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Medical Technology Relating to Pregnancy and Childbirth

Curriculum Unit 99.07.05
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Student Population/Setting

This curriculum unit has been designed to be used in a special education classroom within a small, inner-city, public secondary school. Our enrollment varies from sixty to seventy students or more. The school provides an alternative academic setting for pregnant teens, and mothers of newborn babies. Classroom instruction is provided through a selection of academic subjects, as well as elective courses in home economics, and computer skills. All students participate in parenting and life skill classes. Prenatal and postnatal classes are an integral part of the program.

Students transfer onto the school throughout the year, depending on individual circumstances. Most students stay for at least two marking periods, while others remain until the end of the school year. They then return to their sending schools the following September. We strive for a smooth transition; one which maintains curriculum content. However, because of the ongoing population flux, curriculum planning needs to be elastic as well as flexible.

The special education population attending the school includes students who are mentally delayed, learning disabled, brain damaged, and or seriously emotionally disturbed. Ability levels within the special education classes cover a wide range. Many of the students have limited reading and writing skills. Some students exhibit negative behaviors, which are best addressed in small groups within a highly structured setting. Class size, in general, tends to be small. Many of the students have a history of poor school attendance, which has resulted in significant gaps in their learning. Whole sections of information may be missing from their fund of knowledge. Individual education plans (IEP), which address specific strengths and weaknesses, are implemented in teaching the curriculum content to the special education students attending our school.

Although this unit has been planned for use in a special education setting, it would be appropriate to include all or selected sections of the curriculum in a high school parenting class, or as a unit in a regular education general science class. It could be modified bases on the individual interests and ability levels of the population being served.

Rationale

The effect of technology on the medical field, during the last decades, has been substantial. Baring an unforeseen event, it will continue to grow at an accelerated rate into the 21st century and beyond. It can be expected that we will all experience its progress in some form or another. Let us hope that our individual experiences with medical technological advances and devices will be positive and helpful.

The students in our school encounter these medical machines during the course of their pregnancy. Pregnancy and childbirth can be a time of uncertainty and anxiety for these very young expectant mothers, as well as for their friends and family. The entire experience is new and unknown. Along with a changing body, they must deal with both the emotional and practical consequences of the situation. Often, the medical aspects of pregnancy and childbirth are cause for the most concern. It is for this reason that I have chosen to develop a curriculum which addresses this topic. Students will gain knowledge and understanding by exploring the scientific background, as well as, the medical technology related to pregnancy and childbirth. It is my hope that along with greater understanding, will come a more relaxed and accepting attitude.

Unit Goals and Objectives

Unit Goals:

Students will gain academic progress and developmental growth in science education

Students will gain academic progress and developmental growth in reading

Students will gain academic progress and developmental growth in written expression

Students will gain academic progress and developmental growth in analytical thinking skills

Students will gain academic progress and developmental growth in problem solving skills

Unit Objectives:

Students will demonstrate a simple understanding of basic physical scientific principles, through the directed study of energy, light, sound, electricity, and magnetism.

Students will demonstrate a functional understanding of the technology related to childbirth and pregnancy, through directed study of sonography, fetal monitoring devices, MRIs, and CAT scans.

Students will demonstrate gains in the basic academic skills of reading, writing, and thinking, through directed lessons, demonstrations, and experimentations focusing on scientific topics

Background Information A Simplified Explanation

Energy

Energy makes things happen. It makes a thing able to move, or causes something else to move. There are many forms of energy. Examples of energy are light, electricity, and heat. Light travels in waves. The biggest source of light energy is the sun. Heat energy is caused by the movement of the atoms and molecules in an object. The atoms in a hot object move faster than the atoms in a cold object. Electrical energy comes from atoms and electrons. Electrons have electrical charges which move in a path. Lightening is an example of electrical energy. Energy has the ability to move or transfer heat. Energy can be taken from one thing and added to another, but it cannot be destroyed. Mechanical energy is released by the working parts of a machine. Chemical energy is the energy stored in molecules. Chemical energy is released when the atoms in molecules are pulled apart. An example of chemical energy would be burning wood at a campfire. Nuclear energy is produced in nuclear reactors by the splitting of atoms.

