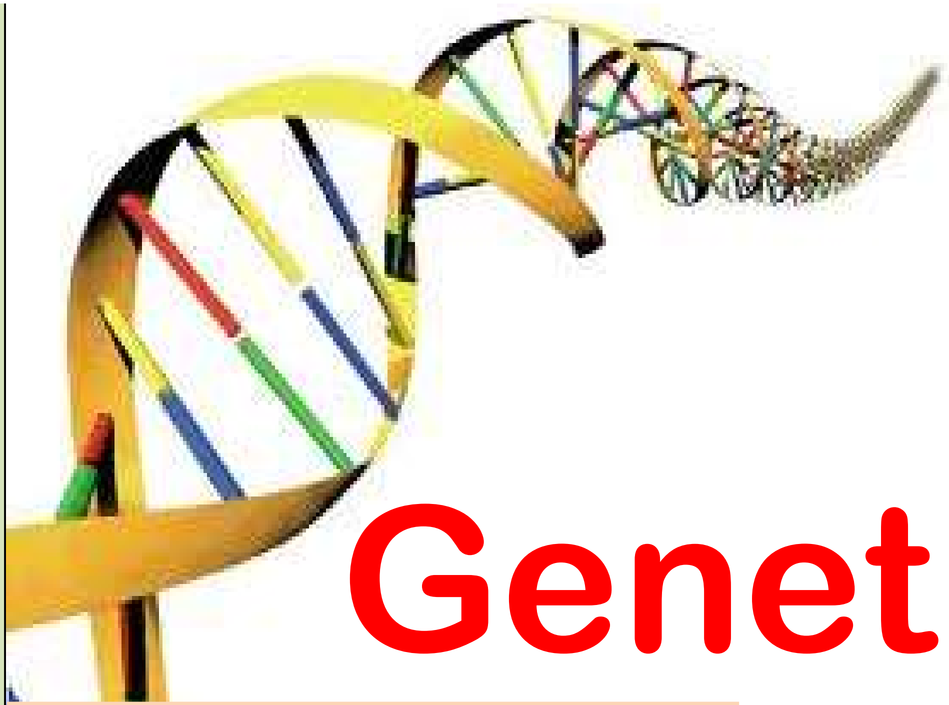
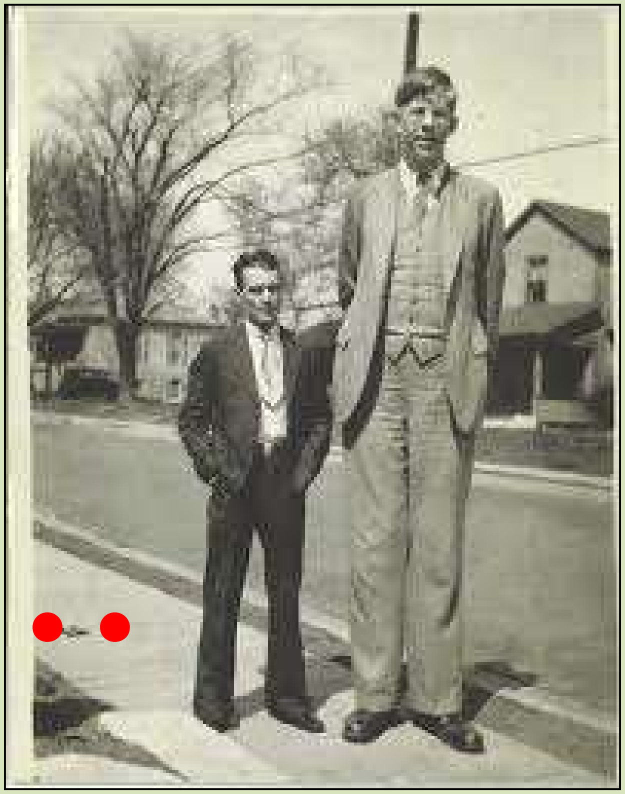
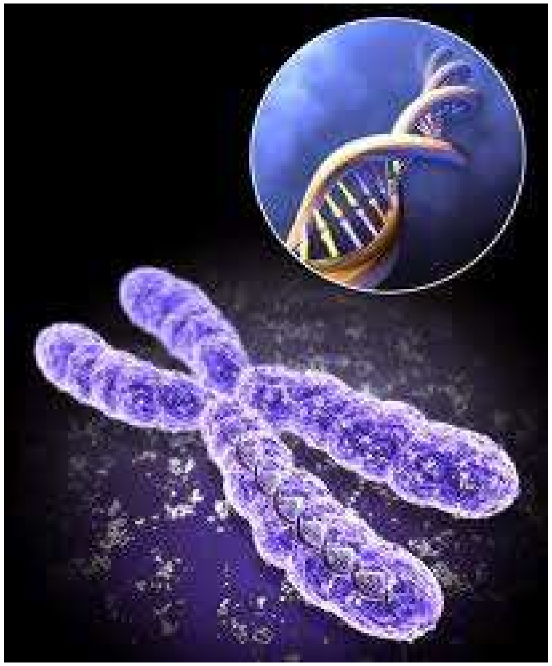
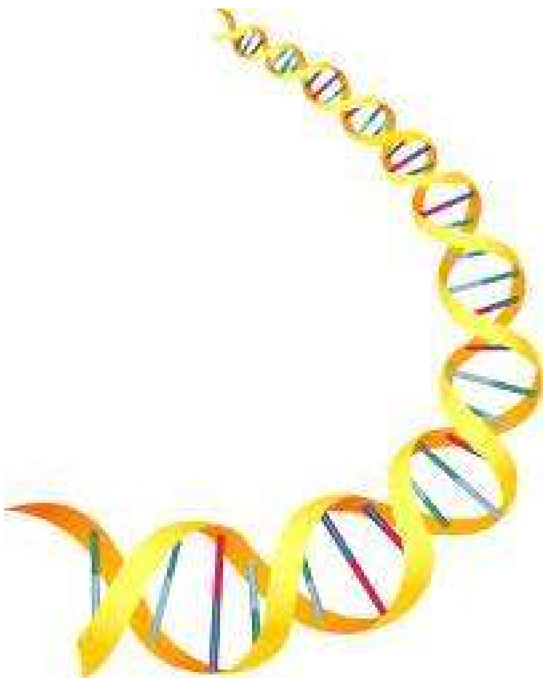




