

Genetics and Heredity Lab

Name _____ Period _____ / SBG

Genetics is the study of the way in which different characteristics of an organism (e.g. finger shape, eye color, height, the ability to make a certain digestive enzyme) are determined and passed on from parent to offspring.

The basic unit of heredity is the **gene**. A gene is a **locus** on a **chromosome** containing a portion of **DNA** that codes for a specific **protein**. Each gene is able to govern a particular feature of an organism by determining the type of protein produced. This protein can function as a structural protein, enzyme, or hormone (e.g. insulin) affecting that particular feature. Typically, each gene has several different forms (called **alleles**) that result in the variation of a feature one sees in different individuals. For example, one form (allele) of the gene for finger shape (B) may code for bent little fingers, whereas another form of that same gene (b) may code for straight fingers. The difference between the alleles is in the type of protein produced by each, which is due to a difference in the base sequence of DNA making up each allele.

The genetic make-up of an individual for a particular trait is referred to as the **genotype**. Since organisms are typically **diploid** (i.e. with chromosomes occurring in **homologous pairs**), there are a pair of genes governing each trait. For example, the genotype for finger shape may be Bb which actually represents the pair of alleles on a homologous pair of chromosomes.

The actual expression of these alleles is called the **phenotype**. The phenotype of a trait is always the product of the interaction between the individual's genetic make-up for that trait and the individual's environment. The purpose of today's lab is to consider some basic terminology and concepts of genetics and to determine the genotype of members of the class by looking at your phenotypes for 20 different traits.

Formation of Gametes

In preparation for the genetics problems below, write the possible **gametes** (sex cells) that can be formed from the following genotypes. Place a circle around each gamete. Remember that gametes are haploid and that each gamete must contain one of each kind of gene found in the genotype of the diploid parent forming the gamete.

Genotype	Possible Types of Gametes
AA	A
Aa	A, a
AABb	A/B, A/b
AaBb	A/B, A/b, aB, a/b
AaBbCc	A/B/C, A/B/c, A/b/C, A/b/c, a/B/C, a/B/c, a/b/C, a/b/c

Using the information presented, try to solve the following problems:

- In peas, the allele (T) for tallness is *dominant* over the allele for short stems (t). If a plant which is *homozygous* for tallness is crossed with one *homozygous* for short stems:

- What are the genotypes of the parents? **TT x tt**
- What are the possible types of gametes they can produce? (Draw a circle around each gamete.) **T and t**
- What is/are the possible genotype(s) of the offspring? What is/are the possible phenotype(s)?

Genotypes **Tt**

Phenotypes **tall**

- In the following matings, write the gametes that can be produced by each parent, and draw a circle around each gamete. Then write the possible genotype(s) of their offspring. Use a Punnett Square to organize the information in part b.

- TT • Tt

parent 1

parent 2

gametes **TT**

 Tt offspring genotypes **TT, Tt**

- Tt • Tt

gametes **Tt**

 Tt offspring genotypes **TT, Tt, tt**

3. In cattle, the allele (A) that produces the polled (hornless) condition is **dominant** over the allele (a) for the horned condition. A certain polled bull is bred to three cows. With Cow A, which is horned, a polled calf is produced; with Cow B, also horned, a horned calf is produced; and with Cow C, which is polled, a horned calf is produced. Give the Genotypes of each of the parents and the calves produced by each cow.

Bull _____ **Hh** _____

Cow A (**horned**) _____ **hh** _____ calf _____ **Hh** _____ (**polled**)

Cow B (**horned**) _____ **hh** _____ calf _____ **hh** _____ (**horned**)

Cow C (**polled**) _____ **Hh** _____ calf _____ **hh** _____ (**horned**)

Human Genetics

In this part of the lab you will look at 23 different traits in each of yourselves. By observing the phenotype of each trait, you will then try to determine your genotype for each feature. We have selected traits which are easy to determine. Many of them, such as eye color, are governed by more than one pair of alleles. Others are also affected by different exposure in the environment, as in the case of freckles. For the sake of simplicity, we will ignore these shades of difference in the expression of these traits and simply lump dark colored eyes into one category and light colored eyes into another. Record your results in the chart below. Also record these data on the summary chart for the entire section up at the front of the lab. There are photographs and illustrations at the front of the room and on your lab table to assist you.

Traits

PTC Tasting - The allele (T) for tasting PTC is **dominant** over the non-tasting allele (t).

Sodium Benzoate Tasting - The taster allele (S) for sodium benzoate is **dominant** over the non-taster allele (s).

Shape of Little Finger - Hold your hands before your face with the palms toward you. Place the little fingers side by side and press them together. Do they run parallel their entire lengths or do the terminal digits flare out away from each other? Each bone in a finger is termed a phalanx. The allele for bent phalanx (B) is **dominant** over straight phalanx (b).

Mid-Digital Hair - Hair on the back of the middle digits of the fingers (H) is **dominant** over hairless middle digits (h).

Hitchhiker's Thumb - Hold your hand in the hitchhiker's position and look at the angle that is formed. If the thumb forms an angle with the fist of greater than 50 degrees it is due to the recessive allele (ht). If the thumb cannot hyperextend, it is due to the presence of the **dominant allele** (HT).

Tongue Rolling - The ability to roll the tongue into a longitudinal U-shaped trough (R) is **dominant** over the lack of this ability (r).

Tongue folding - Tongue folding (F) is **dominant** over the lack of the ability (f). A tongue folder must be able to hold the tongue out and without bracing it against the teeth, fold the tip back sharply.

Dimples - The allele for dimples (D) is **dominant** over the allele for no dimples (d).

Freckles - The allele for freckles (FR) is **dominant** over the one for the absence of freckles (fr).

Ear Lobe Attachment - Free ear lobe (E) is dominant over attached ear lobe (e).

Darwin's Ear Point - Darwin's ear point (EP) is **dominant** over no ear point (ep). Check both ears. The size of the ear point may vary.