There are two main types of energy. Potential energy is stored, or possible, energy. An example would be the energy in a roller coaster car at the top of the first hill. Kinetic energy is energy in motion. An example would be the same roller coaster car speeding at the bottom of the hill.

Light and Sound

Light and sound are both forms of energy that travel in waves. Light comes originally from the sun. Light can travel through space. Sound travels through a substance that has molecules which are able to move around. Light travels at 186,000 miles per second. Sound travels more slowly, between 1,083 and 1,115 feet per second in air. This is why we see the lightening before we hear the thunder.

Light waves travel in straight lines. The top of each wave is called the crest, and the bottom of each wave is called the trough. The distance from one crest to the next is called the wavelength. The height of a wave is its amplitude. A larger amplitude, creates a brighter light. It is called reflection when light rays bounce off shiny objects, like mirrors. Light changes speed when it passes through substances like water. The light rays slow down and bend. This is called refraction. Color is caused by the wavelength of light. Some colors cannot be

seen. The colors red, orange, yellow, green, blue, indigo, and violet are the bands of color called the light spectrum. At the red end of the spectrum are infrared rays, microwaves, radar, television, and radio waves. At the violet end are ultraviolet, X-rays, gamma rays, and cosmic rays. Light waves are a form of electromagnetic radiation.

A laser beam is a beam of pure light, with waves that are all the same length. This creates a beam which is narrow, but very powerful. Lasers are used in the medical field to cut and repair tissue. The word laser stands for light amplification by stimulated emission of radiation.

Sound is made by vibration of objects. When matter moves backward or forward it vibrates, and produces sound. The molecules around it vibrate and set up a sound wave. If these waves reach your ears, bones inside your ears vibrate, a message is sent to your brain, and you hear the sound. Our vocal cords vibrate when we talk or sing.

The amplitude (height) of sound waves determines its loudness. Sound is measured in decibels. The softest sound that a human can hear is zero decibels. Because of the large range of intensities over which the ear is sensitive, a logarithmic (non-liner) scale is used to express loudness. Therefore 100 decibels is not twice as loud as 50 decibels. Sounds of 140 decibels or more can damage the ears. Normal conversation is at about 60 decibels. The frequency of a sound wave is the number of waves that pass by in a second. The higher the frequency, the higher the pitch. Low-pitched sounds have longer wavelengths and lower wavelength frequencies.

Electricity and Magnetism

Electricity is the movement of electrons (tiny particles) and the energy they release. The nucleus of every atom is surrounded by one or more electrons. Atoms have the same number of electrons as they have protons (parts of an atom). This makes atoms neutral, not electrically charged. But electrons can be rubbed off and moved to other atoms. This movement of electrons causes electricity. An atom with extra electrons has a negative charge. An atom with missing electrons has a positive charge. An electric current is a flow of electric charges, pushed along by a force. Electrical charges are controlled by making them flow in circular paths. A circular path of electrical charges is called a circuit. All circuits must have a source of energy. This could be a battery. The electrical energy flows through insulated wire, it powers a machine, and then flows back to the source of energy.

There are two kinds of current. Direct current (DC) flows in only one direction. Alternating current (AC) changes its direction of flow at regular intervals.

Electricity moves through some materials better than others. Metals are good electrical conductors. Water is also a good conductor. This is a good reason not to go swimming during a storm. Insulators are used on electric machines for protection. Plastic is a good insulator. All electrical wires and panels are covered with plastic or rubber.

A magnet is any solid substance that attracts iron or steel. Magnetism is caused by the electrical charges of electrons. The electrons around an atom spin in no special order. This changes when an object is magnetized. Then all the electrons are lined up. They pull together magnetically in opposite directions. This action creates a magnetic field. Each end of a magnet is called a pole. There is a north pole and a south pole in the magnetic field. Magnets may repel or attract each other. Opposite poles attract one another. Like poles repel each other.

