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Genetics and Heredity

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Introduction

Most scientific knowledge begins with an observation by a curious individual. But science would not have progressed to have made the astounding discoveries that we find almost commonplace today, if the casual observation did not instigate further investigation.

Even a person lacking astute powers of observation will notice that family members frequently resemble each other in some manner. With most seventh grade students, however, such an observation stands on its own; it's usually taken for granted-"Oh, it's just that way". Encouraged to step beyond the observation to investigate the mechanism on which the perceived resemblance is based, the seventh grader becomes the curious young scientist and is fascinated with his discoveries. On this premise, this unit has been developed.

This curriculum unit is designed to provide the seventh grade life science student with a basic knowledge of genetics to encourage the investigation of genes and the transmission of characteristics to succeeding generations in humans. To accomplish this task, students must possess a background on the cell. It is with this topic of cellular structure that my unit commences. With this knowledge of cell organelles and their functions mastered, I will progress to cell duplication in somatic cells and germ cells. The role of DNA, its arrangement in the gene will also be included. Certainly no unit on genetics and heredity would be complete without the early history of genetics with the findings of Mendel. My presentation will also include the topic of sex chromosomes and sex-linked traits. The topic of gene mutation will conclude the unit.

The content of this curriculum unit will include:objectives for each subtopic, background information for teachers and students, lesson plans and activities with emphasis on development of scientific vocabulary. A glossary of related terms, bibliographies for both teachers and students will conclude the unit.

THE CELL

I. Objectives:

A. To identify the cell organelle and their functions
B. To name the two structures found exclusively in the plant cell

II. Background Information on the Cell The cell is the basic unit of structure and function in all living organisms. Cells range in size from 1/200th of an inch in diameter as found in the ovum, one of the largest cells, to 1/5000th of an inch. Thus most cells are invisible to the eye without the magnification of the microscope. Until the development of the high power compound microscopes knowledge of the structure and function of the cell was greatly limited.

Our concept of the cell luckily has improved since 1665 when Robert Hooke used a primitive microscope to view wafer thin sections of cork. Hooke observed the cells were “not very deep but consisted of a great many little boxes’ separated out of one continued long pore, by certain diaphragms.” The cell theory formulated by Schleiden and Schwann in 1839 moved boldly beyond to state that all living things are composed of cells and that all cells arise from other cells.

The cell is the smallest unit of a living organism that carries on life functions. Within the human body there are more than one hundred different kinds of cells, each designed to carry on a distinct function. Although cells vary in size, shape, and function, most cell possess a very similar basic structure.

The *nucleus* is usually the most prominent structure of the cell. It directs the activities of the cell and is especially involved with the cell’s reproductive processes.
Within the nucleus is a tangled network of material called *chromatin* . These threads of chromatin coalesce during cell division to form chromosomes.
A thin membrane, *the nuclear membrane* , surrounds the nucleus and regulates the passage of materials into and out of the nucleus.
Within the nucleus are one or more spherical *chromosomes* , composed of deoxyribonucleic acid and proteins that are visible only during the cell’s reproductive phase.
The *cell membrane i* s a thin saclike covering of the cell. It regulates the entrance of materials needed for cell growth into the cell as well as the exit of cellular waste products through minute pores in the membrane.
The *cytoplasm* is the viscous material between the cell membrane and the nuclear membrane.
The *mitochondria* are found in the cytoplasm and vary in number from cell to cell. They are centers of cellular respiration and energy-producing metabolism.
The *endoplasmic reticulum* found in the cytoplasm are minute two-walled membranes that function like a canal system connecting the cell and nuclear membranes. They transport as well as store materials.
Ribosomes are tiny cellular bodies found on the endoplasmic reticulum. They are sites of protein production used for cellular growth, repair,and reproduction. Enzymes, controlling the rate of

metabolism are made in the ribosomes.
Lysosomes , located in the cytoplasm, contain enzymes that break down macromolecules into smaller molecules so they may be oxidized in the mitochondria.
Golgi Bodies , or Golgi complex, are also in the cytoplasm. They function as accumulating and concentrating areas for secretions of proteins.
Centrioles are small paired cylindrical bodies located near the nucleus and function in cell division.
Vacuoles are bubblelike spaces found in the cytoplasm and used to regulate and store water, food, and cellular waste products.
The *cell wall* is a rigid structure made of cellulose surrounding the cell membrane providing strength and support to the plant cell.
Chloroplasts are tiny structures found in the plant cell containing chlorophyll.