Eye Color - Assume an allele for various shades of brown eyes (BR) is **dominant** over the allele for blue or blue-gray eyes (br). (Note: this is an over simplification. There are over 40 shades of eye color, and several pairs of alleles are involved.)

Hair Color, Dark/Light - Assume the allele for dark hair (HC) is **dominant** over light hair (hc), and that a **heterozygous** person, HChc, will have dark hair. (As in the case with eye color, this is an oversimplification, for there are many shades of hair color.)

Hair Color, Red/Non-red - The color of red is inherited independently of dark/light hair coloration. Assume that the gene for red (rd) is **recessive** to the gene for non-red (RD), and that a person who is **heterozygous** (RDrd) will have non-red hair.

Hair Form - Assume the allele for curly hair (U) is **not completely dominant** over the allele for straight hair (u). The heterozygous condition (Uu) produces wavy hair.

Hair Whorl Pattern - When viewed from above, the whorl pattern of the hair which is clockwise is due to the *dominant* allele (W). The counterclockwise pattern is due to the allele (w) in the *homozygous* condition.

Hairline - Examine the hairline on your forehead. The allele for a widow's peak (V) is *dominant* over the allele for a straight or curved hairline (v).

In the chart below, record your phenotype for each trait (taster or non-taster, straight or bent little finger, etc.), and circle your genotype.

Trait	Your Phenotype	Circle Your Genotype
PTC Tasting	_____	T- tt
Sodium Benzoate Tasting	_____	S- ss
Bent Little Finger	_____	B- bb
Mid-Digital Hair	_____	H- hh
Hitchhiker's Thumb	_____	HT- htht
Tongue Rolling	_____	R- rr
Tongue Folding	_____	F- ff
Dimples	_____	D- dd
Freckles	_____	FR- frfr
Ear Lobe Attachment	_____	E- ee
Darwin's Ear Point	_____	EP- epep
Eye Color	_____	BR- brbr
Hair Color, Dark/Light	_____	HC- hchc
Hair Color, Red/Non-red	_____	RD- rdrd
Hair Form	_____	UU UU' U'U'
Hair Whorl Pattern	_____	W- ww
Hairline	_____	V- vv

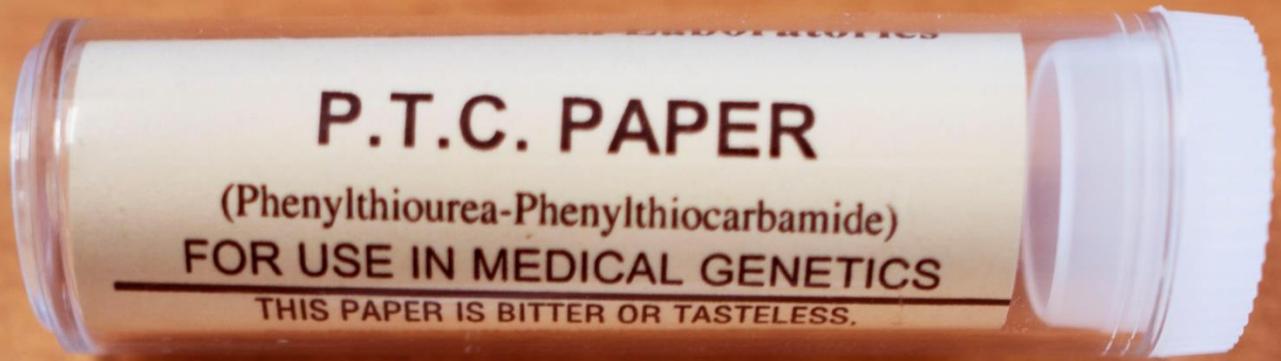
1. Because an allele is dominant, does this necessarily mean that it will occur at a high frequency in a group? **It depends on the number of dominant vs recessive traits in the given group. If the gene pool has more recessive alleles, the recessive trait will occur more frequently.**

What does the term "dominant" mean?

Dominant means to mask or overshadow the recessive trait.

2. By knowing the phenotype for a feature (e.g. eye color), can we always determine the genotype exactly?

Explain. There may be alleles on the genotype that aren't expressed because they are recessive. Recessive traits won't show on the phenotype, so you can't be sure if the genotype is homozygous dominant or heterozygous.



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Scientific Equipment & Supplies

**SODIUM
BENZOATE**

Chemical Formula: $\text{NaC}_6\text{H}_5\text{O}_2$

Form: Powder

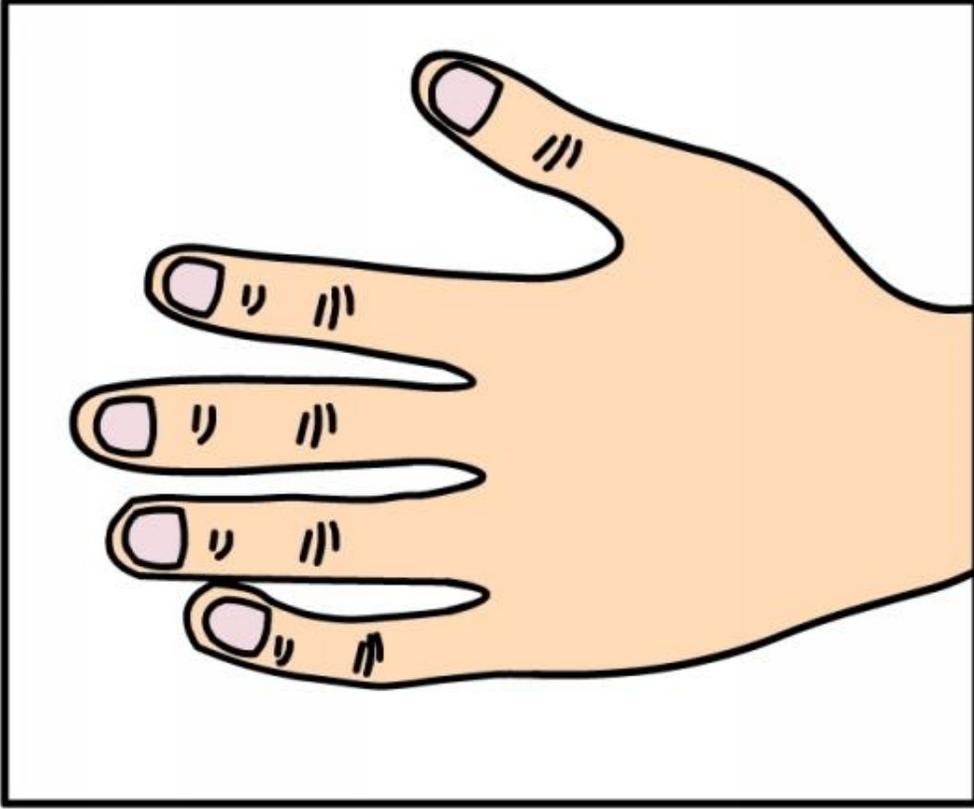
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(57 gm.)

