Technology Advances Our Knowledge of Science: Cells, Viruses, Heredity and Genetic Engineering

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Academic Setting:

Lyndon Baines Johnson Middle School is a middle-class urban school located on the West Mesa in Albuquerque, New Mexico. This section of Albuquerque is one of the most rapidly growing neighborhoods in Albuquerqueu on the West side. It has a diverse student population ranging from Anglo, Spanish, and Native American, special populations include both special education, gifted, and severely handicapped students. Approximate number of students attending is 1,230. Grade levels at L.B.J. Middle School are six, seven and eight. The incoming sixth graders are incorporated into teams with two teachers who share the same students for Language Arts, Social Studies, Math, and Science. As part of the integration into middle school, the sixth grade teachers teach in blocks of time. A single teacher will teach both Math and Science within a 92 minute block. Seventh and eighth grade students move to a more traditional schedule with single subjects per a given teacher.

Academic goals at L. B. J. Middle School are high. The community is highly involved at the school with a large percentage of parent involvement in the form of committee members, task force members, science fair coordinators, office volunteers, tutors, and class room assistants. Approximately ninety percent of the sixth grade students turn in their homework on a regular basis. The sixth grade students at L.B J. are open to a variety of ideas and welcome discussions on topics relating to current events and their effects on the future. These sixth graders are eager to ask questions, find answers, and draw conclusions based on old and new information.

This curriculum unit is designed for a life science class for sixth graders. The unit will be presented in the first semester. The length of the unit will be approximately six to seven weeks. In addition to student text books, supplemental information will be gained from other sources (see student reading list).

Narrative

With the continual changes in technology, our society is constantly trying to keep up with the latest (new) knowledge from science and technology. The use of technology has brought us from the days of using only memory, word of mouth, and painting on cave walls, to the

use of a pencil, a calculator, and now a computer! Inventions in science have led us from what one might call "limited knowledge" to an array of improved and ever changing information. Humans are thirsty for knowledge and continue to search for new and better ways to improve the world in which we currently live. In this search we have learned about cells and their processes, and how to enhance the plants we grow making them bigger, better, brighter.

Many scientists have gone beyond the focus of plants and are very interested in animals. The genetic engineering of animals is on the rise. Scientists are experiementing with cows which will produce more and better quality milk. Cattle industries are also interested in creating a steer that produces the best quality meats. With the cloning of a sheep named Dolly, scientists are trying to puch gentic engineering to new heights. Sheep, goats, cows, and mice are now being cloned (Vogel 2437). Scientist's efforts are perfecting cloning continue. One team's (at the Rockefeller University in New York) most successful experiment took more than 1000 cloning attempts to obtain 13 mice that lived to adulthood (Vogel, 2437).

Wanting to learn more, scientists have turned their microscopes on themselves, searching for stronger, healthier, and smarter humans. Scientists are asking questions; Why are some individuals healthy and others are not? Can faulty genes be replaced by home grown or cloned " healthy genes?" Besides cloning a single gene, or a cell, can a human be cloned? As scientists gain further knowledge in the area of genetics and the human genome we need to become aware of possibilities being created for ourselves, whether positive or negative. It appears that the race for more knowledge continues: Who will be able not only to map each gene on the 23 chromosomes, but to know exactly what each gene does and how it functions? What do proteins have to contribute to this vast inquiry?

Objectives:

This unit's focus is to teach sixth grade students how technology has aided our increased knowledge of science. By introducing the topics of technology, cell processes, viruses in our lives, inheritance, and genetics, students will see the close connections between technology and science.

The unit can be used as to connect studies of the use of technology, Gregor Mendel's paper on heredity, cell processes, how viruses interact with cells, genetics, and finally genetic engineering. Listed are the goals for each week:

Students will:

Week One-
- Recognize how lives are affected by technology
- Interview a parent or guardian about technology
- Identify the common tools of a scientist
- Explore the differences between types of microscopes
- Discuss the pro's and con's of technology within the past two generations
- Be asked to *Go A Day Without* (using one technological advance, i.e., phone, computer, etc…)

Weeks Two and Three -
- Explain how traits are inherited
- Discuss Gregor Mendel's research
- Explain genotype and phenotype
- Learn about and use a Punnett square to predict offspring outcomes
- Participate in a Heredity Lab (Who did you get what from, Mom or Dad?)
- Explore incomplete dominance
- Participate in a Finger Print Study/Lab (to include identifying the killer at a crime scene)

