Lesson 6.4

Dragon genetics, pt. II: Monohybrid crosses

Name

Date

Period

Key Terms			
Monohybrid cross	Dominant trait	Recessive trait	

Engage

BACKGROUND: A long time ago, in a world far, far away, a great race of beings lived on a mountain called Blackreach. The inhabitants were known as Dragons. They are made up of 27 basic genes (unit) that code for their appearance. Each one of these genes is made up 2 alleles (traits). With this in mind, there are infinitely different possible combinations for their appearance! This is called their **phenotype** or their physical appearance. If we look at their genes, there are infinitely different combinations of the alleles! This is called the **genotype** or genetic makeup. Remember that we use letters for the alleles that control the genes and one letter or allele is inherited from each parent. You will be using Dragons, who use the same genetic principles as a pea plant, to see how genes are passed on and inherited following Mendelian rules. You will be using Punnett Squares to do this.

Here are some things to help you. You must understand these concepts and terms! Traits from the lesson 6.12 will be used as examples.

Phenotype: The physical appearance or what the gene makes an organism look like. Examples would be Chin spike or no chin spike, long neck or short neck

1. Dominant: The trait that is expressed when present. Example: Chin spike is dominant to no chin spike.
2. Recessive: The trait that is hidden or masked in the presence of the dominant trait. It is expressed when no dominant alleles are present. In this example: no chin spike

Genotype: The genetic makeup of an organism. We use letters for the genotype. Remember that you need to look at the genotype to see what the phenotype will be.

Example: There is a gene or unit for no chin spike in a dragon. The alleles or traits (individual genes) for no chin spike and chin spike. There are 2 alleles for each gene and we use letters for each allele. The capital letters are the dominant alleles and the lower case letters are the recessive alleles.

Gene	Allele
No chin spike	1. Chin spike = A
	2. No chin spike = a

1. **Heterozygous:** The term used for different alleles. There is always one dominant and one recessive allele. Example: Aa. There is only one possibility for this!
2. **Homozygous:** The term used for having the same alleles. This will be either 2 dominant alleles or 2 recessive alleles. Example: AA or aa. There are 2 possibilities for this!

Please refer back to this to help you as you work through this assignment. You will use the accompanying dragon genome sheet to complete the problems that follow. Everything you need is in the table! You will be studying one family. Be sure to read each problem carefully, because in each case the information is built upon the previous problem.

1. **For each genotype below, indicate whether it is heterozygous (He) or homozygous (Ho)**

   AA: _____ Bb: _____ Cc: _____ DD: _____ Ee: _____ ff: _____

2. **For the following genotypes, determine what phenotypes would be possible.**

   a. Long Neck is dominant to short neck – FF: _____ Ff: _____ ff: _____

   b. Long Tail is dominant to short tail - II: _____ Ii: _____ ii: _____

3. **For each phenotype below, list the genotypes (remember to use the letters from 6.12)**

a. Red eyes are dominant to yellow: _____ red (Ho) _____ red (He) _____ yellow (Ho)

b. Long arms are dominant to short: _____ long (Ho) _____long (He) _____ short (Ho)

Explore I: Monohybrid Cross Problem Set

Genetics is the study of heredity and variation in organisms. We begin with a study of the *monohybrid cross*, investigated by Mendel. In a monohybrid cross, organisms differing in only one trait are crossed. Our objective is to understand the principles that govern inheritance in plants and animals, including dragons by solving problems related to the monohybrid cross.

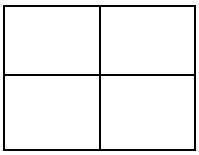
In dragons, chin spikes (A) are dominant to no chin spikes (a) Typically a capital letter is used to indicate the *dominant* allele and lower case for the *recessive*. Often the choice of letter is determined by the dominant trait. In a genetic cross of two dragons that are heterozygous for the chin spike, we will now determine what fraction of offspring will have chin spikes.

The figure above represents a monohybrid cross of F1-hybrid plants. Both parent plants are heterozygous (Aa) for an allele that determines chin spikes. Presence of the dominant allele (A) in homozygous (AA) or heterozygous (Aa) dragons results in chin spikes. Homozygous recessive (aa) dragons have no chin spikes.

To solve problem 1, you'll need to set up a Punnett square. This tutorial will walk you through that process.

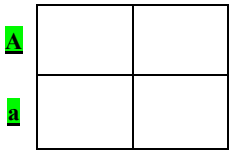
DIRECTIONS for setting up a Punnett square:

A. Set up a 2 by 2 Punnett square.



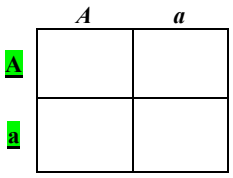
B. Write the alleles for parent 1 on the left side of the Punnett square.

Each gamete will have one of the two alleles of the parent. In this particular cross, ½ of the gametes will have the dominant (A) allele, and ½ will have the recessive (a) allele. We will use highlighted underlined (vertical letters) and ***italics*** (horizontal letters) to keep track of the alleles of each parent.



