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You Are Your Genes

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by Joanne Pompano

INTRODUCTION

Students afflicted with hereditary eye conditions such as congenital cataracts, albinisim, glaucoma, and retinitis pigmentosa may find it difficult to function in a classroom setting. Some of these children develop academic, social or emotional problems that are influenced by their visual disorder including isolation, withdrawal, difficulty with school work or prejudice displayed by their peers.

The majority of students with visual disorders have significant optical difficulties including marked reduction in visual acuity, opacity of the lens, lack of pigmentation of the eyes, or restriction of the field of vision. Such problems may result in the need for corrective lenses with marked magnification or the use of large print or braille translations of textbooks and materials. In addition, it may be necessary for the student to use special equipment such as magnifiers or a cane to aid in mobility. All such things call attention to the student and may interfere with their ability to develop academically and socially along with their classmates.

For some of these students it is difficult to interact with their classmates because their peers may not understand or appreciate their conditions. In addition, visually impaired individuals may not understand why they are different and may not have the skills to be assertive when they are teased or singled out.

Children with genetic eye disorders, therefore, often need guidance in the development of social skills. In addition, it may be necessary to educate their peers in understanding how to appreciate and celebrate the diversity of all individuals.

Developed for students in grades 9-12, this curriculum will allow students to explore the role genetics plays in the make-up of each individual. It will help them to understand that every person is unique while also helping them to appreciate the differences of individuals.

It will also show how diseases and disorders are passed from parent to

child. Four genetic eye disorders: congenital cataracts, albinism, glaucoma, and retinitis pigmentosa will be discussed.

The unit will consist of the following sections:

1. Teacher pack— lessons plans, information, materials
2. Student pack—reading list, vocabulary, activities
3. Parent pack—names of organizations and support groups, information on disorders, genetic information
4. Assessment
5. Bibliography

GOAL OF PROJECT:

Entitled “You Are Your Genes,” this curriculum was developed to assist teachers in integrating visually impaired students more successfully in the school setting.

There are three major goals for this project:

1. This curriculum will provide students with a basic understanding of genetic terms and concepts and will allow them to understand the role genetics plays in their life and the life of others. It will assist them in understanding how they are both unique and similar to others.
2. This curriculum will increase their understanding of how diseases and disorders are transmitted and will provide them with information on four common vision disorders.
3. This curriculum will assist visually impaired students and their classmates in understanding genetic disorders. In addition, it will help the student who is visually impaired to accept and deal with their impairments and disabilities by providing them with information that will allow them to answer the questions posed by their classmates.

DEVELOPMENT OF THE CURRICULUM

Lack of knowledge often results in insensitivity, curiosity, or problems relating to one another. Working under the assumption that one way to desensitize a problem is to provide information and to talk about a subject, this curriculum will provide activities that will assist individuals in understanding how and why an individual develops from single cell to complex individual and how humans are both similar and yet very different from one another.

Armed with information about genetics and hereditary disorders, students with visual impairments will be provided with information that will allow them to understand themselves and to answer questions about their condition. Doing so will be at least a first step in helping these students to develop a more positive self image and allow them to discuss and confront problems that may exist.

A series of lessons and activities will provide information about genetic and visual impairments and also be a good beginning for peers to create more understanding and acceptance of individuals who are different. It will help students to value each individual despite their physical differences and help them gain a more positive attitude toward individuals with genetic disorders including conditions such as the four visual disorders to be discussed.

BACKGROUND INFORMATION ON GENETICS

CELLS

Every human is made up of billions of microscopic cells. In fact, there are more than 200 different types of cells in the human body. (1) Each of these tiny cells carries a blueprint to create a unique living creature. This blueprint is called the genetic code.

Cells are composed of water, sugars, fats, and proteins. These substances can be combined using many different recipes. It is the combination of these proteins in the cell that determines the inherited characteristics of an individual such as body structure and intelligence. The nucleus of a cell is a control center which determines how these substances will be combined.

CHROMOSOMES

DNA is coiled up in the center of the cell in 46 threadlike structures called chromosomes. Chromosomes determine what kind of individual will develop. Living things inherit chromosomes from each of their parents and provide a genetic link from one generation to another.

