Name_____

Genetics and Heredity

Unit Question:

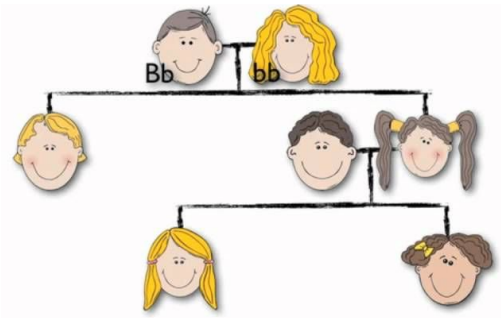
What factors influence an organism's traits?

Twins that Look Nothing Alike

Learning Target: *I can explain how people get their unique traits.*

Do Now - Traits Video

TRAIT	YES	NO
Detached earlobes		
Tongue rolling		
Dimples		
Right-handed		
Freckles		
Naturally curly hair		
Cleft chin		
Allergies		
Cross left thumb over right		
See the colors red and green		
Have a straight hairline		

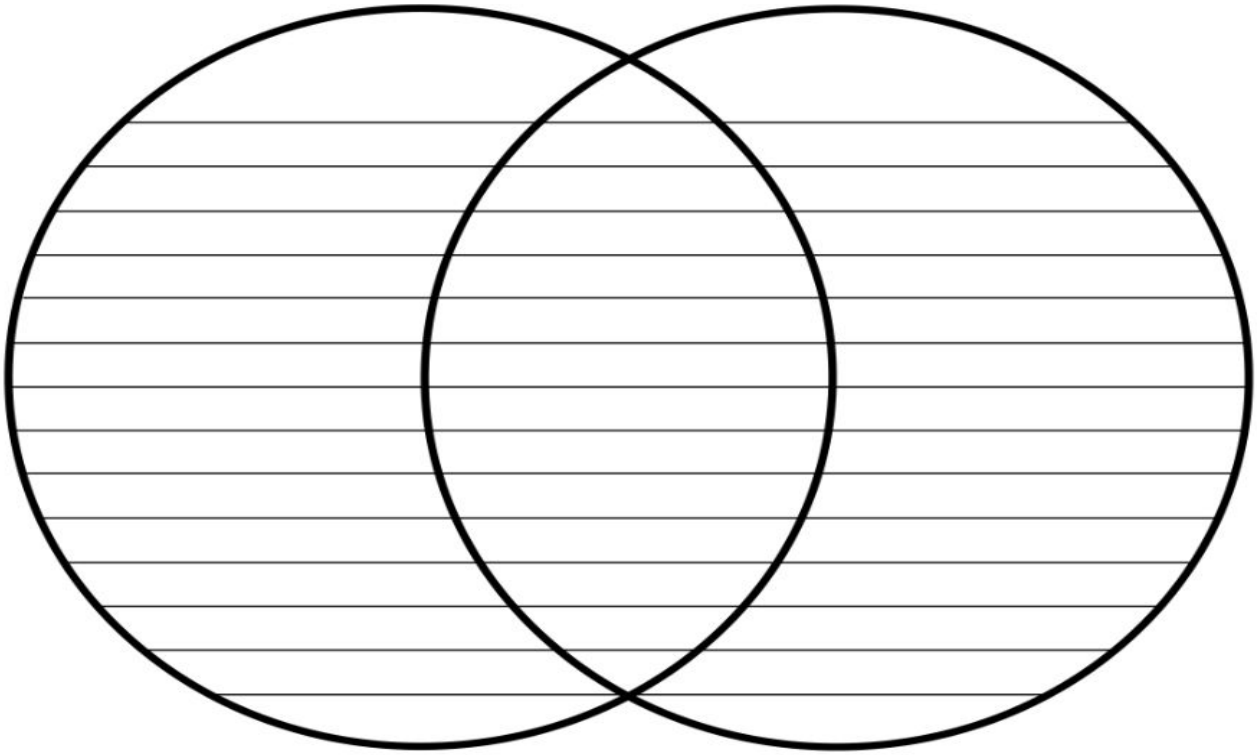


1. Why doesn't everyone have the same traits?

2. What are some other traits that people may have that are not included on this list?

Phenomena Video - Compare and Contrast Traits of Lucy and Maria

Let's take a moment to observe the image found on the front page of this packet. The seemingly unrelated young ladies in the picture are not just related, they are twins! How can this be?



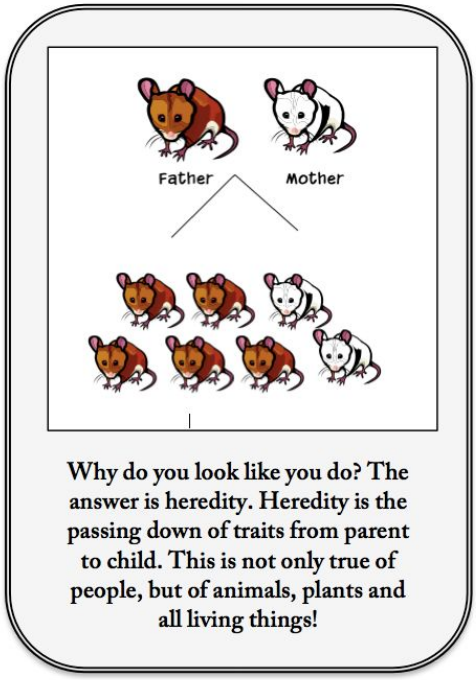
Nature versus Nurture

Today we're going to briefly go over an age-old philosophical question, nature versus nurture (or, in other words, genetics traits versus environmental traits). Are people born a certain way or are they *'shaped'* to become a certain way, based on the environment around them? Is it their nature (inherited traits)? Or their nurture (environmental traits)?

Claim: Lucy and Maria are twin sisters who physically look very different from each other. This is mainly caused by their **genetics** / **environment**.

The person you are -- from what you look like to how you behave -- is a combination of genetic and environmental influences. You might get your freckles from your mom, through genetics, but you might also get your sense of humor from her, a learned environmental trait. Or you might get your blonde hair from your dad, but you might be a great singer, while he is not. You possess a combination of inherited and environmental traits, which helps to explain your similarities and differences from your family.

Our genetic traits come from our parents, and grandparents, and so on. We inherit them, which is why genetic traits are also referred to as inherited traits. This term comes from the word heredity, the passing on of physical or mental characteristics genetically from parents to offspring. Offspring, or children, look similar to their parents because of the traits they inherit.



Genetic traits are usually physical characteristics that you inherit from your parents or relatives through genetics. For example, you might inherit your mother's eye shape or color, or you might inherit your grandmother's smile. Height, hair color, eye color, facial features, and more can all be inherited traits. You have no influence on what traits you inherit. Other genetic traits include certain diseases, teeth, vision, blood type, hair color, things like that are clearly passed down from our parents.

Now there are certain traits that are caused by the environment and that have nothing to do with genetics. Things like where we grow up and who we grow up around influence us. The language we speak is shaped entirely by what we hear as a child. You speak English, but had you been born in a different country, let's say Japan, you would speak Japanese. Language is just one example of traits that are not passed down, but rather learned through our environment. Environmental traits are acquired through observation, through experimentation, and effort. For example, you may be tall but unless you practice basketball, you may not be very good at it . You may pick up your sense of humor by being around your parents and hearing what they think is funny. Other environmental traits include how a person behaves socially, their manners, and how they communicate. These are all learned characteristics.

