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You are a Unique and Special Person

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> "No two snowflakes are exactly alike."
> "Variety is the spice of life."
> Musical variations on a theme . . .

One of a kind designer gowns . . . At first glance it would seem that we live in a world which values individuality and uniqueness. To be yourself is to be recognized as being a strong person. Those who dare to do what no one else has done or to be what no one else has been are recognized as trendsetters, heroes and heroines, or adventurers. In the midst of all of this, however, is the reality that although uniqueness is recognized as a very special quality, there can also be a stigma attached to being "different". It is almost evident in the terms: a friend might feel flattered if you refer to her as "unique", but might well take offense at being referred to as "different". Society tends to feel that Edmund Hillary was unique for his achievements, but the first hippies were "weirdos"', yet both wanted to do something differently than it had been done before.

Physical and mental differences, whether visible or not, are all too often regarded with suspicion, if not disdain. They are often seen as a reason to laugh at people or as cause for derogatory remarks. Such is often the case with special education students. Although projects such as the Special Olympics, educational campaigns stressing differences in learning styles and research on the brain, and movies such as "Rain Man"' have helped to inform the general public about just what the terms "mentally retarded"' or "'learning disabled"' mean, many people persist in seeing children placed in Learning Center classes as "'weird"', "'strange"', or "'sick"'.

I currently teach a fifth/sixth grade special education class in New Haven where my first challenge each Fall is to talk with students about why they are in a Learning Center class and what the main differences are between learning center and mainstream classes. Often students focus on the fact that they are "'dumb"' and mainstream students are "smarter". From that point we talk about specific reasons a person could need special education, and how it can help him/ her. I make certain to explain to students that if they were "dumb"

they could not be classified as learning disabled because that term requires average or above average intelligence for children of their age. Hopefully every child is made to feel that he or she has the same potential to make a positive impact on society as any other person their age.

I feel committed to trying to set an environment where the labels that these children might carry do not inhibit their normal social growth. In the course of this goal. I would like to expose my students to the idea that all individuals have built-in differences, and that these are factors which all people deal with. I feel that the students would benefit a great deal from participating in a basic science unit on heredity and genetics, where my main objective would be for them to see that every one of us is unique and different. My objectives for this unit will include having students begin to understand the basic units of life, including atoms, molecules and cells; and contrasting living organisms with non-living objects. Understanding how atoms combine in an infinite variety of ways to create molecules which are different from each other would begin to demonstrate the concept of differences. Exploring the concept of living versus non-living would further help students to explore differences, and could allow them concrete hands-on activities.

I would begin teaching this portion of my unit by explaining that everything in the world is made up of atoms, which are so tiny that only the most powerful of microscopes can show them. An interesting observation is that if you had one atom for every single person alive today, you could fit them all onto the head of a pin. [1] The ancient Greeks were the first people who thought that atoms were the smallest particle of matter that exists in our world. They named these particles atoms because the Greek word “atomos” means “that which cannot be split”. However, many years later, starting in the 1890s scientists found that the atom could be divided into even smaller particles, called protons, neutrons and electrons.

Although they are so small that we cannot see them without an extremely powerful microscope, atoms are considered to be the building blocks of our world. During the eighteenth century, chemists who were experimenting found that they could divide substances like water into two other substances, hydrogen and oxygen. But when they tried to divide the hydrogen and oxygen into other chemicals, they found that they could not do it. The same thing happened when they divided table salt into sodium and chlorine, but could not divide these substances down into further chemicals. Scientists decided from these experiments that most of the things in our world are made up of combinations of substances; these combinations are called chemical compounds. The substances which made up these compounds, which they could not break down were then called elements.

A very important English scientist named John Dalton announced in the early 1800’s that he had a scientific theory concerning atoms. This atomic theory stated that all elements are made up of atoms, and that the atoms in any particular element are always the same. For example, an atom of gold is like any other atom of gold, just as an atom of hydrogen is like any other atom of hydrogen. He further stated that atoms of different elements are different from each other,including having different weights. For example, an atom of oxygen weighs more than an atom of carbon, and an atom of carbon weighs more than an atom of hydrogen.