Genetics…

EQ; What are some exceptions to Mendel’s rules?





There are some exceptions to these principles. Not all genes show a pattern of _dominance and recessiveness_. For some genes, there are more than _two alleles_. Many times, traits are controlled by more than one _gene_. Now we will begin to examine some of these exceptions to Mendel's rules.

Genes and the Environment

Plants grown in light   Plants grown in darkness

Gene expression is always the result of the interaction of:

genetic potential with the environment.

A seedling may have the genetic capacity to be green, to flower, and to fruit, but it will never do these things if it is kept in the dark. A tree may never grow tall if the soil is poor and no water is available.

In other words, the presence of the gene is not all that is required for the __expression of a trait.__. The _gene_ must be present along with the proper _environmental conditions_.

The phenotype of any organism is the result of interaction between: genes and the environment.

Incomplete Dominance or Nondominance

+

=

All traits are not so clear-cut as dominant and recessive traits.

For example: In some flowers, such as snapdragons and four o'clocks, a homozygous red flower crossed with a homozygous white flower yields a _heterozygous pink_ flower.

Some genes appear to: blend together.

This is known as: incomplete dominance or nondominance.

No allele is dominant or recessive - they blend together in the offspring.

Since there is no recessive allele, use only _capital_ letters. For example: A red flower would be _RR_, and white flower would be _WW_, and the pink hybrid would be _RW_.

 +  = 

What type of offspring might be produced by two pink flowering plants?

What are the genotypes of the parents? RW and RW

	R	W
R	RR	RW
W	RW	WW

Genotypes	Phenotypes
1/4 RR	1/4 Red
2/4 RW	2/4 Pink
1/4 WW	1/4 White

In a certain plant, flower color shows nondominance, but the stem length shows dominance. The allele for long stem is dominant over the allele for short stem. Cross a heterozygous long stemmed, red plant with a short stemmed pink plant.

