Math Strand 2: Algebraic Relationships

CLE: 2.1 Understand patterns, relations and functions
Example: Identify and compare functions. Understand and compare properties of linear and nonlinear functions. Use symbolic algebra to represent and solve problems that involve linear and quadratic relationships

Health Profession: Medical Technologist (Certified Laboratory Scientist)

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References:

Children's Mercy Hospitals and Clinics, Department of Pathology and Laboratory Medicine, Exchange Transfusion. Document Number: 515 Document Type PY, Revision: 2 11/1/07

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2008-09 Edition*, Clinical Laboratory Technologists and Technicians, on the Internet at http://www.bls.gov/oco/ocos096.htm (visited *March 03, 2008*).

Objectives:

At the completion of this presentation the high school student will be able to:

1. **Explain how algebraic equations can be used to perform an Exchange Transfusion.**
2. **State 3 healthy behaviors to prevent the spread of communicable diseases.**
3. **Write out the formula used to Calculate the Exchange transfusion.**
4. **Explain the importance of the algebraic equation shown in saving lives.**

Background Summary of Information as Related to X-ray Technologists and CLE

Medical Technologists work in laboratories in Hospitals doing a variety of skills to aid other health care professionals in the building. Medical Technologists use a variety of mathematical equations as well as high tech machinery to run clinical tests on blood, urine, organs, tissues etc.

Clinical laboratory personnel examine and analyze body fluids, and cells. They look for bacteria, parasites, and other microorganisms; analyze the chemical content of fluids; match blood for transfusions; and test for drug levels in the blood that show how a patient is responding to treatment. Technologists also prepare specimens for examination, count cells, and look for abnormal cells in blood and body fluids. They use microscopes, cell counters, and other sophisticated laboratory equipment. They also use automated equipment and computerized instruments capable of performing a number of tests simultaneously. After testing and examining a specimen, they analyze the results and relay them to physicians.

Medical technologists are often faced with the task to combine blood and plasma to specific percentages to give to an infant. On occasion, a mother will have a different blood type than that of her unborn baby. If the mother does not receive a shot to counteract the difference, then the baby is born with anti-bodies in the blood that essentially attack the baby and will kill it. To prevent the death of the Baby, that

blood must be taken out, cleaned and replaced with new clean blood with matching anti-bodies that has been donated.

All blood that is donated is tested for specific communicable diseases. (ie. HIV, HEP C, HEB B) If the blood is contaminated, then it is discarded and that person is contacted and no longer allowed to donate blood. It is in this manner that the Medical Technologists knows the blood they are working with is ok/clean to use.

The doctor specifies the mixture of blood that he wants to put into the child and sends the numbers to the lab. It is up to the medical technologist to use algebra to slove for x and make the mixture of blood for the baby. If the blood is not exactly to the doctors specifications, and x is not found correctly the baby will die.

Scenario:

Ernie was born 1 week ago into a loving home with a mother father and 2 year old sister. This morning, Ernie became very sick. He was unable to breathe well, and was barely moving. Noticing a problem quickly, the mother called 911, and an ambulance soon arrived. They took the baby to the hospital. While doing the lab tests, they noticed that the baby's blood type was AB -. They looked on their records and noticed that the mother's blood type was B+. They knew right away that these 2 blood types were not compatible. Knowing this was critical to the baby's health, and that if its blood wasn't changed and cleaned right away it would die, a call was put in for the helicopter to transport Ernie and his parents to Children's Mercy Hospital in Kansas City MO.

After a quick and thorough assessment, the doctor ordered from the lab a mixture of AB – Blood with the following ingredients:

- **Total volume of blood needed by the doctor= 75ml**
- **Desired hematocrit given by the doctor = 30**
- **Hematocrit value on the Bag of donated blood is 45**

What the Medical technologist doesn't know and must know is the hematocrit of the blood in the bag that was donated, and the volume of red blood cells. To find the hematocrit of the blood in the bag, he/she must just look on the bag. For this case, the known Hematocrit of the blood in the bag is 50%.