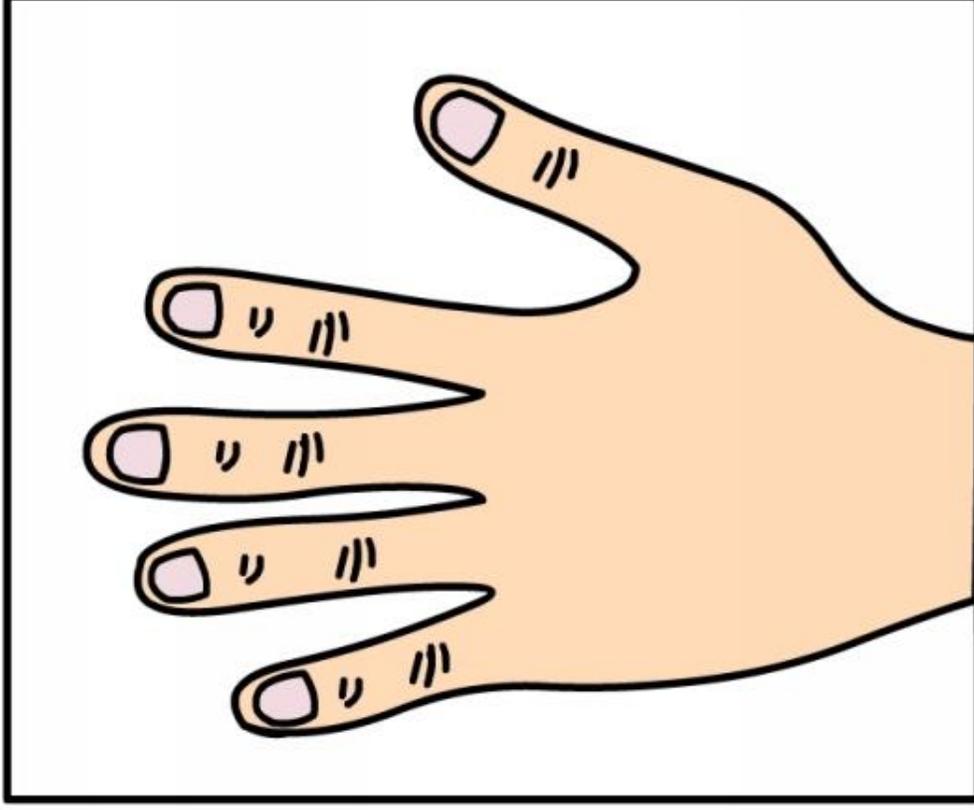
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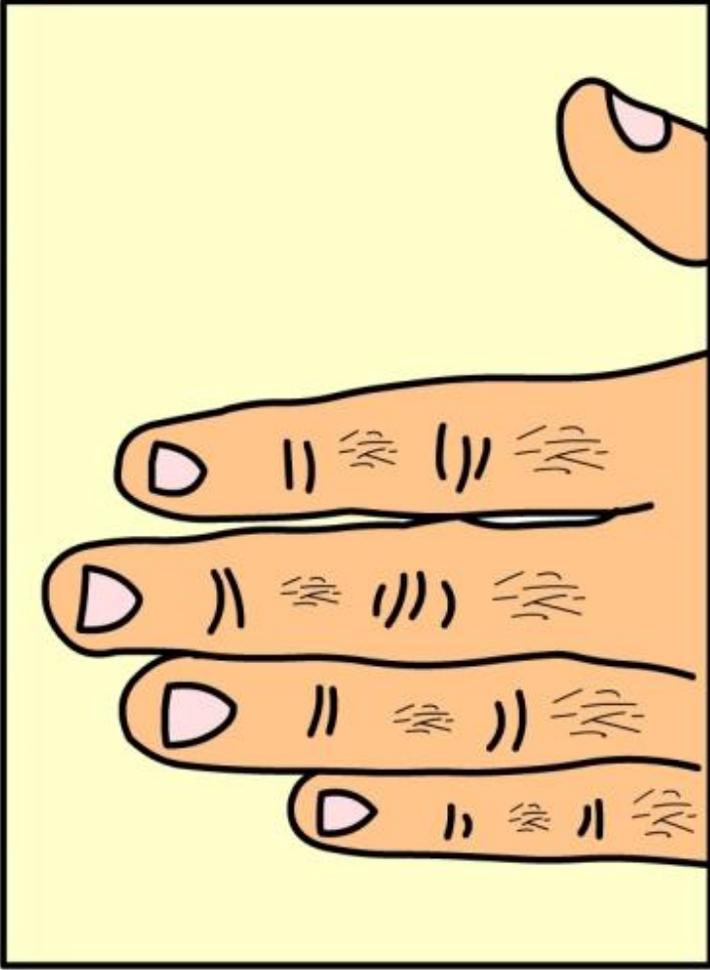




