

**“Radiobiology Methods Web-Based Course” Prepared by the
Center for Medical Countermeasures Against Radiation (CMCR)
Consortium Coordinating Core, Joel S. Greenberger, M.D.,
Principal Investigator**

**I. Introduction (Purpose of the Course): Radiobiology and Radiobiologic
Methods Course from the Center for Medical Countermeasures Against
Radiation CMCR Consortium:**

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu; David Brenner,
Ph.D., D.Sc., (212) 305-3229, djb3@cumc.columbia.edu; William McBride, D.Sc., Ph.D.,
(310) 794-7051, wmcbride@mednet.ucla.edu; Nelson Chao, M.D., MBA, (916) 668-1011,
chao0002@mc.duke.edu; Andrea DiCarlo, Ph.D., (240) 627-3492, cohen@niaid.nih.gov

II. Table of Contents:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

III. Overview:

What is Radiobiology?:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

**IV. Practical Applications: Rad Countermeasures, Rad Safety Hospital and Home,
Diagnostic and Rad Therapy:**

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

V. Radiation Chemistry: Origins of life on earth, SPEs, GCI, gamma rays:

Joel S. Greenberger, M.D., 412-647-3602, greenbergerjs@upmc.edu

VI. Redox Chemistry:

Douglas Spitz, Ph.D., 319-335-8001, Douglas-spitz@uiowa.edu

VII. Low Dose Rate and Sporadic High LET Radiation:

**Diets, microbiome, and antioxidants – Chronic Administration of Countermeasures,
Monitoring responses to chronic irradiation.**

Discussion includes: Carcinogenesis Relative to Other Research in Galactic Cosmic Radiation, Solar Protons Event, Low Dose Rate, Sporadic Radiation, and Late Effects from Prolonged Sporadic, but Continuous Space Irradiation:

Jeffrey Jones, M.D., (281) 483-4418, jajones@bcm.edu, Carlos Montesinos, Ph.D., (281) 616-6865, carlos@astromedresearch.org, Fathi Karouia, Ph.D., fathi.karouia@nasa.gov ; Dmitri Popov, M.D., 416-727-4725, dipopov@rogers.com , Doug Boreham, Ph.D., 705-662-7175, dboreham@nosm.ca , Octav Cristea, M.D., 619-807-5179, ocristea2013@gmail.com , Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

VIII. Acute Radiation Effects: Total body, subtotal, species differences:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu; Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu

IX. Acute Radiation Effects: Organ Specific Organs Dose and Species Differences:

- a. **CNS:** Joel S. Greenberger, M.D. (412) 647-3602, greenbergerjs@upmc.edu; Michael W. Epperly, Ph.D. (412) 623-3214, epperlymw@upmc.edu
- b. **Skin:** Rhonda Brand, Ph.D., (412) 648-3399, rmb91@pitt.edu
- c. **Immune System:** Dörthe Schaeue, Ph.D. (310) 825-8246, DSchaeue@mednet.ucla.edu ; William McBride, D.Sc., Ph.D. (310-794-7051, WMcBride@mednet.ucla.edu
- d. **Marrow:** John Chute, M.D., (310) 206-3037, jchute@mednet.ucla.edu
- e. **Oral/oropharynx/esophagus:** Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu; Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu
- f. **Lung:** Michael W. Epperly, Ph.D., (412) 623-3214, mwepperly@upmc.edu; Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu
- g. **Intestine:** Brian Leibowitz, Ph.D., (412) 623-3255, bjl40@pitt.edu ; Liang Wei, Ph.D., (412) 623-3255, liw45@pitt.edu ; Xinwei Wang, Ph.D., (412) 647-5362 axw5@pitt.edu ; Jian Yu, Ph.D., (412) 623-7786, YuJ2@upmc.edu
- h. **Rectum – Bladder – Prostate:** Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu
- i. **Kidney:** Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu; Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu
- j. **Large Animal Models:** Karla Thrall, (425) 407-0121, kthrall@SNBLUSA.com; Ronald Manning, Ph.D., (425) 407-0121, RManning@SNBLUSA.com
- k. **Fetal/Placental Effects:** Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu; Lora Rigatti, VMD, (412) 624-3641, rigattil@pitt.edu; Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

- l. **Irradiation Effects On the Microenvironment:** Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu; Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu

X. Late Radiation Effects:

- a. **Organ failure, CNS, Cardiac, Aging – Senescence, Cancer, and Leukemia:** Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu
- b. **CNS:** Hulya Bayir, M.D., (412) 692-5264, hub22@pitt.edu
- c. **Lung:** Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu; Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu
- d. **Cardiac:** Barry London, M.D., Ph.D., (319) 356-2750, barry-london@uiowa.edu
- e. **Aging/Senescence:** Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu; Aranee Sivananthan, (412) 623-1012, Michael W. Epperly, Ph.D., (412) 623-3214, mwepperly@upmc.edu
- f. **Cancer and Leukemia:** Christopher Bakkenist, Ph.D., (412) 623-7765, cjb38@pitt.edu
- g. **Primate Late Effects Methods:** J. Mark Cline, DVM, Ph.D., DACVP, 336-716-1564, jmcline@wakehealth.edu; Gregory O'Dugan, DVM, 336-716-1564

XI. Other Forms of Injury:

- a. **Infection:** Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu ; Karin E. Byers, M.D., (412); 648-6429, byerKE@upmc.edu
- b. **Thermal Burns:** Larry Jones, M.D., 614-293-5710, jones.4101@osu.edu
- c. **Fracture:** Julie Glowacki, Ph.D., (617) 732-6855, jglowacki@bwh.harvard.edu; Michael Weaver, M.D., MJWeaver@partners.org
- d. **Overpressure Concussion:** Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu ; Hulya Bayir, M.D., (412) 692-5164, hub22@pitt.edu