Genetics and the environment both play a large role in determining our characteristics. However, it is important to note that many of our physical traits are given to us by our biological parents, whereas our behavior is largely due to our environment.

Key Concept 1

All _____ things transfer their _____ traits to their _____.

Key Concept 2

Genetic traits are _____ or features that you inherit from your _____.

Exit Ticket

Claim	Lucy and Maria are twin sisters who physically look very different from each other. This is mainly caused by their **genetics** / **environment**.
Evidence	_____ _____ _____ _____ _____ _____
Reasoning	_____ _____ _____ _____ _____ _____

Introduction to Genes

Learning Target: *I can describe what determines a person's traits.*

Do Now:

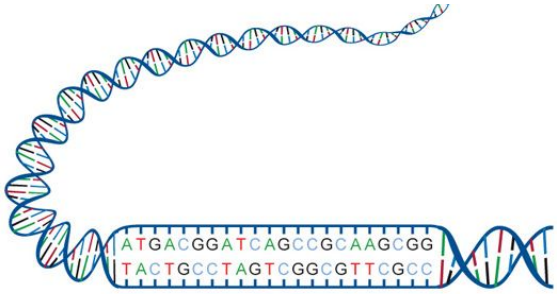
Part 1: Determine whether each trait is genetic or environmental.

Scenarios	Genetic Traits	Environmental Traits
Ian is bilingual, he speaks both English and Spanish.		
Samantha has a dimple on her left cheek.		
Rachel can roll her tongue.		
Joey has many calluses on his feet from running.		

Part 2: Two identical twins were separated at birth. Identical twins are genetically the same and share all the same genetic traits. One of the twins was raised in Montana and the other in Britain. How might the twins be the same? How might they be different?

What are genes?

Did you know that we all have the same genes? If that's true, then why don't we all look alike? A gene is a set of instructions for a specific trait. Genes are like a recipe for the specific trait that you have. We all have a gene for hair color, but the instructions look different if you have brown, red, black or blonde hair. There are about 20,000 genes in our body. They give the instructions for things like eye color, height, blood type and so much more.



Genes act as a "recipe" for traits in not just humans but all organisms (living things). Genes are small segments of information found in your DNA. Each gene segment is made of even smaller units. It's kind of like how words are made of letters of the alphabet. If you change the order of the letters, you make a different word.

Genes hold the instructions for different traits

There are roughly 20,000 genes in your body. Each gene gives the instructions for a different variation of each trait. List as many variations of each gene listed below:

Gene	Human Eye Shape	Bird Feather Colors	Plant Leaf Shape	Dog Hair Textures
Types of Gene Variations				

Key Concept 3

A _____ is a set of instructions for a specific trait in all _____ _____.

A Recipe for Traits Activity

You will each be creating a unique dog by randomly selecting segments of DNA. Each segment of DNA represents a gene. Each gene will give you the recipe or code for a specific dog trait.

As a group, you will take turns selecting genes from the "Dog Gene Envelopes" provided by your teacher. Begin with the trait "dog shape" and work your way through the traits until you reach dog "hair."

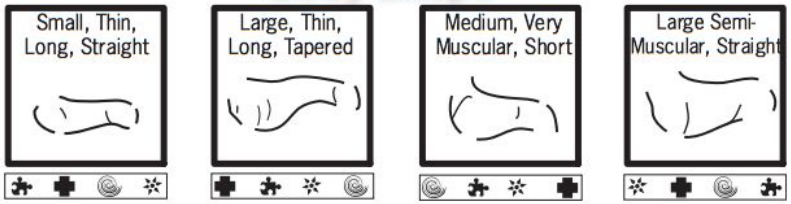
1. *Person 1 selects a gene from the "Dog Gene Envelope"*
2. *Person 1 will match the gene to the body shape and circle that trait variation.*
3. *Person 1 keeps the gene segment and passes the envelope to the next person in the group.*
4. *Repeat for every person and for every trait.*
5. *Return all the genes back the the envelope at the end.*