Bent little finger present

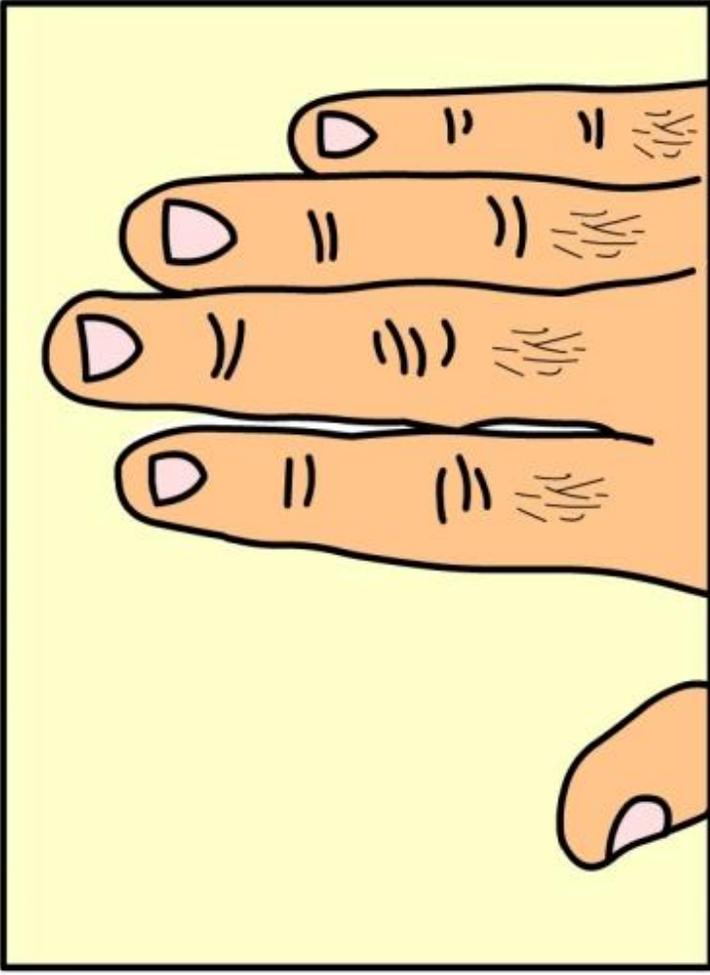


Straight little finger present



Mid-Digital Hair

Present