Week Four-
- Take notes and define vocabulary words
- Discuss the cell theory
- Explain the importance of the cell theory
- Review the difference between microscopes
- Participate in a Microscope Lab (viewing cells)
- Diagram an animal and a plant cell
- Explain the difference between cells, tissues and organs

Week Five-
- Describe the structure of a virus and explain how cells are used as hosts
- Explain the benefits of vaccines
- Recognize how a potential AIDS vaccine can prevent the disease
- Discuss what role technology has played in gaining knowledge of viruses and vaccines.
- Note take and discuss types of cell processes
- Recognize that there is a relationship between chemistry and life science
- Describe the processes of diffusion and osmosis (how they work with cells)
- Compare and contrast passive and active transport (in cells)
- Discuss how cells get energy
- Take a concept and vocabulary test

Week Six-
- Describe mitosis (cell division)
- Explain how DNA copies itself
- Participate in a Cell Jello Lab (creating their own cell)
- Describe and draw the stages/phases of mitosis
- Learn about genetic disorders
- Explain the importance of genetic engineering
- Describe the goals of the Human Genome Project
- Identify an inherited human disease
- Define and discuss what a clone is and any possible advantages or disadvantages

Week Seven-
- Discuss and debate ethical issues being created by science and technology
- Research and explain what present impacts of technology have changed the world in which we live (Paper)

Background Information:

The students will begin by exploring how their lives are affected by technology. Due to technology and the invention of magnifiers and microscopes, scientists are able to look at cells and their processes on a chemical level. The invention of the microscope was an important factor in the study of cells. Cells were not discovered until the microscope was improved in the mid-1600's. In 1838, Matthias Schleiden used a microscope to study plant parts and concluded that they were made of cells. The world of science had been observing different animal cells, concluding that all living tissues are made up of cells. This new information could not have been possible with out the invention of the microscope.

Gregor Mendel studied science and math, eventually becoming a priest and a teacher. Mendel began experimenting with peas in his father's orchard. Eight years of studying pea plants lead Mendel to write a paper on his findings, in 1866, titled " Experiments with Plant Hybrids." Mendel was able to predict what the first and second generation of plants might look like (phenotype) and how their alleles would be coded (genotype) using a Punnett square. Mendel noticed that occurred, sometimes a plant would not show a particular gene (like an expected color). This was called a recessive factor. Recessive means that the information is coded in your gene but does not show up there. This gene may be passed on to the next generation, and show up. If the information is coded in your gene and shows up, it is called a dominant factor. Later, in 1900, scientists working with plants (botany) rediscovered the work of Mendel and came to the same

conclusions. Because Gregor Mendel was the first known scientist to document the study of genes and alleles he is credited with being the Father of Genetics.

Approximately 15 years after Matthias Schleiden used a microscope to study plants and cells, the observations and conclusions of many scientists culminating cell theory which states: All organisms are made up of one or more cells. Cells are the basic units of structure and function in all organisms. All cells come from cells that already exist.

"Cells are the smallest unit capable of an independent existence." (Webster 216). Living cells have several things in common. They all have a membrane and a gel-like material inside the membrane. In the cell is a control center called the nucleus or nuclear material. There are two types of cells: Prokaryotic and Eukaryotic. Cells with no membrane around their nuclear material are prokaryotic while eukaryotic cells have a membrane around their nucleus.

Cells in our bodies are continuously active. Our body has two types of cells; body (or "somatic") and sex cells. The body cells muscle cells, skin cells, etc… differ and all have a specific job to do: Each cell contains a nucleus with a set of instructions for operation. This set of instructions/materials is manifested as DNA (deoxyribonucleic acid). Tissues form when the same body cells gather together, (e.g, muscles). An organ is created by like cells forming tissues and thus like tissues form organs. For example, like body tissues form a muscle and the muscles in turn form the heart.

As the body grows and develops, the number of cells increases. If you fall and scrape your arm, your cells are quickly dividing to replace the skin which was scraped away. Not all cells replace missing cells. Unlike your skin (a large organ) being replaced after a scrape, your finger would not be replaced if it were missing or accidentally cut off. On the other hand, red blood cells are produced at a rate of two to three billion per second to replace worn out red blood cells. Mitosis is the division of body cells wherein a single cell produces a duplicate set of chromosomes within the cell wall. The cell then divides itself into two separate but identical cells with 23 pair of chromosomes.