Dog Traits Key

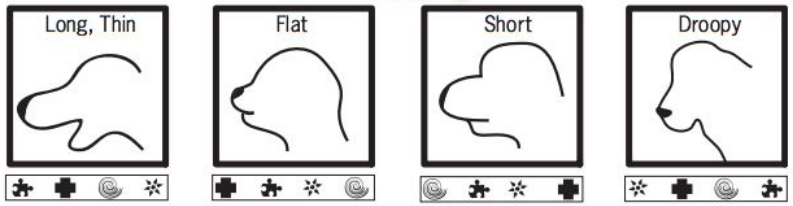
http://teach.genetics.utah.edu

Learning Center

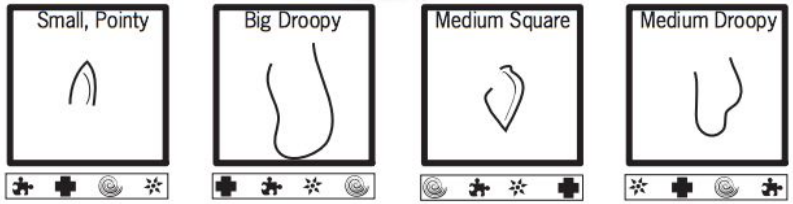
Body Shape



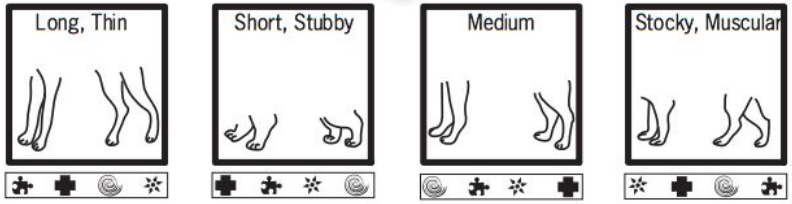
Head Shape



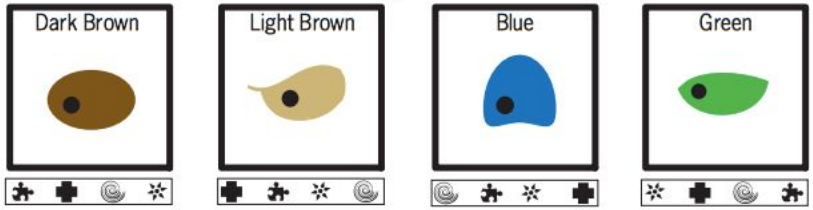
Ears



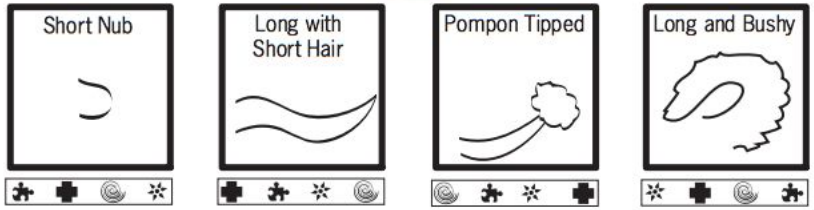
Legs



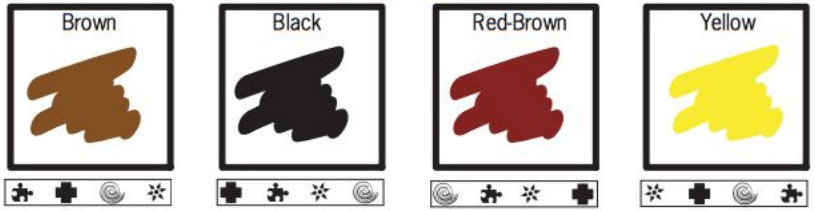
Eyes



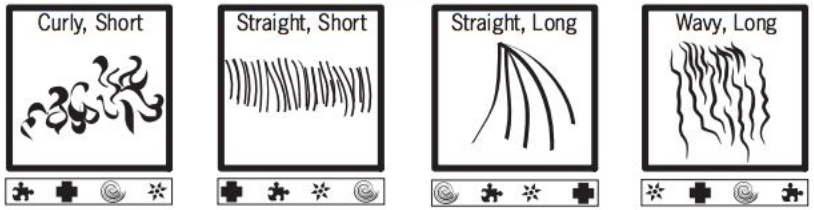
Tail



Coat Color



Hair



Homework

A Recipe for Traits

This is _____ the dog. His unique traits are caused by

(Name your dog)

_____. Each gene act as a set of _____ for a

specific trait. All_____, or living things, have genes.

Genes *Parents* *Traits* *Organisms* *Chromosomes* *Offspring* *Instructions*

Draw a picture of your dog below:

Introduction to DNA and Chromosomes

Learning Target: *I can explain what DNA chromosomes are and where they are located.*

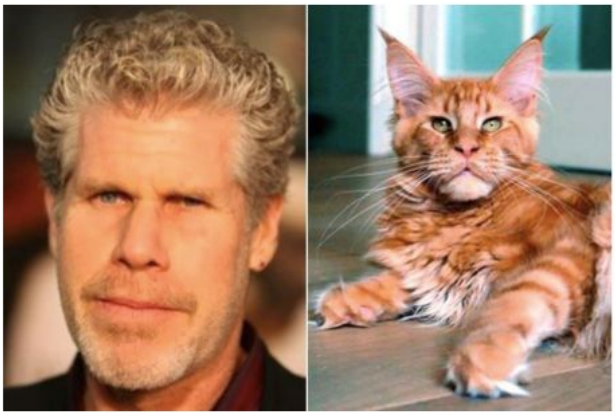
Do Now:

Can you figure out the coded messages below?			
🔥🥔		😢🐺	
⏰➕👃☕		🐶🗣️⬆️❌🌳	
Why are codes used in the real world?			

Are you Fur-Real?

Dear Abby is an American advice column founded in 1956 by Pauline Phillips under the pen name "Abigail Van Buren." Dear Abby is known for providing common sense solutions to everyday problems...read the letter below submitted to Dear Abby by a worried cat-lover in the year two-thousand never.

Dear Abby: My cat Cinnamon and I are best friends. We like watching YouTube videos of other cats together. We have a mutual understanding that if I scratch her back she'll scratch my face off and, you've probably heard how pets can sometime start looking like their owners. Well, I look Cinnamon! We have the exact same reddish brown hair. It's even the same length.



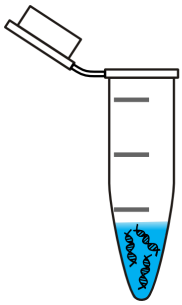
Here's the problem Abby, there has been a murder! Cinnamon often visits the old man across the street. Her cat hair is all over his home. The police came to see me this morning. They want a hair sample from me for DNA analysis.

My question is, am I about to be framed by my cat?

Sincerely,
Ridi-claw-lously Worried

Cat and You: DNA Doubles?

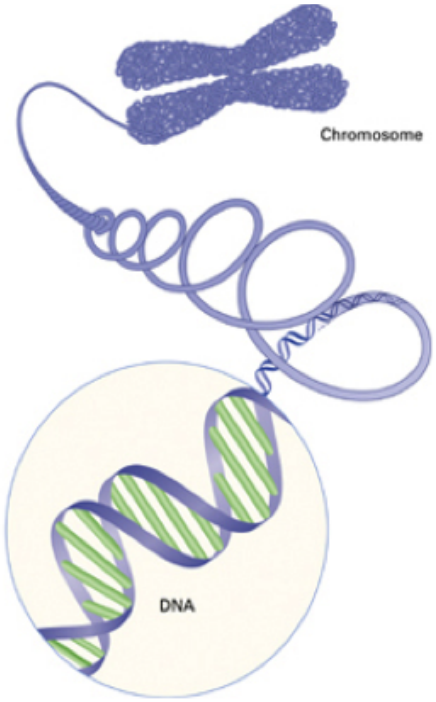
Does Ridi-claw-lously Worried actually have something to be worried about? Is the DNA in cat hair the same as the DNA in human hair?



The stringy stuff in the test tube is DNA. But you can't tell which organisms it comes from just by looking at it. That's because DNA looks exactly the same in every organism on Earth. All living things have DNA. And whether it comes from you, a pea plant, or your pet rat, it's all the same molecule.

What is DNA? DNA is short for *deoxyribonucleic acid*. DNA is an essential molecule for life. You read that right, DNA is just a molecule. A very important molecule. It contains the instructions telling our bodies how to develop and function. DNA acts sort of like a computer program code. Your body "reads" the code written in your DNA so that it can function, grow and survive.

Watch the video "What are DNA and genes?" and complete the information in the model below.

DNA Facts:	
1. **DNA** has a _____ helix shape. Similar to a twisted ladder. 2. _____ are small segments of DNA that act like code for a trait. 3. **If** you unraveled all the DNA molecules in your body and placed them end to end, it would stretch to the _____ and back several times. 4. **DNA** coils itself into tightly packed _____. 5. **Humans** cells contain _____ pairs of chromosomes, so 46 per cell. 6. **Almost** _____ cell in the human body contains DNA: the cells in your skin, the hair on your head, and even your big toe has DNA. 7. **A** cell's set of DNA is called its _____	

Humans vs. Cats Comparison Chart

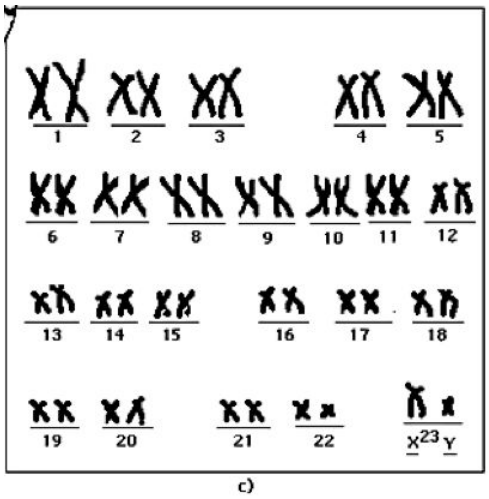
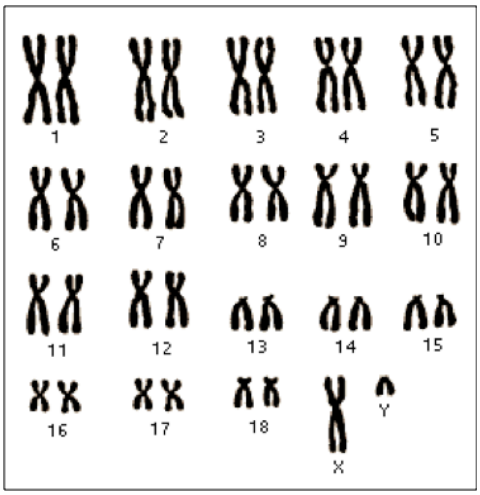
Human	Cat
 Figure 1	 Figure 2

Figure 1 above is an image of the human genome. The human genome is a name for all the DNA found inside a single cell. The picture shows us that humans have 23 pairs of chromosomes (so 46 in total). Humans are 99.9% the same as the person sitting next to us. The 0.1% difference tells us everything from our eye color to whether we're predisposed to certain diseases.

