



Department: Radiologic Technology
Course Title: Radiation Biology and Protection
Section Name: RADR 2313
Semester: Spring 2013
Time: 9:30-10:50 am MW
Classroom: CT 107

Instructor: Catherine Everett
Email: cleverett@odessa.edu
Office: CT 114
Phone: (432) 335-6449
Office Hours: as posted

Course Description:

Effects of radiation exposure on biological systems. Includes typical medical exposure levels, methods for measuring and monitoring radiation, and methods for protecting personnel and patients from excessive exposure.

Required Texts: Radiation Protection in Medical Radiography, Sherer/Visconti/Ritenour, 6th Ed.
Radiation Protection in Medical Radiography Workbook, Sherer/Visconti/Ritenour, 6th Ed.

Description of Institutional Core Objectives (ICO's)

Given the rapid evolution of necessary knowledge and skills and the need to take into account global, national, state, and local cultures, the core curriculum must ensure that students will develop the essential knowledge and skills they need to be successful in college, in a career, in their communities, and in life. Therefore, with the assistance of the Undergraduate Education Advisory Committee, the Coordinating Board has approved guidelines for a core curriculum for all undergraduate students in Texas.

Through the application and assessment of objectives within the institution's core curriculum, students will gain a foundation of knowledge of human cultures and the physical and natural world; develop principles of personal and social responsibility for living in a diverse world; and advance intellectual and practical skills that are essential for all learning. Appropriate Odessa College faculty periodically evaluates all of the courses listed in the descriptions on the following pages of this catalog and keys them to Odessa College's Institutional Core Objectives (ICOs), as defined by the Texas Higher Education Coordinating Board (THECB). (Source: *Odessa College Catalog of Courses 2012-2013*, page 73)

Odessa College's Institutional Core Objectives (ICOs):

- 1) *Critical Thinking Skills* - to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information
- 2) *Communication Skills* - to include effective development, interpretation and expression of ideas through written, oral and visual communication
- 3) *Empirical and Quantitative Skills* - to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions
- 4) *Teamwork* - to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal
- 5) *Personal Responsibility* - to include the ability to connect choices, actions and consequences to ethical decision-making
- 6) *Social Responsibility* - to include intercultural competence, knowledge of civic responsibility, and the ability to engage effectively in regional, national, and global communities

Learning Outcomes for RADR 2313 Radiation Biology and Protection (Source: *Odessa College Catalog of Courses*)

Outcome	ICO
Students will be learning radiation protection practices and how their actions produce changes.	<i>Critical Thinking Skills</i> - to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information
Students will learn how to communicate radiation protection practices and information to patients and the general public.	<i>Communication Skills</i> - to include effective development, interpretation and expression of ideas through written, oral and visual communication
Students will learn basic methods for radiation monitoring, detection, and measurement.	<i>Empirical and Quantitative Skills</i> - to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions
	<i>Teamwork</i> - to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal
Students will be learning radiation protection practices and how their actions produce changes.	<i>Personal Responsibility</i> - to include the ability to connect choices, actions and consequences to ethical decision-making
Students will learn the biophysical mechanisms of radiation damage on humans and implement radiation protection practices.	<i>Social Responsibility</i> - to include intercultural competence, knowledge of civic responsibility, and the ability to engage effectively in regional, national, and global communities

Odessa College Policies

Academic Policies

Note that the OC Student Handbook states (page 32) that “[i]n cases of academic dishonesty, the instructor has the authority to impose appropriate scholastic penalties. Complaints or appeals of disciplinary sanctions may be filed in accordance with the college due process procedure. Copies of the college due process procedure are available in the office of The Director of Student Life (CC104).”

For more information on your rights and responsibilities as a student at Odessa College, please refer to the following: *The 411 of OC: Student Handbook 2012-2013; Student Rights & Responsibilities*

<http://www.odessa.edu/dept/studenthandbook/handbook.pdf>

Scholastic Dishonesty

Scholastic dishonesty shall constitute a violation of these rules and regulations and is punishable as prescribed by board policies. Scholastic dishonesty shall include, but not be limited to, cheating on a test, plagiarism and collusion.