Scientists went on to discover that atoms join together to form molecules. Molecules are chemical combinations of atoms which can be either the same or different. Atoms of the same element combine to form molecules of that element, while atoms of different elements combine to form molecules of compounds. There are about 100 different kinds of atoms, but there are thousands of different kinds of molecules. One suggestion in understanding this idea is to think of the atoms as letters of the alphabet, and molecules as words which are made from these letters. Any two of the same letter look exactly the same, but the combinations of letters into words yields a tremendous variety of resultant combinations. [2]

Even though molecules are combinations of atoms, they are still too small for scientists to see under any but the most powerful of microscopes.

The next objective of my unit is to expose students to the concept of cells, giving them an idea of what they are, a general overview of cell parts, and the concept of living organisms versus non-living objects. I would start by explaining to students that all living organisms in our environment, no matter how different they may seem from each other, are made up of cells. Cells are one of the smallest units of matter that are able to grow and reproduce (viruses being another). The cells are highly organized units of molecules and macromolecules in which chemical reactions are carried out to produce the quality we call life. [3]

Biologists believe that the overall composition of cells is basically the same. Each cell has a nucleus that serves as the control center for the cell. The nucleus also contains the chemical substances which determine the inherited characteristics of the cell. The nucleus contains the plans for the chemicals that are made in the cell and helps to direct the many chemical reactions that go on inside the cell. Chemical messengers constantly pass in and out of the nucleus of the cell bringing in information about what is happening in the cell, what new chemicals are needed, and carrying out the plans for building new materials in the cell. The nucleus is enclosed in a thin covering called a membrane which surrounds it but allows some materials to pass in and out of the nucleus. The nuclear sap, which is somewhat like cytoplasm, contains fine threads called chromatin which will help pass the cell's characteristics to its daughter cells when it divides.

Cytoplasm is the name given to the grayish, jelly-like material which makes up the cell outside of the nucleus and which is surrounded by the cell membrane. The cytoplasm is almost clear near the outside of the cell, but is denser and appears more granular near the center of the cell. The cytoplasm is about 70% water, but contains a variety of other substances such as dissolved nutrients like proteins, which are the building blocks of the cell, vitamin cofactors and sugars, starches, and fats which provide energy.

The cell membrane is thin and semipermeable to allow gases and fluids to pass through it. This allows cells to get nutrients for growth and oxygen for respiration. It further allows the cell to get rid of carbon dioxide and other waste products. In most cells there is increased room for activity due to the fact that the cell membrane contains many folds and wrinkles .

There are tiny structures in the cell called "little organs" or organelles. Among these are important oval shaped structures called mitochondria, which change their shape as conditions within the cell change. Mitochondria are involved in respiration, which is the process whereby oxygen is taken in and food is burned to generate energy. This process produces waste products including carbon dioxide and water.

There are many chemical reactions taking place constantly within the cell during which chemicals are built up or broken down. There are thousands and thousands of different chemicals within each cell. Lysosomes are small bodies within the cell which contain chemicals called enzymes which aid in the digestion of larger molecules. Lysosomes also remove undigested wastes from the cytoplasm by moving them to the surface of the cell, where they are passed out.

Ribosomes are another important part of the cell. These float freely in the cytoplasm and help in the production of protein. Membranous sacs which are flat and stacked like pancakes are called the Golgi apparatus and are packages of protein made by the ribosomes and transported to wherever they are needed.

All organisms are composed of cells, but not all organisms are considered to be alive. We each assume that we know how to differentiate between those things which are dead and those which are alive. However, there

are certain scientific qualities which we use to determine the distinction between these two terms. There are six properties which must all be present in order to qualify a cell as living.

1. Living cells carry on processes which derive energy from their environment to allow them to grow and reproduce. This process is known as metabolism.

2. Living cells demonstrate growth as an end product of the utilization of energy. They increase in size and weight, although this may be a finite process as with brain cells which do not grow after a point.
3. Living cells reproduce, giving rise to two identical copies of themselves.
4. During the process of growth and reproduction, cells occasionally undergo a mutation (permanent change in their genetic information).
5. Living organisms respond and react to their environment.