III. Lesson Plans/ Activities

A. Viewing prepared slides

Obtain prepared slides from a science supply house of plant and animal cells to facilitate the visualization of the cell.

Using various types of cells, i.e. blood, muscle, neuron, etc. the students will realize that there are numerous types of cells, each with its own size and distinctive shape but all possessing standard characteristics such as the nucleus, cell membrane, cytoplasm, vacuoles.

B. Making slides

1. Duplicate Robert Hooke’s observation of cork cells. use a single-edged razor blade to cut a

thin slice of cork. Place the cork on the slide under the microscope to observe. Just as Hooke observed over four hundred years ago, rows of tiny empty boxes can be seen.Since the cork is dead material,only the nonliving material cellulose composing the cell wall can be seen.

2. Take the inner leaf of an onion and slice a 1/4 inch square on the inner side of the leaf. Mount and stain. You should be able to observe the nucleus, cytoplasm, cell membrane and cell wall.

3. Place a drop of water on the slide and add an elodea leaf. Stain with iodine and cover with slip. Cell organelles should be visible under low microscopic power.

4. Obtain an amoeba either from a supply house or pond water. Place a drop of water on the slide and cover. Examine under a microscope at low power to focus. Change to a higher power to observe organelles.

C. Drawing the cell

Using reference material, have students draw stylized plant and animal cells. Also view and draw various types of cells to illustrate the diversity in size and shape while emphasizing the commonality of certain cell organelles.

D. Three dimensional model

We usually picture the cell in two dimensions. To develop a more accurate concept a three-dimensional model would be appropriate.

Obtain a clear plastic container of some sort, the type used for food storage is fine. Prepare a package of gelatin and allow it to begin to congeal. Before completely set use various food items to represent cell organelles. Have the class determine what items would be most appropriate. Making a tasty salad as well as an accurate model can be a task requiring much thought. Some suggestions might include hard boiled eggs or brussel sprouts as nuclei; shredded carrots or pickled eggplant provide convincing endoplasmic reticulum;mini chocolate chips could be used for ribosomes. Allow mold to set completely. Bon Appetite if you dare.

5. View film

Obtain VCR tape of “The Fantastic Voyage”. In this old science fiction film, a crew of scientists and doctors and their equipment are miniaturized to be inserted into the ailing body of some eminent scientist to repair damage. It includes sequences that depict the functions of cells and organs. It also serves to help explain the concept of cell size as various small objects are shown as massive obstacles to be overcome throughout the voyage.

Innerspace here we come. Enjoyable and informative.

6. Vocabulary puzzle sheet

On separate sheet

CELL VOCABULARY PUZZLE SHEET

Directions: Write the correct term that best matches each definition or description. Place the letters that have numbers below them in the blanks at the bottom to complete the puzzle.

Material forming chromosomes

(figure available)

CELL DIVISION

I. Objectives A. To distinguish between somatic (body) cells and germ cells, or gametes.

B. To explain cell division in somatic cells-mitosis

C. To explain the meiotic process cell division occurring in the germ cells

D. To explain what happens to the chromosomes in mitosis and meiosis

II.Background Information “Omnis cellula e cellula”

Virchow

As stated in the cell theory, all cells come from cells. Walther Flemming was the first to describe the event occurring internally when a cell divides to produce a new cell. Mitosis is the process by which somatic cells reproduce. It is an asexual process in which an individual cell is replaced by two daughter cells, which are exact replicas of the parent. Fundamental to mitosis is the formation of nuclear filaments, or chromosomes and the equal division of this material in the two daughter cells. Somatic, or body cells usually undergo the process of mitosis every three or four hours.

Every somatic cell in the human body contains twenty-three pairs of chromosomes. In mitosis, the cell will reach a specific size before the chromosomes within the nucleus duplicate. Once the chromosomes have duplicated, they separate to produce two new daughter cells.

Illustration of the process below uses only one pair of chromosomes to facilitate clarification of the process.

(figure available)
Parent cell with one pair of chromosomes

Chromosomes duplicate

Chromosomes separate

2 daughter cells

(figure available)
When the two sets of chromosomes separate, the cell completes a new membrane and splits into two new cells identical to the parent.