"Cheating on a test" shall include:

- Copying from another student's test paper
- Using test materials not authorized by the person administering the test.
- Collaborating with or seeking aid from another student during a test without permission from the test administrator.
- Knowingly using, buying, selling, stealing or soliciting, in whole or in part, the contents of an unadministered test.
- The unauthorized transporting or removal, in whole or in part, of the contents of the unadministered test.
- Substituting for another student, or permitting another student to substitute for one's self, to take a test.
- Bribing another person to obtain an unadministered test or information about an unadministered test.
- "Plagiarism" shall be defined as the appropriating, buying, receiving as a gift, or obtaining by any means another's work and the unacknowledged submission or incorporation of it in one's own written work.
- "Collusion" shall be defined as the unauthorized collaboration with another person in preparing written work for fulfillment of course requirements. (Source: *Odessa College Student Handbook 2012-2013, page 29-30*)

Special Populations/Disability Services/Learning Assistance

Odessa College complies with Section 504 of the Vocational Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. If you have any special needs or issues pertaining to your access to and participation in this or any other class at Odessa College, please feel free to contact me to discuss your concerns. You may also call the Office of Disability services at 432-335-6861 to request assistance and accommodations.

Odessa College affirms that it will provide access to programs, services and activities to qualified individuals with known disabilities as required by **Section 504 of the Rehabilitation Act of 1973 and Title II of the Americans with Disabilities Act of 1990 (ADA)**, unless doing so poses an undue hardship or fundamentally alters the nature of the program or activity. Disabilities may include hearing, mobility or visual impairments as well as hidden disabilities such as chronic medical conditions (arthritis, cancer, diabetes, heart disease, kidney

disorders, lupus, seizure disorders, etc.), learning disabilities or psychiatric or emotional disabilities. A student who comes to Odessa College with diagnosed disabilities which may interfere with learning may receive accommodations when the student requests them and submits proper documentation of the diagnosis. A Request for Accommodations form and guidelines for beginning the request process are available in the OC Help Center or on the Odessa College web site at www.odessa.edu/dept/counseling/disabilities.htm. The college strives to provide a complete and appropriate range of services for students with disabilities such as assistance with testing, registration, information on adaptive and assistive equipment, tutoring, assistance with access and accommodations for the classroom where appropriate. For information regarding services, students with disabilities should contact the Office of Disability Services in the OC Help Center located in Room 204 of the Student Union Building or call 432-335-6433. (Source: *Odessa College Catalog of Courses 2012-2013*, page 52)

Dropping a Course or Withdrawing from College

Students wishing to drop a non-developmental course may do so online using WebAdvisor, at the Wrangler Express, or Registrar's Office. A student wishing to drop a developmental course or withdraw from college should obtain a drop or withdrawal form from the Wrangler Express or the Registrar's Office. Students are encouraged to consult with instructors prior to dropping a class. Students may not completely withdraw from the college by use of the Web. Students must drop a class or withdraw from college before the official withdrawal date stated in the class schedule. Students who are part of the Armed Forces Reserves may withdraw with a full refund if the withdrawal is due to their being ordered into active duty. A copy of the student's orders must be presented to the Registrar's Office at the time of the withdrawal. For details, please contact the Office of the Registrar. **No longer attending class does not automatically constitute withdrawal from that class, nor does a student's notification to an instructor that the student wishes to be dropped. Failure of a student to complete the drop/withdrawal process will result in a grade of "F."** (Source: *Odessa College Catalog of Courses 2012-2013*, page 36)

Learning Resource Center (LRC; Library)

The Library, known as the Learning Resources Center, provides research assistance via the LRC's catalog (print books, videos, e-books) and databases (journal and magazine articles). Research guides covering specific subject areas, tutorials, and the "Ask a Librarian" service provide additional help.