Mid-Digital Hair

Absent











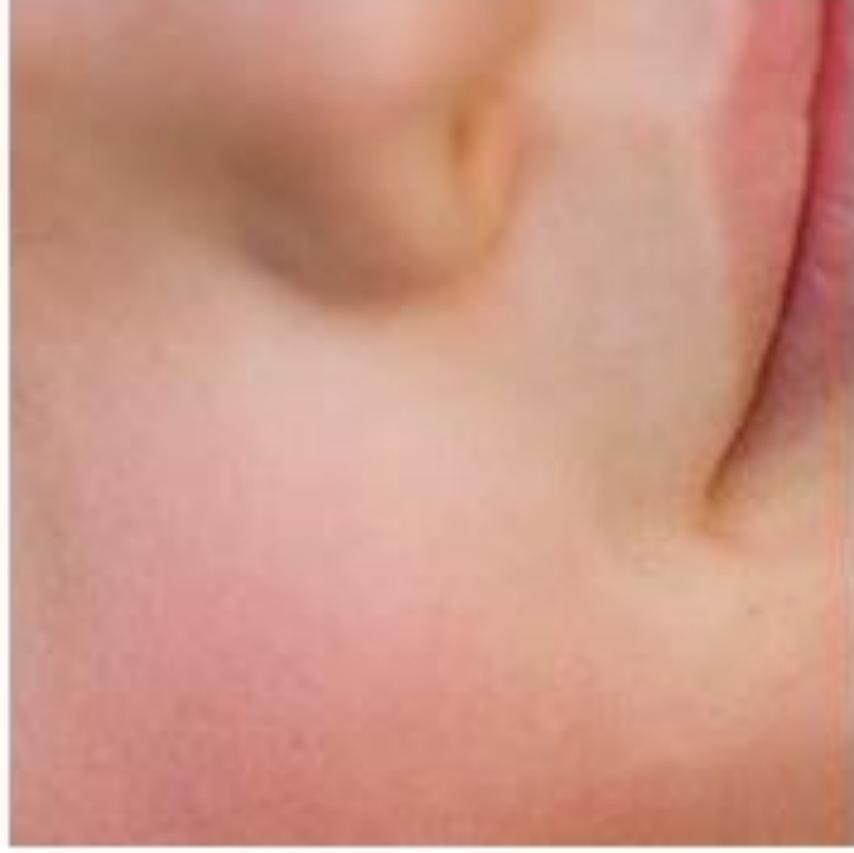
Dimples



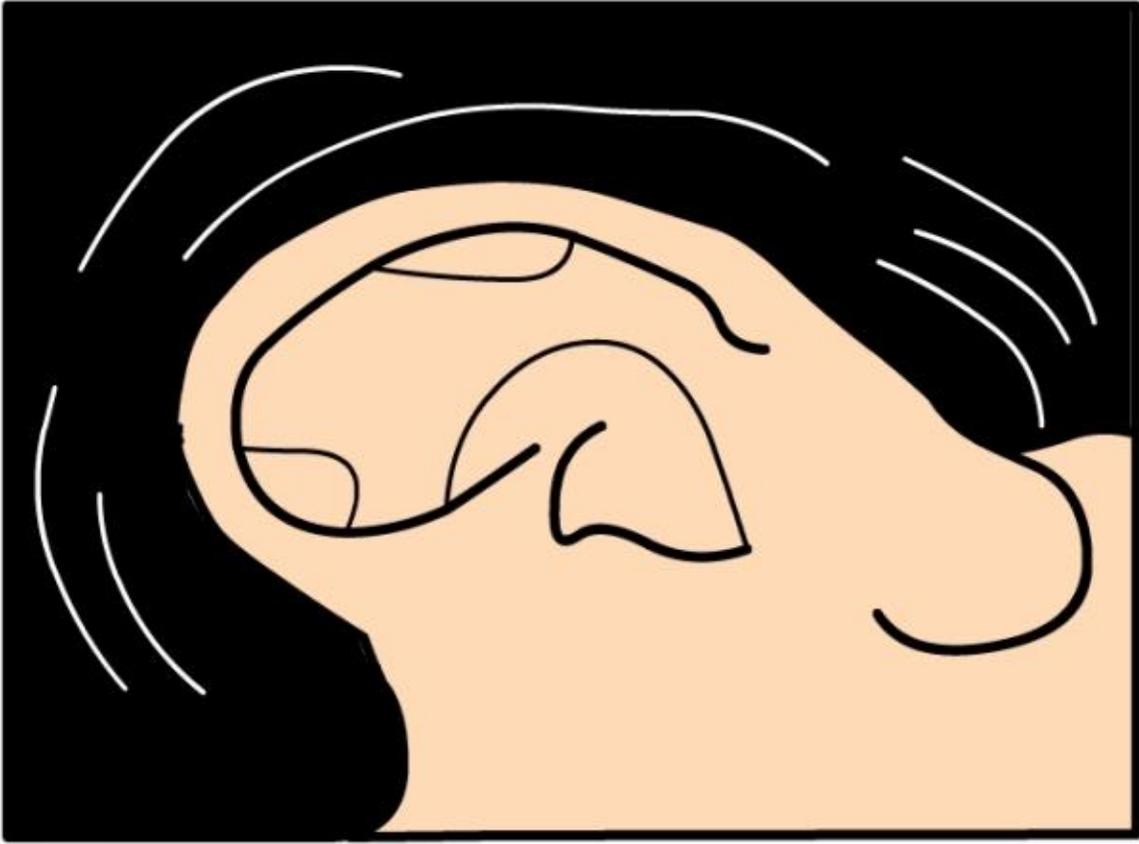
No Dimples



Freckles