Human beings have 23 pairs chromosomes in each cell. Each pair is different from any other pair. Members of a pair are essentially identical, with the exception of sex chromosomes in males. Sex is determined by X and Y chromosomes The female has two chromosomes called X chromosomes. The male has both an X and a Y chromosome.

There are 22 pairs of autosomes which are the non-sex determining chromosomes. Traits such as eye color, hair color and height are determined by two genes. Some traits, such as freckles, are determined by only one pair of genes while others, such as blood-type, are determined by several pairs of genes. Four pairs of genes determine skin color. These genes control the production of a chemical called melanin which adds coloring to skin. The more melanin that is produced the darker the color of the skin. Individuals who have albinism produce little or no melanin.

GENES

A gene is a short section of a longer DNA molecule. Each human cell may have as many as 100,000 genes. (2) Genes are important because they carry the formulas for making proteins and proteins dictate how each cell in our body will be constructed.

Genes are composed of DNA and contain the coded message that instructs the cell to produce a particular kind of protein which affects a particular characteristic of the cell.

The genes and the chemicals found in them, DNA and RNA, are the basic building blocks of an organism. One of these chemicals, DNA or deoxyribonucleic acid, directs the production and growth of every cell in the human body. In addition, hereditary information is passed on to the cells by another chemical messenger called RNA or ribonucleic acid.

DNA, is the molecule that makes up the genes. Composed of two coiled strands it is joined by rungs between them. These rungs or steps are composed of pairs of chemicals that carry instructions for guiding the formation of a particular protein.

DNA is made up of sugar, phosphate, and four chemicals called bases. The bases are cytosine (C), guanine (G), adenine (A) and thymine (T). The sugar and phosphate form the long strands or sides of the ladder while the bases form the steps. The steps are made of two pieces which also pair this way: a with t and g with c. Inside the nucleus loose bases attract other bases floating by in the above combinations. The new DNA strands formed are identical to the original DNA. This reproduction of DNA is the key to heredity.

THE DOUBLE HELIX

Two strands make up the DNA thread. The strands twist and wind around each other. This twisting ladder of DNA is called a double helix. When the first cell divides it copies it's DNA plan and becomes two cells. These two cells have identical sets of plans. This process of dividing and copying the original plan continues until millions of cells later a unique individual is formed.

There are 4 chemicals that make-up the DNA contained in each cell.

The 4 chemicals are ADENINE, THYMINE , CYTOSINE , and GUANINE.

We refer to them by there the letters A, T, C, And G. Each single strand joins up in a very precise order: A always joins up with T

C always joins up with G

G always joins up with C

After the copying is finished and has created 2 identical DNA threads, each with 46 chromosomes, and the cells divide.

THE DIVIDING CELL

Each individual begins as a single fertilized cell. The DNA in this cell contains the directions that determines the make-up of this individual. Nearly all the information needed to make a unique human being are contained in the chromosomes found in those cells. When a sperm cell with 23 chromosomes merges with an egg cell containing 23 chromosomes they unite to form an individual that has genes donated from each parent.

When it is about to divide into two cells DNA coils up tightly. In the center of the cell are the chromosomes which contain the DNA. Before a cell divides the nucleus divides. Each time the cell divides all the information contained in the DNA is duplicated so that both of the cells has the same DNA blueprint. This process is called REPLICATION. In human cells the DNA condenses into 46 pairs of chromosomes after this process of replication.

In the first step of this process, the double helix unzips creating two single strands of DNA. Each single strand serves as a template for a new strand complementary to itself thus creating two new DNA molecules. The DNA

helix unravels and each side of the DNA molecule pulls away from its mate. Each half is a model for a new molecule. The recipe for that particular protein is copied from one strand to another. The nucleotids attaches in the T to A, G to C, and G to C pattern and each new double strand retwist itself into a helix. The cell then divides and forms two new cells. Each cell houses 46 chromosomes.

The copy strand is called RNA which is like a small piece of DNA except that one chemical is different. This copy strand does not have thymine but instead uses a chemical call URACIL known as U. The usual DNA strand copies as usual in the following way except if the strand has an A it copies a U.

The copy strand then travels within the cell in search of the ribosome where it reads the instructions on the copy strand. Each copy stand has instructions for a particular combination of amino acids. Amino Acids are the chemicals that make all proteins. In the human body there are thousands of different proteins all made from 20 amino acids joined up together in numerous combinations.