What is the genotype of the first parent? LlRR

What is the genotype of the second parent? llRW

	LR	LR	lR	lR
lR	LlRR	LlRR	llRR	llRR
lW	LlRW	LlRW	llRW	llRW
lR	LlRR	LlRR	llRR	llRR
lW	LlRW	LlRW	llRW	llRW

Genotypes	Phenotypes
4/16 LlRR	4/16 Long, red
4/16 LlRW	4/16 Long, pink
4/16 llRR	4/16 short, red
4/16 llRW	4/16 short, pink

Codominance

In humans, four blood types are possible:
A, B, AB, and O

There are three alleles that determine blood type. These three alleles are written as follows: I^A, I^B, and i.

Alleles I^A and I^B are codominant, and the allele "i" is recessive.

Codominance:
Both dominant alleles are apparent in the phenotype of the heterozygous offspring.

The possible genotypes for blood types are as follows:

Genotypes	Phenotypes
$I^A I^A$	Type A blood
$I^A i$	Type A blood
$I^B I^B$	Type B blood
$I^B i$	Type B blood
$I^A I^B$	Type AB blood (Since these alleles are codominant, both are expressed in the offspring)
i i	Type O blood

What types of offspring might be expected if one parent has type AB blood and the other parent is heterozygous for type A blood?

What is the genotype of the first parent? $I^A I^B$

What is the genotype of the second parent? $I^A i$

	I^A	I^B
I^A	$I^A I^A$	$I^A I^B$
i	$I^A i$	$I^B i$

Genotypes	Phenotypes
¼ $I^A I^A$	Type A blood 2/4
¼ $I^A I^B$	Type AB blood 1/4
¼ $I^A i$	Type B blood 1/4
¼ $I^B i$	

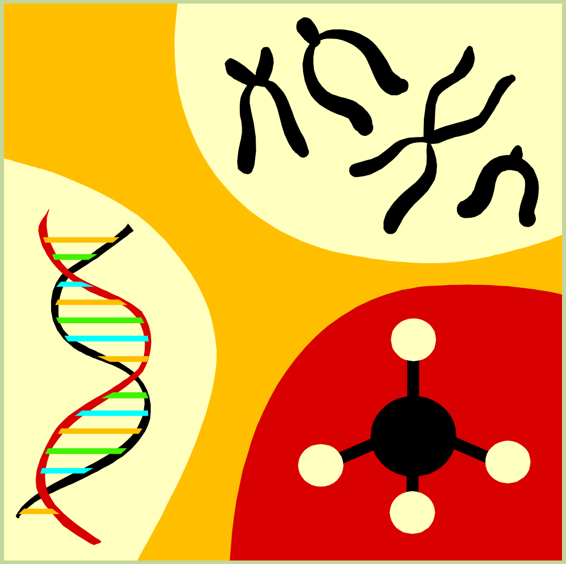
A man and a woman have four children. Each child has a different blood type. What are the genotypes of the parents and the four children?

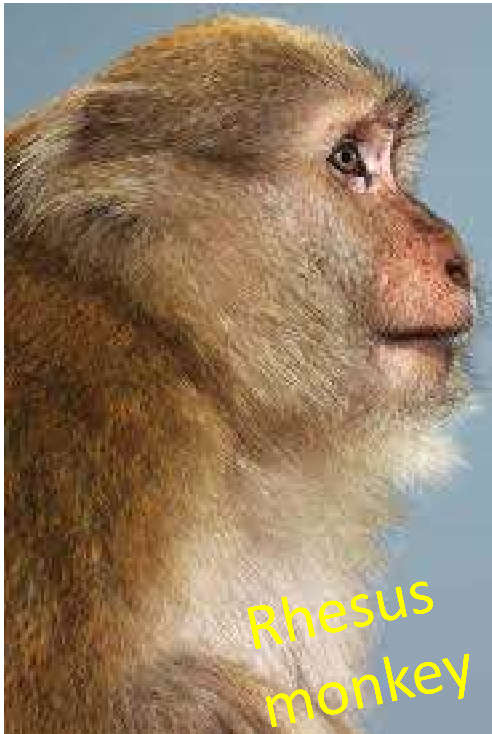
The parents would have to be:

$I^A i$ and $I^B i$.

