**Underlying Causes of Some Genetic Conditions**

**PKU** (phenylketonuria) is a metabolic disease that affects the way the body processes phenylalanine, one of the amino acid building blocks that make up proteins in all organisms. People with PKU don’t have *phenylalanine hydroxylase*, an enzyme (protein) necessary for normal processing of phenylalanine. Because they lack this enzyme, phenylalanine builds up in their bloodstream, causing brain damage and, subsequently, cognitive disability.

**Sickle cell disease** is a disorder that results in abnormal hemoglobin. Hemoglobin is the protein found in red blood cells that carries oxygen. When a person has sickle cell disease the hemoglobin in their red blood cells is different from normal hemoglobin. When the oxygen levels in the blood go down, the abnormal hemoglobin changes shape which causes the red blood cell to assume a sickle or crescent shape. Sometimes the sickled cells block the small blood vessels (capillaries) in the body which causes pain. People with sickle cell disease may also experience other complications such as damage to vital organs, shortage of red blood cells (anemia), and frequent infections. Infections are the leading cause of death in children with sickle cell disease. Individuals with sickle cell disease have a shorter life expectancy than people with normal hemoglobin and in many parts of the world they are likely to die as children.

Individuals with **achondroplasia** are dwarfed in stature mainly due to a shortening of the long bones of the arms and legs. They have a long, narrow body trunk. Their heads are large, with prominent foreheads. Most are of normal intelligence and have a normal life expectancy. The skeletal growth features of achondroplasia are caused by problems with certain protein molecules on the surface of their cells that are supposed to act as receptors for a molecule called fibroblast growth factor 3 (FGFR3). Our bodies produce several different kinds of fibroblast growth factors. FGFR3 seems to play a role in the formation of certain types of bones, such as those in the arms and legs.

**Albinism** occurs when the body produces small amounts or no melanin pigment. Because melanin is responsible for the color of your skin, a person with albinism has pinkish or white skin, eyes, and hair. There are several genes that code for several proteins that contribute to making of melanin. Albinism occurs when there is a mutation in any of the genes.

In humans there are four different blood types: A, B, AB, and O. Each of these types are genetically different in that people with type A and B blood each have a different protein on the surface of their blood cells. People with AB blood produce a combination of both surface proteins, and people with O blood do not produce any surface proteins.

**Peppered moths** have genes that control the melanin, or **wing coloration**. Today, most peppered moths have a black and white peppered coloration, and as we have learned, some have a black wing coloration. A mutation in the *cort* gene caused the protein *cortex* to malfunction and as a result the pepper moth with this mutation is all dark instead of black and white. The mutation that results in the dark form of the peppered moth occurs about 1 in every 200,000 offspring or .0005% of the time.

**Duchenne’s Muscular Dystrophy** is a condition involving the gene that codes for the protein *dystrophin*, a large protein that plays a role in the contraction of muscle cells. Without the full function of dystrophin, persons with the condition begin to experience muscle degeneration before three years of age, are often confined to a wheelchair by age 12 and frequently die by age 20. Muscles involved in breathing and heartbeat are also affected so heart and respiratory failure contribute to DMD being a lethal condition. Fortunately, DMD is extremely rare, occurring in less than 7 of every 100,000 births in the U.S.

**Cystic Fibrosis** is a condition in which mucus builds up in several different organs including the lungs and pancreas. Mucus in the lungs makes it difficult for the infected person to breathe, traps bacteria that results in infections and ultimately damages the lungs. Mucus in the pancreas stops important enzymes from being released, leading to the failure of nutrient absorption. The gene responsible for normal mucus secretion is the gene CFTR. It codes for the cystic fibrosis transmembrane conductance regulator. When this gene is damaged, the protein can no longer regulate normal mucus production. Thanks to modern medicine people suffering from Cystic Fibrosis now live to 40 years of age and can live fairly normal lives depending on the severity of their disease.