Student Success Center (SCC)

Located in the LRC, the Student Success Center (SSC) provides assistance to students in meeting their academic and career goals. We strive to provide new and updated resources and services at no charge to OC students. Academic support services include tutoring, study skills training, workshops, and the mentoring program. Tutoring is available for a variety of subjects including college mathematics, English, government, history, speech, chemistry, biology, and all developmental coursework. Appointments are preferred, but walk-ins will be served as soon as possible. Smarthinking online tutoring is also available. All computers in the center have Internet access, Microsoft Office, and software resources to assist OC students in improving their reading, writing and mathematical skills. The center also offers special assistance to students preparing for the THEA/COMPASS test. Computer lab assistants are available to assist students with student email, Blackboard, OC portal, Course Compass and more. For more information or to make an appointment, please call 432-335-6673 or visit www.odessa.edu/dept/ssc/ (Source: *Odessa College Catalog of Courses 2012-2013*, page 54)

Student E-mail

Please access your Odessa College Student E-mail, by following the link to either set up or update your account: <http://www.odessa.edu/gmail/>. **Correspondence will be submitted using your Odessa College email as an alternative method to contact you with information regarding this course.**

Technical Support

For Blackboard username and password help and for help accessing your online course availability and student email account contact the Student Success Center at 432-335-6878 or online at https://www.odessa.edu/dept/ssc/helpdesk_form.htm.

Expectations for Engagement – Face to Face Learning

To help make the learning experience fulfilling and rewarding, the following Expectations for Engagement provide the parameters for reasonable engagement between students and instructors for the learning environment. Students and instructors are welcome to exceed these requirements.

Reasonable Expectations of Engagement for Instructors

1. As an instructor, I understand the importance of clear, timely communication with my students. In order to maintain sufficient communication, I will
 - provided my contact information at the beginning of the syllabus;
 - respond to all messages in a timely manner through telephone, email, or next classroom contact; and,
 - notify students of any extended times that I will be unavailable and provide them with alternative contact information (for me or for my supervisor) in case of emergencies during the time I'm unavailable.
2. As an instructor, I understand that my students will work to the best of their abilities to fulfill the course requirements. In order to help them in this area, I will
 - provide clear information about grading policies and assignment requirements in the course syllabus, and
 - communicate any changes to assignments and/or to the course calendar to students as quickly as possible.
3. As an instructor, I understand that I need to provide regular, timely feedback to students about their performance in the course. To keep students informed about their progress, I will
 - return classroom activities and homework within one week of the due date and
 - provide grades for major assignments within 2 weeks of the due date or at least 3 days before the next major assignment is due, whichever comes first.

Reasonable Expectations of Engagement for Students

1. As a student, I understand that I am responsible for keeping up with the course. To help with this, I will
 - attend the course regularly and line up alternative transportation in case my primary means of transportation is unavailable;
 - recognize that the college provides free wi-fi, computer labs, and library resources during regular campus hours to help me with completing my assignments; and,

- understand that my instructor does not have to accept my technical issues as a legitimate reason for late or missing work if my personal computer equipment or internet service is unreliable.
2. As a student, I understand that it is my responsibility to communicate quickly with the instructor any issue or emergency that will impact my involvement with or performance in the class. This includes, but is not limited to,
 - missing class when a major test is planned or a major assignment is due;
 - having trouble submitting assignments;
 - dealing with a traumatic personal event; and,
 - having my work or childcare schedule changed so that my classroom attendance is affected.
 3. As a student, I understand that it is my responsibility to understand course material and requirements and to keep up with the course calendar. While my instructor is available for help and clarification, I will
 - seek out help from my instructor and/or from tutors;
 - ask questions if I don't understand; and,
 - attend class regularly to keep up with assignments and announcements.

Institutional Calendar Spring 2013 (8/27-12/14)

<http://www.odessa.edu/college-calendar12-13.pdf>

Registration:

On the Web (5 am to Midnight, 7 days a week).....	Nov 12-Jan 21
In Person (See Business Hours Above).....	Nov 12-Jan 18
***REGISTRATION PAYMENT DEADLINE	
* For students registered who register prior to Jan 7.....	Payment is DUE Jan 7 (Mon)
* For students who register on or after Jan 7.....	Due on Day of Registration
Holiday (Martin Luther King Day - Offices closed except for Wrangler Express).....	Jan 21 (Mon)
Classes Begin.....	Jan 22(Tue)
Late Registration & Schedule Changes (Add/Drop):	
On the Web (5 am to Midnight, 7 days a week).....	Jan 22-23 (Tue-Wed)
In Person (See Business Hours Above).....	Jan 22-23 (Tues-Wed)
** Late Registration & Add/Drop Payment Deadline.....	Due on Day of Registration
Census Day.....	Feb 6 (Wed)
Deadline for Spring Degree Application.....	Mar 20 (Wed)
First Eight Weeks End.....	Mar 22 (Fri)
Spring Break (Offices Closed – No Classes).....	Mar 11-16 (Mon-Sat)
Second Eight Weeks Begin.....	Mar 25 (Mon)
Holiday (Good Friday).....	Mar 29 (Fri)
Last Day to Drop or Withdraw with a "W" (full semester length courses).....	Apr 16 (Tues)
Student Evaluation of Instruction Survey Available Online.....	April 28-May 4
Last Day to Drop or Withdraw with a "W" (2nd eight week courses).....	Apr 30 (Tues)
Last Class Day.....	May 11 (Sat)
Final Exams.....	May 13-16 (Mon-Thurs)
Spring Graduation.....	May 17 (Fri)
End of Semester.....	May 17 (Fri)