The amino acids moves along the copy strand and finds the ribosome where it reads the A's, C's, G's and U's so that it knows in what order to join up the amino acids. They then join up together like beads of a necklace. When the copy strand has completed its job it leaves the chromosomes and the DNA zips up again.

THE SEX CELLS

DNA is found in pairs in the nucleus except for the germ cells— sperm and egg (ovum) cells which are not in pairs. Instead of containing 46 chromosomes as the other cells do, the sperm and ovum contain only 23. However, when a sperm fertilizes the egg, these single sets will pair up in a new cell. Each parent contributes their half of the genetic code and the full 46 chromosomes are restored. This cell will then multiply again and again and develop into a individual.

Sex chromosomes contain genes for several traits such as color blindness, a visual disorder in which people cannot distinguish between certain colors. The gene for color blindness is recessive. The X chromosome carries the recessive gene and the dominant gene for normal color vision.

THE INHERITANCE OF TRAITS

An organism receives two genes for each trait. One gene comes from the gamete or female reproductive cell while the second gene comes from the male gamete.

Certain genes produce certain traits but some of these genes have a stronger influence than others. The stronger gene is called DOMINANT GENE and the weaker is the RECESSIVE GENE.

Genes produce traits that are either dominant or recessive. A recessive gene produces a certain trait only if its effects are not overridden by those of a dominant gene.

If an individual has one dominant gene and one recessive gene the organism will have the trait of the dominant gene. The recessive gene will be hidden. Individuals with two same genes for a particular trait are called PURE and those with two different genes for a particular trait are called HYBRIDS.

The visible trait or physical appearance for an organism is called the PHENOTYPE. The unique combination of genetic information that is inherited from the parents is called the GENOTYPE.

DOMINANT INHERITANCE

A trait that is determined by a dominant gene will not appear in an offspring unless it also appears in one or both of the parents. If the trait depends on a dominant gene, the offspring of two individuals who do not show

the trait will produce only normal descendants Dominant traits do not skip generations— that is children do not show the trait unless a parent did.

RECESSIVE INHERITANCE

Recessive genes do not follow the rules that have been laid down for dominant traits. Recessive traits commonly do skip although they may not do so.

The recessive gene is not changed or destroyed. Its influence is masked by the dominant gene in the hybrid generation. It, however, is carried and passed to the next generation unchanged. Not only two but three, four or more generations may be skipped

For instance, children with albinisim often are born to parents who had no idea that they or their ancestors possessed the gene for albinism.

THE INHERITANCE OF EYE COLOR

To understand how inheritance of traits works we can study eye color.

The gene that determines brown eyes is dominant while the gene for blue eyes is recessive. If a child has a brown-eyed parent who carries two brown eye genes mates with a parent with blue-eyed genes the child will have brown eyes. This is because the brown-eyed parent has only dominant brown-eye genes to contribute to the genetic make-up of the child.

If the brown-eyed parent has a dominant brown eye gene and a recessive blue eye gene , the child will have a fifty-fifty chance of receiving a blue eye gene from each parent and will have blue eyes. Two blue eye parents will always produce blue eyed offspring because it involves only recessive blue eye genes.

The offspring of two brown-eyed individuals who each have a recessive blue eye gene have a one-in-four chance of receiving a blue eye gene from each parent and will result in having blue eyes. This illustrates how a recessive gene can be present but not obvious thus allowing a trait to appear unexpectedly after skipping generations.

THE EVOLVING CELL

When a cell divides into two it makes a copy of all its genes. Sometimes a mistake is copied because the gene was faulty or because the DNA was damaged. These faulty genes are called mutations. Usually mutations die because they cannot function properly and so other healthy cells replace them. This process takes place many times in our body. If the mutated cell is a sperm or egg cell, and it does survive, it may be passed on to a new generation. In this way, diseases and disorders can be passed on to the next generation.

Inherited mutations such as color blindness may not be serious problems but others such as sickle cell anemia or thalassemia may be devastating. However, sometimes the mutations are beneficial. In fact the various plant and animals found on the earth today exist because of this process of mutation.