What are the genotypes of the four children?

The type O child is ii.
The type AB child is $I^A I^B$.
The type A child is $I^A i$.
The type B child is $I^B i$.





Another component of our blood type is the Rh factor.
Some people have Rh positive blood and others have Rh negative blood.

The Rh factor is determined by one gene with two alleles.
The allele for Rh positive is dominant over the allele for Rh negative.
Let's use "R" to represent the positive allele and "r" to represent the negative allele.

Work this problem: A woman whose blood type is AB negative marries a man with blood type O positive. The man's mother had blood that was A negative.

What is the genotype of the woman? $I^A I^B$ rr

What is the genotype of the man? ii Rr

What is the genotype of the man's mother? I^A i rr

	I^A r	I^A r	I^B r	I^B r
iR	I^Ai Rr ✓	I^Ai Rr ✓	I^Bi Rr ✓	I^Bi Rr ✓
ir	I^Ai rr ✓	I^Ai rr ✓	I^Bi rr ✓	I^Bi rr ✓
iR	I^Ai Rr ✓	I^Ai Rr ✓	I^Bi Rr ✓	I^Bi Rr ✓
ir	I^Ai rr ✓	I^Ai rr ✓	I^Bi rr ✓	I^Bi rr ✓

Genotypes	Phenotypes
4/16 I^Ai Rr	4/16 Type A Rh positive
4/16 I^Ai rr	4/16 Type A Rh negative
4/16 I^Bi Rr	4/16 Type B Rh positive
4/16 I^Bi rr	4/16 Type B Rh negative

Multiple Alleles

Many genes have two or more alleles and are said to have multiple alleles .

The best example for multiple alleles involves coat color in rabbits.

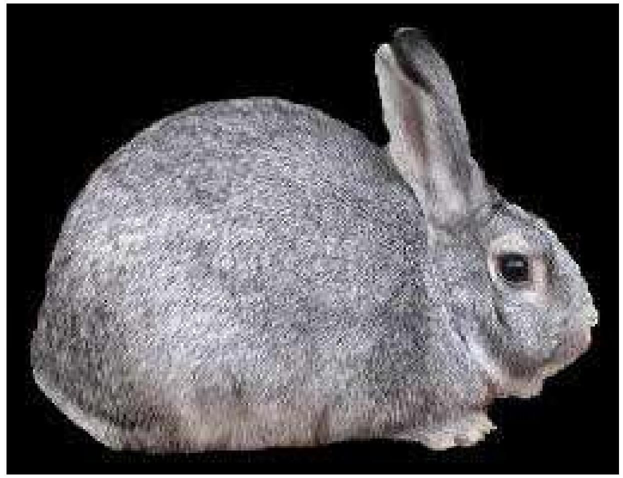
Coat color in rabbits is determined by a single gene that has at least 4 different alleles.

These four alleles demonstrate a dominance hierarchy in which some alleles are dominant over others.

The four alleles for coat color in rabbits in order of dominance are as follows:

This means that there are two or more alleles for the trait.

C – Full color (often called wild type or agouti)



c^{ch} - light gray or chinchilla

c^{h} - albino with black extremities or

c - albino

These alleles are listed in order of their dominance

What would be the possible genotypes of each of these rabbits?

Full color: CC, C c^{ch}, Cc^{h} , Cc

Chinchilla: c^{ch} c^{ch}, c^{ch} c^{h}, c^{ch}c

Himalayan: c^{h} c^{h}, c^{h}c

Albino: cc

POLYGENIC INHERITANCE

In polygenic inheritance, the determination of a given characteristic is the result of:
the interaction of many genes.

Some traits, such as size, height, shape, weight, color, metabolic rate, and behavior are not determined by one pair of alleles. These traits are the cumulative result of the combined effects of many genes. This is known as polygenic inheritance.

A trait affected by a number of genes - or polygenes - does not show a clear difference between groups of individuals. Instead, it shows a:

graduation of small differences

Many normal human traits are thought to be polygenic.

