## Multiple Alleles and Polygenic Traits

## READ

## Multiple Alleles

Some inherited traits involve more than two alleles of a single gene. In humans, for example, three alleles (A, B, and $\mathbf{O}$ ) determine blood type. A person can have only two of the alleles, but there are three different ones found in the human population. The $\mathbf{A}$ and $\mathbf{B}$ alleles are equally dominant. A child who inherits and $\mathbf{A}$ allele from one parent and a $\mathbf{B}$ allele from the other parent will have type $A B$ blood. The $\mathbf{O}$ allele is recessive to both $\mathbf{A}$ and $\mathbf{B}$ alleles. A child who inherits an $\mathbf{A}$ allele from one parent and an $\mathbf{O}$ allele from the other parent will have a genotype of AO and a phenotype of Type A blood. Use this information to complete the tables below. Then check your work using the chart found in Section 11.3 of your student text.


| Genotype | Phenotype | Chance |
| :---: | :---: | :---: |
| AA | Type A blood | $1 / 9=11 \%$ |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## EXAMPLE

A man with type A blood marries a woman with type B blood. They have ten children together. All of the children have type AB blood. What do you suppose are the genotypes of each parent?

## Solution:

The father must be either AA or AO. The mother must be BB or BO . If one parent had the recessive O gene, we would expect that some of the children would have type A or type B blood. If both parents had the recessive $O$ gene, we would expect that some children would have type A, type B, or type O blood. Since all ten children have type AB blood, it is likely that the father is AA and the mother is BB .

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## PRACTICE

Use your tables from page 1 to answer the following questions:

1. A man with type A blood marries a woman with type B blood. Their first child has type O blood. What do you know about the genotypes of the parents?
2. One parent has type AB blood while the other has Type O blood. Which two blood types could their children have?
3. A child is born to a woman with type $O$ blood. If the child also has type $O$ blood, what are the three possible genotypes of the father?
4. A woman with type O blood gives birth to a child with type A blood. What are the three possible genotypes of the father?
5. If both parents have Type AB blood, what blood types are possible in their offspring?

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## Polygenic traits

Polygenic traits are inherited characteristics where more than one gene is involved in determining the phenotype. Most of the traits you learned about earlier involved just two possibilities: attached or free earlobes, can or cannot roll tongue, etc. Polygenic traits involve several possibilities. Hair color in humans is a polygenic trait. Eye color is, too. Height is also a polygenic trait, but nutrition during childhood also plays an important role in determining height. Even if your phenotype for height is six feet tall, without proper nutrition you won't reach that height.

Kernel color in wheat is an interesting polygenic trait to study. There are two genes that work together to determine kernel color. Dark red kernel plants are AABB. White kernel plants are aabb. When you cross a dark red with a white, the combination looks like this:


The AaBb offspring have kernels that are an intermediate color-a medium pink. What happens if you cross two AaBb plants? Fill in the table below to find out.

|  | AB | Ab | aB | ab |
| :---: | :---: | :---: | :---: | :---: |
| AB | $A A B B$ | $A A B 6$ | $A a B B$ | $A a B b$ |
| Ab |  |  |  |  |
| aB |  |  |  |  |
| ab |  |  |  |  |

## EXAMPLE

How many different colors of wheat are possible when you cross two plants with the AaBb genotype for kernel color? Use the table on the previous page to answer the question.

## Solution:

There are five different colors possible. The darkest red occurs when all four alleles are represented by upper case letters. With three upper case alleles, you get dark pink. Two upper case alleles give a medium pink, and one upper case allele results in light pink. The fifth possible color is white, represented by no upper case alleles.

## PRACTICE


6. When you cross two wheat plants that are AaBb for kernel color, which kernel color is the most likely result? What is the percent chance of getting this kernel color?
7. When you cross two wheat plants that are AaBb for kernel color, what is the percent chance of getting a light pink kernel color?
8. What is the percent chance of getting a pure color (either dark red OR pure white) when you cross two wheat plants that are AaBb for kernel color?
9. A dark pink kernel plant (genotype AaBB ) is crossed with a light pink kernel plant (aaBb). Make a punnett square of the cross and list the possible genotypes and phenotypes of the offspring.
aB ab


| Genotype | Phenotype | Chance |
| :---: | :---: | :---: |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

10. Suppose three genes control a single inherited trait. If the genes are represented by $\mathrm{Aa}, \mathrm{Bb}$, and Cc , what are the possible combinations of alleles that one parent could contribute to its offspring?
