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HEREDITY – INCOMPLETE DOMINANCE & CODOMINANCE

Incomplete Dominance

So far, every hereditary cross we have discussed has been *complete dominance*. In *complete dominance* one trait is completely dominant over another trait (recessive trait) resulting in two phenotypes. With **incomplete dominance**, there are two traits, neither of which are totally dominant, and when these traits appear together, in a heterozygous genotype, a third phenotype appears. *Incomplete dominance* will involve a third phenotype which happens to be a "mix" or "blend" of two different phenotypes.

Incomplete Dominance Phenotype/Genotype Example

The flower color of a plant known as a *snapdragon* has three different colors. The snapdragon flower may be red, white, or pink. When an allele from the red trait is paired with an allele from the white trait a pink-colored flower results.

Snapdragon Flower Color			
Phenotype	**Genotype Possibilities**		
Red	RR	RR	RR
White	rr	R^1R^1	WW
Pink	Rr or rR	RR^1 or R^1R	RW or WR

There are a few different ways for writing the genotypes of *incomplete dominance* phenotypes, depending on the resource. Staying with our example of *snapdragon* flower color, some resources will use the genotype **RR to represent Red Flowers, rr to represent White Flowers, and Rr to represent Pink Flowers**. This is probably not the best method because many students will think the White phenotype is recessive since the genotype is two lowercase r's. Keep in mind, if a White Flower was truly recessive they would not influence the Red Flower alleles when they come together to form Pink Flowers. Some resources will use **RR for red, R^1R^1 for white, and RR^1 for pink**. The R^1 (said as "R prime"), that you see in the white and pink genotypes, only uses the "1" to distinguish one allele from another. The "1" has no other unique meaning. A third method used for genotypes is **RR for red, WW for white, and RW for pink**. Many prefer this method, however, be very careful. The common mistake made with this method is creating a third letter for the third phenotype. Many students will want to create a third letter of "P" for pink. Remember, the only reason pink exists is because a red allele and a white allele come together, there is no pink allele.

Incomplete Dominance Example

Many times you will be told when you are dealing with an *incomplete dominance* cross, however, sometimes you will not be made aware. The key is to recognize a third phenotype. Whenever you see a third phenotype that is a mix or blend, then you know you are involved in an *incomplete dominance* cross.

For an example, we will cross the following parents:

Parents: Red snapdragon flower x White snapdragon flower

***Little Note:** Notice how there is no need to use the terms homozygous or heterozygous.

1. Genotypes of Parents: RR x WW

Due to the law of segregation, the alleles will now separate into gametes.

2. Gametes of Parents: R, R x W, W

You will continue the process in the same fashion as you do monohybrid crosses.

3. Crossing the Parents' Alleles:

	R	R
W	RW	RW
W	RW	RW

4. Genotypic Probability

Record the Genotype of the upper left box of the Punnett square (RW). Then count how many boxes out of the 4 have that same genotype. In this case, the **genotypic probability is 4/4 RW**. The genotypic probability of this cross between the Red Flower parent plant and White Flower parent plant tells us that 100% or all of the offspring will be of the genotype RW.

5. Phenotypic Probability

Record the Phenotype of the upper left box of the Punnett square (Pink Flower). Then count how many boxes out of the 4 have that same phenotype. In this case, the **phenotypic probability is 4/4 Pink Flower**. The phenotypic probability of this cross between the Red Flower parent plant and White Flower parent plant tells us that 100% or all of the offspring will be of the phenotype Pink Flower.

Incomplete Dominance Practice

For practice, cross the following parents:

Parents: Pink snapdragon flower x White snapdragon flower

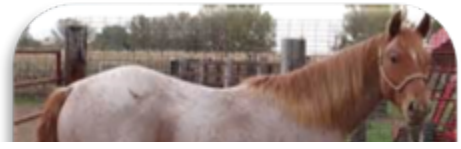
(Go to the end of this unit for the answers.)