Scientists have determined that the genes from a single cell that lived millions of years ago is the origin of all these life forms. This cell changed and developed to adapt to its surroundings again and again and so from this single cell more complex plants and animals developed. At some point in history the species Homo Sapiens was created. Humans adapted and developed over the centuries developing features and characteristics that allowed them to survive. These adaption included such features as the ability to stand upright , development of a movable thumb, and the ability to use tools. Each of these adaptations were due to

the gene changes. This evolution from a single cell to complex human organism took place because the changes in the genes were beneficial to the organism and aided them in their survival.

All life forms— plants and animals (including human beings) are all related. In fact, 99.5% of the DNA of any human is in the same order as any other person. It is the combination of DNA in the that other .5% that makes each of us unique. (3)

With such knowledge we should be able to help our students understand how they are both very different and yet very much the same as their peers. This then can be the first step in helping them to understand those individuals who face problems due to their genetic make-up. It can also provide them with information that will allow them to work toward celebrating individual differences.

TEACHER'S GUIDEBOOK

EYE DISEASES

I. ALBINISM

Albinism is a group of inherited conditions in which there is little or no pigment in eyes, skin and or hair. It results from inherited genes that do not synthesize adequate amounts of the pigment MELANIN. The cells in skin make a protein called melanin that gives skin color and protects it from harmful rays in sunshine. The lack of pigment in the eyes causes visual problems and people with albinism are abnormally sensitive to sunlight due to this lack of this pigment. Albinism affects all races and is found in one person in every 17,000 births. (4)

A parent who has a child with albinism must carry the gene for albinism. For most types of albinism both parents must carry the gene. The parents will have normal hair and eye color for their ethnic background but still carry the gene for albinism. However, when both parents carry the gene but neither has albinism, they have a one in four chance that each pregnancy will bear a baby with albinism This type of inheritance is known as AUTOSMAL RECESSIVE INHERITANCE.

There are at least six different genes that may result in albinisim depending on the position where the biochemical block of the melanin occurs. If all these defects in melanin synthesis are inherited as autosmal recessive traits then it is possible for two persons with albinism to produce normal offspring. For instance, two individuals such as a pair who are homozygous recessive for different defects in the melanin synthesis may produce normal offspring because they have albinisim for different reasons.

There are many types of albinism and DNA studies have shown numerous types of changes in the genes of those with albinism. A test has recently been developed to identify individuals who carry the gene for TY-NEG ALBINISM and for other types of albinism in which the tyrosinase enzyme does not function. This test uses a blood sample to identify the gene for the tyrosinase enzyme.

To test for Ty-Positive albinism a hair-bulb incubation test is conducted in which single hairs with the bulb intact are plucked from head of individuals and incubated in a solution of tyrosine. If the hair bulb is found to contain tyrosinase it means pigment developed and the individual with albinism is said to be tyrosinase-postivive. If the hair bulb did not contain tyrosinase, no pigment developed and the individual with albinism would be called tyrosinase-negative.

Ty-neg or similar albinism can also be identified in a fetus by testing for this enzyme from fluid drawn through the process of amniocentesis.

Ty-Negative or Type 1A albinism results from the absence of an enzyme called tyrosinase which helps the body to change the amino acid tyrosine into pigment. No melanin pigmentation is provided. The individual expresses difficulty with vision.

When two individuals with albinism have children it would be expected that all their children will have albinisim. This usually is the case, but occasionally two parents with albinism will have a normally pigmented child.

This is possible if the parents have albinism for different reasons. that is because they have a lack of different enzymes In this case the father has the enzyme lacked by the mother and the mother has the enzyme lacked by the father. The father could pass on to a child the gene for the enzyme he had and the mother could pass the gene for the enzyme she had with the results that the child would have both needed enzymes and so would be normally pigmented

X-LINKED ALBINISM

For some types of ocular albinism, called X-linked ocular albinism, the explanation above does not apply. The gene for X-Linked ocular albinism is located on the X chromosome. Males have one X chromosome and one Y chromosome. Females have two X chromosomes. X-linked ocular albinism is found almost exclusively in males.

Mothers pass the gene to their sons. For a mother who carries the gene, there is one in two chance of one of her sons having X-linked ocular albinism.

Ocular albinism is a type of albinism which involves primarily the eye but may include lighter hair and skin colors. It is often caused by lack of the enzyme tyrosinase. The pattern of inheritance is X-linked or autosomal recessive.

