

Science Strand 1: Properties and Principles of Matter and Energy

CLE: 1.1 Changes in properties and states of matter provide evidence of the atomic theory of matter.

Health Profession: X-ray Technologist

Name: Erin Nichols; MWSU Senior Nursing Student

**Contributor(s) Rachel Pflugradt RT(R)
Shirley Erickson RT(R), MBA**

Reference(s)

Erkonen, E., Smith, W., Radiology 101, The Basics and Fundamentals of Imaging, 2nd Edition, (2004).

Teaching X-ray Imaging in the H.S. Physics Classroom: Safe, Hands-On and Inexpensive Instruction. Retrieved on February 4, 2008 from:

http://www.vanth.org/docs/ASEE_002.pdf2008.

The effect of high- vs low-density barium preparations on the quantitative features of swallowing. Retrieved on February 23, 2008 from:

<http://www.ajronline.org/cgi/content/abstract/153/6/1191>

Smithsonian Museum Conservation Institute's Facilities and Resources.

Retrieved on February 23, 2008 from:

http://www.si.edu/mci/english/about_mci/facilities/index.html

Objectives:

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

- 1. Explain the concept of density and how it is used in radiology.**
- 2. Figure density of various items by participating in an activity that involves finding the mass and volume using scales and graduated cylinders.**
- 3. Identify the importance of density and how it relates to a career as a radiology technician.**

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

A radiology technician is responsible for preparing a patient prior to a radiology examination. Technicians must utilize good communication skills in order to explain x-ray procedures to patients. Technicians are responsible for properly operating complicated radiographic equipment prior to and during an examination. Because x-rays are used to look through a patient's tissue and examine bone, the technician must make sure to set the controls on the x-ray machine so that the radiographs produced will provide an appropriate image with the least amount of films. Radiology plays an important role in the field of medicine as it can be used very effectively in identifying tumors, cancers, diseases and musculoskeletal disorders, as well as the proper treatment of these ailments.

Density is a measure of how much mass is contained in a given unit volume (density = mass/volume). Put simply, if mass is a measure of how much 'stuff'

there is in an object, density is a measure of how tightly that 'stuff' is packed together. In radiology, it is the density of an object being imaged that determines how much of the x-ray beam will be absorbed. In other words, as the density of an object increases, fewer x-rays pass through it. Since denser areas absorb more x-rays, the film receives less exposure and the corresponding areas appear lighter. The amount of x-ray intensity absorbed by the object depends on the density and thickness of the material. Thus, exposing an x-ray sensitive film to the transmitted x-rays provides a recorded image of the interior of the object.

The body consists of various densities that absorb x-rays in varying degrees. Dense bone absorbs much of the radiation while soft tissue, such as muscle, fat and organs, allow more of the x-rays to pass through them. As a result, bones appear white on the x-ray, soft tissue shows up in shades of gray and air appears black.

Knowing this general information, a radiology technician will become alerted when an abnormal area of density or mass shows up on a film where no such site should exist. This concept is used most often to detect the presence of cancer in such radiology techniques as a mammogram for breast cancer.

Scenario:

Kate is a 37 year old female that is very healthy. She is incredibly conscious about her eating habits and activity level. As part of her health regiment, she decides to go in for her very first mammogram to establish a baseline radiograph. She has not been experiencing any problems but she also does not make it a habit to perform monthly self breast exams. After examining her film, an opaque mass is discovered.