Examples:

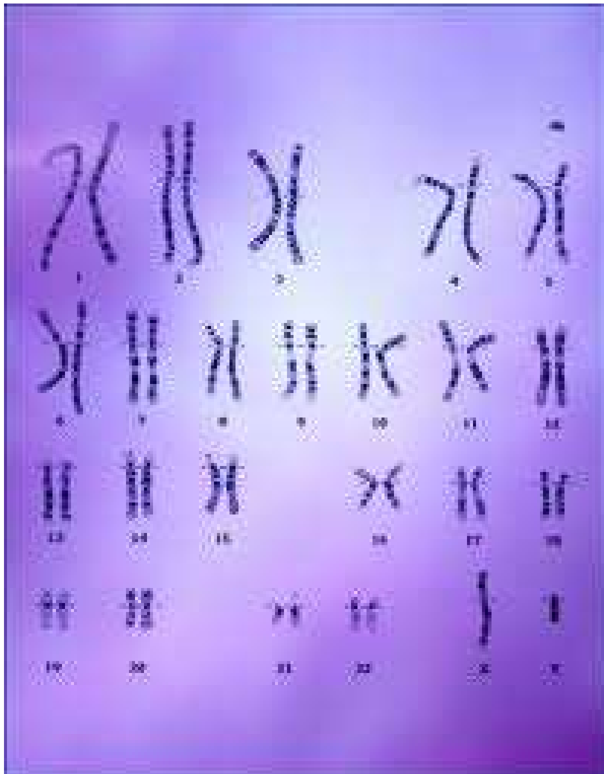
hair color

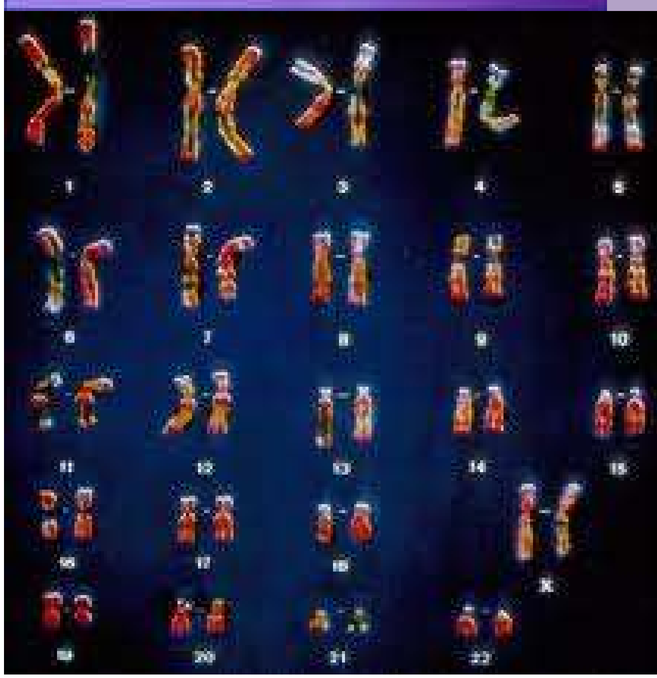
eye color

weight

height

skin color





Sex Determination

1. Human cells contain 23 pairs of chromosomes.

   There are 22 pairs of autosomes, and one pair of sex chromosomes.
2. In males and females, all of the pairs of chromosomes are the same except one pair. The pairs that are the same are called autosomes. Autosomes are all of the chromosomes within a cell except for the sex chromosomes.

3. One pair differs between males and females. This pair is called the sex chromosomes. The sex chromosomes differ in structure.

3. Females have 2 copies of a large X chromosome. Males have one X and one small Y chromosome.

Sex-Linked Genes

There are _many_ genes found on the X chromosome.
The Y chromosome appears to contain only a _few_ genes.

Since the X and Y chromosomes determine the sex of an individual, all genes found on these chromosomes are said to be _sex-linked_.

