WORKSHEET 12: MULTIPLE ALLELE CROSSES (ABO BLOOD GROUP) "CODOMINANCE"

Name_____Year and Section_____
Score_____

Teacher_____

School_____Date_____

Objectives: Find out genetic phenomena using the concepts of multiple alleles.

BIG IDEAS:

DOMINANCE is **NOT ALWAYS COMPLETE**. Multiple alleles is a type of non-Mendelian inheritance pattern that involves more than just the typical two alleles that usually code for a certain characteristic in a species. With multiple alleles, that means there are more than two phenotypes available depending on the dominant or recessive alleles that are available in the trait and the dominance pattern the individual alleles follow when combined together.

Gregor Mendel only studied traits in his pea plants that showed simple or complete dominance and had only two alleles that could contribute to any one trait the plant showed. It wasn't until later that it was discovered that some traits can have more than two alleles that code for their phenotypes. This allowed many more phenotypes to be visible for any given trait while still following Mendel's Laws of Inheritance.

Most of the time, when multiple alleles come into play for a trait, there is a mix of types of dominance patterns that occur. Sometimes, one of the alleles is completely recessive to the others and will be masked by any of those that are dominant to it. Other alleles may be co-dominant together and show their traits equally in the phenotype of the individual.

There are also some cases where some alleles exhibit incomplete dominance when put together in the genotype. An individual with this type of inheritance connected to its multiple alleles will show a blended phenotype that mixes both of the alleles' traits together.

Prepared by: Ronaliza Atiagan Marcos HS

Source: https://www.thoughtco.com/multiple-alleles-definition-and-examples-1224504#:~:text=The%20human%20ABO%20blood%20type,following%20Mendel's%20Laws%20of%20Inheritance.

http://mtcorps.pbworks.com/f/Multiple_Alleles_and_Sex_Linkage_Lesson_Plan-2.pdf

https://byjus.com/biology/co-dominance-and-multiple-alleles/

Examples of Multiple Alleles

The **human ABO blood type** is a good example of **multiple alleles**. Humans can have red blood cells that are of **type A (IA), type B (IB), or type O (i).** These three different alleles can be combined in different ways following Mendel's Laws of Inheritance. The resulting genotypes make either type A, type B, type AB, or type O blood. **Type A** blood is a combination of **either two A alleles (IA IA) or one A allele and one O allele (IAi)**. Similarly, **type B blood** is coded **for by either two B alleles (IB IB) or one B allele and one O allele (IBi). Type O blood** can only be obtained with **two recessive O alleles (ii**). These are all examples of simple or complete dominance.

Type AB blood is an example of co-dominance. The A allele and the B allele are equal in their dominance and will be expressed equally if they are paired together into the genotype IA IB. Neither the A allele or the B allele is dominant over each other, so each type is expressed equally in the phenotype giving the human an AB blood type.

Directions: Answer the following genetic cross problems. You can refer to the "Punnett Square Cheat Sheet" attached at the end of this worksheet to help you solve the different types of problems. It is essential that you know the all of the vocabulary inlcuded in the "cheat sheet" as well. Remember when you are doing a genetic cross to follow the steps below to complete!

STEP 1: Determine what kind of problem you are trying to solve.

STEP 2: Determine letters you will use to specify traits.

STEP 3: Determine parent's genotypes.

STEP 4: Make your Punnett square and make gametes.

STEP 5: Complete cross and determine possible offspring.

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STEP 6: Determine genotypic and phenotypic ratios.

Multiple Allele Genetic Crosses: So far we have studied traits or genes that are coded for by just two alleles. Like in rabbits, there was one allele for brown hair color and one allele for white hair. However, some traits are coded for by more than two alleles. One of these is blood type in humans. This is a violation of Mendel's Principle of unit characteristics.

In humans, there are four types of blood; type A, type B, type AB, and type O. The alleles A and B are codominant to each other and the O allele is recessive to both A and B alleles. So a person with the genotype AA or AO or IAi will have A type of blood. Refer to the table below. The I designation stands for **isoagglutinogen**, another term for antigen.

Genotype	Blood type
$I_A I_A$	A
$I_A I_B$	AB
$I_A i$	A
$I_B I_B$	B
$I_B i$	B
$i i$	O

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1. DRAG and DROP. You are blood type O and you marry a person with blood type AB. Choose from the choices below and drag drop your answers.

A. Complete a Punnett square for this cross.

IBi i IB IAi i IAi IBi IA

b. List the possible blood types (phenotypes) of your offspring.

_____

_____

2. A man with type B blood marries a woman with type A blood. They have the first child with blood type O.

a. What are the genotypes of the father and the mother?

_____

b. What is the genotype and phenotype of the baby?

_____

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