6. Living things evolve over time due to mutations and other biological mechanisms. [4] Now that my students have hopefully begun to sense the infinite possibilities for grouping things together and the way that almost any two things can be made to seem alike or different, depending upon criteria, my next objective for the unit would be to introduce them to the concept of genetic code. This portion of my unit would begin with a discussion of chromosomes and genes, and DNA.

At this point I would ask them to think about the following questions: Why is it that if you take the seeds from a plant, place them in soil and care for them, you usually get a plant that is close in appearance to the original? Why do puppies seem to resemble the parent dogs as they grow up? Are they exactly the same? Why is it that a human baby grows up to look like other humans instead of like a puppy? After discussion of possibilities, students will usually suggest that there is some kind of a “plan” within the organism that controls what it will turn out to be. The term heredity could be introduced now to refer to all of the traits that are passed on to offspring from parent plants and animals.

In fact, the nucleus of each cell contains the information for all the parts of the cells, the shapes and sizes of the cells of the body, and the jobs they do. There is also information required to keep the cell functioning correctly and plans to repair it should it be damaged. This information is passed in sexually reproducing species through the fertilized egg, and through the daughter cell in asexual reproduction in the form of a set of genes needed for the creation of further structures during the course of development of the organism. The material that directs and coordinates the processes involved in the growth and reproduction of an organism is contained in its genome, or the total amount of genetic information contained in an organism. In complex organisms such as humans and animals, the genome is defined as one complete set of chromosomes. The genetic material carried in the chromosomes is actually contained in the DNA molecule that is threaded from one end of the chromosome to the other.

Before students can understand DNA, we need to return to our description of animal cells and take a closer look into the nucleus. Toward the end of the nineteenth century scientists had shown that the nucleus of a eukaryotic cell (that of a complex unicellular or multicellular organism, which would include all plants and

animals) contained a granular region called chromatin. This chromatin was proven to consist of a number of threadlike particles called chromosomes. The name chromosomes came from the Greek words “chroma” meaning color, and “soma” meaning body. They were given the name because they quickly absorb the dyes scientists use on them to be able to study them under microscopes. It should be noted that chromosomes can be clearly seen in most cells only at the time of cell division. Scientists eventually found that these chromosomes contained even smaller units, which were named genes. They realized that within each chromosome the genes could be found to be in a very exact order or pattern which determined traits of the organism.

Before scientists had discovered for certain that chromosomes controlled heredity, they realized that the chromosomes in each cell were made up of protein and a special chemical material called deoxyribonucleic acid. This material was also commonly called DNA. They found that almost all cells within an organism contained the same amount and type of DNA, regardless of the cells’ specific function. Friedrich Miescher, a Swiss chemist, first discovered DNA in 1889 but at that time scientists did not think it was important. However, in 1944 Oswald T. Avery and the Rockefeller Institute in New York City announced that DNA was the sole substance responsible for the transference of hereditary traits.

The structure of DNA was proposed by Francis Crick, an English physicist, and James Watson, an American biologist in 1953. They stated that DNA is composed of two very long strands of molecules twisted together to form a double helix. (A helix resembles the shape of a coil spring or the threads of a screw.) The DNA is made up of a series of genes which are attached to each other and which carry genetic information. A gene is a sequence of nucleotides , with a nucleotide being a unit of nucleic acid made up of three parts: a phosphate, a 5 carbon sugar, and a base. These are arranged so that different units are opposite each other, and it is always the same pair of units which are opposite each other in the same human being and in all other living organisms, even viruses. These units refer to four different chemicals, all belonging to the same family, which are called organic bases. The four bases found in DNA are adenine, thymine, guanine and cytosine (often abbreviated as A, T, G. and C.) In the two chains of the helix, adenine must always pair with thymine, and guanine must always pair with cytosine. These pairs are said to be complementary. The stability of the two long helical chains in DNA is due to the hydrogen bonds that connect the complementary bases along the entire length of the double helix. The backbone of each chain consists of repeating units of sugar molecules (deoxyribose) with attached phosphates. [6]

Watson and Crick determined that it is the number, arrangement and kinds of units in DNA that determine a person’s genetic code. DNA could be compared to a computer which regulates the activities needed to keep the body healthy, and “tells” various parts of the body when and how much to grow [5] Each single strand of the DNA double helix actually contains all of the genetic information in a given organism, since the alignment of the bases on that strand will determine the alignment of the second strand. The replication of genetic information is accomplished by creating two new chains of DNA with bases which pair up to their complementary bases in an existing chain. This would produce two double helical models which are informationally identical to the original because they contain the same sequence of bases as the original.

