

Name: \_\_\_\_\_

Class: \_\_\_\_\_

## STEM Project

## Chapter 1 – Genetics

Pages 1–38

### Dragon breeding

Before geneticists figured out how to tamper with DNA directly in the lab, the only way to have an effect on the traits of organisms was by selective breeding. In this activity, you are going to explore the slow and inexact science of selective breeding by creating a litter of baby dragons.



#### Dragon DNA facts

You will need to know the following about dragons to complete this project:

- Dragons are made from the same DNA structures as real-world species.
- Dragons have six chromosomes: two pairs of autosomes and one pair of sex chromosomes (X and Y).
- Dragons have a gene for **fire breathing**.  
The dominant allele is F (breathes fire) and the recessive allele is f (does not breathe fire).
- Dragons have a gene for **wing size**.  
The dominant allele is W (large wings) and the recessive allele is w (small wings).
- Dragons have a gene for **tameness**.  
The dominant allele is T (fierce – not tame) and the recessive allele is t (tame).
- The gene for tameness in dragons is sex-linked and is located on the X-chromosome.

#### Dragon DNA materials

The following materials will represent the building blocks of your dragon's DNA:

- Four black pipe cleaners

Separate four black pipe cleaners into two pairs and make one pair look different to the other by folding over the ends. These pairs will represent two pairs of autosomes. The fire-breathing gene will be located on one pair and the wing-size gene will be located on the other pair.

- Two pink pipe cleaners OR one blue and one pink pipe cleaner

The pink and blue pipe cleaners will represent the sex chromosomes. Two pink pipe cleaners represent a female and a combination of pink and blue represents a male. Make sure there is a balance of male and female dragons in the class. The sex-linked tameness gene will be located on the pink pipe cleaner only.

- Coloured beads

Beads will represent dragon genes once placed on the pipe cleaners. The different bead colours represent the different alleles as shown in the table on the following page.



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Bead colour	Dominant/Recessive	Trait	Allele symbol
red	dominant	fire breathing	F
white	recessive	not fire breathing	f
blue	dominant	large wings	W
green	recessive	small wings	w
purple	dominant	fierce	T
yellow	recessive	tame	t

## Create your dragon

You are now ready to create your dragon.

- 1 Randomly select two beads from a jar containing **red and white** beads and place one on each of the black pipe cleaners with the ends folded over. These are your dragon's fire-breathing genes.
- 2 Randomly select two beads from a jar containing **blue and green** beads and place one on each of the remaining black pipe cleaners. These are your dragon's wing-size genes.
- 3 If your dragon is a male, select one bead from a jar containing **purple and yellow** beads and place it on your pink pipe cleaner. This is your dragon's sex-linked tameness gene.
- 4 If your dragon is a female, select two beads from a jar containing **purple and yellow** beads and place one on each of your pink pipe cleaners. These are your dragon's sex-linked tameness genes.

Based on bead colour, write down the genotypes and phenotypes of your dragon for the three traits considered. For example, if you have two white beads your fire-breathing genotype will be 'ff' and your phenotype will be 'not fire breathing'

Trait	Bead Colour 1	Bead colour 2	Genotype	Phenotype
fire breathing				
wing size				
tameness				

Note that if your dragon is male, your genotype for tameness will have only one allele. Why?

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## Find a mate and predict your offspring

Find another student in your class who has created a dragon of the opposite sex to yours. Your dragons will make a breeding pair and give birth to a litter of baby dragons.

Fill in the Punnett squares below using the genotypes of your breeding pair to find the predicted percentage of babies with each trait. The Punnett square for the sex of the baby dragon has been done for you.

### Punnett squares for dragon offspring traits

Sex (X or Y)

		Father	
		X	Y
Mother	X	XX	XY
	X	XX	XY

Expected % male: 50%

Expected % female: 50%

Male offspring: tameness (T or t)

		Father	
Mother			

Expected % males fierce: \_\_\_\_

Expected % males tame: \_\_\_\_

Fire breathing (F or f)

		Father	
Mother			

Expected % fire breathing: \_\_\_\_

Expected % not fire breathing: \_\_\_\_

Female offspring: tameness (T or t)

		Father	
Mother			

Expected % females fierce: \_\_\_\_

Expected % females tame: \_\_\_\_

Wing size (W or w)

		Father	
Mother			

Expected % large wings: \_\_\_\_

Expected % small wings: \_\_\_\_



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Why has the Punnett square for the tameness trait been separated into male and female?

How does the tameness of the father dragon affect female offspring differently to male offspring?

## Data and results

### Breeding time!

Now you will breed some baby dragons and see whether they have the traits you predicted.

- 1 Hold your dragon's chromosome pairs behind your back with one in each hand. Ask your partner to choose a hand. The chosen chromosome and allele are for your first dragon baby.
- 2 Repeat this process for all three of your chromosome pairs.
- 3 Now do the same thing for your partner, randomly choosing a chromosome from each of their chromosome pairs.
- 4 Gather together all of the chosen chromosomes. There should be three new pairs, each containing one chromosome from each parent. This collection of chromosomes is for your first baby dragon!

Note down the genetic traits of your dragon offspring.

sex:	
fire-breathing genotype:	
fire-breathing phenotype:	
wing-size genotype:	
wing-size phenotype:	
tameness genotype:	
tameness phenotype:	

- 5 Repeat this process to create at least six baby dragons. For each new dragon, complete the table below, noting down the sex and traits of each.

Baby	Sex	Fire breathing	Wing size	Tameness
1				
2				
3				
4				
5				
6				



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## Discussion and reflection

### Dragon analysis

Now analyse the traits that have been inherited by your litter of dragons and compare it to what you'd expect, based on genetics.

Start by calculating the percentage of baby dragons that show each trait. For example, if three of your six babies were tame (tt genotype), the percentage of tame babies would be  $\frac{3}{6} = 50\%$ .

male:	%
female:	%
fire breathing:	%
not fire breathing:	%
large winged:	%
small winged:	%
fierce boys:	%
tame boys:	%
fierce females:	%
tame females:	%

Compare the trait percentages above from your litter with the percentages that the Punnett squares predicted. Are they the same? If not, why?

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If your dragons produced a litter of 1000 dragons, how do you think the trait percentages would compare to the predictions from the Punnett squares? Why?

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How can Punnett squares and our ability to predict the chances of genetic traits occurring be useful?

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**Note:** This activity could also be carried out using wooden skewers of different lengths instead of different-coloured pipe cleaners and different-coloured lollies instead of beads.