Figure 2 above is an image of a cat's genome. Cats are more like us than you'd think. A 2007 study found that about 90% of the genes in the Abyssinian domestic cat are exactly the same as in humans. Think of it like this: if you wrote the code for human DNA in 100 page book, only 10 of those pages would be different from a cat's DNA book.

According to the reading above, human and cat DNA are extremely similar. Use the information above to describe how human and cat DNA are different.

Key Concept 4:

DNA is a long _____ that contains the code for how living organisms grow, _____ and function.

Key Concept 5:

The DNA molecule _____- up into _____ pairs of X-shaped structures called _____.

Revisiting Ridi-claw-lously Worried and his cat Cinnamon:

Question:

Will DNA analysis confuse Cinnamon the cat's hair with her owner, Ridi-claw-lously Worried?

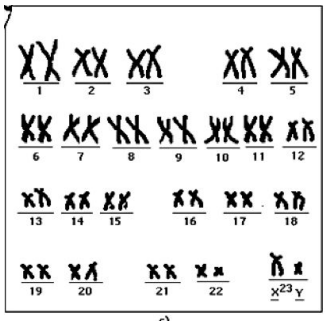
Exit Ticket

Claim	_____ _____ _____
Evidence	_____ _____ _____ _____ _____ _____
Reasoning	_____ _____ _____ _____ _____ _____

Parents and Offspring

Learning Target: *I can explain why offspring do not look exactly like their parents.*

Do Now



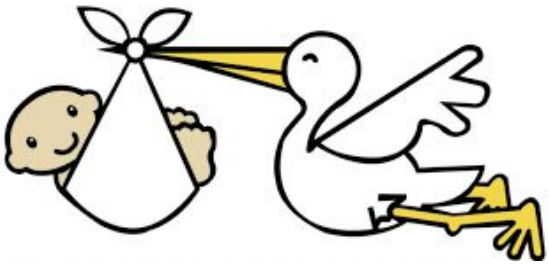
Watch the Gene's, DNA and Chromosomes video clip and answer the following questions.

1. Genes are made of _____.
2. DNA in your cells are packed together to form _____.
3. Humans have _____ pairs of chromosomes.
4. You get _____ from your mom and _____ from your dad.
5. That's a total of _____ individual chromosomes in your body.

Where do Babies come from?

In the Middle Ages, the summer solstice was a big event for Europeans. Weddings were planned for that day, and many communities held large parties with plenty of adult beverages. As a result, nine months after that day, quite a lot of babies would be born. Coincidentally, white storks returned from their migratory travels exactly nine months after the summer solstice as well, and it's believed that storks gained their reputation for bringing babies to mothers because of this scheduling sync-up.

Many adults may still turn to the story of the stork when they want to avoid an awkward conversation of how babies are made, but this is science class. Just like the Bill Nye Video stated, you get 23 chromosomes from you biological mother and 23 chromosomes from your biological father. This process is known as sexual reproduction.



Sexual reproduction is the process where new offspring are produced from their parents, a mother and a father. If you want to learn more about the birds and the bees, ask your parents. We will be focussing on what happens during sexual reproduction at the cellular level. All organisms (living things) reproduce. Sexual reproduction is necessary for the survival of many species such as spiders, elephants, humans and most flowering plants.

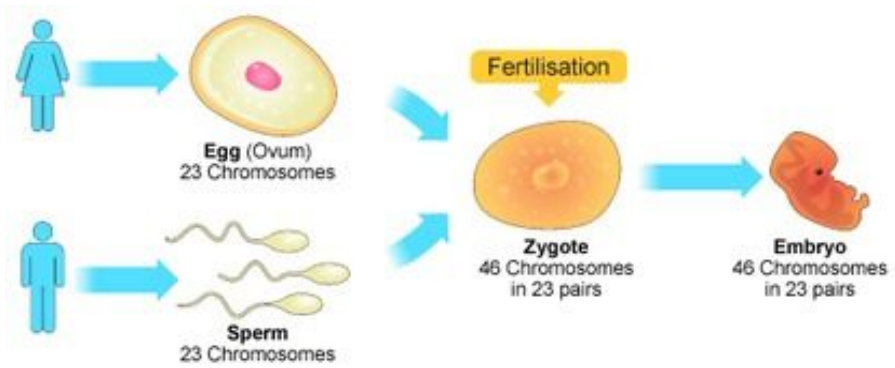
Pollination Video

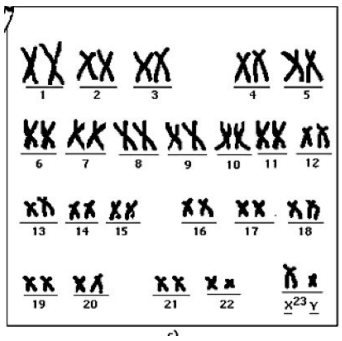
Watermelon Plant	Watermelon Plant Flowers	Role in Sexual Reproduction	Sexual Reproduction leads to formation of a seed.
		**The male flower produces pollen. Pollen is a reproductive cell for flowering plants like watermelon plants. Pollen only contains only half the DNA of a regular flower cell.**	 The pollen and gamete come together to form a cell with a complete set of DNA. Half from the female flower and half from the male. That cell will grow and become a watermelon plant seed.
		**The female flower produces a reproductive cell called a gamete. It waits to receive pollen from the help of a bee, bird, bug or even human.**	

Human Sexual Reproduction

Sexual reproduction requires two parents. Each parent contributes a sex cell that has half of the normal DNA of a regular body cell. In males, the reproductive cell is called sperm and in females, the reproductive cell is called eggs. When these reproductive cells combine during fertilization, the result is a zygote, which then continues to develop into an embryo and eventually a baby. Offspring share traits of both the mother and the father because their cells contain half the mother's DNA and half the father's DNA.

Sexual reproduction increases genetic variation in offspring (in other words, children look different than their parents). You can see the effects of this genetic variability if you look at the children in a large family and note how each person is unique (this is why offspring of children with the same parents all look different from each other). **In species that **do not** reproduce through sexual reproduction, the offspring look identical to the parent.*





- *Zygote contains 23 pairs of chromosomes (so 46 total)*
- *Half come from mom*
- *Half come from dad*

All humans started as a zygote. A zygote is a single cell with all the DNA (and instructions) to turn into a human baby. Zygotes contains 23 pairs of chromosomes. Each chromosome pair is composed of a chromosome from mom and a chromosome from dad.