My objective at this point in the unit would be to give students an overview of cell division, and the passage of hereditary material from one cell to another. Although this can be a very complicated concept, I would try to keep this description as simplified as possible to promote students’ understanding of the material. I would explain to the students at this point that the term “cell cycle” is used to refer to the time between the formation of a particular cell and its eventual division into two daughter cells. The two parts of the cell cycle are : interphase and mitosis or meiosis. Different eukaryotic cells differ in the length of time it takes for them

to complete one cell cycle, and in the amount of time spent on any one portion of the stages of the cycle. The four mitotic stages are: prophase, metaphase, anaphase, and telophase.

In higher plants and animals, DNA replication occurs only during the interval of the interphase referred to as the S period (S referring to synthesis). As stated above, each of the chromosomes in a eukaryotic cell contains a single DNA helix which the cell has to duplicate during the S phase to allow it to pass one copy to each newly created cell. Special enzymes in the cell copy each strand of the DNA helix to make a complementary strand. Following this, two identical copies of the chromosome information are available from the previous single copy. These are referred to as sister chromatids, but are not recognizable during the interphase period. When the cell is ready to divide through meiosis or mitosis, individual chromatids can be stained and identified through a microscope. It is the process of mitosis which ensures that each daughter cell will get one of each of the sister chromatids and therefore end up with a complete set.

During mitosis, the nucleolus becomes undetectable and the chromatid pairs begin the coiling and condensation process. The chromosomes become distinct bodies in the nucleus, with a split along their length, held together in the middle by the centromere. The centriole divides and separates, which creates a radiating system of protein fibers. The two radiating systems which were formed by the splitting of the centriole are now called asters, and they travel to opposite sides of the cell where they become connected by fibers into a system called the spindle. Chromosomes arrange themselves along the equator of the spindle between the asters. Next the chromosomes divide completely, with one set of daughter chromosomes going to each The entire cell divides and two identical daughter cells, each containing copies of the chromosomes of the parent, have been formed. [7]

Division of special sex cells, or gametes, is more complicated. The gametes produced by women are known as eggs, and those produced by men are sperm. An egg and a sperm unite to form a zygote, which grows into a new individual. The difference in humans which sets sex cells apart from other cells in the body is that most cells contain 46 chromosomes (23 pairs) while sex cells contain only 23 chromosomes. This is because at fertilization each sex cell contributes its 23 chromosomes to the zygote, thus giving the zygote 46 chromosomes.

Sex cells reproduce through meiosis. Each chromosome duplicates itself as in mitosis, and they are held at the middle by centromeres. The centriole divides and each new centriole starts to move to the opposite side of the cell. Double chromosomes that are similar line up next to each other, with some parts overlapping. The double chromosomes separate from each other and line up at the center of the cell. When they separate, the chromosomes exchange complementary pieces.

This is called “crossing over.” The double chromosomes are pulled to opposite ends of the cell and the cell begins to divide in two. The original cell then divides into two new cells which each contain 23 double non-identical chromosomes. These double chromosomes in each cell then split apart and each half is pulled to one side of the cell. The cells divide into two again forming gametes, each containing 23 chromatids. In fertilization, two gametes unite to form a zygote, which contains the full set of 48 chromosomes. [8]

The next objective I have for this unit is to give students a brief description of Mendel’s experiments and his findings on inherited traits. How is it that physical traits are passed on from parents to their young? This is difficult to tell in humans because there are so many varied characteristics to keep track of; because it takes a long time for children to grow up to allow you to study fully developed characteristics; because most parents do not have a great enough number of children to provide wide study of cases; and, perhaps most

importantly, scientists cannot experiment.