Now the Medical technologist must use Algebraic equations to find the volume of RBC's to mix with plasma to have the right mixture of blood.

Formula:

(Total Volume of Blood Needed By the Doctor) (Desired Hct) =(Volume) of RBC (x)) (Known Hct on the bag

Example:

- **(105) (25)=(x) (50)**
- **You must first divide each side by 50**
- **Then Do the math and solve for x.**
- **105 x 25= 2625**
- **2625**

50 = 52.5

- X = 52.5

Scenario Example:

(75ml) (30) = (x) (45)

- **Divide each side by 45**
- **That will leave x alone by itself**
- **75 x30 = 2250**
- **Then take 2250 Divided by 45**
- **2250**

_____ = 50

45

X=50

- **So you need 50 ml of the bag to be Red blood Cells.**
- **The total volume should be 75 ml**
- **So, take 75 – 50= 25**
- **You need 50 ml of Red blood cells and 25 ml of plasma**

Activities:

Have prepared before class a quart jar filled ¼ to ½ full of catsup.
Have another quart jar filled with water. Explain that the catsup represents blood and

the water represents plasma (which is the water part of the blood). Ask the class if they would feel comfortable putting the "blood" into a larger full sized adult, maybe like a big football player. The answer should be yes, because he is large and could probably handle it. Now show a picture of a small infant, have a doll or have a real baby. Now ask the class if they would put that same amount of thick blood into the tiny baby? The answer should be no, because the babies blood vessels are too small and would not be able to support the blood.

Have one of the students come to the front of the class and have them pour about half of the water into the jar with the catsup. Stir well. The catsup is now thinner. Explain that now the blood could be put into the baby, and it should be able to support the new mixture.

Class discussion:

- **If this was a real live situation, we would have to get the exact right amount of RBC's and plasma and mix them together, or we would kill the baby. How can we get that exact amount? How do we find it? With Algebra (Math) my friends. And this is how we can use math to save a babies life…**
- **Teach the class the algebraic equation**

- **Give them equations to solve and have each one of them sove them at their desks.**
- **Provide assistance to those that need it**
- **If time permits you could divide the class up into 4 groups and have them have board races to master the equation.**
- **Explain that it is by that easy equation that medical technologists help to save lives.**
- **Introduce to them the scenario and have them figure out how much RBC's should be mixed with plasma to save the baby.**
- **Afterwards explain how important it is to stay clean of communicable diseases so that you can donate blood to help save lives.**

Other Related Information:

Wages:

Median annual wage-and-salary earnings of medical and clinical laboratory technologists were $49,700 in May 2006. The middle 50 percent earned between $41,680 and $58,560. The lowest 10 percent earned less than $34,660, and the highest 10 percent earned more than $69,260. Median annual earnings in the industries employing the largest numbers of medical and clinical laboratory technologists were:

Federal Government	**$57,360**
Medical and diagnostic laboratories	**50,740**
General medical and surgical hospitals	**49,930**
Offices of physicians	**45,420**
Colleges, universities, and professional schools	**45,080**

Certification and other qualifications. **Many employers prefer applicants who are certified by a recognized professional association. Associations offering certification include the Board of Registry of the American Society for Clinical Pathology, the American Medical Technologists, the National Credentialing Agency for Laboratory Personnel, and the Board of Registry of the American Association of Bioanalysts. These agencies have different requirements for certification and different organizational sponsors.**

In addition to certification, employers seek clinical laboratory personnel with good analytical judgment and the ability to work under pressure. Technologists in particular are expected to be good at problem solving. Close attention to detail is also essential for laboratory personnel because small differences or changes in test substances or numerical readouts can be crucial to a diagnosis. Manual dexterity and normal color vision are highly desirable, and with the widespread use of automated laboratory equipment, computer skills are important.

Bachelor's degree programs in medical technology include courses in chemistry, biological sciences, microbiology, mathematics, and statistics, as well as specialized courses devoted to knowledge and skills used in the clinical laboratory. Many programs also offer or require courses in management, business, and computer applications. The Clinical Laboratory Improvement Act requires technologists who perform highly complex tests to have at least an associate degree.