Germ cells, or gametes, reproduce in the process of meiosis. In germ cells a single, or haploid, set of twenty-

three chromosomes are contributed by each parent, providing the zygote with a double, or diploid, set of twenty-three. A reduction in chromosome number must take place in germ cells to accomplish this task. Thus meiosis is frequently called a reduction division. It is really a specific form of mitosis consisting of two successive divisions that resemble mitotic division except only one chromosomal division occurs.

In the first division the DNA has already replicated forming two strands. Usually some of the DNA breaks off and crosses over to the other chromosome. The chromosomes separate from each other and two new cells are formed. In the second division the strains of the chromosomes separate producing four sex cell (egg or sperm), each containing twenty-three chromosomes. The union of egg and sperm provides the zygote with twenty-three diploid chromosomes.

In humans, each germ cell has twenty-three pairs of chromosomes. To simplify the process only one pair is shown.

Parent cell

Chromosomes duplicate

DNA crosses over

Cell divides each with a pair of chromosomes

Two cells produced

Chromosomes separate

Four germ cells

(figure available)
The crossing over of DNA results in cells that are not the exact duplicate of the parent cell.

III. Lesson Plans/ Student Activities

A. View slides

View prepared slides obtained from a science supply house under the microscope to observe the various stages in mitosis and meiosis. With higher level students identification of each stage by name may be appropriate. With lower level students the ability to sequence the stages is sufficient.

B. Student prepared bulletin board

Use a bulletin board divided into two for diagrams of the stages in mitosis and meiosis. Have the students copy onto their own papers, adding short captions to describe each step.

C. Models

The differences between mitosis and meiosis using clay can be very effective. Use two different colors of clay to represent the chromosomes in meiosis with a tag board background for the nucleus. This can be used to illustrate the two divisions as well as the crossing over of the DNA.

D. Worksheet

The sheet the follows can be used to assist in identification of steps in mitosis and meiosis.

From the boxes on the right and the bottom of this sheet, cut out the steps and the labels showing the stages of mitosis and meiosis. Glue onto the correct spot in the diagrams.

(figure available)

CHROMOSOMES, GENES, AND HEREDITY

I. Objectives

A. To explain the structure of the DNA molecule B. To understand how DNA duplicates
C. To understand that chromosomes are responsible for the transmission of hereditary traits

II. Background Information Chromosomes are minute threadlike materials found in the nucleus of the cell. Genes are located on the chromosome. These genes are composed of a molecule called deoxyribonucleic acid, or DNA. This molecule possess a chemical code that determines the characteristics transmitted to the offspring.

In 1953 James Watson and Francis Crick proposed the molecular structure of DNA. Basing their work on that of many scientists studying DNA, The Watson-Crick model explained the manner in which DNA replicates.

DNA is composed of a sugar, deoxyribose, a phosphate, and four kinds of bases. These bases are adenine (A), thymine(T), guanine(G), and cytosine(C).

The DNA molecule can best be described as a spiral staircase, or double helix. The staircase has a right-handed twist, or completes a full turn for each ten steps or base pairs. The sides of the staircase are composed of the sugar and the phosphate while the steps are combinations of the four bases. Each step is composed of two bases united by hydrogen bonding. Base A can combine only with T and C joins only with G.

The DNA replicates by dividing neatly along its spiral length between the previously bonded bases.

The two strands unwind and the bases of each strand serves as a template for the formation of a new partner strand. Thus two DNA strands with the same sequence of bases, and the same genetic code have resulted.

III. Student Activities

A. Drawing the DNA molecule
B. Three dimensional model of DNA
C. Vocabulary puzzle sheet

DNA DIAGRAMS

DNA is a large molecule made up of a sugar, a phosphate, and four bases. The sugar and phosphate make up the sides of the ladder and the bases make up the rungs. Each rung is composed of two bases. The bases are adenine (A), thymine (T), guanine (G), and cytosine (C). A can only pair with T and C only with G.
(figure available)
(figure available)
(figure available)

B. Three dimensional model of DNA
l. materials needed: Straws in five colors
toothpicks
string
ringstand
two rings
cheerios
2. Directions:.
Attach the two rings to the ringstand, one at the top and the other at the base.To the bottom ring, about 2 1/2 inches apart.tie two strings of about 20 inches. Cut straws in one inch lengths. Starting at the bottom string white straws alternately with cheerios. Complete to top of string and tie to the top ring. Complete the second string in the same manner. With the four remaining colored straws establish a pattern of color with each color representing a different base.Put two different straws on a toothpick, always pairing base A with T and base C with G. Stick toothpicks into two opposite cheerios. Unfasten top ring from the strand and twist it once. refasten to the ringstand. With any luck, your model is complete and resembles the DNA molecule.