Magnetism and electricity are closely connected. One can produce the other. An electromagnet consists of a coil of wire wound around a piece of iron. When an electric current flows through the coil, the iron becomes a magnet. The electromagnet loses its magnetism when the current is turned off. Microwaves are a form of shortwave electromagnetic radiation. Dynamos are generators that turn mechanical motion into electrical current. A wire coil is wound between the poles of a magnet. This motion in the magnetic field produces electricity in the wire. Microwaves are a form of shortwave electromagnetic radiation. They are used for communication, and also microwave ovens.

Core Unit Topics

X- Rays

Wihelm Conrad Roentgen, a German physicist, is credited with discovering X-rays in 1895. He was experimenting with metallic salts, electrical current, and a vacuum tube. He passed high-voltage electric currents through the tubes, causing a screen in another area of the room to shine. This occurred even though his tube was covered with black paper. He had discovered a new form of radiation, imperceptible to the human eye, and different from cathode rays. He called them X-rays (unknown) because he himself did not know what they were. His first X- ray was of his wife's hand, showing her bones and wedding ring. He discovered that these invisible rays passed through wood, glass, and human flesh, but not bone or metal. Roentgen was awarded the first Noble Prize in physics in 1909 for his discovery of X-rays. It is now known that X- rays are part of the electromagnetic spectrum of energy. They are a type of electromagnetic radiation whose wavelength is smaller than visible light. They have higher frequency, and greater energy than light waves. They are very penetrating and pass through dense objects that absorb ordinary light.

To take an X-ray, the area to be looked at is placed between a metal cassette holding the film and X-ray tube. Electrical current passing through an X-ray tube produces a beam of ionizing radiation that can pass through the the body part being examined to produce an image on film. A lead shield is used to protect parts of the body which are not being X-rayed. X-rays pass easily through air and soft tissue, but stop when they encounter bone, which is made up of calcium, phosphate, and other minerals. A contrast medium, such as barium or other iodine-based compound, may be injected or inserted into the body to better define intestines, blood vessels, or other soft internal structures. When X-ray films are examined, bones appear white, and soft body tissues, muscles, and organs are grey to black because their density is similar. The contrast material introduced into the body helps to make the organ being examined stand out. Because X-rays are often somewhat difficult to read, it takes a trained radiologist to interpret to results with accuracy.

X-rays expose the body to ionizing radiation. This is a major drawback which poses certain health risks. Even low doses of X-rays can cause birth defects when a fetus is exposed to them during critical stages of development. Radiation exposure can also damage male sperm and female eggs and can result in genetic defects. Radiation exposure has a cumulative effect. Frequent exposure increases the risk of damage. X-rays are contraindicated during pregnancy unless they are absolutely necessary. If they are done at all, it is with the judicious use of a lead shield. Routine X-ray screening tests, such as chest X-rays, are no longer recommended.

CT Scans

British electronics engineer, Godfrey Houndsfield, won a Nobel Prize in 1979 for his invention of computerized axial tomography. Computed tomography combines the basic principles of radiology with computer technology. During a CT scan an X-ray tube rotates around the person being examined, and generates hundreds of images as it makes a 360-degree circle. These images are received on a series of special plates. Data on these detectors is then transmitted to a computer which processes them to create two-dimensional cross-sectional views of the body. An iodine substance is often used, as a contrast medium, as barium might be used in conventional X-rays.

Although a large number of images are taken during a CT scan, the total amount of radiation could be less than in an X-ray. However, there is still risk to a developing fetus; therefore, CT scans are not recommended during pregnancy.

MRI

Available since the early eighties, the diagnostic technique, magnetic resonance imaging, uses a magnetic field to create two-dimensional images which show a cross section of an internal organ or structure. These images are much like CT scans results, but do not require ionized radiation to produce them. MRI provides more detailed images than CT scans, often giving a much greater contrast between normal and abnormal tissue.

The technique is based on the principle that the most abundant atom in the body is hydrogen. When placed in a powerful magnetic field, the nuclei of these hydrogen atoms line up in one direction. When energy from radio waves is directed into the field of the body part being examined, the nuclei are temporarily moved out of alignment. When the radio waves stop, the nuclei return to their alignment. The machine's computers record the duration and the intensity of these signal changes and convert the data into information that produces an image which shows the internal structure of the part being examined.