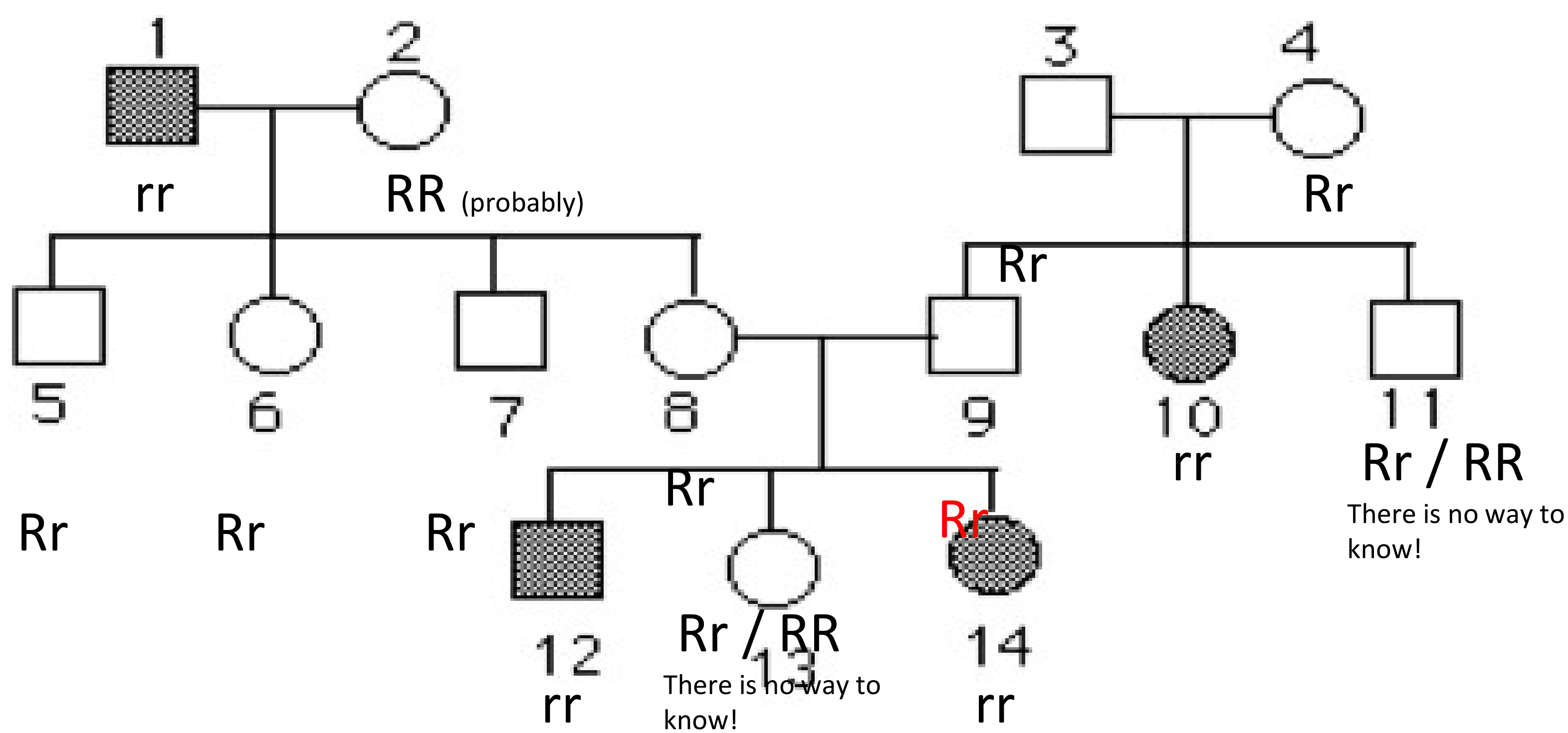
More than 100 sex-linked genetic disorders have now been associated with the X chromosome.

Sex-linked traits include _color blindness, hemophilia, and muscular dystrophy_.
These are caused by _recessive_ alleles.

