# **G**eni**G**ames

# Worksheet Packet

## **Determining Differences**

Different variations of traits exist. Some of them are more common than others. Working in groups tally the number of students that have each trait. Then determine which traits are common and which are not.

Trait	My Group	Total in the Class
Hitchhiker's Thumb		
Normal Thumb		
Can Roll Tongue		
Can't Roll Tongue		
Attached Ear Lobe		
Not Attached Ear Lobe		
Widow's Peak		
No Widow's Peak		
Brown Eyes		
Grey Eyes		
Green/Hazel Eyes		
Blue Eyes		
Curly Hair		
Straight Hair		
Dimples		
No Dimples		

- 1. What traits were the most common in the class? What does this mean?
- 2. Were there any traits that no one in the class had? What does this mean?

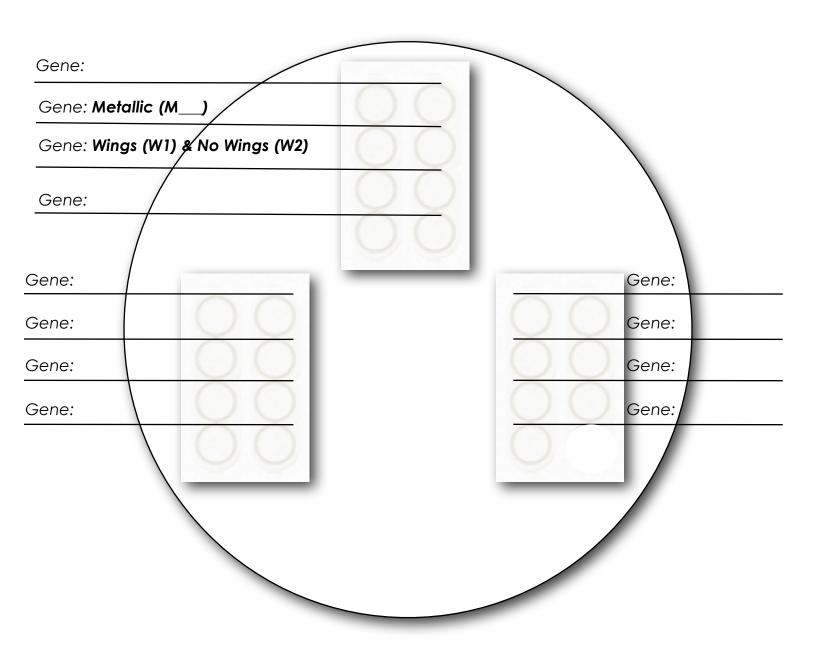


## T.A.C. Chart

What do you know about breeding? What breeding approaches could you take to breed for or against specific traits?

What I Think I Know	Approaches to Finding Out	Conclusions

**Chromosome Track Sheet:** Use this cell to keep track of the location of the different genes.



Trait: Wings and No Wings
<b>To Consider:</b> What do you have? What do you know? What do you need?
W1 = Wings
W2 =
Important things to remember:
The inheritance pattern is:

### Meiosis: Understanding the Drake's Genome

Only sperm and egg cells are produced by a type of cell division called meiosis. Watch the animation of a cell going through a meiotic division.

1. Watch the animation, pausing it at major changes. Sketch the key steps below.	
2. Looking at one parent cell, how many chromosomes does it have before it goes through meiosis?	
3. How many cells are there at the end of meiosis?	
4. How many chromosomes are in each of these cells?	
5. Why is this important?	
6. How can you tell if the parent cell comes from a male or a female?	

### **PUNNETT SQUARE WORKSHOP**

A Punnett square is a tool that helps you calculate the mathematical probability of inheriting a specific trait. With a Punnett square you can see all of the potential combinations of genotypes of offspring, and therefore phenotypes, than can occur when you know the genotypes of the parents.

Example: What is the probability of an offspring having a Gg genotype if one parent's genotype was GG and the other was gg?

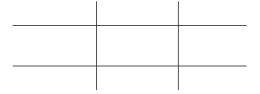
		Parent 1 gg	
		g	g
Parent 2 GG	G	Gg	Gg
	G	Gg	Gg

Answer: There is a 100% probability that the offspring will have a genotype Gg.

1. A couple wants to have a child. One parent is heterozygous for a trait (Tt) while the other parent is homozygous (tt). What is the probability that their child will have at least one "t" allele in their genotype?



2. Two parents, who are both heterozygous for a particular trait (Tt), want to have children. What are the possible genotypes of the offspring? What is the probability of getting each genotype?



3.	In dogs, deafness (d) is recessive to being able to hear (D). A breeder wants
	to know the odds of having a deaf puppy if the mother's genotype is
	heterozygous and the father's is homozygous recessive.



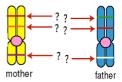
4. If the male dog was homozygous dominant, how does this change the probability of having a deaf puppy?