MRI is most often used to examine the brain and spinal cord, the joints, and soft tissues of the body. It provides a non invasive method to evaluate inflammatory conditions and infections. It is also used to assess response to treatment, especially chemotherapy or radiation therapy. MRI can produce detailed images of the heart and major blood vessels, as well as the internal structure of the eye and ear. It is often used to examine sport injuries of the knee and shoulder joints.

MRI is not suitable for all individuals. The person being examined lies on a table that slides into a narrow tube and is surrounded by electromagnets. The procedure is not painful, but it is noisy and confining, and especially difficult for people who are claustrophobic. The procedure often takes from one to three hours. MRI cannot be used for individuals with pacemakers or other metal implants because the magnet may move the object and cause injury. The high cost of MRI (about $1,000 per examination) can also be a limiting factor of this technology. MRI evaluation during pregnancy should be carefully considered on an individual basis, with the decision being made between the patient and her doctor.

Ultrasound

A Scottish doctor named Ian Donald is credited with building (with others) the first ultrasound machine in the late 1950s. Ultrasound or pulse-echo sonography is a medical diagnostic tool which uses high frequency sound waves to create a visual image on a screen. Obstetrical scans provide 'pictures' of the fetus within the mother's body.

The use of diagnostic ultrasound is based on the piezoelectric effect, which was discovered by Pierre and Jacques Curie in 1880. The application of a pulse of electric charge in a transducer produces a change in the thickness of the element. Repeated application of voltage results in the generation of pressure or sound waves. The transducer then converts one form of energy into another form. An ultrasound transducer converts electricity into mechanical energy in the form of vibrations by using the piezoelectric effect. The waves produced in diagnostic ultrasound are generated in short pulses, repeated 1,000 times a second. When the sound waves come in contact with the target object they bounce back and an amplifier amplifies the returning echo signals. These are then electronically processed and translated to dots on a screen for display on a cathode ray tube, as in a television screen. Computers are also used to process data, along with cameras, and video recorders to record images and data. Doppler ultrasound is a development of ultrasound which can detect waves of moving fluid, because it can pick up moving structures, such as circulating blood. The returning echo contains a change or shift in tone and this can be used to measure blood flow. This information can then be used to interpret the baby's heartbeat.

Obstetrical ultrasound scans are safer than previous diagnostic techniques. They are non invasive, and their imaging does not involve X-ray radiation, which can be harmful to the fetus. It is a fast, easy procedure which should cause the mother no discomfort. Because results are often difficult to read and interpret, it takes a highly trained and skillful sonologist to complete the procedure.

An obstetrical ultrasound exam is not painful, although it may be somewhat uncomfortable because it is necessary to have a full bladder in order to view the uterus clearly. A gel is applied to the abdomen which enables the ultrasound waves to be conducted directly into the abdomen. The transducer box is moved slowly back and forth while the doctor views the the resulting image on an oscilloscope or computer screen.

Two types of ultrasound scans may be done during pregnancy. The first is referred to as a stage one examination. It is a short, simple exam which measures the widest dimension of the baby's head. This provides a good indication of the baby's gestational age. During this exam the location of the placenta, the amount of amniotic fluid, and the general position of the baby can be determined. Stage one ultrasound is also used to verify fetal growth if the baby seems to be growing either very rapidly or very slowly, and to confirm the diagnosis of multiple babies. Fetal anomalies or an ectopic pregnancy may also be discovered. The heart beating can be seen at about the 6th or 7th week. The baby's heartbeat can be heard at about 12 to 14 weeks with an auditory scan.

Stage two ultrasound is a longer examination, performed if there is the possibility of a potential problem with the pregnancy. It is used to rule out or confirm congenital malformations. Common defects of the neural tube, including spina bifida, hydrocephalus, and anencephaly may be detected; as well as anomalies of the gastrointestinal tract, renal tract, and heart and other soft tissues.