II CONGENITAL CATARACTS

Cataracts are a partial or complete opacity in the crystalline lens of the eye. When cataracts are present the lens becomes more and more opaque which results in progressively impaired vision The removal of the cloudy lens may restore vision.

VISUAL FUNCTIONING

Len opacities may be present from birth or may develop soon after. An individual’s acuity may be near normal or may be very impaired. Glare tends to be a problem and outdoor vision may be blurred or hazy. Contrast is reduced. Nystagmus (rapid movement of the eyes) and strabismus (deviation of the gaze from their normal straight position) may present problems. Field of vision is normal. The progression and severity may vary. The pupil will appear white when the cataract is total. Individuals with a central lens opacity will have trouble in

bright light.

The only treatment is surgery to remove the affected lens. After their removal The patient is fitted with corrective lenses or contacts to compensate for the loss of the lens. A significant and permanent increase in visual acuity usually is the result of treatment.

Aphakic individuals (lens removed) may have corrected visual acuity of approximate 20/70. They may no longer have power of accommodation

(the ability to adjust from far to near vision.) Corrective lenses for near vision, bifocal lenses or with contacts lenses may be helpful. Reading lens or hand magnifiers will help with reading. For distance viewing a telescopic device may be necessary.

INHERITANCE Congenital cataracts are usually transmitted as a dominant trait. For instance, juvenile cataracts are determined by a dominant gene. The trait never skips a generation, that is, no child has cataracts unless one of the parents has cataracts. However, sex-linked and recessive transmission are also possible.

III. RETINITIS PIGMENTOSA

INHERITANCE Retinitis Pigmentosa is usually a recessive trait, but it may be an autosomal dominant or sex-linked.
Retinitis Pigmentosa is a hereditary degeneration of the retina in which the retinal rods, cones, and nuclear layers are slowly destroyed. The onset of this disease is usually seen in the teenage years. It is more common in males. The disease is almost always bilateral.

Loss of peripheral vision and night blindness are the first problems. As the disease progresses the field of vision contracts until only a tiny central area of vision remains. It is a disease that progresses slowly. Some retention of some central field is present for some individuals.

Because visual fields continue to become smaller until only time central vision remains there is often difficulty in mobility. A cane or guide dog may become necessary.

Students experience difficulty in reading because they can see only words, not phrases. Braille usually becomes a needed skill as more and more vision is lost.

No treatment is available at this time so genetic counseling is important.

IV. GLAUCOMA (Open angle)

INHERITANCE Autosonal recessive trait
Glaucoma is a disease of the eye in which an abnormally high intraocular pressure is present. In this condition the aqueous outflow is defective because the drainage channels are clogged due to the high intraocular pressure. This increase in pressure causes pathologic changes in optic disc and defects in visual field.

Glaucoma may be primary, secondary or congenital and is a major cause of visual impairments and blindness in adults. Infantile glaucoma is present at birth to three years. Congenital cataracts are usually bilateral. This disorder is more common in boys.

When left untreated it results in severe visual loss or blindness because pressure stretches the cornea and it swells. Tissue damage causes the peripheral vision to fade and abnormal blind spots develop. In latter stages the central vision is lost.

The drug pilocarpine or other miotic medications are used to constrict the pupil and help to facilitate aqueous flow. Such mediations help stop the progress of glaucoma by keeping the pressure under control.

In some cases, surgery to the tissue blocking anterior chamber helps reduce the tension and is required. When there is no treatment the eye will continue to stretch and may rupture.

LESSON PLANS

LESSON ONE

ACTIVITY To predict the offspring of a cross between two individuals using a Punnett Square

PROBLEM How is chance involved with inheritance of genes?

BACKGROUND INFORMATION
Genes are the plans or instructions that determine what characteristics an individual will have and how that body will run. Pairs of genes for traits are inherited from parents and each parent contributes one gene for each trait to the offspring. These genes provide complicated instructions for determining the body features an of individual.

This exercise will show how genes from each parent can combine. It should be noted that: A. some genes can combine so that their offspring are bound to inherit certain genes and B. some offspring can inherit some genes by chance.

Some features such as eye and hair color are inherited involving only or two genes. If offspring has conflicting genes, such as one gene for blue eyes and one for brown, the body follows instructions in the dominant gene.

MATERIALS
1. 200 cards-100 each with symbols circle and square

2. Container to hold cards

Note: Genes are represented by cards and parent by container. Any pair of cards in container represents gene pair.