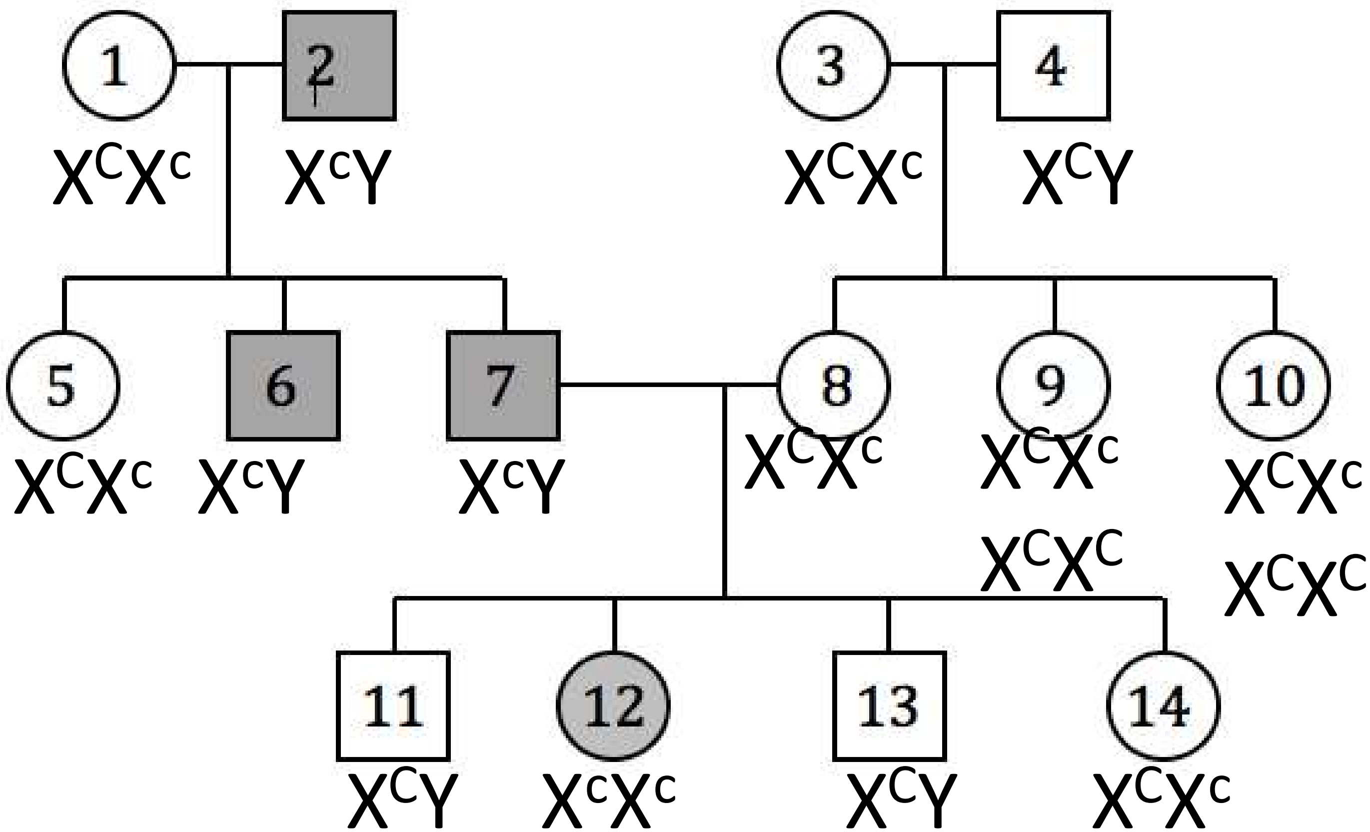
Since males have only one copy of the X chromosome, they will have the disorder if they inherit just _one copy_ of the allele. Females must inherit _two copies_ of the allele, one on each of their X chromosomes, in order for the trait to show up. Therefore, sex linked genetic disorders are much more common in males than females.

Genealogy Tables (Pedigree Charts)

A. A pedigree chart shows relationships within a family.
B. Squares represent males and circles represent females.
C. A shaded circle or square indicates that a person has the trait.
D. The following table shows three generations of guinea pigs. In guinea pigs, rough coat (R) is dominant over smooth coat (r). Shaded individual have smooth coat. What is the genotype of each individual on the table below?



The following pedigree table is for colorblindness. This is a sex-linked trait. Shaded individual have colorblindness. Determine the genotype of each of the following family members.



Left Side Activity

1. Explain the difference between Codominance and Incomplete Dominance.
2. What is Polygenic Inheritance?
3. What are Sex-linked Genes?
4. Which sex is more likely to have disorders due to sex-linked genes? Why?
5. Explain how to read a Pedigree chart.