5. In Labrador Retrievers, one gene controls black and brown pigment; black (B) is dominant to brown (b). If you cross two black Labs (both Bb), what phenotypic ratio would you expect in the puppies? Why is the genotype ratio?



Trait: Metallic vs NonMetallic	
<b>To Consider:</b> What do you have? What do you know? What do you need?	
M1 =	
Important things to remember:	
The inheritance pattern is:	



### **TEST CROSSES**

In dogs, shorthaired alleles are dominant to longhaired alleles. Determine the genotype of a shorthaired dog if...

1) You want to determine the genotype for a shorthaired male dog. You decide to breed it with a longhaired female dog. All of the offspring are shorthaired. What is the genotype of shorthaired male? Explain your answer.

2) If when you breed the shorthaired male dog with a longhaired female you received offspring that were both longhaired and shorthaired, what is the genotype of the shorthaired male? What would the expected ratio of longhaired to shorthaired offspring be and why? Explain your answer. Use a Punnett square if needed.

3) Why is using a test cross useful in determining the genotype of an individual?

Trait:	
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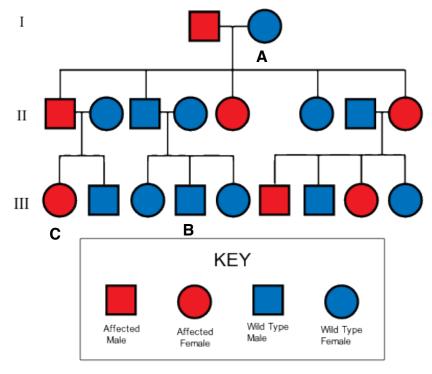
# The Case of the Calico Cat

In cats, one of several genes controlling fur color is located only on the X chromosome — the Y chromosome does not carry this gene at all. The specific gene has two alleles. One form of the gene codes for orange fur  $(X^O)$ , and the other form codes for black fur  $(X^B)$ . A female cat that is heterozygous for this gene  $(X^BX^O)$  has *patchwork* orange and black fur, a condition known as tortoiseshell or calico.

1.	What are the potential genotypes and phenotypes for a female cat?
2.	Can a male cat have a calico phenotype? Why or why not?
3.	Show each of the crosses below and include the phenotypic ratios of the offspring.  a. A black male crossed with an orange female
	b. An orange male crossed with a calico female
4.	If you are a cat breeder, what type of parents should you choose to have the MOST number of calico kittens?

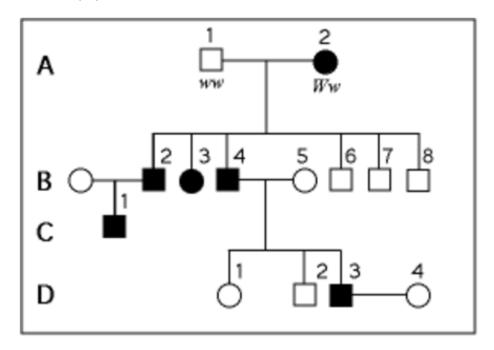
# **Pedigree Charts**

1. In fruit flies, normal wings are the wild-type/dominant allele. Short, miniature wings are the affected/recessive allele.



- i. What is the genotype of individual A? How do you know?
- ii. Do you know the genotype of individual B? Why or why not?
- **iii.** If individual C reproduced with a heterozygous male, what is the probability that their offspring would show the affected/recessive phenotype?

2. In humans, having a widow's peak hairline is dominant (W) to not having a widow's peak (w).



- i. What is the genotype of individual B4? How do you know?
- ii. What is the genotype of individual B8?
- iii. What is the likelihood that individuals D3 and D4 will have offspring with a widow's peak hair?

Trait:	
To Consider: What do you have? What do you know? What do you need?	
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# **Homework: Incomplete Dominance**

1.	A cross between a blue bird and a white bird produces offspring that are all silver. There are only two alleles that control color.
	a. What are the genotypes of the parent birds in the original cross?
	b. What is/are the genotype(s) of the silver offspring?
	c. What would be the phenotypic ratios of offspring produced by two silver birds? (Remember to use a Punnett square if you need to).
2.	In northern Maine there is a flower that comes in three colors: red, blue and purple. This trait is controlled by a single gene and has two different alleles. A homozygous (BB) flower is blue, a homozygous (bb) individual is red and a heterozygous individual (Bb) is purple.
	a. What would be the genotypes and phenotypes of the offspring if a blue flower was crossed with a red one?
	b. If you cross two of the offspring from part a, what are the genotypic and phenotypic ratios of this second generation of offspring?