Diagnostic ultrasound is also used to guide the needle used in the amniocentesis procedure; a test which analyzes amniotic fluid for chromosomal abnormalities. This is generally performed around 16 weeks if there is an indication of a problem or if the mother is in a high risk category.

Ultrasound is also commonly used to examine other abdominal organs such as the liver, spleen, gallbladder, and pancreas; as well as the kidneys, bladder, heart, and thyroid gland.

Fetal monitoring devices

EFM, or electronic fetal monitoring, began to be used in the late 1960s. Up until that time, the fetal heartbeat

was heard using a regular stethoscope, or later a fetoscope. The fetoscope has now largely been replaced by a portable ultrasound device which is easier to use and can pick up sounds that may be hard for the human ear to distinguish. During such monitoring, the fetal heartbeat is picked up and then recorded on a graph.

There are two types of fetal monitors. One type uses external leads that are taped or strapped to the mother's abdomen, the other uses an internal lead that is inserted under the baby's skin, usually on the scalp. They provide a continuous record of the baby's heartbeat. Monitors are used in conjunction with an electronic pickup which measures the motion of the uterus during contractions. When this is used during labor, the effect of each contraction on the baby's heart rate, can be clearly seen.

The external fetal monitor is more commonly used for low-risk pregnancies. With this device the fetal heart rate is measured with pulsed ultrasound. Two straps containing electronic transducers are placed around the mother's abdomen. One transducer records the baby's heartbeat, while the other measures the strength of her contractions. The monitor provides a continuous reading. New devices work by remote control, allowing the mother more freedom of movement as she is not attached to a machine.

Internal monitoring is considered to be the most accurate means of monitoring the baby's heart rate. It is used more often if the pregnancy is thought of as high-risk. During the procedure an electrode is inserted through the cervix into the baby's scalp. A safety feature prevents it from penetrating more than 2 millimeters. The heartbeat is recorded by picking up electrical impulses from the baby's heart, like an electrocardiogram. A transducer is strapped around the mother's abdomen to measure the pressure of the contractions. Once the leads are in place, they provide a continuous, detailed picture of the baby's heart rate in comparison to the mother's contractions. If the baby's heart rate drops too much during contractions, the baby is considered to be in danger. This situation would call for appropriate medical intervention, and the possibility of a cesarean section delivery.

Methodology

Students will gain an understanding of the unit topics in a variety of ways. Instruction will be guided by individual learning styles and ability levels. Materials will be presented on several different levels. A variety of literature relating to scientific topics will be made available, in the classroom, to the students. Students will select books to study and read based on their individual interests and reading abilities. The teacher will interact with the students in order to inform, explain information, and to clarify ideas and concepts. The teacher will read aloud to the class from appropriately selected material, and will present information to the class through lecture, demonstration, and guided group discussion. The teacher and students together will investigate scientific principles, and conduct simple experiments relating to the unit topics. Creative expression will be addressed through hands-on projects and creative writing assignments.

Classroom materials will include teacher generated informational sheets relating to specific unit topics. Science books rich with photographs, illustrations, and diagrams will be brought into the classroom from local and school libraries. General art supplies, and experiment equipment will be provided as needed. Students will have access to research information available to them through the use of encyclopedias, newspapers, magazines, and the Internet.

Evaluation

Gauging student progress in a special education classroom is directly related to carefully following each students individualized education plan (IEP). Progress is measured in increments of growth, such as an improved reading level, as measured by standardized tests. Strengths are built upon, and weakness are remediated whenever possible. Individual portfolios containing written work, and projects are studied by the classroom teacher in order to further evaluate progress. Depending on outcome, adjustments may be made in content focus or in teaching strategies.

Teacher observation of a student's individual and group participation in classroom projects, as well as interaction with other students is an ongoing process of evaluation. Behavior management is measured according to an individual's specific behavioral plan. It might include such things as; time on task, promptness to class, use of appropriate language, control of outbursts, or completion of assignments.

Graded tests and quizzes, teacher corrected worksheets, completed assignments, including both classroom and homework assignments, are additional ways of evaluating student progress. Classroom participation, including positive contributions to group discussions, is another valuable tool for accessing individual progress. Clearly the most important evaluation of an individual's school success or failure is a review of his attendance record. Virtually all failures in my classroom, and in the school in general, are due to lack of consistent school attendance. The ramifications of poor attendance override the best teaching strategies, and the finest curriculum.