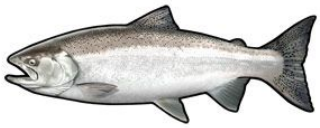
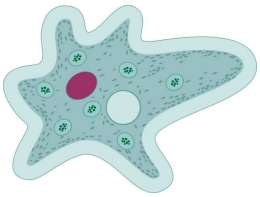
Key Concept 6:

The process of _____ reproduction leads to offspring that have _____ the DNA of each of their parents. As a result, the offspring have _____ from both parents.

Key Concept 7:

Species that do not reproduce through sexual reproduction produce _____ that are _____ to their parents.

Sexual Reproduction or Not?

A seahorse is unique among fish. It mates for life with the same partner. And it's the dad who gets pregnant! A female deposits her eggs in the mate's pouch. The male then carries the eggs for 2-4 weeks until they hatch. Muscle contractions help the male give birth to about a hundred baby seahorses. 	Redwood trees are the tallest and largest trees in the world. Like other conifers, the trees have male and female cones that rely on the wind for pollination. New trees also sprout from large, shallow roots, generating a circle of trees identical to the parent. 	A volvox is a microscopic green algae that lives in pond water. Thousands of individual cells group together to form a hollow sphere called a colony. The spheres inside the colony are mini clones of the parents. 
Sexual Reproduction or Not	**Sexual Reproduction or Not**	**Sexual Reproduction or Not**
Salmon live in the ocean, but they reproduce in freshwater streams. When mature, they migrate upstream to the place where they were born. Many swim great distances and only the fittest salmon survive the journey. The female digs one or more nest holes in the stream bed. As she deposits her eggs, a male covers them with sperm. The salmon dies soon after. 	Salmonella is a bacteria that causes food poisoning. In the small intestine, a single Salmonella cell divides in two, rapidly producing many copies of itself. The microscopic bacteria invade our cells and our immune system responds. We experience fever, nausea and diarrhea. 	Single-celled amoebas live in ponds and wet soil. To reproduce, they copy their DNA then the cells squeezes in the middle and pinches into two. The two amoebae are copies of each other. When conditions are right, amoebae divide every 48 hours. 
Sexual Reproduction or Not	**Sexual Reproduction or Not**	**Sexual Reproduction or Not**

Exit Ticket

Why don't offspring of sexual reproducing species look exactly like their parents?

Dominant vs. Recessive Traits

Learning Target: *I can explain why only some inherited genes become visibly expressed traits.*

Do Now

What combination of traits do you have? Complete the survey to find out.

Trait	Yes	No	Number of students trait
Widow's Peak			
Dimples			
Brown/Black Hair			
Freckles			
Brown Eyes			
Detached Earlobe			

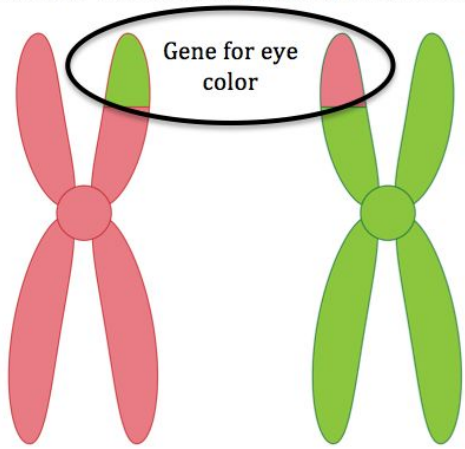
Why do you think some traits are more common in the class than other traits?

What are Dominant and Recessive Alleles?

Traits are determined by genes, which are molecular instructions inherited from your parents that influence what you look like. Half of your genes came from your mom, and the other half came from your dad, giving your body a full set of instructions to build you. **Alleles** are the specific variations of a gene that can result in different traits in living things.

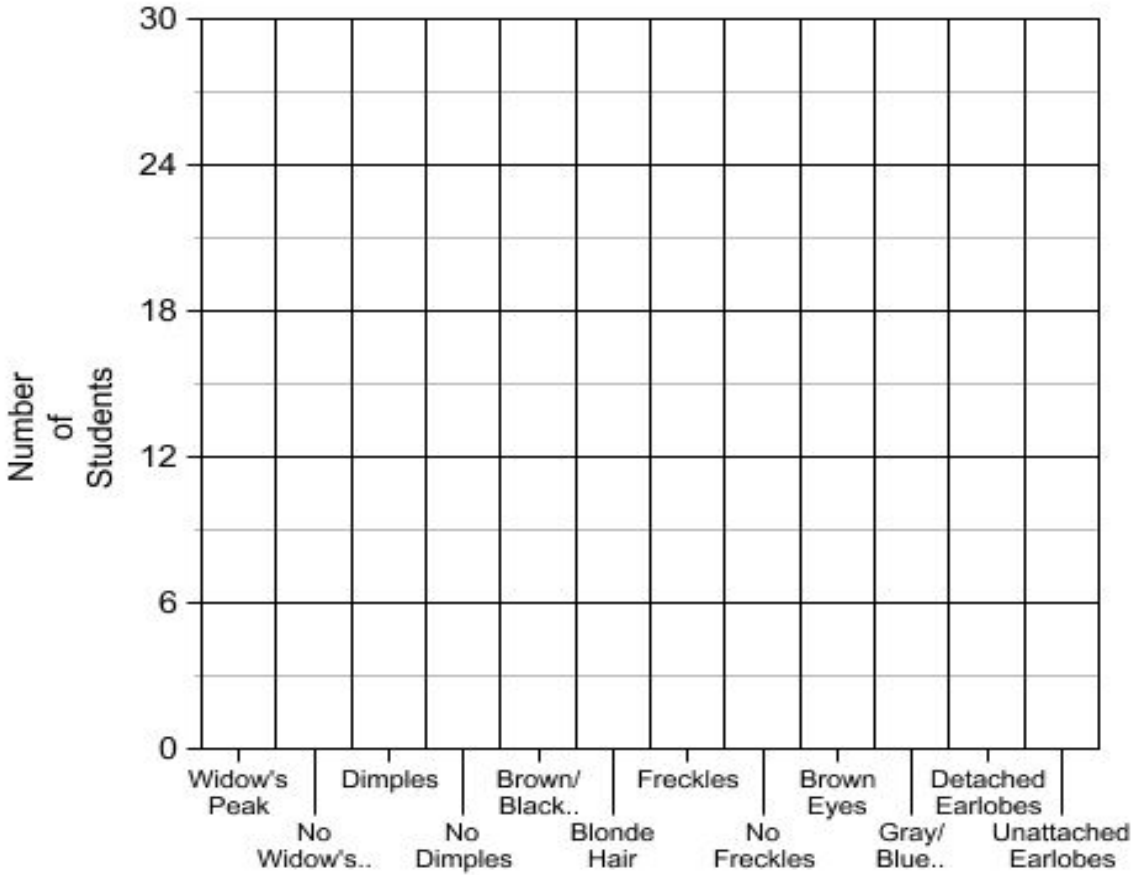
Sexually reproducing species, including people and other animals, have two copies of each gene. The two copies, called **alleles**, can be slightly different from each other. The differences can cause variation in the trait that is expressed by the offspring. For example, somebody with blue eyes has at least one blue eye allele, while somebody with brown eyes has at least one brown eye allele.

Chromosomes come in pairs. One comes from your biological mother and one from your biological father. Your parents each give you an allele for each gene. Alleles can be dominant or recessive. Dad might give a dominant allele while mom might give you a recessive one.



The terms **dominant** and **recessive** describe which trait will be visibly expressed (and which one won't) when someone gets two different alleles at the same gene.

