Topics in cancer biology, MB&B S50

Yale University Freshman Seminar
Summer, 2020

Monday, Wednesday, Friday 9:00 to 11:15AM EST
Office hours: Mondays 11:15-1:15PM EST

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Successful completion of this course satisfies either a SC or a WR distribution credit

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Learning objectives: The main purpose of this course is to introduce to students the concept that cancer as a genetic disease, with particular emphasis on landmark discoveries in cancer biology that offer insights into the molecular biology of cancer. Students will emerge from this course with a firm understanding of the molecular pathways perturbed in various cancers and the therapeutics currently used to exploit these pathways for cancer treatment. The other goals of this course are that students will learn to (1) read primary scientific literature, (2) present this material to the class and (3) write a short research paper. These skills are essential for any successful scientist or physician, and it’s important to master them early.

Primary Research Papers: All students are expected to read the assigned journal articles and be prepared to discuss them in class. All students will be divided into teams and assigned specific parts of a given paper to discuss. Work in groups-collaboration is an essential aspect of this class.

Problem sets: these will serve to guide you in understanding important points in the assigned papers. You might have to do some internet sleuthing to answer the questions. Do not spend a lot of time on these! One succinct sentence demonstrating your understanding of the question is sufficient. I DO NOT want a 20-page paper! Problem sets are scored in a 1 (worst) to 10 (best) scale. Late P-sets will be penalized: 10 points off for each late day, up to 3 days, after which the p-set will receive a 0. Work in groups to understand the paper, but I want individual answers to each question.

Research paper: Students will be expected to produce a 8-10 page research paper on any topic related to cancer, and may write on a topic we discussed in class. You can use the papers we read in class for reference. In addition, you must find and read at least three new papers (two primary papers, one review paper) to gain a better understanding of the chosen research topic. You will
need to know how to use PubMed to find papers online, and work with your writing tutor to come up with a polished piece of writing. Please consult the Yale writing tutor. You will have the opportunity to do a re-write to improve upon your initial grade. **Your first version is due in my inbox by 5PM on June 15. Remember, proper citations are essential!**

**Exams:** one exam and a quiz will consist mostly of short answer essay questions that will test your understanding of the subject, NOT how well you memorize facts. I will ask you to design experiments, interpret experimental data, etc. You will be given a number of questions to choose from, and partial credit will be given for short answer question answers.

**Grades:** Grades will be based on the performance on the final paper (20%), exam (15%), 1 quiz (5%), problem sets (4% each, 40% total) and class participation (20%). Each student will be assigned a numerical score. The modal score (most common score) will be assigned a “B+”. Scores of 90-94% will be assigned an “A-“ and anything above a 94.9% will be an “A”. A score above 65% is considered passing.

**Textbook:** available on Amazon.

Required: *The Emperor of All Maladies: A Biography of Cancer*, Siddhartha Mukherjee, New York: Scribner, November 2010. ISBN-10: 1439107955, $10.80 paperback on Amazon (abbreviated as “EOAM”). This is one amazing book and really gives the reader an excellent, global view of cancer. It is divided into sections that we will read out of order to track more closely with the lectures. Now also a must-see 3-part PBS series which I highly recommend.

Primary scientific articles to be discussed in class and corresponding problem sets will be posted in Canvas.

**Comment on academic integrity:** academic integrity is the pursuit of scholarly activity free from fraud and deception. All University policies regarding academic integrity apply to this course. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. All homework and exam answers and research papers must be the student’s own work.
May 25 (M) Session 1: **Introduction to the class, molecular biology tools**
   Session 2: **Oncogenes 1-tyrosine kinases**
   Week 1: read EOAM chapters 5, 6
   Problem set 1 (due 5/27/20)

May 27 (W): Session 3: class discussion on Piwnica-Worms et al., *Cell* 1987
   Session 4: **Targeted therapeutics against tyrosine kinases**
   Reading: Druker et al., *NEJM* 2001; Drucker et al., *Nat Med*; Rowley *Science*.
   Problem set 2 (due 5/29/20)

May 29 (F): Session 5: class discussion on Druker et al., *NEJM* 2001; *Nat Med*; Rowley *Science*
   Session 6: **Oncogenes 2-Ras G-proteins**
   Reading: Shi and Weinberg *Cell* 1982
   Problem set 3 (due 6/1/20)

June 1 (M): Session 7: class discussion on Shi and Weinberg *Cell* 1982
   Session 8: **Carcinogens, DNA damage and genomic instability**
   Reading: Brown et al., *Cell* 1986
   Week 2: read EOAM chapters 1, 2
   Problem set 4 (due 6/3/20)

June 3 (W): Session 9: **Quiz (Sessions 1-7)**
   Session 10: class discussion on Brown et al., *Cell* 1986

June 5 (F) Session 11: **Tumor suppressor 1: Retinoblastoma and defects in cell cycle control**
   Session 12: Class discussion EOAM chapters 1, 2, 5, 6
   Problem set 5 (due 6/8/20)

June 8 (M) Session 13: class discussion of Friend et al., *Science* 1986
   Session 14: **Tumor suppressor 2: p53, apoptosis and cellular senescence**
   Reading: Malkin et al., *Science* 1990
   Week 3: Read EOAM chapters 3, 4
   Problem set 6 (due 6/10/20)

June 10 (W): Session 15: class discussion of Milkin et al., *Science* 1990
   Session 16: **Exam 1 (topics presented in Sessions 1-14 and chapters 1, 2, 5, 6 of EOAM)**

June 12 (F): Session 17: **Telomeres, telomerase and cellular immortality I**
   Session 18: **Telomeres, telomerase and cellular immortality II**
   Reading: Kocak et al., *G&D* 2014
Problem set 7 (due 6/15/20)

June 15 (M) Session 19: class discussion on Kocak et al., 2014
Session 20: **Invasion, metastasis and angiogenesis**
   Reading: Braun et al., *NEJM* 2000
Problem set 8 (due 6/17/20)
**First draft of research paper due in my inbox by 5PM**

June 17 (W) Session 21: class discussion on Braun et al., *NEJM* 2000, EOAM
   Session 22: **Tumor immunology**
   Reading: Ribas *NEJM*; Eggermont et al., *NEJM*, Maude et al., *NEJM*
Problem set 9 (due 6/19/20)

June 19 (F) Session 23: class discussion on *NEJM* papers
   Session 24: **Breast cancer**
   Reading: Wood et al., *Science* 2007
Problem set 10 (due 6/22/20)

June 22 (M) Session 25: class discussion on Woods et al., *Science* 2007
   Session 26: class discussions on entire EOAM

June 24 (W): Session 27: class discussion on entire EOAM
   Session 28: class discussion on research paper topics

June 26 (F) Session 29: class discussion on research paper topics
   Session 30: class discussion on research paper topics