Sex cells divide in a fashion similar to mitosis with the exception of a second division resulting in not two identical cells but four cells with only one chromosome for each pair. This process is meiosis and contains the same phases as mitosis. Unlike mitosis, meiosis has two divisions, the result of which is one-half the chromosomes of the original cell. When an egg with 23 single chromosomes joins a sperm (also with 23 single chromosomes) a new cell is formed with 23 pairs of chromosomes, and a new individual begins to form.

As cells divide complications can occur in the form of errors or mutations. Mutations are a change in a gene or chromosome of the cell. Traits are controlled by the genes you inherit from your parents. If the proteins are not correctly coded, an organism can't grow or repair itself. Sometimes during replication, an error is made in the copying of a gene. A cell might receive an entire extra chromosome. Scientists believe mutations are caused by x-rays, radiation, or chemicals which cause the chromosome to break. Several mutations have proven to be harmful to most organisms, while other mutations have positive or no effects at all. Because viral and bacterial agents progressively mutate, an organism may become resistant to vaccines or medicines.

Viruses are the smallest microbes of all. They use and destroy the cells in our body. Many viruses have geometric shapes and are the cause of the diseases in our world (Ward 7). They carry a complement of genetic information that does nothing other than make proteins that directly assist in their reproduction and survival (Scott, 43). For viruses to survive they must multiply by attaching themselves to a host (cell) and injecting its genetic information into the host for duplication of virus particles. Viruses escape the host cell by rupturing and, thus, killing the cell. The common cold, influenza, measles, small-pox, hepatitis, rabies, polio, herpes, AIDS, and cancer are just a few diseases that viruses can cause.

Vaccination is an exposure to a small amount of an infectious agent to protect against the full-blown disease (Scott 160). Vaccines are not restricted to viruses. It has also been highly effective against bacterial infections such as diphtheria, tetanus, cholera, whooping cough, etc., (Scott 159). Vaccines we developed in England in the 1700's by Edward Jenner. The body's response to the small amount of infectious agent creates an ability to fight the agent easily without creating a serious infection. If the body is later exposed to the same infectious agent, an immune memory kicks in and fights the infection before any damage is done. Viral vaccines are a preventative vaccine and not a cure for a virus, whereas bacterial vaccines are used to cure the infection.

To fully understand and appreciate genetics and the human genome, one must first learn about cells and their processes of division. As sex cells divide and an egg is fertilized by a sperm, a new life forms. The collection of traits passing from parents to offspring is called heredity. When pairs of chromosomes separate into sex cells during meiosis, pairs of genes also separate from one another. The sex cell ends up with one form of a gene for each trait that an organism shows, (e.g., type of hairline, color of eyes, shape of nose, size of ears). The

different forms of a gene’s traits are called alleles. The study of how traits are inherited through the actions of alleles is called genetics. A trait is inherited from the parent(s) whether good or bad. A parent can pass on a trait for a disease, color-blindness, even allergies. Although, a given trait may not appear for a generation or more, it is still passed on from one generation to the next, showing up at random.

By looking a little deeper into traits and genes one can predict which traits are candidates to get passed on to an offspring. Genes are inherited material located on an organism’s chromosomes. "The chromosomes are the packages of genes that allow exact passage of genetic information from one generation to the next-from cell to cell as tissues grow and from parents to child as families grow." (Jackson 1). Several diseases are caused by malfunctions in particular genes. Some of these malfunctions are inherited, while others arise through damage to the genes in the course of a person’s lifetime (Wade 38). Scientists and computers have spent years mapping genes in what is currently known as the Human Genome Project. The 23 pairs of chromosomes in a human contains a total of 30,000 genes. Scientist don’t know the identity of all the genes and/or the proteins created by the genetic information in the genes (Hensley 1). First scientists learned about the cell, secondly, the human genome was mapped, and now the knowledge of proteins is being sought (a new computers is being programmed to help understand protein shapes) (Hensley 4).

Genes have traits; in many cases two or more traits (alleles) control an outcome. For example, blood type or skin color in humans may be caused by more than one allele. Polygenic inheritance happens when several groups of gene pairs act together to create a trait. Another example of polygenic inheritance is eye color. Eyes come in a variety of shades of blue, brown, etc... Our finger prints also show polygenic inheritance; being that no two individuals have the same set of finger prints.