Inventory of traits (Whole class)



Trait Frequency Chart- Which traits are dominant and recessive?

Dominant Trait	Recessive Trait	Fraction of students with dominant trait	Decimal of students with dominant trait	Percent of students with dominant trait	Percent of students with recessive trait
Widow's Peak 	No Widow's Peak 				
Dimples 	No Dimples 				
Brown/Black Hair 	Blonde Hair 				
Freckles 	No Freckles 				
Brown Eyes 	Gray/Blue Eyes 				
Free Earlobe 	Attached Earlobe 				

Dominant and Recessive Misconceptions

1. **Dominant traits are not always more common than recessive traits.**

Looking at data, you might conclude that the dominant traits are more common than the recessive one. But some recessive alleles can be present in a population at very high frequency. For example, natural curly hair is the dominant trait. The gene for straight hair is recessive.

2. **Dominant alleles are not better than recessive alleles.**

The term dominant allele has nothing to do with whether an allele is better. Take rock pocket mice, where fur color is controlled mainly by a single gene. The gene codes for a protein that makes dark pigment. Some rock pocket mice have dark fur, and some have light fur. The dark-fur allele is dominant, and the light-fur allele is recessive.

When mice live in a habitat filled with dark rocks, dark fur is *"better"* because it makes the mice less visible to predators. But when mice live in a habitat filled with light rocks and sand, light fur is "better." It's the environment that matters, not whether the allele is dominant or recessive.

Exit Ticket

Why do only some inherited genes become traits seen in the offspring?

Introduction to Punnett Squares

Learning Target: *I can explain why only some inherited genes become visibly expressed traits.*

Do Now

Yesterday as a class you took data on the amount of students who have recessive traits versus dominant traits. Refer back to the table on page 16 and describe the patterns that you notice. Did more students have dominant traits rather than recessive? Did more students have recessive traits than dominant? Write your reflections below:

_____

_____

_____

_____

Let's review Key Concept 6:

The process of _____ reproduction leads to offspring that have _____ the DNA of each of their parent. As a result, the offspring have _____ from both parents.

Offspring carry half the DNA of each of their parent, meaning that an offspring has ONE trait (one allele) from the father and ONE trait (one allele) from the mother at every gene.

Puppy Problems!

Consider the following situation. Your family has two labradors. One is a black labrador while the other is a yellow labrador. One day, after taking your dogs to the vet, you realize that the yellow labrador is pregnant, and the black lab is the father of your new puppy! Before the puppy is born, you imagine all the different possible colors of your new puppy. Will it be half yellow and half black? Spotted? A mix of the two? The possibilities seem endless, and your excitement builds. When the puppy is finally born, you pick it up and make a shocking realization: the puppy is completely black! It doesn't look anything like its mother! How could this be? Aren't offspring supposed to show the traits of *both* parents? You take the three dogs back to the vet looking for answers.

Lesson from the Veterinarian

In this scenario, the gene we are interested in is _____ and the two traits for this gene are _____ _____ and _____ _____ . In order to determine the fur color in the offspring, we have to consider the alleles that each parent carries first. Instead of writing out the words "black fur" and "yellow fur" every time, we just use <u>one</u> letter of the alphabet to stand for fur color. In this situation, we will use the letter "f" for fur.

Lesson from the Veterinarian continued…
In labradors, scientists know that the dominant trait for fur color is black fur, while the recessive trait for fur color is yellow fur. To represent this difference, we write these alleles differently. **We write a <u>dominant allele</u> with a <u>capital letter</u> and a <u>recessive allele</u> as a <u>lower case</u> letter.** Let's summarize this information in the table below.

LABRADOR GENE: _____	
DOMINANT TRAIT: _____	RECESSIVE TRAIT: _____
DOMINANT ALLELE: _____	RECESSIVE ALLELE: _____

After doing some genetic testing, the veterinarian finds out some important information about the two parent labradors. Your black lab comes from a long line of black labs, and it received a black fur color allele (F) from its mom and a black fur color allele (F) from its dad. Your yellow lab comes from a long line of yellow labs, and it received a yellow fur color allele (f) from its mom and a yellow fur color allele (f) from its dad. This means that your black lab has two black F alleles and your yellow lab has two f alleles.

FATHER (Black Lab)	MOTHER (Yellow Lab)
Allele Combination: __ __ Fur Color Trait: _____ 	Allele Combination: __ __ Fur Color Trait: _____ 

KEY VOCABULARY:

In genetics, we have specific terms that we use to discuss an organism's allele combinations and traits.

GENOTYPE: *An organism's allele combination for a gene (the alleles it received from its parents)*

PHENOTYPE: *An organism's observable behaviors or traits*

Let's use this new vocabulary to restate the information we just recorded above.

Genotype: __ __ Phenotype: _____ 	Genotype: __ __ Phenotype: _____ 

STOP & THINK: Why does the father (black lab) have black fur while the mother (yellow lab) has yellow fur?

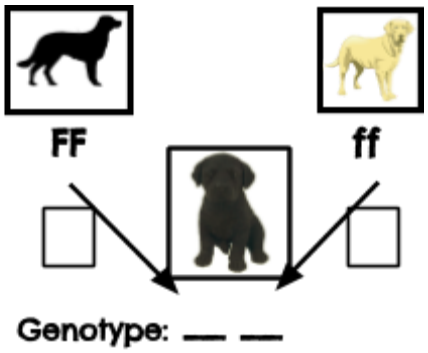
_____

_____

_____

What is the genotype (allele combination) of the puppy?

Now that we know the genotypes (allele combinations) of both the parents, we can predict the genotype (allele combination) of their puppy. In order to make this prediction, we have to consider what alleles the parents could possibly pass on to their puppy. Given this information, fill in the blanks below to determine the puppy's genotype.



Why doesn't the puppy look like a mix of both colors?

To answer this question, let's think about those terms "dominant" and "recessive" one more time.

Father (Black Fur)	Puppy (Black Fur)	Mother (Yellow Fur)
		
The father's genotype is ___ ___, meaning he has two _____ alleles. Therefore, he shows the _____ phenotype, which is black fur.	The puppy's genotype is ___ ___, meaning it has one _____ allele and one _____ allele. Therefore, it shows the _____ phenotype, which is black fur.	The mother's genotype is ___ ___, meaning she has two _____ alleles. Therefore, she shows the _____ phenotype, which is yellow fur.
If an organism has one dominant allele and one recessive allele, the dominant trait masks, or covers up, the recessive trait. These traits do NOT mix. Instead, we *only* see the dominant trait (dominant phenotype). That is why this trait is called <u>dominant</u>. It overpowers the <u>recessive</u> phenotype.		

Key Concept 8:

When an organism has one dominant allele and one recessive allele, we only see the _____ trait (phenotype).

