GENETICS/HEREDITY DISCUSSION

Each person begins life with his/her own set of blueprints or specifications. The study of how these blueprints are created is called genetics. All individuals normally inherit 23 pairs of chromosomes or 46 chromosomes in each of their billions of body cells. Chromosomes are rod-shaped chemicals that are tiny strands of DNA and protein that determine the genetic code of an individual. During a process called meiosis, each sex cell separates the paired chromosomes it contains and forms two new cells, each containing only 23 unpaired chromosomes. When the sex cell of a female, containing 23 chromosomes, combines with the sex cell of a male, containing 23 chromosomes, the result is a cell containing 46 paired chromosomes. One chromosome in each pair comes from the mother and one from the father.

Each chromosome is made up of thousands of genes. Genes are biochemical messengers that determine the specific physical and mental characteristics of each individual. The features and capacities that we inherit are determined by the genes given to us at the moment of conception.

These genes are carried on every chromosome on every cell of the body for the rest of the person's life. If that person becomes a biological parent, some combination of his/her genes will be passed on to the child.

Heredity refers to the characteristics that a child receives from both parents. This would include eye color, hair color, height, body build, blood types, intelligence, gender, and many other characteristics.

Special chromosomes, called sex chromosomes or germ cells, are identified by the symbols X and Y; they will determine the gender of the child. In the beginning, each sex cell contains 46 chromosomes. The male sex cell contains both an X and a Y chromosome. The female sex cell contains two X chromosomes. During the process of meiosis, each sex cell divides and reduces to 23 chromosomes. This occurs so a new being can be created, combining to make a new cell of 46 chromosomes.

Since the ovum always contains an X chromosome, she must pass an X chromosome to her child. Males can pass either the X or Y chromosome. If the male's Y chromosome unites with the egg, a boy will result. If the X chromosome from the male unites with the egg, then a girl will be the result. If the Y chromosome is passed from the father, the child will be a male. The sex of the child is determined by the chromosomes passed from the father.

TEACHER NOTE: This can be illustrated on the board or visually using children's stacking toys. Make two stacks of toys, using different color combinations in each stack. This shows that even though they are alike, they are also different.

Genes come from both parents and combine in different combinations. Each individual receives two genes for every inherited characteristic. One gene will come from the mother and one gene will come from the father. When both genes are the same, the characteristic will always be seen and expressed in the child. Some genes are dominant and some are recessive. A recessive trait can only determine the trait when two of them are present. The dominant gene is more powerful and will be the trait seen in a person. The recessive gene is weaker and hides in the background hoping to show up in future generations. The person then will still carry the recessive gene but will exhibit the trait of the dominant gene. For example, brown-eye genes are dominant over blue-eye genes. A person who receives both a brown and a blue-eye gene will have brown eyes; however, that person will still carry the recessive blue-eye gene and is able to pass that gene onto any children he/she might have.

Heredity explains why brothers and sisters often resemble each other. It also explains why brothers and sisters often look very different.

At times, a multiple birth may occur. Sometimes the fertilized ovum splits evenly into two identical cells that duplicate the chromosomal structure and continue to divide and grow into separate embryos. This produces monozygotic identical twins who have inherited the same genetic makeup. This means they will be the same gender.

There are times when the ovaries may release two or more eggs at the same time. These eggs are then fertilized by different sperm and begin growing simultaneously in the uterus. Since the babies are the result of different eggs and different sperms, they will look no more alike than any of the other children in the family. They may be different genders. These twins are called dizygotic or fraternal twins.

In multiple births of more than two, the babies may be identical, fraternal, or both. For example, triplets may be identical if the ovum splits into 3 parts, which then develop independently. If two eggs were released, and one of them splits apart, developing independently, there will be two identical babies and one single fraternal baby.

Siamese twins result when an ovum splits apart, but the separation is not completed. The babies will be joined at some part of their bodies. These births are very rare.

Some traits are carried by the sex chromosomes but are not specifically male or female traits. These are called sex-linked traits. They are determined by the recessive X chromosome. Since males have only one X chromosome, the mother would be a carrier of the trait and pass this recessive X chromosome to her son. Color blindness is an example of a sex-linked trait. A color-blind male receives the trait from his mother. The mother is usually not color blind herself, unless she received a recessive trait from both her mother and father. Dad cannot pass an X trait to his son, so if he has color-blindness, he will not pass it to his son.

Sometimes as the chromosomes come together and the genes matchup they do not pair properly and certain diseases or disabilities may be passed on to the child. When several signs or symptoms appear together, scientists categorize it as a particular problem. This is called a syndrome. Sometimes, these problems are evident right at birth and the child is born with the problem. This is called a congenital malformation because the problem was passed through the genes to the fetus.

Other times, the diseases of disabilities may be caused by a variety of factors. This type of problem is called a multifactorial defect.

There are times when the chromosomes are misshapen or there are too many or too few. This is called a chromosomal error.

Genetic counselors help people understand the way hereditary diseases and disabilities are passed on. Couples who have had a child with a problem or know that the family members have had problems may want to seek genetic counseling.

The genetic counselor, with the help of the couple, researches the problem. Tests are often given to determine if either partner is a carrier of a recessive gene.

A test can be performed to see if the fetus may have some genetic disorders. One of these tests is called amniocentesis. A sample of the amniotic fluid is removed with a needle inserted through the woman's abdomen into the amniotic fluid. The fluid contains cells cast off by the fetus. The doctors then study the cells to determine if the faulty chromosomes have been passed on to the fetus.

Even though there are many possibilities that a child may be born with a hereditary disease or disability, the majority of children come into this world as healthy, happy babies. Many consider this to be a miraculous happening.