Course Policies

Disclaimer

This syllabus is tentative and subject to change in any part at the discretion of the instructor. Any changes will be in accordance with Odessa College policies. Students will be notified of changes, if any, in timely manner.

Original Effort

The work submitted for this course must be original work prepared by the student enrolled in this course. Efforts will be recognized and graded in terms of individual participation and in terms of ability to collaborate with other students in this course.

Description of students

Students enrolled in this course are pursuing or researching a career in Radiologic Technology.

Course prerequisites

Prerequisite: RADR 2333.

Corequisites: RADR 1191 and RADR 2267

(Source: *Odessa College Catalog of Courses 2012-2013, page 178*)

Course Alignment with Industry Standards

This program is accredited by the Joint Review Committee on Education in Radiologic Technology and the course content is outlined in the American Society of Radiologic Technologists curriculum guide.

Digital Protocol

Cell phones must be placed on either *vibrate* or *silent* mode and are to be accessed in emergency cases only. The use of laptops or any other digital device is permitted in order to facilitate note-taking relative to instruction. Any written assignments will be submitted electronically on Blackboard. **The electronic recording of the time on Blackboard will be considered the time of assignment submission. Take necessary steps to ensure that your assignments are submitted on “Blackboard” time.** Back-up and/or additional copies of all assignments submitted is encouraged. **Computers/printers are available to OC students in the LRC (301-303); therefore, not having access to a computer due to technical issues (crash; corrupted files) will not be considered as an acceptable reason for not completing assignments.** If there is a loss of server connection with Odessa College due to maintenance, then an email will be sent to student with pertinent information and status reports. Assignments submitted electronically need to be **WORD documents (doc or docx).**

Attendance Policy

Student attendance at every class, lab and clinical practicum is expected. Students shall be prompt to class and clinical practicums. Points will be deducted from a student's final course grade for absences. (1-2 abs = .5pt. ea., 3-5 abs = .75 pt. ea., 6-7 abs = 1 pt. ea.) A student is considered absent if more than 30 minutes late to lecture or lab or more than two (2) hours late for clinical practicums.

AVID

This course has been identified as a course by Career, Technical, and Workforce Education as one in which teaching and learning strategies adopted by AVID will be implemented. As a student in the legal program, you will be expected to develop an understanding of the strategies, to model the strategies, to maintain fidelity of implementation, and to examine how these strategies may impact your effectiveness as a professional in your chosen area of occupation, either through coursework or practicum experience as outlined by the course instructor.

Grading Policy

Please understand that this is a required course for the RAD TECH program in order to prepare you. Quality work and active participation is expected and not to be negotiated. As a general policy, grades will be taken in class. Any written assignments or tests will be graded outside of class. You can expect feedback on assignments within a week's time.

Students will be allowed to make up tests; however, 10 points will be deducted for each class day a student fails to take the examination.

Grade Inquiry Policy

It is the responsibility of the individual taking this course to maintain accurate track of assignment submissions and grades. There will be opportunities during the semester to meet with the instructor to discuss your academic progress. Contact the instructor to schedule an appointment. Class time will not be used for grade inquiries. All grades are final.

Communication Plan

The best way to communicate with the course instructor is via email through Blackboard. Also, check in Blackboard regularly for announcements, including any changes in the course schedule due to instructor illness or conference attendance. Appointments with the instructor may also be scheduled.