Today's Last Key Scientific Vocabulary Terms

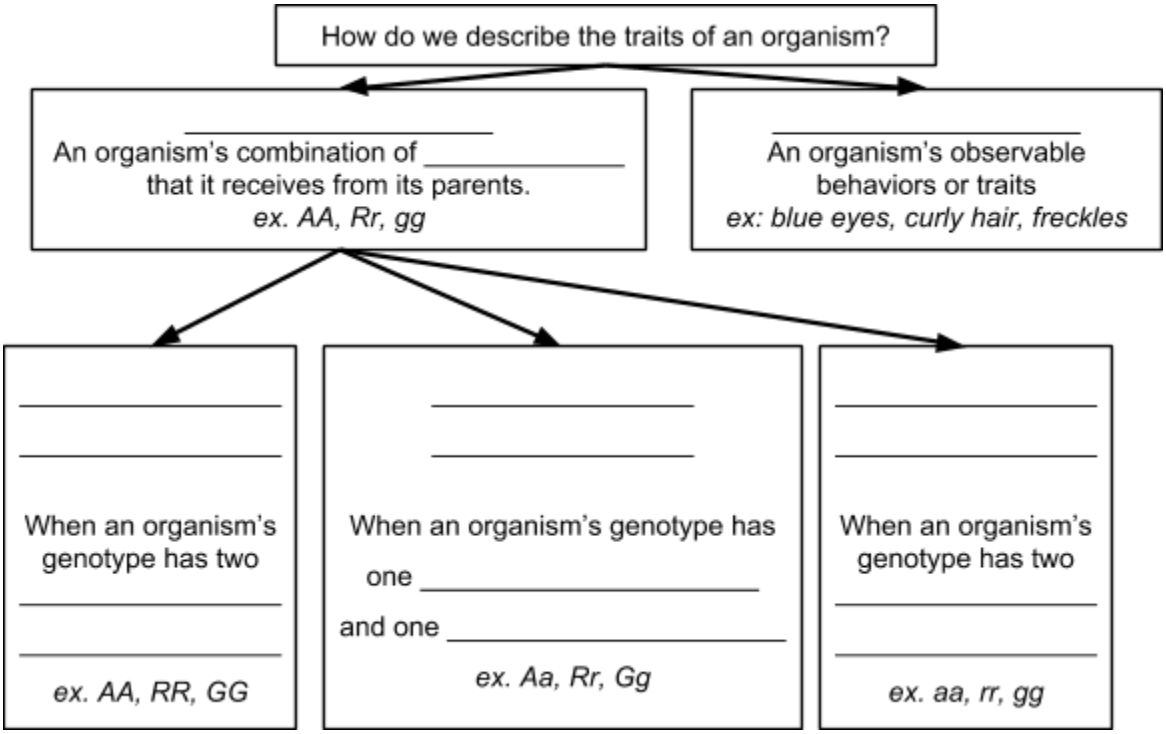
Scientists use key vocabulary to discuss organisms that have different combinations of alleles. Let's apply these key terms to what you just learned about our family of dogs.

Key Vocabulary		
 **FF** If an organism has two alleles that are _____ _____ and _____, this organism is said to be: **Homozygous Dominant**	 **Ff** If an organism has two alleles that are _____ , this organism is said to be: **Heterozygous**	 **ff** If an organism has two alleles that are _____ _____ and _____, this organism is said to be: **Homozygous Recessive**

Thinking Maps - Making Sense of Vocabulary

A Thinking Map is designed to help people understand the relationship between different ideas, concepts, or words. Complete the thinking map below with the new vocabulary terms you've learned in today's lesson.

Word Bank				
Dominant Alleles	**Recessive Alleles**	**Alleles**	**Genotype**	**Phenotype**
Homozygous Dominant	**Homozygous Recessive**		**Heterozygous**	**Different Alleles**



Vocabulary Practice - Applying what you've learned

In the space below, circle the word (or words) that correctly describe the information provided. If you get stuck, refer to your vocabulary thinking map on the previous page!

1.	Curly Hair	**CIRCLE ONE:**	This is a GENOTYPE	This is a PHENOTYPE	
2.	*Aa*	**CIRCLE ONE:**	This is a GENOTYPE	This is a PHENOTYPE	
3.	*g*	**CIRCLE ONE:**	This is a GENOTYPE	This is an ALLELE	
4.	*Hh*	**CIRCLE ONE:**	Homozygous Dominant	Heterozygous	Homozygous Recessive
5.	*TT*	**CIRCLE ONE:**	Homozygous Dominant	Heterozygous	Homozygous Recessive
6.	*bb*	**CIRCLE ONE:**	Homozygous Dominant	Heterozygous	Homozygous Recessive
7.	H	**CIRCLE ONE:**	This is a Dominant Allele	This is a Recessive Allele	
8.	h	**CIRCLE ONE:**	This is a Dominant Allele	This is a Recessive Allele	

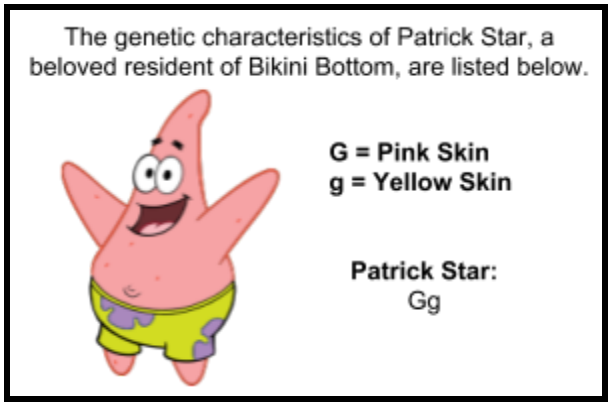
The image below summarizes the genetic and physical characteristics of Patrick Star. Based on this informaton, fill in the blanks below.

Patrick's Genotype: _____

Patrick's Phenotype: _____

The Dominant Allele: _____

The Recessive Allele: _____



Exit Ticket

In pea plants, the allele that codes for round seeds is "**R**" and the allele that codes for wrinkled seeds is "**r**". Based on this information, if a pea plant has the genotype **Rr**, what color seeds will it have? How do you know?

_____

_____

_____

_____

Challenge Question - Can you figure it out???

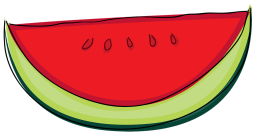
Five years later, your black lab puppy has grown up and is ready to have puppies of its own. It has a baby with another black lab. When the new baby is born, you can't believe your eyes. The baby puppy has yellow fur - it doesn't look like ***either*** *of its parents! Once again, you return to the vet demanding answers. Can you figure out how this could have happened?*

Creating a Punnett Square

Learning Target: *I can explain how punnett squares are used to predict genetic characteristics.*

Do Now

In watermelons, solid green rind color (G) is dominant to stripes (g).



The genetic characteristics for a watermelon that you bought from the store is **Gg.**

What is your watermelon's **genotype?**: _____

What is your watermelon's **phenotype?:** _____

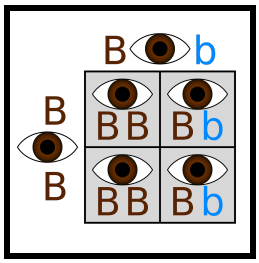
What is the **dominant allele**?: _____

What is the **recessive allele?** _____

What is a Punnett Square?

In order to truly predict hair, eye color, or any other genetic characteristic, you have to think of the genetic traits of your parents, your grandparents, and even your great-grandparents. Even though some people have dominant traits, like brown hair or brown eyes, it doesn't mean they don't also have some recessive genes in their DNA. They might just not be showing! Even though your mom or dad might have dominant traits, they can still pass on recessive genes to you.

Scientists figure out the probability, or likelihood, of someone's genetic traits using a **Punnett Square.** This model helps us to see what traits the child could have based on the different combinations of the parents' genes.



