

# INCOMPLETE DOMINANCE and CODOMINANCE

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



## Incomplete Dominance

Previously you have studied genes in which one allele (one copy of a gene) was dominant and the other recessive. For instance, a heterozygous individual whose genotype is Hh, where “H” = right handedness and “h” = left handedness, would be right handed, since the right handed allele is dominant.

There are some gene pairs in which **neither allele is dominant**, and **when both alleles are present in the chromosomes both traits are expressed in the phenotype**. The resulting heterozygote phenotype is typically *in between* the two different homozygote phenotypes. This pattern of inheritance is called **incomplete dominance**. Examples of this include petal coloration in some flower species, curliness of human hair, and human hypercholesterolemia (see text for info on some of these).

In the first example, snap dragons or carnations that are homozygous for a red petal allele are red, flowers which are homozygous for a white petal allele are white, and heterozygous flowers appear pink due to the lack of dominance between the red and white color alleles.

In this case it is common to use two different capital letters of the alphabet to represent the red and white alleles, such that:  
**R = Red color**  
**W = White color**

In this example, red carnations would be RR, white carnations would be WW, and pink carnations would be RW. This is summarized below.

<u>Genotype</u>	<u>Resulting Phenotype</u>
RR	Red flowers
WW	White flowers
RW	<b>Pink</b> flowers (usually, what phenotype would you expect for this genotype? _____)

↗ if this were a dom/rec relationship

## Sample Problem #1

- a. A red carnation is crossed with a white carnation and the resulting offspring are all pink (indicating incomplete dominance). What would be the result of a cross between a **pink** and a **white** carnation?

Pink carnation genotype: RW

White carnation genotype: WW

	<b>R</b>	<b>W</b>
<b>W</b>		
<b>W</b>		

**Fill in the Punnett square and give the phenotype percentages of this cross:**

\_\_\_\_\_ % are \_\_\_\_\_ color

\_\_\_\_\_ % are \_\_\_\_\_ color

- b. Could Red offspring be made from a cross of a White carnation with a Pink one? \_\_\_\_\_  
*(over for answers)*

**Sample Problem #1 Answers:**

a. Punnett square:

	<b>R</b>	<b>W</b>
<b>W</b>	<b>RW</b>	<b>WW</b>
<b>W</b>	<b>RW</b>	<b>WW</b>

50 % are White color

50 % are Pink color

b. Could Red offspring be made from a cross of a White with a Pink? No, this is not possible

**Sample Problem #2**

A curly haired person and a straight haired person mate and all their offspring have wavy hair (note that wavy hair is a phenotype *in between* that of the curly and straight haired individuals).

What would be the result of a cross between **two wavy haired** individuals? (give phenotype %'s)

Key: \_\_\_\_\_ = \_\_\_\_\_

\_\_\_\_\_ = \_\_\_\_\_


The resulting F<sub>1</sub> offspring would be:

**Sample Problem #2 Answer:**

If C = curly hair  
S = straight hair

	<b>C</b>	<b>S</b>
<b>C</b>	<b>CC</b>	<b>CS</b>
<b>S</b>	<b>CS</b>	<b>SS</b>

F<sub>1</sub>: 25% Curly (CC)  
50% Wavy (CS)  
25% Straight (SS)

## Codominance

There is another pattern of inheritance that also is an example of lack of dominance. In this situation, if the resulting phenotype *exhibits both traits of the parents*, the offspring phenotype is said to be the result of **codominance**. Examples of this include A and B blood types in humans, sickle-cell disease, and coat color in cattle and horses.

In this last example, cattle which are homozygous for a red coat allele are red, cattle which are homozygous for a white coat allele are white, and heterozygous cattle appear roan (red hairs mixed with white) due to codominance of the red and white coat color alleles. In this case it is common to use two different capital letters of the alphabet as superscripts to a common letter, to represent the red and white coat color alleles. For example, red cattle would be  $C^R C^R$ , white cattle would be  $C^W C^W$ , and roan cattle would be  $C^R C^W$ , where:

$C^R$  = red coat                      and  
 $C^W$  = white coat

How is this different from red, white, and pink flowers?

Cattle coat color would be considered incompletely dominant if  $C^R C^W$  were completely pink, instead of a patchy red and white.

Carnation petal color would be considered codominant if RW were red and white striped, instead of solid pink.

Nevertheless, both these patterns of inheritance are important for they deviate from the basic dominant/recessive pattern of inheritance.

In summary: Cattle and Horse Coat Color

<u>Genotype</u>	<u>Resulting Phenotype</u>
$C^R C^R$	Red coat
$C^W C^W$	White coat
$C^R C^W$	<b>Roan</b> coat (red hairs mixed with white)

### Sample Problem #3 (answers on back)

1. A roan bull (male) is mated with a white cow (female). What are the possible offspring?

Bull's genotype:

Cow's genotype:

Punnett square:


**Fill in the Punnett square and give the phenotype percentages of this cross:**

\_\_\_\_\_ % are \_\_\_\_\_ color

\_\_\_\_\_ % are \_\_\_\_\_ color

2. Could Red offspring be born to a White cow mated with a Roan bull? \_\_\_\_\_

## Sample Problem Answers

1. Punnett square:


50 % are White color

50 % are Roan color

2. Could Red offspring be born to a White cow mated with a Roan bull? No, this is not possible