Every physical trait an individual has is a result of genes expressing themselves (dominant or recessive). If you know you carry the genes for a disorder, you may choose to seek the advice of a genetic advisor before having children, or you may adopt a child. In the future genetic engineers may be able to alter the disorder in your sex cells or in your unborn child. Genetic engineers are looking for ways to change the chemicals in the DNA sequences that make up a gene. Genes can be inserted into cells to change how the cells perform (gene therapy). This process has already been employed to crop improvement.

As more advances are made scientists focus their genetic engineering efforts not only on food crops and animals, but also on humans. Gene

therapy is being used on humans with disorders. Genetic engineering is venturing beyond gene therapy and gene replacement to cloning. A clone is an individual that is genetically identical to its parent. Clones have been produced in a laboratory setting by growing fertilized eggs, separating the cells. The separated cell acts as if it were the fertilized egg cell and begins to grow a genetically identical sibling (remember that a true clone receives all of its DNA from one parent).

Implementation

Lesson One:

Duration: Approx. 3-4 days
Objectives: Recognize how lives are affected by technology.
Explain the difference between types of microscopes.

New Mexico State Standards:
Content Standard 5: Benchmarks 4,5; Content Standard 14: Benchmark 8.

Procedure(s):
Students will be introduced to the tools/technology of science beginning with tools of the scientist. Subjects to be discussed: Living with Technology, New Technology, Technology and the Dairy Industry.

Brainstorm Session: Beginning with present day, students will be asked to create a list of things science and technology have created to enhance their lives. Students will then come together to discuss their thoughts and create a class list (list 1). Students will then be asked to make a list of technological and scientific advances that have been created since their parents/guardians were their (students') ages. Small groups will once again come together, a class list will be generated as the students discuss and debate what should and should not be on the list (list 2). After the two separate lists have been generated, students will compare the similarities and differences between the lists.

Assessments:
Students will be required to identify the common tools of a scientist (day 1).

Student Research: Students will be assigned the task of interviewing a parent/guardian to find out which items were accurately placed on class list 2. In addition, students must interview a grandparent or elderly guardian to explore items that are on the class list that were not invented when the grandparent/elderly guardian was in the 6th grade (day 2).

Wrap Up: A class discussion will follow as an updated list is generated (per class). The lists will be displayed in the classroom. Students will discuss things they have today that their elders did not have. A discussion will follow debating the impacts, whether pro's or con's, of what science and technology have generated within the last two generations (day 3).

Activity: Students will be asked to *Go A Day Without* (T.V., riding their bike, using the phone or radio, using something make of plastic, etc…). Write a paragraph on what it was like to Go Without (day 3 or day 4).

Lesson Two:

Duration: 8 to 9 days

Objective(s): Explain how traits are inherited.
Use a Punnett square to predict an outcome.
Explain genotype and phenotype.
Explain incomplete dominance.
Participate in Finger Print Study.
Describe two genetic disorders
Explain the importance of genetic engineering.
Describe the goals of the Human Genome Project.
Identify an inherited human disease.

New Mexico State Standards:
Content Standard 4, Benchmark 5; Content Standard 5, Benchmarks 5, 6;
Content Standard 10: Benchmark 5 (g).

Procedure(s):
Students will focus on traits that they have inherited from their parents concentrating on which parent they inherited a specific trait from such as a hairline, a type of earlobe or eye color. Students will be introduced to heredity, alleles, genetics, dominant, recessive, Punnett squares, genotype, phenotype, homozygous, and heterozygous terms. Students will look at Gregor Mendel's pea study, as well as dominant and recessive factors. Students will see that Mendel's work does not mention incomplete dominance, which was later noted by other scientists. Multiple genes will enter the picture along with the idea of multiple alleles. Students will gather finger prints and study the variations, trying to identify the print owners. Students will learn about genetic disorders and their effects on humans. The Human Genome Project will be studied and discussed as DNA sequencing continues around us, and technologies continue to emerge and

improve.

Assessment(s):

Participate in Heredity Lab (day 2).

Written test: Given a parent's set of genes, use a Punnett Square to determine possible traits of offspring. Describe two genetic disorders. Define vocabulary words (day 6). Participate in a Finger Print Lab (day 7 to day 9).