What could the opaque mass be? *The mass could possibly be a cyst or a tumor.*

Why does the mass show up on the radiograph? *The mass shows up on the radiograph because it has a greater density than the soft tissue of the body.*

How can the diagnosis be verified? *When a mass is suspected, a physician can order additional diagnostic testing (MRI, CT scan, barium series, etc.) or a biopsy can be done.*

Activity

Start by dividing up the students into groups of 3 or 4. Hand out a worksheet that the students can use to figure the densities of different objects. Show these objects to the class. Given the information about how items appear on x-rays, have the students use their critical thinking skills to rank the objects from least to greatest density. Once each group has determined their best guess, the small groups can rotate to various work stations. At each station is one of the objects that they had been shown, a scale, a graduated cylinder, and a calculator. Each

group must determine the actual object's density by weighing and figuring its volume. This technique will allow the student to utilize the lab equipment as well as the density formula ($D = M/V$). After figuring the densities of all the objects, the small groups can compare their findings with their original expectations to see if they were correct. Finally, they must decide, according to the object's density, if the object will show up white, grey or black on an x-ray (or lighter to darker) and explain why they think knowing this information is so important to an x-ray technician.

Additional information for activity: A common contrast medium used in radiology is a product called barium. Two types are low-density barium (1.4 g/cm³) and high-density barium (2.5 g/cm³).

Why is this important to know? *The density of barium and the fact that it is a drinkable liquid allows it to be used by x-ray technologists for radiology procedures.*

After each group is done, example x-rays can be shown (via the internet) of their various objects or similar ones to see if they were correct.

Additional Information about a Career as a Radiology Technician:

With additional training, some radiology technicians are able to specialize in more complex techniques such as sonography, fluoroscopy, CT, MRI, nuclear medicine, and mammography.

Professional training for a radiology tech can range from one to four years depending on the curriculum you choose and the certificate you want to receive at the end of the day - a diploma, a Bachelor's degree or a Master's degree, etc. With such specialized training, professionally certified technicians will have no difficulty finding a job. Further specialization in x-rays can increase job opportunities of a radiology technician even more. This can include training in MRI (Magnetic Resonance Imaging), CAT (Computerized Axial Tomography) scans and ultrasound scans. Some radiology technicians are employed in physician offices or diagnostic labs; however, most are employed at hospitals.

Keep in mind Technologists and Technicians are two different entities. Technicians generally go to school for 6 months to a year and are limited in what they can do. They typically earn 37 to 40k yr. Technologists graduate from either 2 year or 4 year college programs and once certified, are unlimited in what they can do within the scope of radiology exams. As of 2005, The American Society of Radiologic Technologists survey showed an average annual income between \$46-\$64,000. These individuals can earn up to \$70-\$80,000 yr. Some Technologists earn over \$100,000 yr. with overtime and callbacks. (being on-call for emergencies).

Locally, Hillyard offers a Radiology Technologist degree that can be completed within 2 ½ years. Application process includes: Complete application packet with all required documentation, assessment with a pre-entrance examination administered at Hillyard Technical Center, interview, applicants will be ranked according to GPA and other qualifications, applicants will be notified in writing of the admission status.

Application packets for admission to the Radiologic Technology Program are available by contacting the Hillyard Technical Center office at 816-671-4170. All information must be completed and returned by January 15th for classes beginning in June. After the application has been returned, a pre-entrance test will be scheduled. The applicant will be notified of the results. After the test results have been determined, an interview may be scheduled. The applicant will be notified of the interview date. If an applicant is unable to meet either of these dates, he/she must notify the school prior to the scheduled time to reschedule.

The selection process is competitive. A Minimum of 16 candidates and 5 alternates will be selected. The alternates may be called for admission up through the first week of class. The students will be notified of their status by April 15. In the event the selection committee is presented with a tie amongst applicant's scores, application submittal date will be the tiebreaker. Prerequisites include: Introduction to Radiology (available at HTC), Computer application class: 3 credit hour college level, Human Anatomy: college level, Math: 3 credit hour college level. Additional information can be found at Hillyard Technology Center's website for radiology technologist at:

www.hillyardtech.com/departments.php?area=radiologytechnology

Equipment needed:

Various objects needed for figuring density,
Scales, Graduated Cylinders with water,
and Calculators

Examples of radiographs from the internet:

www.mayoclinic.com/health/barium-x-ray/MM00009

www.mayoclinic.com/health/barium-enema/MM00366

www.youtube.com/watch?v=ra8NIYp6_rQ