2.2: Genotypes and Phenotypes

The word **genotype** refers to the sum total of all the genes a person inherits. The word **phenotype** refers to the features that are actually expressed. Look in the mirror. What do you see, your genotype or your phenotype? What determines whether or not genes are expressed? Because genes are inherited in pairs on the chromosomes, we may receive either the same version of a gene from our mother and father, that is, be **homozygous** for that characteristic the gene influences. If we receive a different version of the gene from each parent, that is referred to as **heterozygous**. In the homozygous situation we will display that characteristic. It is in the heterozygous condition that it becomes clear that not all genes are created equal. Some genes are **dominant**, meaning they express themselves in the phenotype even when paired with a different version of the gene, while their silent partner is called recessive. **Recessive** genes express themselves only when paired with a similar version gene. Geneticists refer to different versions of a gene as **alleles**. Some dominant traits include having facial dimples, curly hair, normal vision, and dark hair. Some recessive traits include red hair, being nearsighted, and straight hair.

Most characteristics are not the result of a single gene; they are **polygenic**, meaning they are the result of several genes. In addition, the dominant and recessive patterns described above are usually not that simple either. Sometimes the dominant gene does not completely suppress the recessive gene; this is called **incomplete dominance**. An example of this can be found in the recessive gene disorder sickle cell disease. The gene that produces healthy round-shaped red blood cells is dominant. The recessive gene causes an abnormality in the shape of red blood cells; they take on a sickle form, which can clog the veins and deprive vital organs of oxygen and increase the risk of stroke. To inherit the disorder a person must receive the recessive gene from both parents. **Those who have inherited only one recessive-gene are called carriers** and should be unaffected by this recessive trait. Yet, carriers of sickle cell have some red blood cells that take on the c-shaped sickle pattern. Under circumstances of oxygen deprivation, such as high altitudes or physical exertion, carriers for the sickle cell gene may experience some of the symptoms of sickle cell (Berk, 2004).

Box 2.1 Monozygotic and dizygotic twins

Updated: Fri, 05 Feb 2021 06:10:53 GMT
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Many students are interested in twins. **Monozygotic** or **identical twins** occur when a fertilized egg splits apart in the first two weeks of development. The result is the creation of two separate, but genetically identical offspring. That is, they possess the same genotype and often the same phenotype. About one-third of twins are monozygotic twins.

Sometimes, however, **two eggs or ova are released and fertilized by two separate sperm. The result is dizygotic or fraternal twins.** These two individuals share the same amount of genetic material as would any two children from the same mother and father. In other words, they possess a different genotype and phenotype. Older mothers are more likely to have dizygotic twins than are younger mothers, and couples who use fertility drugs are also more likely to give birth to dizygotic twins. Consequently, there has been an increase in the number of fraternal twins recently (Bortolus et al., 1999).