HEREDITY AND GENETICS

I. Objectives

A.To develop an appreciation for the contributions of Mendel to science
B.To explain Mendel's experiments and interpret his results
C.To develop basic vocabulary dealing with heredity D.To distinguish between phenotype and genotype E.To understand the concept of hybrid and purebred

II. Background Information Heredity involves the transmission of traits from parent to offspring. Genetics is the study of how those traits are passed on and expressed in the next generation.

Gregor Mendel, an Augustinian monk, is known as the father of modern genetics. As the son of a farmer and possessing some training in mathematics and natural science, Mendel was intrigued by his observations in plant hybridization. He felt there might be some mathematical relationship among the characteristic forms of different generations of hybrid plants. Working in the monastery garden with garden peas Mendel reached conclusions that have become the basic tenets of heredity. After experimenting with peas for twelve years he presented his findings to the Brunn Society for the Study of Natural Science is 1865. Although not received with any enthusiasm and discounted due to lack of significant proof of his findings his postulates have become known as the Mendelian Laws.

Mendel postulated inheritance is based on pairs of particular factors and these factors occur in pairs in each parent. These factors later became known as genes. He also concluded that a pair of factors are segregated or separated during the formation of sex cells so that each cell receives only one of the pair from each parent(Law of Segregation).

Of each pair of factors acquired by the offspring, one is dominant and the other recessive. When both parents contribute a dominant factor or when both contribute a recessive factor (AA or aa), the offspring will be "pure" for that trait. If the parents contribute one dominant and one recessive (Aa), the individual will be hybrid but will resemble the parent contributing the dominant.

He also felt that since paired elements whether dominant or recessive, are capable of separating, reappearing in their original form and pairing differently in later union; they are not altered as passed from individual to individual.

His findings also stated that if two or more pairs of factors are hybrid in a single plant(Aa and Bb, for example) they sort independently in the formation of the gametes.

Mendel's choice of peas and the seven particular traits he chose to study was certainly an astonishing piece of good fortune. Each trait he chose was controlled by a different chromosome. Because of his fortunate choice, linkage did not occur to confound his results and each trait did sort independently. Had he chosen a trait linking to an allele of a second trait, his results would have been entirely different.

Since Mendel's time not only has it been discovered that genes do not always sort independently, but also that allelic genes sometimes exchange corresponding parts. These recombinations are permanent and inheritable and thus they are passed from individual to offspring.

Mendel's experiments certainly provided a foundation for our knowledge about genes. Mendel himself never even knew of the existence of genes. In 1902, working independently

Three scientists(Sutton, Boveri, and DeVries) proposed that Mendel's hereditary factors were carried in the chromosome.

Another topic Mendel did not encounter in his experiments was incomplete dominance. In some cases a dominant gene does not exist. In these cases there is mixture or blending of characteristics in the offspring.

III. *Student Activities* s

A.Human Genetics Worksheet-separate sheet follows
B.Punnett Squares

Punnett Squares are used to predict the ratio at which offspring will inherit traits. Organisms have two genes for each trait, one gene from each parent. Punnett Squares use symbols to study the possible combinations of genes.

A capital letter represents a dominant trait while a lower case letter is used to designate the recessive trait.

When two like genes combine they produce a pure trait which may be either dominant or recessive. In this case, AA or aa, the offspring will have the same or purebred trait. When two unlike genes combine, a hybrid trait results in which the dominant trait will be expresses in the phenotype.

(figure available)
To complete each square, intersect the gene of the female with the male to see possible outcomes.
(figure available)
Predict the possible offspring combinations for eye color in each of the following crosses. Brown eye color is dominant and is represented by B. The eye color blue is recessive and is shown by b.
(figure available)
(figure available)
(figure available)
(figure available)
Sometimes neither trait is dominant or recessive and is called incomplete dominance. In this case a blending of traits is seen in the phenotype.

Incomplete dominance is seen for color in snapdragons.

W = White R=Red

(figure available)
(figure available)
What are the genotypes and phenotype of these snapdragons?