- 3. A bird watcher visiting an island in the middle of a large lake observes a species of small bird with three distinct types of beaks. Those with short, crushing beaks (BB) consume hard-shelled nuts, those with long and delicate beaks (bb) pick the seeds from pinecones, and those with intermediate beaks (Bb), consume both types of seeds though they are not as great as the other birds.
  - a. Assume that the difference in beak shape is the result of incomplete dominance of a single gene. Which of the mated pairs below will have the best adapted offspring for a year in which most of the food available is in the form of hard-shelled nuts? Why?

Short x Short Intermediate x Intermediate

Short x Intermediate Intermediate x Long

Short x Long Long x Long

b. What would be the phenotypic ratio of offspring resulting from a cross of Bb x bb? Set the ratio up as Long: Intermediate: Short.

c. How many offspring of an Intermediate x Short beak cross will have long beaks? Assume that there are four offspring.

- 4. You decide you like the red flowers and would like to make more. Circle the cross you would perform to produce the most red flowered plants? Explain your answer.
  - 1. Pink x Plnk
  - 2. Red x White
  - 3. Red x Pink
  - 4. Pink x White
  - 5. White x White

Trait:	
To Consider:	What do you have? What do you know? What do you need?
Important thir	ngs to remember:
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### Polyallelic Traits and the Tabby Gene

### The Tabby Gene

The tabby gene in cats causes hairs to alternate with stripes, blotches or spots of solid colored hairs, creating a stripe pattern. This gene has three alleles that follow a polyallelic dominance hierarchy. One striping pattern is known as **mackerel**. This dominant allele (T), most likely a result of an ancestral striping pattern from the African wildcat, produces parallel stripes. The **classic** (t<sup>b</sup>) pattern of stripes is characterized by thick stripes or whirls that create blotched or bulls-eye patterns. This blotched allele is most likely the result of a mutation. The third allele, known as **Abyssinian** (T<sup>a</sup>) results in a cat that has slight striping on its face or tail and a dark stripe down the center of its back only.

The hierarchy of dominance is as follows  $T^a > T > t^b$ .



http://ib.berkeley.edu/courses/ib162/Week3a.htm

- 1. A breeder crossed an Abyssinian cat with a mackerel cat. The resulting kittens had the following phenotypes: classic and Abyssinian.
  - a. What were the genotypes of the parents?
  - b. Are classic and Abyssinian the only possible phenotypes for the offspring? Explain your answer.

Trait:
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Important things to remember:
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### **Meiosis Models Lab**

Problem: How does crossing over affect the genes passed down to daughter cells?

**Hypothesis:** 

### Materials:

• Colored pencils and colored clay/pop beads

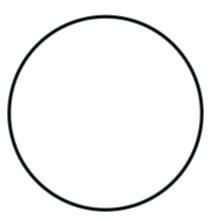
### Meiosis

1. You have an individual whose diploid number is 4 (2n=4). Assign one color to represent chromatids from the mother (ex. Blue) and another color to represent chromatids from the father (ex. Red). Roll out two 6-inch chromatids, each a different color (ex. 1 red and 1 blue). Next roll out two 3-inch chromatids in the same way (ex. one red and one blue). Using your pencil, mark the following genes onto each chromatid.

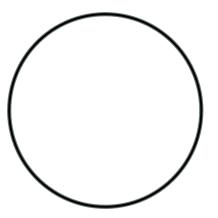
6-inch chromatid from mother	6-inch chromatid from father	3-inch chromatid from mother	3-inch chromatid from father
A B C	a b c	D E	d e

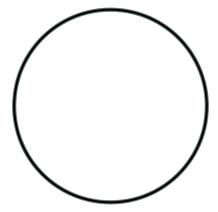
2. Group these four chromatids together in a cell. This is Interphase I.

- 3. Move the chromatids into Prophase I by replicating the chromatids (using more clay). Attach the pairs with twist ties. Make sure to mark the replicated chromatids with the appropriate genes. You now have chromosome pairs with sister chromatids.
- 4. Next move the chromosomes into Metaphase I, lining up the homologous chromosomes. Remember, homologous chromosomes are the same length and have the same genes, although not always the same alleles. Using your colored pencils, recorded what your cell looks like below.