Lesson Three:

Duration: 4 days

Objective(s): Discuss the cell theory.
Explain the difference between types of microscopes.
Explain the importance of the cell theory.
Explain the difference between cells, tissues, and organs.

New Mexico State Standards:
Content Standard 4: Benchmark 7; Content Standard 10: Benchmark 3b, 3c.

Procedure(s):
Students will learn how to use the microscope and the types of microscopes (compound, stereo, electron, etc…). Now that students have some technology background (the microscope) they can study cells, the cell theory, and cell organization. It is important for the students to understand the difference between prokaryotic and eukaryotic cells, as well as the specific part and jobs of cells from the cell membrane through to the nucleus. Students will compare an animal cell to a plant cell noting similarities and differences.

Assessment(s):
Microscope Lab (day 1), lecture notes and vocabulary (day 2), diagram an animal and a plant cell and identify the parts and functions of each (day 3 and day 4).

Lesson Four:

Duration: 2 days

Objective(s): Describe the structure of a virus and explain how reproduction takes place.
Explain the benefits of vaccines.
Recognize how a potential AIDS vaccine can prevent the disease.

New Mexico State Standards:
Content Standard 10: Benchmark 3h; Content Standard 15: Benchmark 9.

Procedure(s):
With our current technology students will be able to study the structure of various viruses and cells, looking at characteristics of viruses, how active and latent viruses cycle, and studying viral diseases and possible vaccines to include AIDS.

Assessment(s):
Lecture notes and vocabulary definitions (day 1); group discussion and concerns (day 2).

Lesson Five:

Materials: computers (sign up for library/computer lab for day 3 of lesson).

Duration: 4 to 5 days

Objective(s): Recognize that there is a relationship between chemistry and life science.
Compare inorganic and organic compounds.
Describe the processes of diffusion and osmosis.
Compare and contrast passive and active transport.
Discuss how cells get energy.

New Mexico State Standards:
Content Standard 6: Benchmark 10; Content Standard 7: Benchmark 5: Content Standard 10: Benchmark 5a.

Procedures:
As we move on to Cell Processes students will identify the nature of matter, briefly being exposed to atoms, elements, and how atoms combine. Organic and inorganic compounds and their compounds will be introduced and examined. The process of cell transport and how cells control materials needed will be demonstrated as diffusion, equilibrium, osmosis, passive transport, active transport, endocytosis, and exocytosis will be explored. Looking at the energy in cells and how our metabolism enable organisms to live will be discussed with respiration and fermentation.

Assessment:
Lecture and class discussions (day 1, day 2, day 4).
Use various sources, including web sites to learn more about cell processes (day 3).

Vocabulary and concept test (day 5).

Lesson Six:

Materials: Microscopes, cell division slides for (day 2), colored construction paper (8 x 11), scissors, glue, lids, thread, tooth picks for day 3 and day 4.

Duration: 5 days

Objective(s): Explain mitosis.
Describe how DNA copies itself.
Describe two genetic disorders.
Explain the importance of genetic engineering.
Identify an inherited human disease.
Describe the goals of the Human Genome Project.
Define a clone and any possible advantages or disadvantages of cloning.

New Mexico State Standards:
Content Standard 10: Benchmarks 3, 5c and 5d; Content Standard 15: Benchmark 9.

Procedure(s):
Students will observe cells dividing and that cells are in constant change. Students will learn about the cell cycle, mitosis (cell division). Sexual reproduction and meiosis will be studied and discussed. Students will learn the importance of sex cells, fertilization, meiosis I and meiosis II. Students will learn what DNA is and how it copies itself. Along with our study of DNA, students will gain knowledge about genes, RNA, and mutations, thus leading to techniques of cloning and Dolly.

Assessment:
Lecture and cell lab (day 1 and 2).
Describe and draw the stages/phases of mitosis in sequential order (day 3 and 4).
Lecture notes and class discussion of cloning (day 5).

Lesson Seven:

Materials: Reading resources and internet access (sign up to use computer lab).

Duration: 4 to 6 nonconsecutive days

Objective: Research and explain what present impacts of technology

have changed the world in which we live.

New Mexico State Standards:
Content Standard 6: Benchmarks 7, 8, 10, 11, 12

Procedures:
Surf the net for additional information (see web sites).
Collect facts from selected journals and/or periodicals (see student reading list).

