

Radiation Biology

ENU 5626

Fall 2005

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Lectures: Period 2 and 3 Tuesdays
Period 2 Thursdays
Room 225 NSC

References: Health Risks from Exposure to Low Levels of Ionizing Radiation, BEIR VII
– Phase 2, Washington D.C., The National Academies Press, 2005.
www.nap.edu

A primer on low-level ionizing radiation and its biological effects, AAPM
Report No.18, American Association of Physicists in Medicine, American
Institute of Physics, 1986.
www.aapm.org

Radiobiology for the Radiologist, Fourth or Fifth Edition;
Eric J. Hall, J.B. Lippincott Company. ISBN 0-397-51248-1, 1994.

Report of the Committee on the Biological Effects of Ionizing Radiation;
BEIR V. Washington D.C., National Academy Press, 1987, 1990.

Course Objective: To provide a fundamental knowledge of the mechanisms and biological responses of human beings to ionizing and non-ionizing radiations through the study of the effects of radiation on biological molecules, cells, and man including cancer and mutagenesis. The course will develop the ability to make objective decisions regarding the relative risks and benefits of radiation use in a variety of applications.

Grading:

Homework	10%
Exam #1	25%
Exam #2	30%
Final Exam	35%

Topics Outline

ENU 5626 - Radiation Biology

Fall 2005

Overview of Radiation Effects

- Acute Radiation Effects
- Late Somatic Effects

Physical and Chemical Mechanisms

- Physics of ionizing interactions: α , β , γ , n
- Free radical production
- Radiation chemistry
- LET, absorption and dosimetry
- Concepts of microdosimetry & energy deposition

Cellular Radiation Biology

- DNA strand breaks
- Chromosome aberrations
- Cell survival curves
 - Target Theory
 - LET and RBE
 - Dose Response Relationships & Models
 - Law of Bergonie & Tribondeau
 - Applications to Radiation Therapy/differential response
- Mitotic cycles and radiosensitivity
 - Dose Rate Effects
 - Repair mechanisms
 - Fractionation
 - Oxygen Effect
 - Radioprotectors

Acute Radiation Effects & Organ Systems

- Tissue and Organ Responses
- Skin & related systems
- Hematopoietic response
- Digestive tract
- Reproductive
- Eye and Cataractogenesis
- Lung, bone, others
- Developing fetus
- Acute Radiation Syndrome

Effective Dose and Weighting Factors

Internal Exposures

- Body burden & radionuclide distributions
- Metabolic pathways & models
- Multi-Compartment Models
- Non-Linear Systems
- Nuclear Medicine Applications

Stochastic Radiation Effects

- Genetic Effects
- Radiation Carcinogenesis
- Pathology of Cancer
- Carcinogenic Mechanisms
- Probability of Causation
- Epidemiological Populations

Absolute & Relative Risk Models

- BEIR V & BEIR VII
- Disease Specific Models
- Assessing Risk vs. benefit

Radiation Hormesis Mechanisms

- Empirical evidence
- Microdosimetry implications

Embryo & Fetal Exposures

- Childhood Cancers

Radiological Basis of Radiotherapy

- Differential response, Reoxygenation, Tumor Kinetics
- Fractionation, Sensitizers & Radioprotectants
- Alternative Radiation Modalities
- Hyperthermia
- Chemo Therapy
- Gene Therapy

Non-Ionizing Radiation Bioeffects

- Ultrasound
- Optical Radiations
- Radiofrequency & Microwave Radiation

Course Schedule - ENU 5626 Radiation Biology

Date	Course Topic	Chapter in Hall	Chapter in BEIR VII Summary
August	23 Overview of Rad. Effects		
	25 Physical & Chem. Mech.	1	1
	30 Physical & Chem. Mech	1	1
September	1 DNA Strand Breaks	2	1
	6 Chromosome Aberrations	2	2
	8 Theory and Modeling of DNA & CA damage	3	2
	13 Cell Survival Curves	3	-
	15 Mitotic Cycle & Radiosensitivity	4	2
	20 Cell Genetics, Repair Mechanisms & Modeling	7,8,11	1,2
	22 Physiological Responses of Tissues & Organs	18, 19	-
	27 Physiological Responses of Tissues & Organs	21	-
	29 Examination		
October	4 Acute Radiation Effects	8, 18	-
	6 Effective Dose & Bioeffectiveness Models	15	-
	11 Internal Distribution of Radionuclides	-	-
	13 Metabolic Models & Compartment modeling	-	-
	18 Models & Mechanisms of Carcinogenesis	10,20	3
	20 Radiation Carcinogenesis	10,20	3
	25 Epidemiology & Risk Models	10	5,6,7, 8, 9
	27 BEIR VII - Risk Models	-	11, 12
November	1 Applications of Risk Models	-	12
	3 Evidence/Mechanisms of Radiation Hormesis	-	App. D
	8 Examination		
	10 Embryo/Fetal Exposures	12	7,9
	15 Radiation Effects on Anatomical Development	12	7
	17 Radiation Response of Tumor Systems	20,21,22	-
	22 Rad Therapy Treatment Protocols	22	-
	24 Thanksgiving Holiday		
29 Rad & Alternative Treatment Strategies	24, 26, 27, 28	-	
December	1 Non-Ionizing Radiation - Ultrasound & RF	28	-
	6 Non-Ionizing Radiation - RF & Optical	-	-
	12 Final Examination (3:00am-5:00am)		

Policies:

Academic Honesty

All students are required to abide by the University's honesty policy as published in UF Rule 6C1-4.017. Students should be familiar with the entire rule which can be reviewed at: <http://www.aa.ufl.edu/aa/Rules/4017.htm> and specifically addresses cheating;

Cheating -- the improper taking or tendering of any information or material which shall be used to determine academic credit. Taking of information includes, but is not limited to, copying graded homework assignments from another student; working together with another individual(s) on a take-home test or homework when not specifically permitted by the teacher; looking or attempting to look at another student's paper during an examination; looking or attempting to look at text or notes during an examination when not permitted. Tendering of information includes, but is not limited to, giving your work to another student to be used or copied; giving someone answers to exam questions either when the exam is being given or after having taken an exam; giving or selling a term paper or other written materials to another student; sharing information on a graded assignment.

Class Attendance

Students are expected to attend each class period. Periods which may be missed should be brought to the attention of the Instructor as far in advance of the class period as possible. In the event of an unexcused absence, it is the student's responsibility to obtain and review the material that was covered during that class period.

Make-up Assignments

Make-up assignments will only be considered for exceptional circumstances and will be implemented by the instructor on a case-by-case basis.

Class Demeanor

Class distractions such as cell phones and pagers are unacceptable. Students will ensure that any such devices that are brought into the classroom will be turned off, or operated in a silent mode, during the class period.

Students with Disabilities

Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.