Gregor Mendel was an Austrian monk who devoted himself to the study of plants. He decided that the best way to attempt to study inherited physical characteristics was through breeding plants. Plant breeding is relatively easy to control since you can take pollen from one plant and put it on the pistil of another to cross-pollinate plants being studied. Then you can compare characteristics of new plants with the old ones that produced the pollen grains and the ovules. For eight years Mendel pollinated pea plants in different ways and studied the results. He worked with short and tall plants and studied ways that they bred true and situations where they did not breed true. In addition to finding that he could eliminate shortness characteristic in a generation of pea plants, he also found that the shortness characteristic could be hidden for one generation and then appear in the next. Mendel explained this by supposing that every plant had two factors inside itself, one contributed by each parent, that controlled the inheritance of physical traits. If the factor for tallness were T, and the factor that brought about shortness s, then a short plant would be described as ss, and a tall plant as TT. However, if the sperm cell from a short plant were to combine with an egg cell from a tall plant, the result would be sT. Likewise, if a sperm cell from a tall plant combined with the egg cell of a short plant, the result would form a seed that was Ts. Either way the seeds would produce tall plants because the T would drown out the effect of the s. Tallness would be dominant ("master"), and shortness would be recessive ("to draw back"). Mendel died in 1884 not knowing that he would someday become famous. For over thirty years after Mendel's papers were published, no one paid any attention to them. Today we know that Mendel's research was the foundation of the study of genetics. His main findings were:

1. Traits are determined by specific factors that are transmitted unchanged from one generation to the next.

2. These factors can be expressed as either dominant or recessive.
3. These dominant and recessive factors assort independently from each other.

4. There are predictable ratios for traits to appear in the F2 generation. The next objective in my unit would be to expose students to the concept of human hereditary diseases, and to briefly discuss at least two of these with them. I would begin by discussing the fact that human hereditary diseases, often referred to as genetic diseases, result from the passage of abnormal chromosomes or mutant genes from parent to child. These inherited diseases exist in the egg or sperm at the moment of fertilization, but are not usually observable until birth or later in the child's life. It is important for students to understand that there are differences between hereditary diseases or defects and other types of diseases. However, it is often difficult to say whether a disease is caused by genetic factors. About five percent of newborns have an observable physical or anatomical abnormality that can be established as a hereditary defect. [9] However, exposure to drugs, infections and environmental factors during pregnancy can also cause observable defects in newborns as can chance events. In general the criteria for classifying a disease as hereditary are: a Mendelian pattern of inheritance (i.e. predictable over several generations), a chromosomal abnormality (loss or gain of a chromosome, or rearrangement of chromosome segments from their normal location), or a biochemical defect that can be assigned to a particular gene. [10]

Two terms which is important for students to understand at this point are *phenotype* and *genotype* . Phenotype refers to visible or otherwise measurable properties of an organism. Genotype refers to the genetic factors responsible for creating the phenotype. Some phenotypic traits are determined by single genes, while

others are determined by several.

Parents in a given situation can be classified as heterozygous or homozygous. If homozygous for a given gene, it means that the parent has two identical alleles (AA or BB). An allele is an alternative form of a gene occupying the same locus on homologous chromosomes. If a parent has different alleles for a given gene(Aa or Bb), he is said to be heterozygous for that gene. The phenotype for a homozygote directly reflects the genotype of the allele, but the phenotype of a heterozygote depends upon the relationship between the type of alleles which are present. If one is dominant, and the other is recessive the phenotype will be determined by the dominant allele. Alleles are considered codominant when they contribute equally to the phenotype. [11]

Genes which are located on the X chromosome are called sex linked because generally only one sex (males) is affected by the mutant alleles. A female may also have sex linked diseases but both of her X chromosomes must carry the mutant allele for her to be affected. (This is assuming that the genes are recessive, as they often are for serious hereditary diseases.) Because chromosomes segregate randomly into egg and sperm cells during meiosis, the probability can be calculated that a daughter will become a carrier of a sex-linked disease or that a son will develop the trait.