Sample Activity Unit Topic: Light and Sound

This worksheet should be assigned during the background study of information relating to light and sound. Students will be in the process of exploring books on the topic. They will be given a handout with pertinent information.

Directions: Choose the best answers from the words in the box below. Write that answer in the blank to complete the sentence. You may use reference materials to help you find the correct answer.

1. Light and sound are both forms of energy that travel in _____.

2. Sound travels more _____ than light.

3. The top of each wave is called the _____.

4. It is called _____ when light rays bounce off shiny objects.

5. The term _____ is used to describe light waves slowing down and bending.

6. Some colors _____ be seen naturally by the human eye

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7. _____ is made by the vibrations of objects.

8. Our _____ vibrate when we talk or sing.

9. Sound is measured in _____.

10. The word _____ stands for light amplification by stimulated emission of radiation.

Sample Experiment Unit Topic: Light and Sound

Reflection

This experiment should be tried during the background study of light and sound. The students will be in the process of exploring various books on the topic..

Directions:

Using a hinged picture frame, cover one side with a mirrored surface and the other side with white paper. Adjust the frame to approximate right angles.

In a darkened room shine a beam of light (flashlight, penlight, etc.) into the mirror. Notice how the light is reflected onto the paper. Observe the light bouncing off the mirror onto the other surface.

Explore variations on this theme by:

Partially covering the light source
Varying the distance between the light and the mirror
Experimenting with a pulsing light source
Taping shapes or designs on a flashlight beam
Covering the light source with colored cellophane
Changing the color or texture of the reflection surface
Replacing the white paper with another mirror

Materials:

light source: flashlight, penlight, candle, etc.
hinged frame
two mirrors, and or mirrored surfaces
white paper, colored paper, cardboard, textured board, etc.
general craft supplies: scissors, tape, paper, colored cellophane, pencils, markers, etc.

.Sample Quiz Unit Topic: MRI

This quiz should be given following the study of the unit topic MRI. Although it is labeled a quiz, it is actually used to reinforce the material that has been presented.

Directions: Answer the following statements with the words TRUE or FALSE. If you think that a statement is false, please correct it with your own words.

1. MRI uses a magnetic field to create two-dimentional images. _____

2. Hydrogen is the most abundant atom in the body. _____

3. MRI stands for: Mothers Rule!, Inc. _____

4. MRI is not painful, but it is noisy. _____

5. MRI is a fairly new (1980s) evaluation technique. _____

6. Internal organs can be viewed using MRI. _____

7. MRI is an inexpensive test, costing less than $100. _____

8. MRI technology has been available since 1942. _____

9. MRI stands for: Magnetic Resonance Imaging. _____

10. People with pacemakers should not undergo MRI testing. _____

Sample Activity Unit Topic: Ultrasound

Letter to Baby

This activity should be assigned after the unit study on ultrasound. Ideally, it should directly follow the student's ultrasound screening. Virtually all of the young women in my classes are considered to have high-risk pregnancies, and therefore undergo ultrasound examination as a matter of course. They very often share the resulting 'picture' with staff and friends. This is a good time for the mothers to begin to focus on the realities to come.

Directions: Write a letter to your baby. Include all of the following:

If you have had an ultrasound, describe the process. Tell what the image looks like. Write, describing the things you already know about your baby.

Tell how it made you feel to actually see an image of your baby. Describe yourself to your baby. Tell what you look like, and what kind of person you are. Write about your dreams, goals, and hopes for the future. Tell about the things that you think are important to teach him.

Tell about your family. Describe the people who he will be living with. Introduce him to the people who will be caring for him while you are at school or working.

Write about the surroundings he will be coming into. Describe your house or apartment. Tell about his room. Will he share it with you? What things have you gotten for him already? Tell about any toys, equipment, or clothes that you have ready for him.

Describe three things that you will do for your baby that will show him that you love, and will take care of him.

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