General Course Requirements

1. Attend class and participate.
2. Contribute and cooperate with civility.
3. **Submit assignments on time. Late work will not be accepted. Medical and/or family circumstances that warrant an extension on assignments need to be presented to the instructor. Extensions will be allowed at the instructor's discretion.**
4. Regular and punctual attendance of all class lectures and laboratory exercise.
5. Read and discuss textbook assignments and outside readings when they are assigned.
6. Complete all course assignments to include worksheets, laboratory exercises, written papers, examinations, etc.
7. Demonstrate proficiency of the requirements set forth in this course by attainment of a grade of "C" or better.
8. Tests - Students will be allowed to make up tests; however, 10 points will be deducted for each class day a student fails to take the examination. It is the student's responsibility to make an appointment with the instructor for the make-up examination.

Grading Scale:

- "A" = 93-100
- "B" = 84-92
- "C" = 75-83
- "F" = 0-74

Incomplete Policy

An 'Incomplete' grade may be given only if:

1. The student has passed all completed work
2. If he/she has completed a minimum of 75% of the required coursework. A grade of an "I" will only be assigned when the conditions for completions have been discussed and agreed upon by the instructor and the student.

Overview of assignments

- 5% Mock Registry
- 10% Project
- 15% Workbook/Quizzes
- 30% Unit Exams
- 40% Final Examination

Schedule (Tentative and Subject to Change)

Quizzes:

At the start of *every new chapter* there will be a 10 multiple choice question Quiz over the chapter so reading the chapter prior to the class is essential.

Project:

There will be a project that you will be doing for your Special Topics class. The topic of the project will relate to this class and will count towards both classes.

Workbook:

Your workbook will be due on test days.

SUMMARY OF ASSIGNMENTS & ACTIVITIES

Chapter 1: Introduction to Radiation Protection

Introduces the student radiographer to radiation protection. It includes a discussion of the use of ionizing radiation in the healing arts beginning with the discovery of x-ray in 1895. The chapter covers the following topics: effective radiation protection, biologic effects, justification and responsibility for radiologic procedures, diagnostic efficacy, occupational and nonoccupational dose limits, the ALARA principle, patient protection and patient education, risk versus potential benefit of radiologic procedures, and the use of background equivalent radiation time (BERT) to inform the patient of the amount of radiation that will be received from a specific x-ray procedure. Also included is a discussion about the types of radiation, the electromagnetic spectrum, particulate radiation, equivalent dose and effective dose, the biologic damage potential of ionizing radiation, natural and manmade sources of radiation, the Three Mile Island-2 and Chernobyl nuclear power plant accidents, and the use of diagnostic x-ray machines and radiopharmaceuticals in medicine.

Test 1: Will cover Chapter 1. The corresponding workbook chapter will be due on test day.

Chapter 2: Interaction of X-Radiation with Matter

Covers basic physics concepts that relate to radiation absorption and scatter. The processes of interaction between radiation and matter are emphasized to provide the background necessary for radiographers to optimally select technical exposure factors such as peak kilovoltage (kVp) and milliamperere-seconds(mAs). By selecting the appropriate techniques, the radiographer can minimize the dose to the patient and produce radiographs of acceptable quality.

Chapter 3: Radiation Quantities and Units

Covers the evolution of radiation quantities and units and emphasizes the desire of the medical community, from the time it became aware of the harmful effects of x-rays, to find a way to reduce radiation exposure throughout the world by developing standards for measuring and limiting this exposure. To be able to measure patient and personnel exposure in a consistent and uniform manner, diagnostic imaging personnel should be familiar with these standardized radiation quantities and units.

Test 2: Chapters 2 & 3. Workbook is due on test day.

Chapter 4: Radiation Monitoring

Covers radiation monitoring. This includes both personnel monitoring and area monitoring. Personnel exposure must be monitored to ensure that occupational radiation exposure levels are kept well below the annual effective dose (E_{FD}) limit. Radiation survey instruments are area monitoring devices that detect and measure radiation. Radiographers and other occupationally exposed persons must be aware of the various personnel and area radiation exposure monitoring devices and their functions.

Test 3: Chapter 4. Workbook is due.

Chapter 5: Overview of Cell Biology

Covers basic concepts of cell biology. The chapter begins with a discussion of the cell, followed by other related topics such as cell chemical composition including a discussion of organic compounds and inorganic compounds, cell structure, and cell division. This material provides a foundation for radiation biology that will be covered in subsequent chapters.