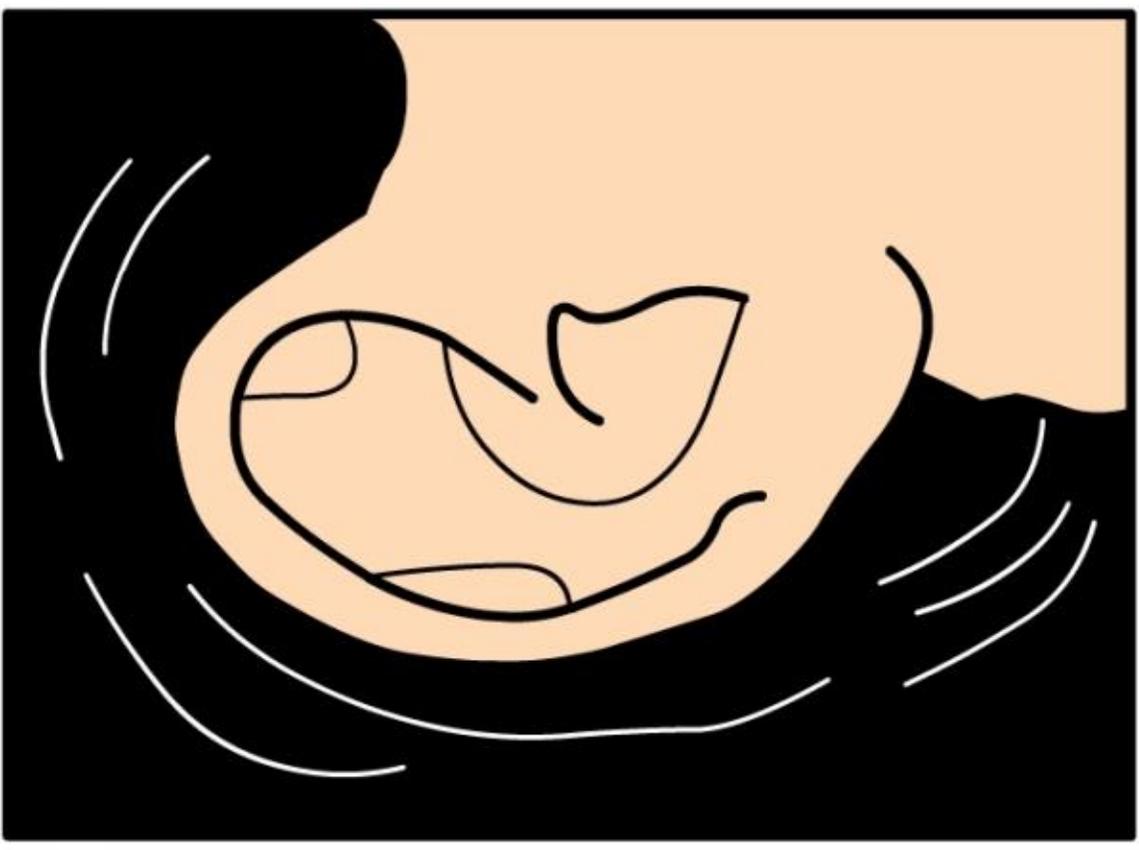
No Freckles

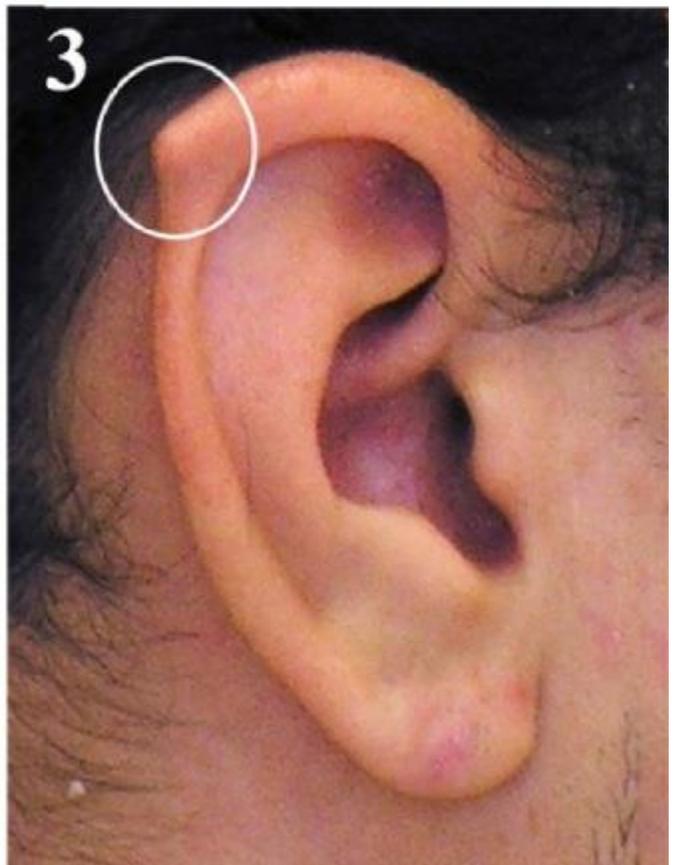
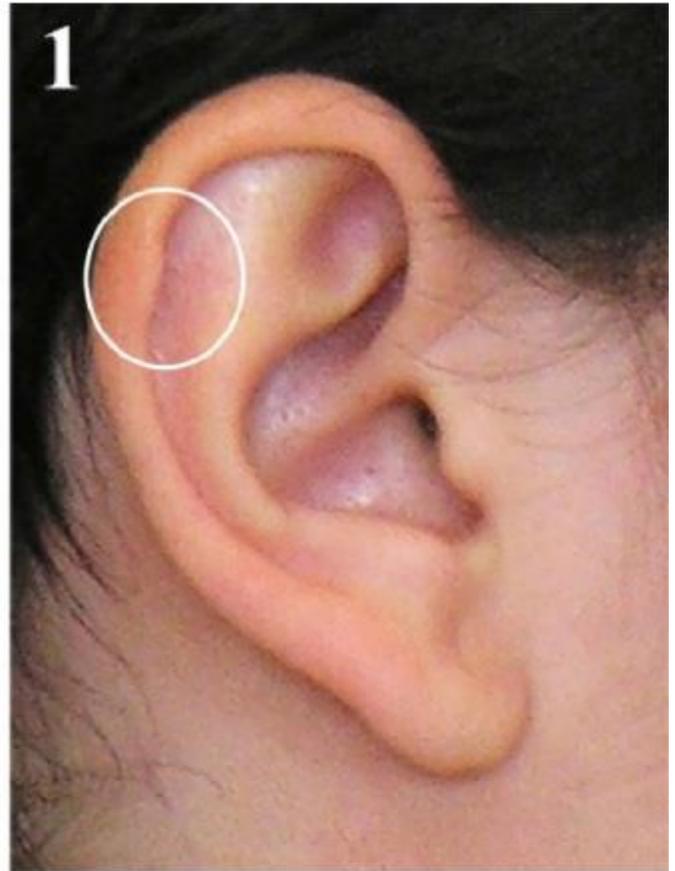