XII. Radiation Disease: Cytokines and the Stages of Apoptosis, Necroptosis, Ferroptosis, Parthenosis, Lysosomal Necrosis, Pyroptosis, and Overlapping Networks

Joel S. Greenberger, M.D., 412-647-3602, greenbergerjs@upmc.edu; Bing Liu, Ph.D., 412-648-3333, liubing@pitt.edu ; Ivet Bahar, Ph.D., (412) 648-3332, bahar@pitt.edu; Hulya Bayir, M.D., (412) 692-5164, hub22@pitt.edu; Valerian Kagan, Ph.D., (412) 624-9479, kagan@pitt.edu

XIII. Radiation Biologic Pathways Intersection and Integration with Other Pathways:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu; Valerian Kagan, Ph.D. (412) 624-9479, kagan@pitt.edu ; Hulya Bayir, M.D., (412) 692-5164, hub22@pitt.edu; Ivet Bahar, Ph.D., (412) 648-3332, bahar@pitt.edu ; Bing Liu, Ph.D., (412) 648-3333, liubing@pitt.edu

XIV. Countermeasures Development based on the Concept of an Evolution of “Radiation Disease”:

William McBride, D.Sc., Ph.D., (310) 794-7051, wmcbride@mednet.ucla.edu ; Dorothe Schaeue, M.Res., Ph.D., (310) 794-7051, dschaeue@mednet.ucla.edu, , Ewa Micewicz, Ph.D., (310) 267-1212, emicewicz@mednet.ucla.edu, Jacqueline Williams, Ph.D., (585) 276-3000, jackie_williams@urmc.rochester.edu

XV. Methods for Study of Radiobiology: Overview:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu ; Xichen Zhang, M.D., (412) 623-1012, xichen@pitt.edu

XVI. Classic Radiobiology Methods:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu ; Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu

XVII. New Methods:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu ; Christopher Bakkenist, Ph.D., (412) 623-7765, cjb38@pitt.edu

XVIII. Specifics Techniques in Radiobiology to Approach Specific Challenges

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

XIX. DNA Repair and Radiation Biology:

Christopher Bakkenist, Ph.D., (412) 623-7765, cjb38@pitt.edu ; Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

XX. RNA-micro, siRNA, and Other RNA Moieties Involved in Radiation Biology:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

XXI. Animal Models: ATm/ATr, Fanconi Pathway Proteins and Scaffold for Nuclear DNA Repair:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu ; Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu

XXII. Proteomics and Networks:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

XXIII. Chemistry of Radiation Protectors:

Peter Wipf, Ph.D., (412) 624-8606, pwipf@pitt.edu ; Detcho Stoyanovsky, Ph.D., (412) 383-6903, stoyanovskyd@upmc.edu

XXIV. In Situ Correlations of Radiation Damage: From the Single Molecule to the Whole Animal

Alan M. Watson, Ph.D., (412) 648-9796, Alan.Watson@pitt.edu; Simon Watkins, Ph.D., (412) 648-3051; swatkins@pitt.edu; Aranee Sivananthan, (412) 647-3602; Stephanie Thermoziar, (412) 647-3602; and Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu

XXV. Bone Marrow Transplantation – Animal Models:

John Chute, M.D., (310) 206-3037, jchute@mednet.ucla.edu ; Heather A. Himburg, Ph.D., (310) 206-3037

XXVI. Bone Marrow Transplantation – Clinical, and the RITN Organization:

Nelson Chao, M.D., MBA, (916) 668-1011, Chao0002@mc.duke.edu; Cullen Case, M.D., National Marrow Donor Program; Dennis Confer, National Marrow Donor Program, (612) 627-5800, dconfer@nddp.org

XXVII. Critical Care Medicine and Management of Mass Radiation Casualties:

Joel S. Greenberger, M.D., (412) 647-3602, greenbergerjs@upmc.edu ; Donald Yealy, M.D., (412) 647-8295, yealydm@upmc.edu

XXVIII. Dosimetry – Physical:

Ke Sheng, Ph.D., (310) 983-3603, ksheng@mednet.ucla.edu

XXIX. Biodosimetry:

David Brenner, Ph.D., D.Sc., (212) 305-3229, djb3@cumc.columbia.edu ; Guy Garty, Ph.D., (914) 591-9244, gyg2101@cumc.columbia.edu ; Sally A. Amundson, Ph.D., (212) 342-0965, saa2108@cumc.columbia.edu ; Evagelia C. Laiakis, Ph.D., (202) 687-3114; Albert J. Fornace, Ph.D., (202) 687-3114

XXX. Biomarkers of Radiation Injury and Medical Countermeasures (MCM) Effects: Predicting Late Effects and Assessing MCM Efficiency:

Joel S. Greenberger, M.D. (412) 647-3602, greenbergerjs@upmc.edu ; Ashwin Shinde, M.D., adshinde@coh.org ; Michael W. Epperly, Ph.D., (412) 623-3214, epperlymw@upmc.edu

XXXI. Product Development and Regulatory Considerations in Delivering Radiation Countermeasures.

David Cassatt, Ph.D., (240) 627-3486, cassattd@niaid.nih.gov

XXXII. The NIAID/CMCR Program Mission Relative to all of the above:

Andrea DiCarlo, Ph.D., (240) 627-3492, cohen@niaid.nih.gov