1. Genotypes of Parents:
2. Gametes of Parents:
3. Crossing the Parents' Alleles:
4. Genotypic Probability:
5. Phenotypic Probability:

Codominance

Codominance occurs when both alleles for a gene are expressed in a heterozygous genotype. In *codominance*, there are no recessive alleles. *Codominance* involves NO "blending" or "mixing" of alleles, as in *incomplete dominance*, instead, both dominant traits are expressed in a heterozygous genotype as a third phenotype. As you already learned the third phenotype concerning *incomplete dominance* shows a "blending" of two alleles, the third phenotype concerning *codominance* will have both dominant traits expressed at the same time.

Codominance Phenotype/Genotype Example



The roan coat color of a horse demonstrates *codominance*. The horse's coat color can be red, white, or roan. The heterozygous roan coat color actually

consists of both white hairs and red hairs together, there is no mixing of color within an individual hair. The genotypes would be **RR for red, R^1R^1 or WW for white, and RR^1 or RW for roan**. Notice the method for creating the genotypes is the same as with *incomplete dominance*, but remember there is NO blending in the heterozygous condition with *codominance*.

Codominance Example

For an example, we will cross the following parents:

Parents: Red coat color x White coat color

***Little Note:** Notice how there is no need to use the terms homozygous or heterozygous.

1. Genotypes of Parents: RR x WW

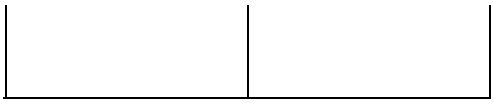
Due to the law of segregation, the alleles will now separate into gametes.

2. Gametes of Parents: R, R x W, W

You will continue the process in the same fashion as you do monohybrid crosses.

3. Crossing the Parents' Alleles:

	R	R
W	RW	RW
W	RW	RW



4. Genotypic Probability

Record the Genotype of the upper left box of the Punnett square (RW). Then count how many boxes out of the 4 have that same genotype. In this case, the **genotypic probability is 4/4 RW**. The genotypic probability of this cross between the Red Coat color and White Coat color tells us that 100% or all of the offspring will be of the genotype RW.

5. Phenotypic Probability

Record the Phenotype of the upper left box of the Punnett square (Roan color). Then count how many boxes out of the 4 have that same phenotype. In this case, the **phenotypic probability is 4/4 Roan color**. The phenotypic probability of this cross between the Red Coat color and White Coat color tells us that 100% or all of the offspring will be of the phenotype Roan Coat.

Codominance Practice

For practice, cross the following parents:

Parents: Red Coat Color x Roan Coat Color

(Go to the end of this unit for the answers.)

1. Genotypes of Parents:
2. Gametes of Parents:
3. Crossing the Parents' Alleles:
4. Genotypic Probability:
5. Phenotypic Probability:

Answer to Incomplete Dominance Practice

1. Genotypes of Parents: RW x WW
2. Gametes of Parents: R, W x W, W

3. Crossing the Parents' Alleles:

	R	W
W	RW	WW
W	RW	WW

4. Genotypic Probability

2/4, 1/2, or 50% RW; 2/4, 1/2, or 50% WW

5. Phenotypic Probability

2/4, 1/2, or 50% Pink Flower; 2/4, 1/2, or 50% White Flower

Answer to Codominance Practice

1. Genotypes of Parents: RR x RW

2. Gametes of Parents: R, R x R, W

3. Crossing the Parents' Alleles:

	R	R
R	RR	RR
W	RW	RW

4. Genotypic Probability

2/4, 1/2, or 50% RR; 2/4, 1/2, or 50% RW

5. Phenotypic Probability

2/4, 1/2, or 50% Red Coat; 2/4, 1/2, or 50% Roan Coat

Unit 24 Worksheet Heredity-Incomplete Dominance and Codominance

UNIT VOCABULARY REVIEW

The term used to describe one of the

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