Free ear lobe



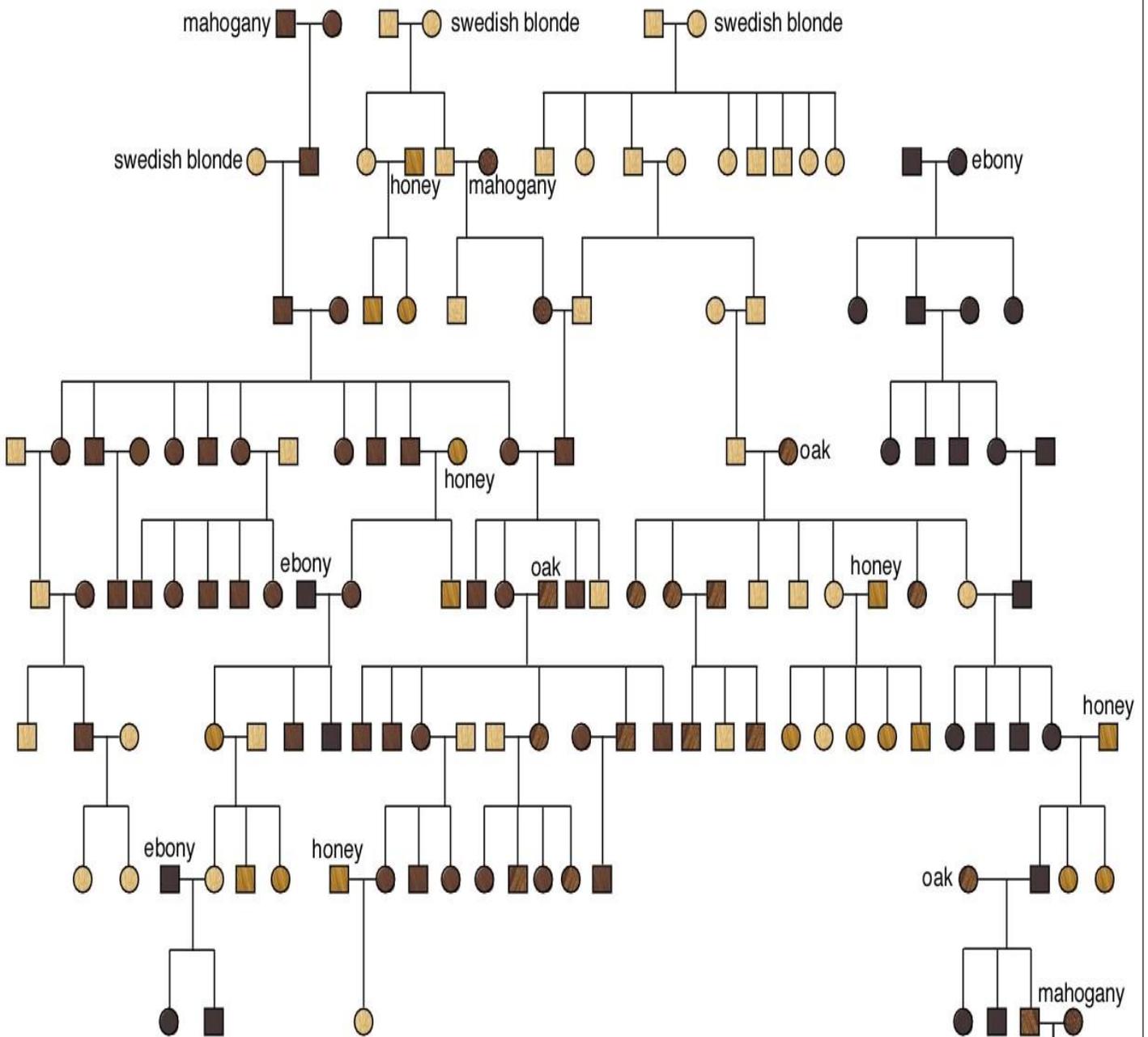
Attached ear lobes





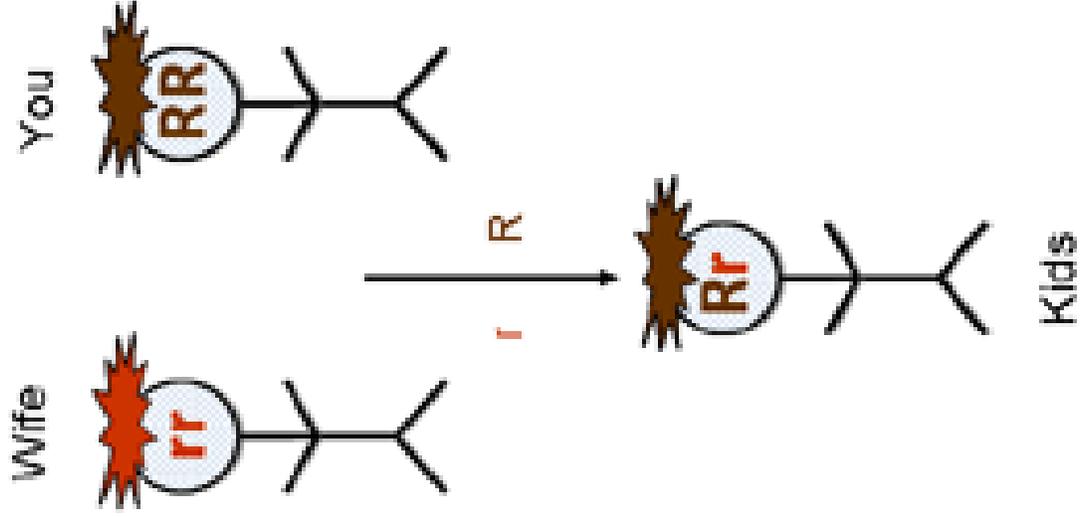


Inheritance of Brown Hair Color

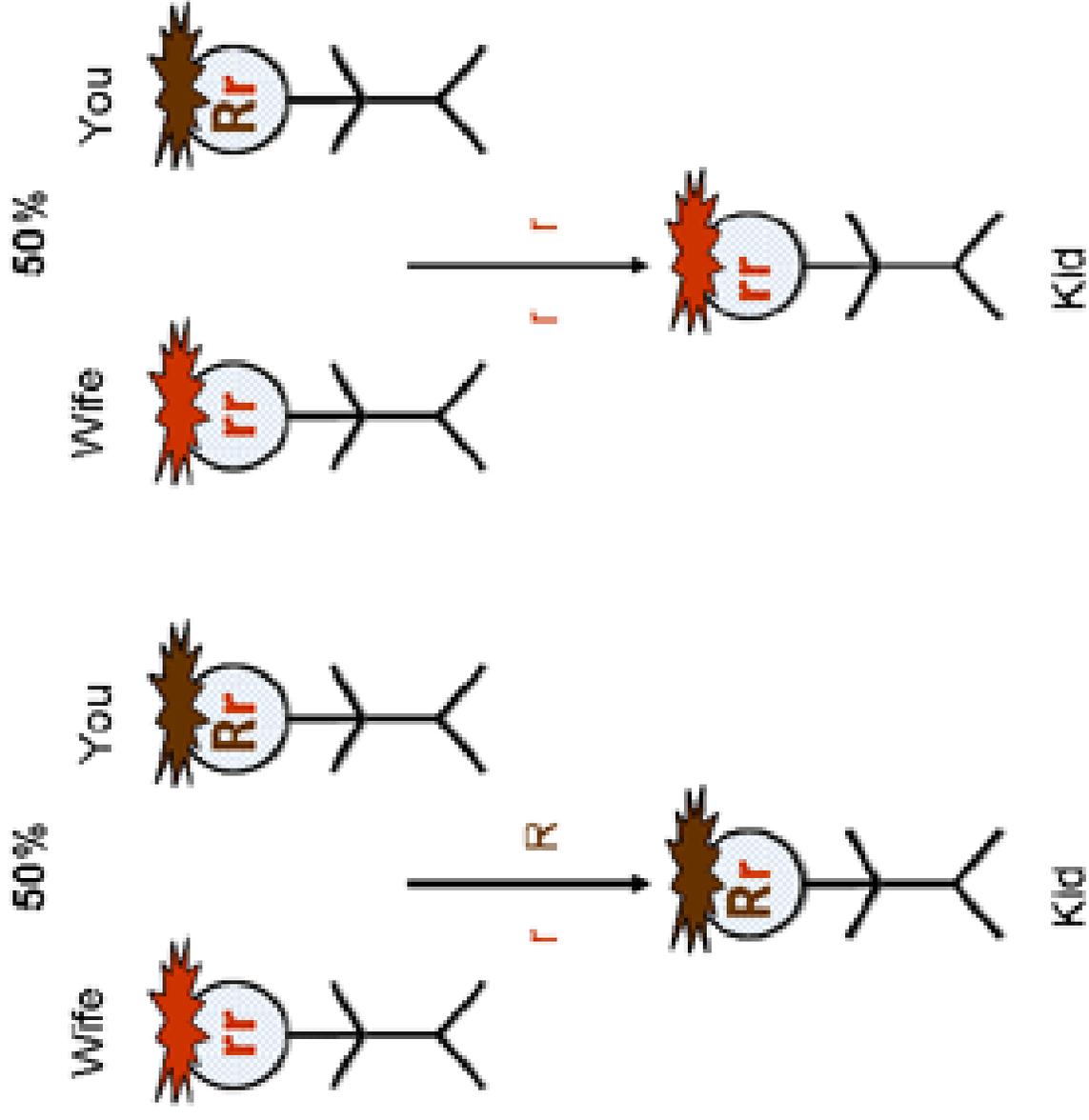


<p>□ Male</p> <p>○ Female</p>	<p>Hair Color (shade of brown)</p> <ul style="list-style-type: none"> ■● ebony ■● mahogany ■● oak ■● honey ■● swedish blonde
