (Blood-Clotting Inability)

X^H – allele for normal blood clotting
 X^h – allele for hemophilia

- ♀ {
 _____ - genotype of normal, noncarrier female
 _____ - genotype of hemophiliac female
 _____ - genotype of carrier female (with normal blood-clotting ability, but carries the recessive allele and can pass it on to her children)
- ♂ {
 _____ - genotype of normal male
 _____ - genotype of hemophiliac male

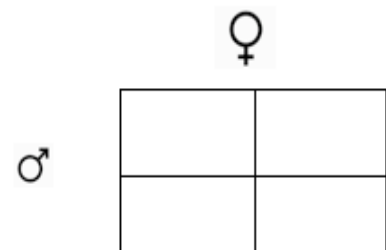
8. A man with normal blood-clotting ability (X^HY) marries a woman who is a hemophiliac (X^hX^h). Make a Punnett square to predict the genotypes of their offspring. Then state the phenotypic ratios and percentages.

- ___/4 or ___% are normal females (include noncarrier and carrier)
 ___/4 or ___% are hemophiliac females
 ___/4 or ___% are normal males
 ___/4 or ___% are hemophiliac males



9. A normal woman (X^HX^H) marries a hemophiliac man (X^hY). Make a Punnett square to predict the genotypes of their offspring. Then state the phenotypic ratios and percentages.

- ___/4 or ___% are normal females (include noncarrier and carrier)
 ___/4 or ___% are hemophiliac females
 ___/4 or ___% are normal males
 ___/4 or ___% are hemophiliac males



RED-GREEN COLOR BLINDNESS (X-LINKED)

◆ **Alleles, Genotypes and Phenotypes for Color blindness**

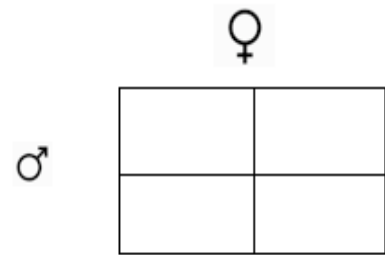
X^N - allele for normal color vision
 X^n - allele for color-blindness

♀ { _____ - genotype of normal, noncarrier female
 _____ - genotype of colorblind female
 _____ - genotype of carrier female (with normal color vision, but who can pass the colorblind allele to her children)

♂ { _____ - genotype of normal male
 _____ - genotype of colorblind male

10. A male with normal vision and a colorblind female have children. Determine their genotypes and make a Punnett square to predict the genotypes of their offspring. Then state the phenotypic ratios and percentages.

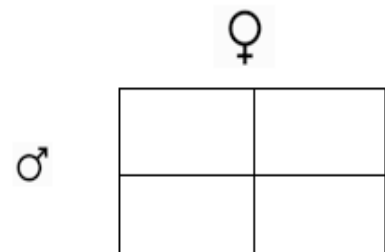
___/4 or ___% are normal females (include noncarrier and carrier)
 ___/4 or ___% are colorblind females
 ___/4 or ___% are normal males
 ___/4 or ___% are colorblind males



11. In number 10, **what percentage of females** born are expected to be carriers?

12. A carrier female marries a normal- visioned male. Determine their genotypes and make a Punnett square to predict the genotypes of their offspring. Then state the phenotypic ratios and percentages.

___/4 or ___% are normal females (include noncarrier and carrier)
 ___/4 or ___% are colorblind females
 ___/4 or ___% are normal males
 ___/4 or ___% are colorblind males



13. In number 12, what **percentage of females** born are expected to be carriers?

 **Explain IV**

- 1) If a human baby boy inherits a recessive allele from his mother, in which circumstance would he *most* likely show the trait coded for by the recessive allele?
 - a) The baby inherits the dominant allele from his father.
 - b) The allele is on an autosomal chromosome and the baby is a twin.
 - c) The allele is on the X chromosome.
 - d) The allele is on the Y chromosome.

- 2) A human male inherits
 - a. an X-chromosome from his mother and an X-chromosome from his father
 - b. a Y-chromosome from his mother and a Y-chromosome from his father
 - c. an X-chromosome from his mother and a Y-chromosome from his father
 - d. a Y-chromosome from his mother and an X-chromosome from his father

- 3) Most recessive sex-linked disorders are passed from mother to ____
 - a) all children
 - b) son
 - c) daughter
 - d) either son or daughter

- 4) The normal sex chromosomes of human males are ____, and the normal sex chromosomes of females are ____.
 - a) XX, XY
 - b) XY, XX
 - c) X, Y
 - d) Y, X

- 5) Which gamete determines gender (sex)?
 - a. Egg
 - b. Sperm
 - c. Zygote
 - d. None of the above

- 6) A purple flower is crossed with a white flower. The first generation of flowers produced have areas of white and areas of purple. This demonstrates
 - a. Incomplete dominance
 - b. Codominance
 - c. Polygenic inheritance
 - d. Sex-linked inheritance

- 7) A dark brown horse and a white horse mate and produce tan colored offspring. This is most likely an example of
 - a. Incomplete dominance
 - b. Codominance
 - c. Polygenic inheritance
 - d. Sex-linked inheritance

- 8) *In your own words*, explain the difference between an autosome and a sex chromosome.

- 9) *In your own words*, compare the phenotypes of the heterozygotes in simple Mendelian inheritance (simple dominant-recessive), codominance, and incomplete dominance.