In looking at autosomal recessive inheritance, a recessive gene which is abnormal is of little consequence as long as the cell contains a normal allele which can mask it. This explains why heterozygous carriers of harmful recessive genes do not exhibit symptoms of the disease. For offspring to be affected, both parents must be carriers of the recessive gene. Autosomal recessive genes are usually recognized in two ways: the trait is usually present in only one generation; or the parents are heterozygous for the recessive gene, the ratio of nonaffected to affected individuals is roughly three to one (for a large number of children or over many families). In autosomal recessive inheritance , there is more often also some degree of relatedness between the parents, i.e. first cousins. These relatives are more likely to have inherited the same nonfunctional gene from a common ancestor. Diseases which are autosomal recessive and their symptoms include Sickle-cell disease (anemia), Cystic fibrosis (respiratory disorders), some forms of Albinism (lack of skin pigment, vision difficulties) and Phenylketonuria (mental retardation).

On the other hand, in looking at autosomal dominant inheritance we find that if the gene is expressed as dominant, the condition will exist in the individual regardless of what other allele is present. There is a much smaller recognized number of autosomal dominant defects than there are autosomal recessive defects. This is largely due to the fact that if the dominant gene limits the person’s chance for survival or impairs reproduction, it is less likely that the gene will be passed on to offspring. Some of the dominant genes that have persisted in occurrence are those which do not make themselves evident until later in life, such as Huntington’s disease and those which do not limit reproduction. A rather common autosomal dominant gene that is fully expressed is the one which causes achondroplasia. This is a dwarfism where there is a disproportionate shortening of the arms and legs. This hereditary defect is caused by abnormal growth of cartilage. Other autosomal dominant diseases include Neurofibromatosis (growths in the nervous system and skin) and Polydactyly (extra fingers and toes).

At the conclusion of this unit, students will recognize that there are many contributing factors in deciding what any one person is like, both physically and mentally. If we have achieved our goal in doing this unit together, they will not feel as stigmatized when teased or taunted about being in special education. Hopefully if they do become involved in comparing themselves to others in this world, they will realize how many wonderful things they have in their favor.

Sample Lesson Plans

Sample Lessons—Likenesses, Differences and Uniqueness

Goal To help students understand ways in which people are alike and different.

Objectives

1. Students will recognize and name ways in which they are like others in their classroom.
2. Students will recognize and name ways in which they are different from others in their classroom.
3. Students will acknowledge ways in which they are unique.

Procedures (These will cover several lessons.)

1. Introduce the concept of likenesses and differences. Ask students to name things they can think of which are similar to each other, and tell why. Ask them to do the same thing for differences. (They need not begin with people, they may pick any items they wish to compare.) Next encourage students to talk about ways in which they think that people in general are alike or different.
2. Encourage children to begin thinking about ways in which they are alike or different from other children in the classroom. For example, use an overhead projector (for shadow) to trace each child's silhouette onto paper, and have the children cut them out and mount on a background sheet. Print the child's name vertically on his or her silhouette and ask the child to choose words beginning with these letters which he feels describe himself and print these on the silhouette.

   An activity which could be combined with this is to have children trace their hands on paper, cut them out, use an ink pad to print their fingerprints on them, and mount these on the bottom corners of the silhouettes. (Shoeprints or footprints can also be traced and mounted as if "walking" along a wall. These might be labeled, or left plain for children to try to guess which are their own.)
3. Choose a large bulletin board and put up a heading " * You Must Have Been A Beautiful Baby . . . * " Ask students to bring in baby pictures without showing their classmates and mount these in windows cut in paper musical notes. Do not identify individuals, but post a list of students whose pictures are displayed and hold a contest to see who can correctly identify the most pictures. After the baby pictures have been up for a few days, take pictures of the students in class and place these around the edge of the board. Discuss ways that people changed as they grew up, and ways in which they still look the same.