The students will revisit the question: What are the present impacts of technology and how have they altered the world in which we live good or bad? As a class we will research the Human Genome Project based on recent studies at the University of New Mexico, Los Alamos Scientific Laboratory, and other close to home governmental agencies, colleges and universities. Students will look at emerging technologies with respect to genetic engineering, tracking human genes, DNA sequencing and cloning.

Assessment:
Discuss/debate ethical issues being created by science and technology.
Research paper: Students will be asked to write a research paper based on information gathered at home and in the class. Topic questions to be discussed in their paper: What is Technology? What is Science? How far is too far in respect to genetic engineering? How has technology altered your life, your parent's lives, or your grandparent's lives?

Class discussions: Where Should We Go From Here? Students will be placed in small groups for this activity. Students will need to brainstorm, debate, discuss ethical issues, and come to a conclusion based on the open ended question posed to them. Each group member (four per group) will be assigned a job. The group must present their finished product to the class.

Finished products must include a visual, a written statement answering the question (clearly stating any reasoning and logic used to draw a group conclusion), and come up with a sentence or phrase summing up their idea(s).

New Mexico State Standards listed are Content Standards for Science (60.30.2.15)

Content Standard 4: Unifying Concepts and Processes: Students will understand the physical world through the concepts of change, equilibrium, and measurement.

Benchmark 5: illustrate that constancy and change are properties of

objects and processes.

Benchmark 7: use elementary scientific devices to measure objects and simple phenomena.

Content Standard 5: Science As Inquiry: Students will acquire the abilities to do scientific inquiry.

Benchmark 4: use the scientific methods within the classroom and school environment.

Benchmark 5: employ equipment, tools, a variety of techniques and information sources to gather, analyze, and interpret data.

Benchmark 6: explain that scientific theories emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories.

Content Standard 6: Science As Inquiry: Students will understand the process of scientific inquiry.

Benchmark 7: use different kinds of methods, including observation, experiments, and theoretical and mathematical models to answer a variety of scientific questions.

Benchmark 8: use their own understanding of science to guide their scientific investigations.

Benchmark 10: choose appropriate methods and analytic techniques for specific science problems and investigations.

Benchmark 11: use technology and scientific methods to gather evidence to enhance the accuracy of their findings.

Benchmark 12: describe the results of investigations with teachers, peers, parent, and others.

Content Standard 7: Physical Science: Students will know and understand the properties of matter.

Benchmark 5: discriminate between elements based on the characteristic ways in which they react with other elements to form compounds that are different substances with unique characteristic properties.

Content Standard 10: Life Science: Students will know and understand the characteristics that are the basis for classifying organisms.

Benchmark 3: use information about living things including: (b) cells

as the fundamental unit of life; (d) cell division.

Benchmark 5: apply information about living things to themselves and the world around them including: (a) cell structure and function, (c) the functions of DNA and RNA in genes and the process of heredity; (d) how almost all human cells contain two copies of 23 chromosomes; (g) that small genetic difference between offspring and parents may accumulate in succeeding generations and may or may not be advantageous for the species; (h) disease as a breakdown in the structure or functions of an organism.

Content Standard 12: Earth and Space Science: Students will know and understand properties of Earth Science.

Benchmark 7: explain how Earth's materials can be transformed from one state to another.

Benchmark 8: experiment with the uses of Earth's materials as resources.

Content Standard 14: Technology and the History of Science.

Benchmark 6: demonstrate trade-offs in safety, cost, efficiency, and appearance related to technological solutions provided through science.

Benchmark 8: examine the role of technology, particularly computers and other electrical advances, in the advancement of science.

Content Standard 15: Technology and the History of Science: Students will know and understand the impact between science and technology in society.

Benchmark 9: demonstrate how the direction for scientific investigations is related to social issues and challenges.

Vocabulary:

active transport: movement of material through a cell membrane with the use of energy.

AIDS: acquired immune deficiency syndrome, a fatal communicable disease caused by the HIV virus. It destroys the body's ability to fight disease. It is spread by sexual contact, through the placenta, or by nursing from an AIDS-infected mother.

allele: a different form of a gene for a trait.

asexual reproduction: a type of reproduction in which a new organism is produced from one parent.

cell membrane: the selectively permeable outer boundary of a cell that allows food and oxygen to move into the cell and wastes to leave it.

cell theory: a major theory of life science. The cell is the basic unit of life. Organisms are made up of one or more cells and all cells come from other cells.

chromatin: hereditary material in a cell's nucleus.

chromosome: threadlike strands of DNA and protein in a cell nucleus that carries the code for the cell.

clone: an individual that is genetically identical to one of its parents.

compound light microscope: an instrument that uses light and convex lenses to magnify objects.

cytoplasm: the gel-like substance inside the cell membrane that contains structures that carry out life processes for the cell.

diffusion: the movement of molecules from areas of greater concentration to areas of lesser concentration.