Above is an example of a Punnett Square for eye color (B-brown dominant) (b-blue recessive)

Creating a Punnett Square:

Yesterday we used the example of two different colored labradors (yellow and black) having a black labrador puppy. Imagine that the black labrador puppy from our example yesterday has now grown up and will be having a puppies of his own with another female black labrador. What are the different possibilities of fur color? Will all puppies be black? Could some have yellow fur? A Punnett Square will allow us to determine the different possibilities of fur color based on the genotype of the parents. Punnett squares can be used for any trait, but today we will use the **fur color** trait.

Investigation Question:

What is the likelihood that the offspring of a heterozygous male (Ff) and a heterozygous female (Ff) have offspring with yellow fur?

We can use Punnett Squares to determine the probability (likelihood) of an offspring's traits.

A Punnett Square has four sections totaling up to represent a 100% chance to occur. Each section represents *one possible offspring combination for a trait* and a _____ chance to occur.

1. **Write the female parent's allele combination along the *left side* of the square with one letter next to one square.**

   (Mother's combination is Ff)

2. **Write the male parent's allele combination along the *top* of the square with one letter above one square.**

   (Father's combination is Ff)

3. **In each box, pull the letter from the left and the letter from the top to form a possible allele combinations.**

Interpreting Percentages--

FF = _____

Ff = _____

ff = _____

Making sense of the Punnett Square:

Write the four possible genotype combinations from your punnett square above:

This means that there is a _____ chance that an offspring will have _____ fur.	This means that there is a _____ chance that an offspring will have _____ fur.	This means that there is a _____ chance that an offspring will have _____ fur.	This means that there is a _____ chance that an offspring will have _____ fur.

Practicing Punnett Squares:

A plant species has two alleles for leaf shape:

CURLY (G) and FLAT (g)

Create a Punnett square for **homozygous recessive (gg)** and a **heterozygous (Gg)** parents.

What is the likelihood for phenotype of curly leaf shape?

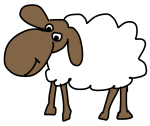
In mussels, there are two alleles for coloring:

BROWN COLORING (B) and BLUE COLORING (b)

Create a Punnett square for a **homozygous dominant (BB)** and a **homozygous recessive (bb)** parent.

What is the likelihood for a phenotype of blue coloring?

In sheep, there are two alleles for belly fur:



BELLY FUR (A) and NO BELLY FUR (a)

Create a Punnett square for a mother with the genotype **Aa** and a father with a genotype **Aa**

What is the likelihood for a genotype of AA?

A Punnett square below shows the genotypes of offspring for the hair length trait in cats.

SHORT HAIR (H) and LONG HAIR (h)

	h	h
h	hh	hh
h	hh	hh

What is the likelihood for a phenotype of short hair?

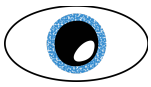
What is the likelihood that any offspring will have a dominant allele?

Punnett Squares Continued

Learning Target: *I can explain how punnett squares are used to predict genetic characteristics.*

Do Now

After a science lesson, you hear your classmate Timmy explain to a friend that he only has his father's traits because he has brown eyes like his father.
Based on what you know about inherited traits from a mother and a father, determine if Timmy's thoughts are correct and explain why or why not.



In our lesson today we are going to use Punnett squares to investigate how the twins from our phenomenon, Maria and Lucy, have such different traits in regards to hair color, eye color and hair texture. In the pages to follow you will see the twins' parents' alleles for hair color, eye color and hair texture. Using their alleles, we will create punnett squares to show how each twin ended up with her gene combination. Below is a recap of the twins:

Lucy	Maria
Eye Color: Blue **Hair Color:** Red **Hair Texture:** Straight 	**Eye Color:** Brown **Hair Color:** Black **Hair Texture:** Curly 

Hypothesize:
How is it possible that Lucy and Maria can be twins while having extremely different traits? Explain your thoughts on the lines below.

Investigation #1: *Eye Color*

MOTHER: Lucy and Maria's mother is *heterozygous* for eye color (**Ee**)	**FATHER:** Lucy and Maria's father is *homozygous recessive* for eye color (**ee**)

Interpretation of Punnett Square (Eye Color)

What were the four possible gene combinations from your Punnett Square?

Write them in the boxes below. Circle the trait the will be expressed, then circle the correct phenotype.

** Brown eyes are considered to be dominant, while blue eyes are recessive.*

Which trait will be expressed? *Dominant or Recessive* **Phenotype:** *Brown eyes or Blue eyes*	**Which trait will be expressed?** *Dominant or Recessive* **Phenotype:** *Brown eyes or Blue eyes*	**Which trait will be expressed?** *Dominant or Recessive* **Phenotype:** *Brown eyes or Blue eyes*	**Which trait will be expressed?** *Dominant or Recessive* **Phenotype:** *Brown eyes or Blue eyes*

a. What was the likelihood of Maria having brown eyes? **b. Is it possible that Maria carries a recessive allele?**	**a. What was the likelihood of Lucy having blue eyes?** **b. Is it possible that Lucy carries a dominant allele?**

Investigation #2: Hair Color

MOTHER: Lucy and Maria's mother is *heterozygous* for hair color (**Hh**)	**FATHER:** Lucy and Maria's father is *homozygous recessive* for hair color. (**hh**)

Interpretation of Punnett Square (Hair Color)

What were the four possible gene combinations from your Punnett Square?

Write them in the boxes below. Circle the trait the will be expressed, then circle the correct phenotype.

** Black hair is considered to be dominant, while red hair is recessive.*

Which trait will be expressed: *Dominant or Recessive* **Phenotype:** *Red hair or Black Hair*	**Which trait will be expressed:** *Dominant or Recessive* **Phenotype:** *Red hair or Black Hair*	**Which trait will be expressed:** *Dominant or Recessive* **Phenotype:** *Red hair or Black Hair*	**Which trait will be expressed:** *Dominant or Recessive* **Phenotype:** *Red hair or Black Hair*

a. What was the likelihood of Maria having black hair? **b. Is it possible that Maria carries a recessive allele?**	**a. What was the likelihood of Lucy having red hair?** **b. Is it possible that Lucy carries a dominant allele?**

Investigation #3: Hair Texture (curly or straight)

MOTHER: Lucy and Maria's mother is *heterozygous* for hair texture (**Tt**)	**FATHER:** Lucy and Maria's father is *homozygous recessive* for hair texture (**tt**)

Interpretation of Punnett Square (Hair Texture)

What were the four possible gene combinations from your Punnett Square?

Write them in the boxes below. Circle the trait the will be expressed, then circle the correct phenotype.

** Curly hair is considered to be dominant, while straight hair is recessive.*

Which trait will be expressed? *Dominant or Recessive* **Phenotype:** *Curly or Straight*	**Which trait will be expressed?** *Dominant or Recessive* **Phenotype:** *Curly or Straight*	**Which trait will be expressed?** *Dominant or Recessive* **Phenotype:** *Curly or Straight*	**Which trait will be expressed?** *Dominant or Recessive* **Phenotype:** *Curly or Straight*

a. What was the likelihood of Maria having curly hair? **b. Is it possible that Maria carries a recessive allele?**	**a. What was the likelihood of Lucy having straight hair?** **b. Is it possible that Lucy carries a dominant allele?**