HUMAN GENETICS WORKSHEET

Genetics explains why we inherit certain physical features. We inherit thousands of features. Some are of minor importance, such as tasting PTC or tongue rolling. Others are very important,like color blindness or hemophilia.

Survey family member for the following characteristics. List names of members surveyed, including yourself.Record only the number of people possessing that particular trait.

CHARACTERISTIC	DESCRIPTION	# WITH TRAIT
l. Tongue rolling	roller	
2. Ear lobes	attached	
3. Dimples	present	
4. Freckles	present	
5. Hair Whorl	clockwise	
6. Widow’s Peak	present	
7. Handedness	right	
8. Hitchhiker’s thumb	thumb bent	
9. Folding Hands	left thumb on top	
10. Tasting PTC	taster	

Complete this chart on yourself using the information below.
(figure available)

1. Check to see if your earlobes are free or attached. *Attached earlobes are recessive (f).
2. Check to see if you roll your tongue.* Tongue rolling is dominant(R).
3. Obtain a piece of PTC paper. Tasting a bitter taste means you are considered a taster which is dominant(T).

Remember****

The actual genetic makeup is known as the genotype. You can only list possible genotypes by observing a trait and knowing if that trait is dominant or recessive.

The physical appearance of an organism is the phenotype.

GENETICS PUZZLE SHEET

Decide if the statements below are true or false. Shade in the boxes below that contain the numbers of the true statements to discover the hidden word.

1. A dominant trait is always observed in the phenotype.
2. DNA is found in the chromosome.
3. Base A is always paired with C.
4.Genes transmit hereditary characteristics.
5.Traits can be purebred or recessive.
6. Recessive traits are expressed in a hybrid genotype.
7. We can determine the phenotype by observing the organism.

8. Genotypes and phenotypes are synonyms.
9. By seeing the phenotype we cannot accurately give a single phenotype. 10.There are three bases in a DNA molecule.
11.The male parent always contributes the dominant gene.
12.Hereditary traits are interesting but they cannot harm an organism.

(figure available)

SEX CHROMOSOMES AND SEX-LINKED CHARACTERISTICS

I. Objectives

A. To explain how sex is determined by heredity
B. To give examples of sex-linked traits

II. BACKGROUND INFORMATION Sexual organisms have a pair of chromosomes which have been specialized for sex determination. The appearance of these sex chromosomes is different in the male and female when observed under a microscope. One chromosome, X, is larger. The Y chromosome in addition to being smaller also has a different shape. The X chromosome determines the female, while the male possess a Y chromosome.

The sex of an individual is determined at fertilization and depends on the gametes. The female is homozygous, or produces only one type of gamete in oogenesis (X). The male is heterozygous, producing two types of gametes in spermatogenesis (X and Y). When the sperm with an X chromosome joins with an egg, a zygote with an XX, or a female, will result. If a sperm with a Y chromosome unites with an egg, the zygote will be male (XY).

Thus the decisive factor in determining sex of an individual is the presence in the sperm of an X or Y chromosome.

The independent assortment observed by Mendel is more of the exception than the rule. We now know that each chromosome carries many genes. Genes located on the sex chromosome remain together through

meiosis, in the gametes, and in the fertilized egg. We refer to such genes are sex-linked.

The work of Walter Summon and thomas Hunt Morgan has led to the realization that a number of traits are controlled by genes on the sex chromosome. Thus certain genetic traits, having nothing to do with sex, will appear only in males or only in females. Color blindness, hemophilia, and baldness are a few traits that have been determined to be linked to the sex chromosome.

The sex-linked gene that determines red-green colorblindness is carried on the X chromosome. Since the female possess diploid X chromosomes and the gene for normal color vision is dominant over that for colorblindness, females are seldom color-blind. However the male possess only one X chromosome and the Y chromosome carries no gene for color vision. If that

X chromosome carries the gene for color-blindness, there is no other X chromosome carrying the dominant normal color vision to overpower the recessive trait.

Hemophilia, a disease that prevents the proper clotting of the blood, is also caused by a recessive gene carried on the X chromosome. Thus,once again, this disease usually occurs in males. Females may possess the gene in its recessive form and not have the disease. They can, however, pass the recessive gene to their offspring, usually a male. In this case, the female is referred to as a carrier.