DNA: deoxyribonucleic acid is a chemical in the nucleus of a cell that codes and stores genetic information.

dominant: the form of a trait that appears to dominate or mask another form of the same trait.

egg : in organisms that reproduce sexually, the sex cell from the female parent.

electron microscope: an instrument that bends beams of electrons in a magnetic field. It also magnifies objects too small for the light microscope.

endocytosis: the process by which a cell transports a large body, like a protein molecule, through a cell membrane into the cytoplasm.

endoplasmic reticulum: a cell organelle consisting of folded membranes that move materials around within the cell. (also known as ER)

enzyme: a protein that speeds chemical reactions in cells without being changed itself.

equilibrium: a condition in which molecules of a substance are spread evenly throughout a space/area.

exocytosis: a process by which a cell moves large molecules out through the cell membrane.

fermentation: a form of respiration (like in plants) that converts energy from glucose when the supply of oxygen is not sufficient.

fertilization: the fusion of an egg and a sperm.

gene: the segment of DNA on a chromosome that directs the making of a specific protein. It controls traits that are passed from parent to offspring.

genetic engineering: biological and chemical methods to change a cell's DNA sequence to produce desirable traits and do away with unwanted traits.

genetics: the science of how traits are inherited through alleles passed from one generation to another.

genome: a map of the location of individual genes on every chromosome of an individual.

genotype: the genetic makeup of an organism for a trait.

Golgi body: cell organelles consisting of stacks of membrane covered sacs that package and move proteins to the outside of the cell.

heredity: passing of traits from parent to offspring.

heterozygous: an organism that has two different alleles for a trait.

homozygous: an organism that has two identical alleles for a trait.

host cell: a living cell in which a virus reproduces.

incomplete dominance: the production of a phenotype in an offspring that is intermediate to the phenotypes of its two homozygous parents.

lysosome: a cytoplasmic organelle that contains chemicals and digests wastes and worn out cell parts.

meiosis: the division of the cell nucleus to produce sex cells.

mitochondria: cell organelles that break down food molecules and release energy.

mitosis: the process where a nucleus divides into two identical cells, each containing the same number and type of chromosomes as the parent cell.

multiple alleles: having more than two alleles that control a trait.

mutation: any permanent change in an organism's genetic material.

nucleus: the central membrane-enclosed part of a eukaryotic cell, containing the chromosomes.

metabolism: the chemical activities o f an organism that enable it to live, grow and reproduce.

organ: a structure made up of different types of tissues that work together to do a specific job.

organelle: in eukaryotic cells, the structures within the cytoplasm that break down food, move wastes, and store materials.

organic compound: class of compounds in living organisms, such as, proteins, lipids, carbohydrates, etc.

osmosis: the diffusion of water through a cell membrane.

passive transport: movement of material across a cell membrane without the use of energy.

phenotype: a physical trait that show as a result of an organism's particular genotype.

polygenic inheritance: occurs when groups of gene pairs act together to produce a specific trait.

Punnett square: a tool used to predict how genes can combine in offspring.

recessive: an allele that will not show if its partner is dominant.

ribosome: a cell organelle on which protein is made.

RNA: ribonucleic acid which carries the codes for making proteins.

sex-linked gene: an allele inherited on a sex chromosome (color blindness).

sexual reproduction: a type of reproduction where a new organism is produced by combining sex cells from two parents.

sperm: the reproductive cell from the male parent produced in the testes.

tissue: groups of similar cells that do the same sort of work, for example, the muscle (tissue) is made of similar cells.

vaccine: a solution made from damaged virus or bacteria particles or

from killed or weakened viruses or bacteria. The vaccine can prevent but not cure a viral disease.

virus: a microscopic particle made of either a DNA or an RNA core and covered with a protein coat that infects host cells in order to reproduce.

zygote: in organisms that reproduce sexually, the cell that forms in fertilization.

Bibliography

Suggested Teacher Readings:

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