5. Move your chromosomes through Anaphase I into Telophase I. What do your two cells look like now? Record below.



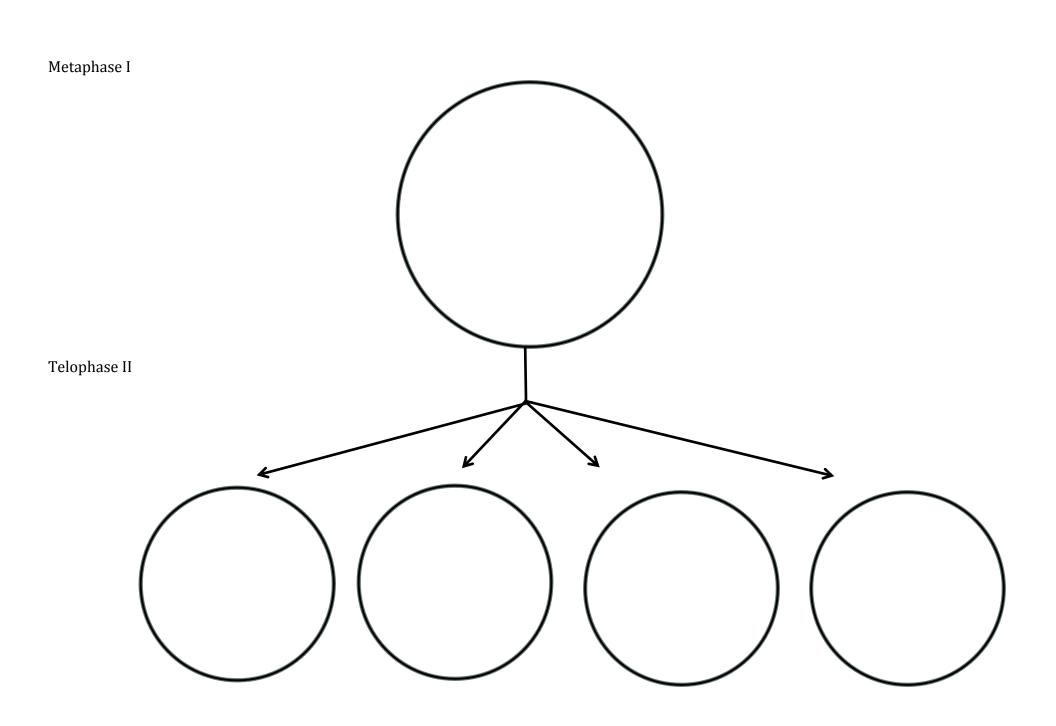


6.	Move the chromosomes in each of the daughter cells through the different stages of Meiosis II. The four resulting cells
	are called

What are the genotypes of the four gametes?

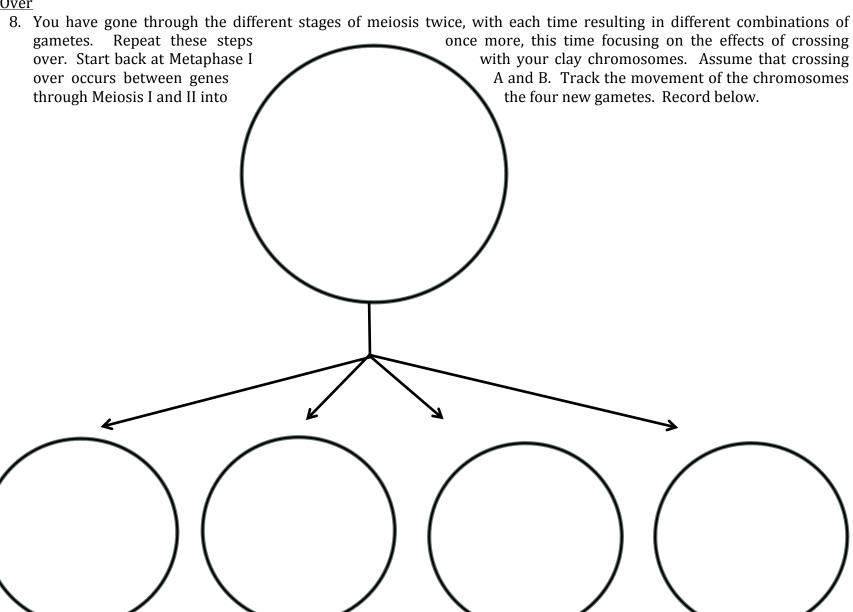
### **Independent Assortment**

7. Look at the four cells in step 6, as well as the one cell in step 4. Is there a way to rearrange the chromosomes in step 4 to produce different gamete cells? Use your clay models and record below.



What are the genotypes of the above gametes?

### **Crossing Over**



9.	List the different gamete combinations you got from the three different takes at meiosis.
10.	. Are there any combinations of alleles that you can get more than once? Why or why not?
Conclu	<u>isions</u>
1.	What is the difference between a haploid cell and a diploid cell?
2.	What does independent assortment mean? How does it affect variation?
3.	Define crossing over.
4.	Are there any advantages to crossing over? If so, what?
5.	Is crossing over random, or does it happen more often at specific points?

6.	Explain why you have two of each type of chromosome.
7.	Explain the reasons why different gametes produced by the same person can have different allelic combinations.
8.	Describe one similarity and one difference between meiosis I and meiosis II.
9.	If a diploid cell that contains 34 chromosomes undergoes meiosis, how many chromosomes will each daughter cell have?
10.	Explain why meiosis is necessary for sexual reproduction.