CHROMOSOMAL CHANGES

I. Objectives

A. To explain what causes mutations
B. To realize why mutations may appear to occur less frequently than they actually do
C. To explain how a mutation may benefit or harm organism

II. Background Information Mendel's theory maintained that genes of a species are permanent and unchanging. Such is not the case. A gene is permanent unless it is mutated. A mutation is a change in the genetic material of the cell. When a gene has mutated, it is a permanent change except for the possibility of future mutation.

Mutations do take place at a regular frequency in both somatic and germ cells. If a mutation is present in a germ cell, the offspring might also inherit the mutation. A muta-a gene is dominant, the offspring would inherit the gene. In many cases, the mutated gene is recessive. Only if the organism mates with another organism with a similar mutated gene would the offspring inherit the mutation.

Most mutant cells are hidden so the frequency of the mutation seems to be lower than in actuality. In some cases the mutation is lethal and the organism does not have the opportunity to reproduce and transmit the mutation to offspring. Many mutant genes are recessive and therefore are not expressed phenotypically. In such a case the mutant gene handed down in its recessive form. If the offspring mates with an organism possessing the identical recessive gene, it is manifested in the phenotype. In some cases the change is so subtle the effect is lost in the same environment. Only if some major environmental change occurs is the

mutation apparent.

Dr. Hermann J. Muller discovered that x-rays can cause the normal frequency of mutations to drastically increase. In addition to radiation, certain chemical and drugs are known to increase the rate of mutations.

Many mutation are harmful, making it more difficult for the organism to survive in a certain environment. Albinos are the result of gene mutation the prevents the organism from having body coloring. In nature, the abnormal coloring increases the organism's visibility to predators.

Other mutations can actually assist an organism 's survival rate in a particular environment, Some mosquitoes have developed a DDT resistant gene that increases the likelihood of living and producing offspring while others not resistant to DDT do not survive.

The knowledge that gene mutations may either be lethal to the organism or improve its chances of survival seems to naturally progress to Charles Darwin's theory of natural selection and evolution.

III. Student Activities

A. The March of Dimes Foundation has a number of films that deal with defects caused by measles, use of drugs and alcohol.View films borrowed from the Foundation.

B. Research the effects of radiation on the individual.

C.Investigate the theory of natural selection and evolution.

GLOSSARY

ADENINE-base in the DNA molecule, pairing with thymine
ALLELES-two forms of the same gene(A and a)
CELL MEMBRANE-thin outer portion of cell which controls material entering or leaving cell
CENTRIOLES-small cell organelles found in the centrosome that separate during cell division,forming spindle
CHLOROPHYLL-green pigment found in chloroplast of plant cell, used in photosynthesis
CHLOROPLAST-plant cell organelle containing chlorophyll
CHROMOSOMES-thread-like strands found in the nucleus, containing genes;determines heredity
CYTOPLASM-gelatinous material found between the cell and nuclear membranes
COLOR-BLINDNESS-sex-linked affirmity in which certain colors can not be seen
CYTOSINE-base found in DNA molecule, pairing with guanine
DEOXYRIBONUCLEIC ACID-material that composes the chromosome made of sugar,phosphate, and bases
DOMINANT GENE-allele able to hide the effects of the other gene

ENDOPLASMIC RETICULUM-two walled network of membrane connecting cell and nuclear membranes, used to transport and store materials
GAMETE-germ cell, either egg or sperm
GENE-hereditary units found on the chromosome
GENETICS-the study of heredity and the transmission of traits
GENOTYPE-the actual genetic make-up of an organism
HEMOPHILIA-sex-linked disease, usually in males, in which blood does not clot properly
HEREDITY-the transmission of traits from parent to offspring
HETEROZYGOTE-organism with both forms of the gene
HOMOZYGOTE-organism containing a pair of identical alleles; purebred
HYBRID-organism containing two different alleles
INCOMPLETE DOMINANCE-the blending of two traits when no dominant trait exists
LYSOSOMES-cell organelle which help to cleave macromolecules
MEIOSIS-cell division that occurs in germ cell in which there is a reduction of chromosomes to the haploid
MITOCHONDRIA-powerhouse of the cell,site of cellular respiration and metabolism
MITOSIS-procell of cell division in body cells
NUCLEAR MEMBRANE-thin covering of the nucleus regulating the passage of materials in and out of nucleus
ORGANELLE-various cell parts
PHENOTYPE-the outward appearance of an organism
PHOSPHATE-chemical component of DNA
PUREBRED-organism containing a pair of identical alleles
SOMATIC CELL-body cell,not germ cell

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