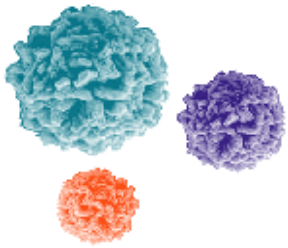
Pre-Hardy-Weinberg

Student Information Page 3D

Activity Background:

Even though blood has been studied for thousands of years, the discovery of the different blood types was not made until the 20th century. In 1901, Dr. Karl Landsteiner identified the three major ***blood types*** A, B, and O. Landsteiner found that each blood type is based on two different ***antigens***, which are molecules capable of producing an immune response. The immune response begins by triggering the production of ***antibodies***. Antibodies are Y-shaped proteins released into the blood or lymph in response to an antigen and can neutralize the antigen by binding to it.



The antigens that determine blood type are located on the surface of red blood cell membranes. They are composed of **glycoproteins** (molecules made of protein and carbohydrate) and **glycolipids** (molecules of fat and carbohydrate). Combinations of various antigens help make-up the four basic human blood types.

Blood types:

People with type A blood have A antigens on their red blood cells and produce antibodies against B antigens (B antibodies).

People with type B blood possess B antigens on their red blood cells and produce antibodies against A antigens (A antibodies).

People with type AB blood have both the A and B antigens and do not produce antibodies for either antigen.

People with type O blood have neither the A nor B antigen on their red blood cell walls, but produce antibodies for both antigen types (A antibodies and B antibodies).

(For more information on the specific blood groups, see ***Activity 3A "Hey, What's Your Type?"***)

Blood type is an inherited trait. An individual receives two genes for each trait he/she inherits; one from mother and one from father. The different forms of a gene are called ***alleles***. In the case of blood types, an individual could receive two genes for the A antigen in which case we would say he/she has received two A alleles and would be blood type A. If he/she inherited a gene for the A antigen from one parent and a B antigen from the other parent, that individual would have received an A allele and a B allele and would be blood type AB. If a person inherits two genes that keep him or her from making an A or B antigen, then he/she would be blood type O. See ***Table 1*** for the alleles in each blood type.

Table 1 Alleles in Each Blood Type

Type A:	**AA,**	**AO**
Type B:	**BB,**	**BO**
Type AB:	**AB**	
Type O:	**OO**	

Activity Materials:

- 10 red poker chips
- 10 blue poker chips
- 10 white poker chips
- 1 copy *Student Information Page* (per group)
- 1 copy *Student Data Page*

Activity Instructions:

1. You and your partner will work together in this simulation. First, gather your materials. For the first simulation, you will need 4 poker chips – 2 red and 2 white.

2. The *red chips* represent the *A allele*. The *white chips* represent the *O allele*.

3. Put all 4 chips behind your back and shuffle them. Your partner should do the same.

4. Take one chip from behind your back. This will represent the allele that you are contributing to your offspring. Your partner should do the same thing.

5. Record the genotype of the offspring on the data sheet. This is the first generation.

6. Use this information to determine what chips you need for the second generation.
   a. For example, if you had 2 red chips for the first generation, you will need to put away your white chips and get 2 more red ones.

   b. If you had 2 white chips for the first generation, you will need to put away your red chips and get 2 more white ones.

   c. If you had a red and white chip for your first generation, you can keep your 2 red chips and 2 white chips.

7. Find another partner. Repeat steps 3-5 and record the genotype of the second generation offspring on the data sheet. Again, use this information to determine what chips you need for the third generation.

8. Continue this pattern until you have recorded genotypes for 5 generations.

9. Determine the frequency of the alleles by counting the number of offspring in each generation that was AA (2 red chips), AO (1 red, 1 white chip), or OO (2 white chips).

10. Use this information to determine if this frequency was different than the initial class frequency.

Heterozygote advantage instructions:

1. Follow the instructions for steps 1-4 from the previous section.

2. If your offspring is AA, flip a coin. If the coin lands on "heads" the offspring will survive. If the coin lands on "tails" the offspring will not survive and you must repeat steps 1-4. Once you have produced a surviving offspring, you may continue with steps 5-10 remembering to flip a coin any time your offspring is AA.

3. Compare this information with the frequency of alleles in the original simulation. How has the frequency changed?

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