(figure available in print form)

(figure available in print form)

4. Measure students' heights and list and graph them. If this activity is done early in the year, save the graphs to be redone and compared at the end of the year. (If you expect to do this activity in the spring, it's nice to measure heights at the beginning of the year for comparison.)
5. Have students create "recipes" for themselves, such as "Take a dash of mischief, add a sparkling smile and a happy heart, . . . " etc. (Encourage students to look at positive traits, as some special education students see themselves very negatively.) If you find that students are reluctant to name their own traits, you may want to choose friends to write about each other.

Sample Lesson Plans—Living and Non-Living

Goal To help students develop an understanding of the differences between living and non-living objects.

Objectives

1. Students will recognize the characteristics which qualify a thing as living.
2. Students will differentiate between living and non-living things.
3. Students will be able to sort objects into living or non-living categories.

Procedures

1. Brainstorming and categorizing: Print the words "living" and "non-living" on a blackboard. Ask students to discuss what they think these terms mean. List their comments under the appropriate term. Encourage the students to name things which they feel are examples of each term. As suggestions are given, encourage the students to think about definitions they may have given so far and see whether they still seem appropriate. For example, a student may suggest that living things can walk and may give people as an example. Write his suggestions on the board for students to think about. The next student may suggest that living things grow, and may suggest a plant as an example. Encourage them to consider whether people grow, and whether plants can walk. At the end of the lesson, summarize what students have come up with.
2. Hand out a list of the 6 characteristics of living things and discuss them with the class. Ask them to compare the list with the ideas they generated in the previous discussion. Talk about each of the qualities and give as many examples as possible, i.e. Growth as an end product of the utilization of energy: babies to adults, kittens to cats, seeds to plants, etc. Response to environment can be explored through the eye's reaction to light (close them tightly for a minute

and then open them in a classroom where all the lights are on).
3. Using the given characteristics, ask students to give examples of each category: living and non-living. Give them names of objects and ask them to name the category. Have them sort given pictures into piles for each category. Ask students to use magazines to make a large classroom collage with 1/2 of the paper reserved for each category.

Sample Lessons—Sickle Cell Anemia, An Autosomal Recessive Disease

Goal To increase students' knowledge of hereditary diseases

Objectives

1. Students will have a basic understanding of how some diseases can be hereditary.
2. Students will further their understanding of the terms *dominant* and *recessive* .
3. Students will be exposed to facts about a disease, sickle cell anemia, which is not uncommon in our school setting.
4. Students will be less fearful and more understanding of peers or adults whom they know have sickle cell anemia.

Procedures

1. Reintroduce the concept of hereditary diseases which will already have been briefly covered before this lesson. Remind students of the meanings of the terms dominant and recessive as covered in the section on Mendel and his findings.
2. Ask students whether they have ever heard of sickle cell anemia. Allow them to share any information they have learned, encouraging them to share information they may have about people they know who have the disease, although I would stress to the class that they probably should not give names of the people involved unless it is common knowledge that the person is affected.(The idea of confidentiality could be introduced now.) Encourage students to voice their feelings about the disease: Are they afraid that they might catch it from a person who has it? Can they? Are they uncomfortable being around people with the disease? Do they know what happens to you if you have this disease?
3. Hand out the information sheet in this unit about sickle cell anemia. Read it together as a group and discuss thoroughly. Allow students to ask questions and answer them as thoroughly as possible.
4. Arrange for a local medical professional to come into your classroom to speak with children about sickle cell anemia and other hereditary diseases.

5. Discuss with children the feelings and/or concerns they shared before learning about the disease. Do they still feel the same way about being with a person with sickle-cell now that they know that person cannot infect them? Encourage students to think about how education about sickle cell changed their mind about people afflicted with it, and ask them to consider and talk about whether the same would be true for their own situation if other people understood better what special education is.

Facts About sickle Cell Trait and Anemia

What is sickle Cell Anemia?

Sickle Cell Anemia is a genetic blood disease. Normally a drop of blood looked at through a microscope will show lots of round, red bodies called *red cells* . However, in some people the red blood cells may appear to have a sickle shape instead of being round and so we call them *sickle cells* , and the disease which causes them is called *Sickle Cell Anemia* .