PROCEDURE
Draw a box with four squares. Write the genes that the male parent contributes across the top. Write the genes that the female contributes down the left side. Fill in each square with one male gene and one female gene. The filled in chart will demonstrate the predicted genotypes of the offspring.

The Punnett square shows how genes from each parent can combine.

Example 1: Parent has identical pairs of genes and parents are the same

Circle Circle
——————————————-
Circle Circle Circle
——————————————-
Circle Circle l Circle
——————————————-

Both parents have circle-circle gene pairs

So circle will be passed to their offspring

All offspring will have circle-circle pairs

Example 2: One parent has identical pairs and the other parent has the identical pairs of genes but the genes are different from each other.

Circle circle Circle circle
————————————————————

Square square

————————————————————

Square square

————————————————————-

One parent has identical pair of genes

So does the other parent—but the 2 parents are different from each other.

Results: All the offspring has the same combination of genes, which is circle-square

Example 3: Circle Square
————————————————————-

Circle

————————————————————

Square

————————————————————-

One parent has circle—square pairs

One parent has circle—square pairs

Circle—square are passed to offspring

All offspring has circle—square pairs

Both parents are the same—they each have different pair of genes—circle-square combinations. Each parent can pass on either square or circle genes. The offspring can have 3 different types of genes pairs possible. The types of combinations that can result will follow the mathematical laws of chances.

Note: Mixed pairs of genes will result in the dominant gene dictating the feature that will result.

EXERCISE 4:

1. Get two hundred index cards

2. Draw circles on 100 cards and squares on the other 100 cards

3. Put 100 squares and 100 circle cards in each container

4. Mix well.

5. Draw card from each container and pair them

6. Repeat until all cards are used

7. Chart the results

What proportions were square-square, circle-circle, and square-circle pairs?

LESSON TWO

PROBLEM How do you read a pedigree chart?

BACKGROUND INFORMATION
A Pedigree chart is a device used to trace genetic traits through a number of generations. It can be used to study the inheritance of certain diseases or disorders in humans, such as albinism. It shows the possible combination that can result when two organisms are crossed.

MATERIALS Pencil and paper

PROCEDURE
The following symbols will be used in the pedigree chart.

(figure available in print form)
1. Study the pedigree charts shown for two parents who have albinism.
(figure available in print form)

Explain the results:
(The mating of parents who have albinism almost always result in all offspring having albinism)
2. Develop a pedigree charts showing albinism among the offspring of a father with albinism and a mother who does not carry the trait.

(figure available in print form)

3. Study the chart in which parents with albinism produced offspring that do not have albinism.

(figure available in print form)

How can this be so?
(The parents have albinism for different reasons)
Can your predict if the grandchildren or great-grand children will have albinism?

EXAMPLES OF PEDIGREES

The individuals represented by the solid square and solid circles show a certain trait.

Example 1:

(figure available in print form)
Example 2:
(figure available in print form)

OBSERVATIONS

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l. How many carriers are in each generation?
2. How many generations are represented in the chart?
3. How many individuals were born with this trait?
4. In which generation did the trait first show itself?
5. Do these disorders affect both male and female?
6. Does it affect each generation?
7. Do these pedigrees represent dominant or recessive traits?

8. What eye disorders might they represent?

CONCLUSIONS:

1. What can be determined about a family using a pedigree chart?

LESSON THREE

PROBLEM What is the structure of DNA?

SKILLS Modeling, comparing, analyzing

OBJECTIVE To construct a model of DNA
Student will construct model of the double helix using construction paper

BACKGROUND INFORMATION
DNA is a molecule that makes up the genes. It looks like a twisting ladder with chains of sugar groups and phosphates connected by pairs of nitrogen bases. Four chemicals make up the chemical contained in each cell they are ADENINE, THYMINE, CYTOSINE, and GUANINE. The letters A, T, C, and G stand for these bases.

MATERIALS
Scissors

Construction paper in white, black, green, red, blue, and yellow

Tracing paper

Tape

PROCEDURE

1. Trace and cut out 12 white sugar molecules and 21 black phosphate molecules. Label each molecules.

4. Trace and cut out 12 nitrogen bases: 3 green A's, 3 red T's, 3 yellow C's, and 3 blue g's. Label each bases.
5. Construct the two sides of the DNA molecule with the sugars and phosphates.
6. Complete the molecule of DNA by fitting base pairs along the sides of the molecule.
7. Tape the DNA molecule together.