Chapter 6: Molecular and Cellular Radiation Biology

Covers molecular and cellular radiation biology. Areas of study included in the science of radiation biology are the sequence of events occurring after the absorption of energy from ionizing radiation, the action of the living system to make up for the consequences of this energy assimilation, and the injury to the living system that may be produced. The chapter provides a basic knowledge of aspects of molecular and cellular radiation biology that are relevant to the subject of radiation protection. It also provides a foundation for radiation effects on organ systems that are covered in the next chapter.

Test 4: Chapters 5 & 6. Workbook is due.

Chapter 7: Early Radiation Effects on Organ Systems

Radiation-induced damage at the cellular level may lead to measurable somatic and genetic damage in the living organism as a whole. This chapter focuses on early organic damage resulting from ionizing radiation exposure.

Chapter 8: Late Radiation Effects on Organ Systems

Radiation-induced damage at the cellular level may lead to measurable somatic and genetic damage in the living organism as a whole. This chapter focuses on late organic damage resulting from ionizing radiation exposure.

Test 5: Chapters 7 & 8. Workbook is due.

Chapter 9: Dose Limits for Exposure to Ionizing Radiation

Discusses occupational and nonoccupational effective dose (EfD) limits and equivalent dose (EqD) limits for tissues and organs such as the lens of the eye, skin, hands, and feet. To minimize the risk of harmful biologic effects, exposure of the general public, patients, and radiation workers may be limited by adhering to established dose limits. The effective dose limiting system has been established for this purpose. Covers radiation protection standards, organizations and U.S. regulatory agencies. Current radiation protection philosophy is discussed, and goals and objectives for radiation protection are identified. Other topics covered include the ALARA concept, responsibilities of a radiation safety officer, risk of radiation-induced malignancy, action limits, and the theory of radiation hormesis.

Test 6: Chapter 9. Workbook is due.

Chapter 10: Equipment Design for Radiation Protection

A description of the devices required for all diagnostic x-ray imaging systems is included in this chapter with equipment minimum requirements. Some devices are characteristic of either radiographic or fluoroscopic imaging systems, and some are mandated by federal regulation for all diagnostic imaging systems. Covers devices and ways devices are employed to reduce radiation exposure during diagnostic x-ray procedures.

Test 7: Chapter 10. Workbook is due.

Chapter 11: Management of Patient Radiation Dose during Diagnostic X-Ray Procedures

Covers protection of the patient during diagnostic x-ray procedures. This involves limiting radiation exposure by employing appropriate radiation reduction techniques and by utilizing protective devices that minimize such exposure. Patient exposure can be substantially reduced by using proper body or part immobilization, motion reduction techniques, appropriate beam limitation devices and adequate filtration of the x-ray beam, and the use of gonadal or other specific area shielding. The selection of suitable technical exposure factors used in conjunction with either high-speed film-screen combinations or computer-generated digital images, correct radiographic film processing techniques or appropriate digital image processing, and the elimination of repeat radiographic exposures can also significantly limit patient radiation exposure. This chapter provides an overview of the tools and techniques radiographers use to minimize radiation exposure to patients during diagnostic x-ray procedures.

Chapter 12: Management of Imaging Personnel Radiation Dose during Diagnostic X-Ray Procedures

When fulfilling professional responsibilities associated with diagnostic imaging, imaging radiographers may be exposed to secondary radiation (scatter and leakage), thereby increasing occupational exposure. Presents an overview of methods that may be used to reduce this exposure. Diagnostic x-ray suite protection design is also covered with emphasis on new approaches to shielding in accordance with NCRP Report No. 147.

Test 8: Chapters 11 & 12. Workbook is due.

Chapter 13: Radioisotopes and Radiation Protection

Covers radioisotopes and radiation protection. This chapter gives a brief discourse on the usage of radioisotopes for both diagnostic and therapeutic medical procedures and discusses some relevant radiation issues. The chapter also focuses on the use of radiation as a terrorist weapon and includes some of the fundamental principles of dealing with radioactive contamination in the health care setting.

Test 9: Chapter 13. Workbook is due.

Final is comprehensive.