Codominant Traits

Name_____
Date_____

Introduction

With a single gene trait we always use the same letter for the two allele types (upper vs. lower-case of the same letter) - example, "Ff". However, in the case of codominant gene traits there are two dominant alleles. Both dominant alleles must be upper-case letters, therefore we must use two different letters for the dominant genes and a third lower-case letter for the recessive allele. In this activity you will work with codominant genes for two different red blood cell (RBC, also termed **erythrocyte**) traits – blood types and RBC hemoglobin (normal vs. sickle shaped).

There are three **blood type** alleles (A, B, and O) with A and B being codominant and O being recessive. When a person contains A and/or B alleles, then they have A and/or B receptors on the surfaces of their RBCs. When codominant genes are paired together, then the proteins coded by those genes will both be expressed. Similar is the case when red flowers mix with white flowers to create pink or red and white striped flowers (these plants usually do not have an additional recessive allele) – both red and white alleles are codominant.

BLOOD TYPES

Blood Type Alleles: A, B, and i

The proper way to write codominant genotypes is to choose a letter to name the gene followed with a superscript letter indicating the allele form of each gene.

In blood typing, the gene letter is usually "I" for the dominant allele form and "i" for the recessive allele form of the gene. The codominant alleles are distinguished with a superscript of the allele A or B (I^A, I^B). Two recessive alleles (no dominant allele present) forms Type O blood.

1. Write all of the possible genotypes for the following:

Type A _____ _____

Type B _____ _____

Type AB _____

Type O _____

Punnett Square Problems

2. If a Type O is crossed with a Type AB parent, then what chance does the offsprings have of having the same blood type as one of their parents?

Answer: _____

3. Is it possible for any offspring to be Type O if one parent is Type AB?

Answer: _____

Explanation:

_____

_____

4. Cross a heterozygous Type A person with a heterozygous Type B person.

What will be the phenotype ratio of the offspring?

Types: _____ _____ _____ _____

Ratio: _____:_____:_____:_____

5. If both parents have Type O, then what phenotype(s) can their offspring have?

Answer: _____

6. If both parents have Type AB blood, then what phenotypes can their offspring have?

Answer: _____

RBC HEMOGLOBIN

Hemoglobin Alleles: A, S

RBC hemoglobin can be formed into different shapes which affects its oxygen-carrying capacity. Normal hemoglobin is shaped like a donut, where the center of the RBC is concaved inwards, but does not become a complete hole as a donut does. This hemoglobin carries up to 4 O_2 molecules throughout the body.

Some people have a mutation in this gene causing their blood to sometimes change into or always be sickle shaped (half-moon shaped). At most, each sickle RBC can carry 2 O_2 molecules. Lack of oxygen **(anemia)** causes exhaustion and stunted growth of all cells. RBCs have two points which makes blood clots causing pain and higher rates of stroke and cardiac arrests (heart attacks).

There are two types of sickle phenotypes – sickle cell trait and sickle cell anemia. Those with sickle cell trait are born with normal blood but can change to sickle when triggered by a specific environmental factor (high altitude, excessive exercise). One who is born with sickle cell anemia will never have normal blood and will likely live to approximately 12 years. The only confirmed people to have this mutation are of African decent. In the U.S., 10% have sickle cell trait while 0.25% has sickle cell anemia. Those with this mutation are able to survive malaria.

Hemoglobin shape is determined by its codominant allele combination. A for normal and S for sickle. There is no recessive allele for this trait.

The gene letter is "H" to signify it as the hemoglobin gene. A or S are superscripts on the H gene to signify it as normal (H^A) or sickle (H^S).

1. What are the genotypes for the following hemoglobin types?

   Normal _____ Sickle Cell Trait _____ Sickle Cell Anemia _____

2. Who has the greater chance of having a child with hemoglobin S – someone who has the trait or someone who has anemia?

3. Explain why you cannot determine if you have sickle cell anemia by knowing your blood type?

4. Can a person with sickle cell trait develop sickle cell anemia (temporarily)?

5. What treatment would you suggest for someone who has sickle cell trait or anemia?

6. Would you mind receiving a blood transfusion from someone who has sickle cell trait when considering that RBCs live for only 120 days?

7. Should you move to a location which has a high probability for malaria, which phenotype would you most want to have? Explain.

8. What parental genotype crosses can produce an offspring born with sickle cell anemia? Which is the most likely to occur? Why?
Show Punnett Squares to determine!!

9. Name any other genetic disorders that are found more frequently in specific ethnic populations.