OBSERVATIONS:

1. What chemicals make up the sides of the DNA molecule?
2. What chemicals make up the rungs?
3. What nitrogen bases always pairs up with each other?

CONCLUSIONS

1. Do all the DNA models have the same shape and general pattern?
2. Are all the DNA models exactly the same?

(figure available in print form)
PATTERNS:

POST TEST (Match the vocabulary word with the correct definition.)

VOCABULARY
1. Genes

2. Heredity

3. Dominant gene
2. Recessive gene
5. RNA
6. Trait
7. Hybrids
8. Genotype
9. Gamete
10.Phenotype
11. DNA
12. Genetics
13. Replication
A. Combination of genes for a particular trait—genotype
B. The weaker of two genes— recessive
C. Units of hereditary information—genes
D. The visible trait of an organism—phenotype
E. The stronger of two genes—dominant
F. The messenger for DNA—RNA
G. Study of heredity—-genetics
H. The process by which DNA is duplicated—replication
I. The characteristic of an organism—trait
J. Chemical that is the main substance in chromosomes—DNA
K. The traits received from your parents—heredity

EVALUATION

Possible Points Actual

1. Student can locate and name the parts of a cell 10 _____
2. Student can define genes, DNA, RNA 10 _____
3. Student receives 90% or more on post test 10 _____
4. Student can name and describe 4 eye diseases 10 _____
5. Student can describe the parts of a Helix Ladder 10 _____
6. Student can describe the evolution of the cell 10 _____
7. Student can explain why mutations are harmful 10 _____
8. Student can explain why mutations are helpful 10 _____
9. Student will explain dominant traits 10 _____
10.Student will explain recessive traits 10 _____

Total

Grades: 90-100 points =A 80-90 points =B 70-80 points=C

PARENT INFORMATION

National Genetics Foundation
555 West 57th Street
New York, NY 10019 (212) 586-5800
(Computerized analysis of family history; clearinghouse to refer individual to local genetic centers)
The American Foundation for the Blind
Address: AFB, 15 West 16th Street,
New York, NY 10011. Phone: 800-AFB-LIND

(Provides direct and technical assistance services to persons who are blind and their families. Clearinghouse for information. Publications)
National Organization for Albinism and Hypopigmentation
1500 Locust Street, Suite 1816,
Philadelphia, PA 19102 1-800-473-2310
(NOAH provides a vehicle for persons with albinism and their families share their experience)
Association for Education and Rehabilitation of the Blind and Visually Impaired
206 North Washington, Street, Suite 320
Alexandria, VA 22314
(Latest information on education and rehabilitation)
National Association for Parents of the Visually Impaired
P.O. box 562
Camden, NY 13316

(Holds national and chapter conferences. Provides information, services, and peer support)
Exceptional Parent
P.O. Box 3000
Denville, NJ 07834 (Publication for parents of the exceptional child)
Connecticut State Board of Education and Services for the Blind
170 Ridge Road
Wethersfield, Ct. 06109 1-800-842-4510
(Connecticut State agency for children and adults with vision disorders.
American Foundation for the Blind

15 West 16th Street
New York, New York 10011
(Provides information, programs, and clinics)

BIBLIOGRAPHY

Faye, Eleanor, M.D., “Clinical Low Vision,” Little Brown and Co., Boston, 1984, Second Edition.

(This collection is a good source for teachers seeking detailed information on eye diseases. The chapter by Irwin M.Siegel on “Genetics for the Clinician” provides an understanding of basic genetics and the role genetics plays in eye diseases.)

Haefemeer, J.W., King, R.A., and LeRoy, Bonnie, “Facts about Albinism.”

(A 44 page booklet written about medical aspects of albinism. International Albinism Center, Box 485 UMHC, The University of Minnesota Hospital and Clinic, Minneapolis, Minnesota 55455.)

“Information about Albinism,” National Organization for Albinism and Hypopigmentation,1500 Locust Street, Suite 1816, Philadelphia, PA 19102

(NOAH provides a vehicle for persons with albinism and their families share their experience)

Jose, Randall T., “Understanding Low Vision,” American Foundation for the Blind, l983

(An overview of visual impairments including causes, treatments, evaluations, future trends, and other issues that impact on the individual.