Normal Cells:
(figure available in print form)
Sickle cells:
(figure available in print form)
All red blood cells contain hemoglobin, the substance that gives the red color to blood and that carries iron and transports oxygen from the lungs to make it available to tissues of the body for metabolism. However, in sickle red cells the molecular structure of the hemoglobin is slightly different from that of normal red cells. When these cells release their oxygen, the red cell's shape may change into a sickle.

Although the hemoglobin in sickle cells can carry just as much oxygen as a normal cell, there are two important differences between the two. For one thing, round blood cells can flow easily through even very small blood vessels because they are soft and can change their shape if needed, like a tiny balloon. Sickle cells, on the other hand, are hard and cannot change shape, and this means that they sometimes get stuck and jammed in small blood vessels causing the blood flow to be stopped. (Think of the sickle cells as twigs and branches that beavers might use to block a small creek—pretty soon little or no water can flow through.) You can see the problems this would cause to the parts of the body which cannot receive the flow of blood with the oxygen they need to survive.

The second difference between sickle cells and normal red cells is that the sickle cells do not last very long. A normal red cell lives for about 120 days, but sickle red cells only live about 30 days. As you can tell, the body of a person with sickle red cells would need to keep replacing the red cells about four times as fast as it produces normal red cells. Unfortunately, the body cannot produce the new red cells at a fast enough rate, and so it ends up with fewer red cells and less hemoglobin than a healthy body. This condition is named *anemia* .

What Does It Feel Like To Have Sickle Cell Anemia?

First of all, it is important to know that not all of the people who have sickle cell hemoglobin in their red blood cells have Sickle Cell Anemia. Sickle Cell Anemia is an autosomal recessive hereditary disease, which means that you can be a carrier but not have the disease. In that case, you would be said to have *sickle Cell Trait.* That would mean that you would probably lead a healthy life, but that if you grew up and decided to get married and have children,it would be possible for your children to have Sickle Cell Trait or Sickle Cell Anemia.

People who do have Sickle Cell Anemia have pain that might occur in any part of the body at any time when the sickle cells block the flow of blood. The pain might go away very quickly, or it might last as long as a week or two. If the pain is mild, aspirin might make it feel better, but it could also be so severe that the person might have to go to the hospital. The sickle cell anemia also makes the person get very tired easily. However, in between the attacks of pain, children with Sickle Cell Anemia can play and go to school, as long as they do not play sports that are too rough.

Is There a Cure for Sickle Cell Anemia?

Unfortunately, at this time we do not know a cure for Sickle Cell Anemia. You are born with it, and you have it all of your life. Treatment from a doctor usually involves giving medicine for the pain and giving blood transfusions when the number of red cells and the quantity of hemoglobin in the blood is too low. Sickle Cell Anemia shortens some people's lives, but people with this disease can lead satisfying lives.

Are Some People More Likely to Have Sickle Cell Anemia Than Others?

"Sickle Cell Anemia is a major health problem in Africa, South America, Latin America, the West Indies and the United States. In the United States, about 1 out of every 10 black Americans has Sickle Cell Trait and about 1 out of 400 has Sickle Cell Anemia. But Sickle Cell Anemia is not confined to black people. It is also found in some racial groups which live around the Mediterranean Sea. . . . The reason African and other peoples who live in that area have sickling appears to be related to malaria. Although having Sickle Cell Anemia has always been a disadvantage, having Sickle Cell Trait is beneficial in areas where malaria is a problem. Individuals with Sickle Cell Trait are resistant to malaria; they do not get it as frequently as normal individuals, but if they do get malaria they do not die as frequently." [12]

Notes

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1. Berger Melvin, *Atoms, Molecules and Quacks* , p 11.
2. *Ibid* . P.31
3. Edlin, Gordon, *Genetic Principles* , p. 26.
4. Ibid,p.29.
5. Dunbar,Robert, *Heredity* , p.32.
6. Edlin, p. 52.
7. Fichter, George, *Cells* , pp. 48-49.
8. Ibid, pp. 50-51.
9. Edlin, p.275.
10. Ibid, p.280.
11. Lewin, Benjamin, *Genes III* , p.20

12. Whitten, Charles. *Highlights of the Sickle Cell Story* , p.8

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