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OPTION 1
(you are not a carrier)



OPTION 2
(you are a carrier)



Incomplete Dominance



Curly Hair (CC)

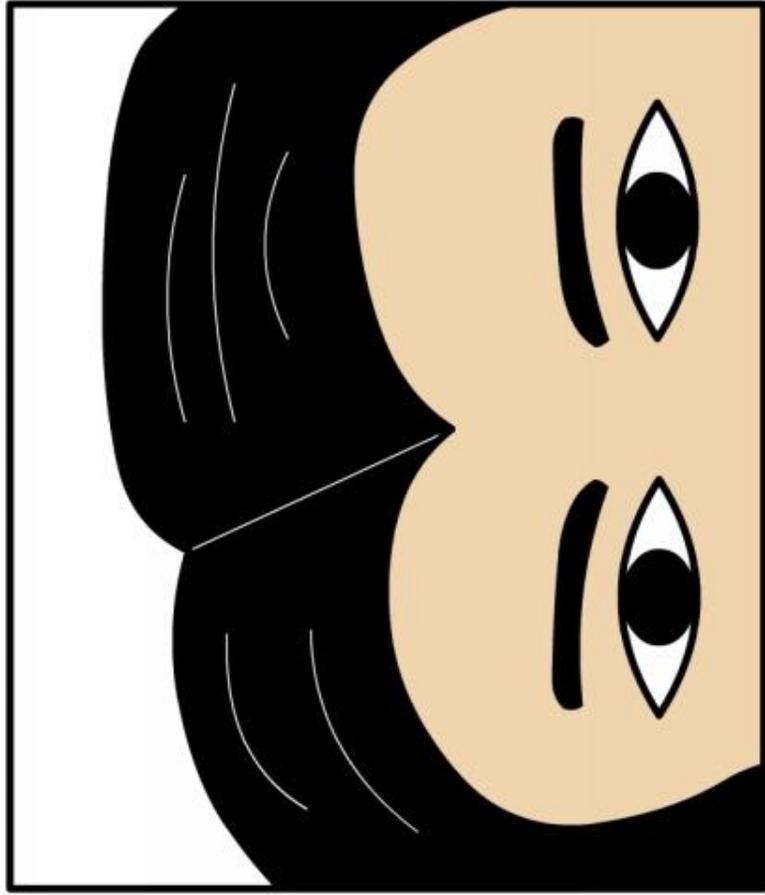


Wavy Hair (Cc)

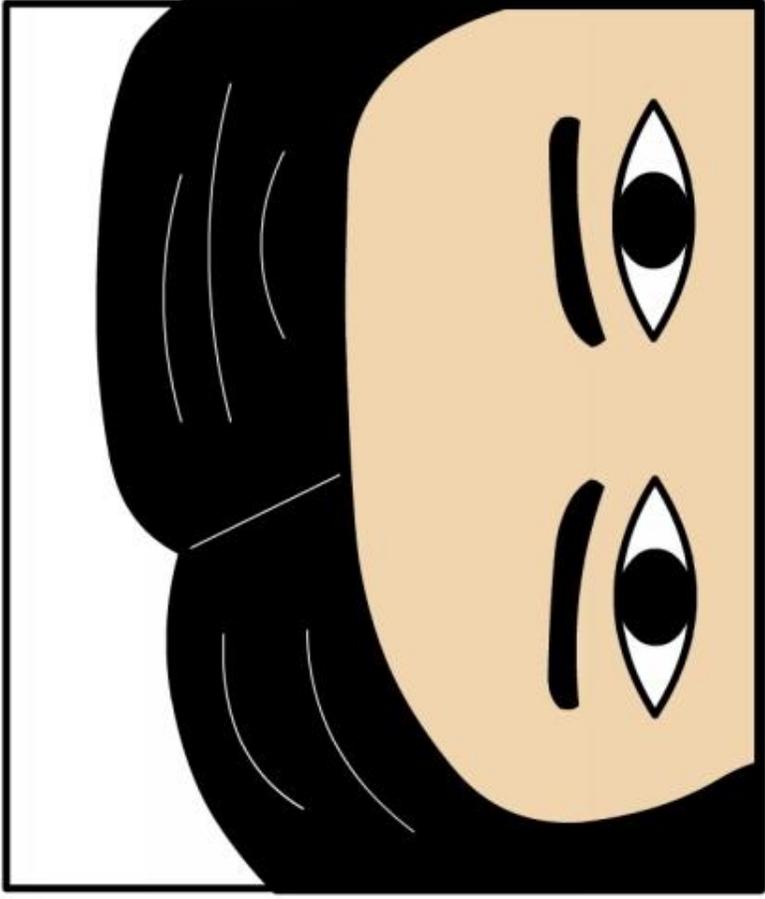


Straight Hair (cc)





Hairline with Widow's peak



Straight hairline