It provides a resource that is essential for the professional working with low vision students.)

Jones, Steven, “The Language of Genes:Solving the Mysteries of Our Genetic Past, Present and Future,” Anchor Books Doubleday, New York,1993

(Provides easily understood information on genes and how they tie us to our ancestors.)

Kirk, Edith Cohoe, “Vision Pathology In Education,”Charles C. Thomas, Illinois, l981

(A book that provides detailed information on eye diseases and disorders including the impact those problems have in education.)

Singer, Sam, “Human Genetics: An Introduction To The Principles of Heredity,” 1985,Second Edition , W.H. Freeman and Company, New York

(Excellent source of information on human genetics and heredity.)

Anderson, French W., “Gene Therapy,” “Scientific American,” Sept. 1995, Vol. 73, Number 3, p. 124-128

(An interesting article on gene therapy in language that students, parents, and teachers will understand.)

Haefemeyer, J.W. , R. A. King, and Bonnie LeRoy, “Facts about Albinism,” International Albinism Center, Box 485 UMHC,The University of Minnesota Hospital and Clinic, 420 Delaware Street S.E., Minneapolis, Minnesota, 1992

(Provides general information about albinism.)

NOTES:

1. Balkwill, Fran , “DNA Is Here To Stay,” p.23

2. Parker, Steve, “How the Body Works,” p.176

3. Balkwill, Fran, “DNA Is Here To Stay,” p.24

4.“Information about Albinism,” National Organization for Albinism and

Hypopigmentation, p. 1

STUDENT READING LIST

Balkwill, Fran Dr., “Amazing Schemes within Your Genes,” Carolrhoda Books, Inc., Minneapolis, l993

(Covers the basic genetic process including the structure and function of genes, how they are structured, how they adapt and mutations. It will provide interesting reading for students through high school.)

Balkwill, Fran Dr., “DNA Is Here To Stay,” Carolrhoda Books, Inc., Minneapolis, 1992.

(Provides a simple and interesting explanation of DNA including topics such as chromosomes, the genetic code, and the double helix with entertaining cartoon illustrations.)

Balkwill, Fran Dr., “Cells Are Us,” Carolrhoda Books, Inc., Minneapolis, 19

(The third in this series. It is helpful, well-written, and provides a good

overview of the cell and its functions.)

Balkwill, Fran Dr., “Cell Wars,” Carolrhoda Books, Inc., Minneapolis, 19

(This book is interesting and will provide the information needed for students to understand the problems cells encounter as they attempt to do their jobs.)

Edelson, Edward, “The Healthy Body: Genetics and Heredity,” Chelsea House Publishers, New York, 1990.

(Part of series, this book presents an overview of genetics including the historical, medical, and scientific areas. The introduction is written by C. Everett Koop, M.D., former Surgeon General of U.S.)

Herskowitz, Joel, “Double Talking Helix Blues,” Cold Spring Harbor Laboratory Press, Plainview, NY, 1993.

(This wonderful book uses Peter-Maxx type illustrations to explore the the structure of the DNA molecule and its role in shaping new life. Included is a folksy tape that vocalizes the text. This package will be interesting and useful for children 8 year up to adults.)

“Larry,” National Association for Visually Handicapped, New York, NY, 10010.

(A book about a child with albinism for students)

Knapp, Brian, “Reproduction and Heredity,” Vol. 9, “Science in Our World,” Grolier Educational Corp., Atlantic Europe Publishing Co., Danbury, Ct., l993

(Well written and with good illustrations it will be of interest to the student looking for an introduction to genetics and heredity.)

Serrano, Marta, “Invisible World of Cells, Genes, and Chromosomes,” Chelsea House Publishing, New York, l995

(Students will find this both interesting and informative.)

Parker, Steve, “How the Body Works,” Reader’s Digest Association, Inc.,

Pleasantville, N.Y., l994.

(Information on genetic and heredity is presented in an interesting and informative format that will easily allow students to understand the basic concepts of this subject.)

“Decoding the Book of Life,” Produced by Jon Palfreman

Coronet Films, Deerfield, IL 60015 1-800-441-NOVA

(This episode of NOVA covers the history of genetics in approximately one hour.)