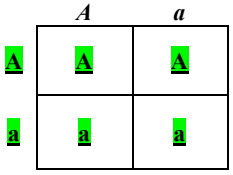
C. Write the alleles from parent 2 above the Punnett square.

For this heterozygous parent (Aa), half of the gametes will have the dominant (A) allele, and half will have the recessive (a) allele.



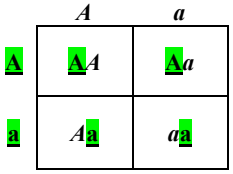
D. Fill the squares for parent 1.

Fill each square with the allele from Parent 1 that lines up with the row.



E. Fill the squares for parent 2.

Fill each square with the allele from Parent 2 that lines up with the column.



Interpreting the results of a Punnett square:

We now have the information for predicting the outcome of the cross. The genotypes in the four boxes of the Punnett square are each equally likely to occur among the offspring of this cross. We may now tabulate the results.

Genotypes and predicted ratios/percentages that resulted from this monohybrid cross (Aa x Aa)

	A	a
A	**AA**	Aa
a	Aa	aa

¼ or 25% homozygous dominant

	A	a
A	AA	**Aa**
a	**Aa**	aa

$^{2}/_{4}$ or 50% heterozygous

	A	a
A	AA	Aa
a	Aa	**aa**

¼ or 25% homozygous recessive

Phenotypes and predicted ratios/percentages that resulted from this monohybrid cross (Aa x Aa)

- ¾ or 75% have chin spikes (AA and Aa)
- ¼ or 25% have no chin spikes (aa)

Explain I

Practice with Crosses. Show all work! Look at lesson 6.12 dragon alleles. *For this lesson*, put the DRAGONETTE (female) gametes' alleles across the top of each Punnett Square and the DRAGON (male) gametes' alleles on the left side of each Punnett Square.

4. Cross a heterozygous long neck dragon with a short neck dragonette.

A. Write down the cross (what are the genotypes of the two parents?)

__ __ X __ __

B. Fill in the Punnett Square

♂ \ ♀		

C. Predict how many dragons have long necks? *(Express as a fraction = x/4 AND as a percentage in parentheses)*

D. Predict how many dragons have short necks? *(Express as a fraction = x/4 AND as a percentage in parentheses)*

5. Cross a homozygous four-clawed dragon with a heterozygous four clawed dragonette.

A. Write down the cross (what are the genotypes of the two parents?)

__ __ X __ __

B. Create and complete a Punnett Square

C. Is there more than one phenotype in the offspring? Explain.

6. Cross a heterozygous long armed dragon with a heterozygous long armed dragonette.

A. Write down the cross (what are the genotypes of the two parents?)

B. Create and complete a Punnett Square

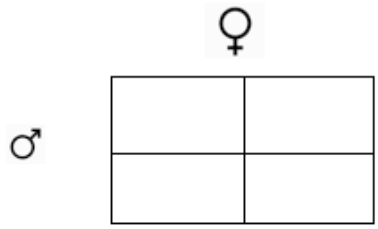
C. List how many of each genotype *(Remember to express as a fraction = x/4 AND as a percentage)*

D. List how many of each phenotype *(Remember to express as a fraction = x/4 AND as a percentage)*

7. Cross an elbow spiked dragon with a heterozygous no elbow spike dragonette.

A. Write down the cross (what are the genotypes of the two parents?)

B. Fill in the Punnett Square



C. List how many of each genotype *(Remember to express as a fraction = x/4 AND as a percentage in parentheses)*

D. List how many of each phenotype *(Remember to express as a fraction = x/4 AND as a percentage in parentheses)*

8. Fango, a male who is homozygous for long neck meets Dragona, who has a short neck.

A. Write down the cross (what are the genotypes of the two parents?)

B. Create and complete a Punnett Square

C. List how many of each genotype *(Remember to express as a fraction = x/4 AND as a percentage in parentheses)*

D. List how many of each phenotype *(Remember to express as a fraction = x/4 AND as a percentage in parentheses)*

9. Fango and Dragona have four offspring including two boys, Flamo and Mazik, and two girls, Elizardbeth and Mistelle. Many years later, Flamo meets and marries Wiza who is short necked. (Use Punnett square to show work)

A. What are the phenotypic possibilities for the neck height of their offspring?

Hint: Look at #8 for neck information on Flamo

10. Elizardbeth, one daughter, meets a dragon named Davik who is heterozygous for long neck. (Use Punnett square to show work)

Hint: Look at #8 for neck information on Elizardbeth

A. How many will be long?

B. How many will be short?

C. How many will be FF?

D. How many will be Ff?

E. How many will be ff?

11. Flamo mated with Wiza who has no chest plate. All their offspring have chest plates. (Use Punnett square to show work)

A. **What phenotype and genotype is Flamo *most likely*?**

12. Mazik and Tagla each have a large comb on their head. (Use Punnett square to show work)

A. Predict what would their offspring look like.