1-2003

MICB 404.01: MIcrobial Genetics

Frank Rosenzweig
University of Montana - Missoula, frank.rosenzweig@mso.umt.edu

Microbiology 404 Microbial Genetics Spring 2003

Instructor: **Frank Rosenzweig, Assoc. Prof. Microbiology**
Office: Health Science 505B
Office hours: MWF 12N-1PM and by appointment.
Ph: (406) 243-4834
E-mail: rrose@selway.umt.edu

Text: **L. Snyder & W. Champness. *Molecular Genetics of Bacteria.* ASM Press**
Additional reading will be placed on Reserve in the University Library.

Lecture: **Journal 306 MWF 11:10 – 12:00N**

Course Description – Microbial Genetics 404 is a senior/graduate level course that satisfies a core requirement for degrees in Microbiology and Cell & Molecular Biology. The syllabus is organized around mechanisms by which microorganisms regulate and transmit their hereditary apparatus to meet environmental challenges and reproduce. Underlying these mechanisms are principles variously elaborated among microbes representing the major Divisions of life. Our major objectives for this course will be to grasp these fundamental principles, recognize the diverse ways in which they are manifest and consider how they may have evolved. These objectives are central to becoming a competent Microbiologist or Molecular Biologist. Just as the 20th Century was the Age of Physics, the 21st Century will be the Age of Biology. The explosion of knowledge in the field of microbial genetics is in no small measure why.

Grading

CATEGORY	NO. * POINTS	TOTAL
Hourly exams	3 * 100 pts	300
Final exam	1 * 150 pts	150
Research proposal	1 * 125 pts	125
Precis of research articles	3 * 25 pts	75
		600 pts

GRADES WILL BE ASSIGNED ON A STRAIGHT SCALE * WHERE,

≥ 540 pts	≥ 90 %	**A**
480 – 539 pts	80 – 89 %	**B**
420 – 479 pts	70 – 79 %	**C**
360 – 419 pts	60 – 69 %	**D**
≤ 359	≤ 59%	**F**

* **PASS/FAIL credit.** Any student electing to take MICB404 P/F will be expected to earn ≥ 400 pts.

GRADUATE STUDENTS enrolled in MICB404 will be expected to fulfill an additional requirement for either a letter grade or a PASS. They will summarize a group of 2-3 papers centered around a topic of relevance to our course. This topic will be chosen in consultation with the instructor one month before the presentation. One week before the presentation, the student will announce his or her topic and distribute one of the 2-3 papers, preferably a short review article. The presentation

will be 20 minutes. She or he will then lead a 5 min discussion. After the presentation, all materials will be placed in a bound folder and presented to the instructor.

EXPLANATION OF CATEGORIES

Hourly Exams [300 pts] Exams will be 60% essay, 25% short answer, 15% multiple choice and True/False. Essay questions will be designed to test not only your grasp of concepts and the supporting facts, but also their application in problem solving. For example, you might be given a set of observations, and then asked to hypothesize a mechanism that accounts for these observations and a set of experiments to test your hypothesis. If appropriate, you will be asked to select the mode of statistical inference, and you will always be expected to articulate clearly your null hypothesis. Short answer questions will consist of defining terms and/or drawing structures. Multiple choice and T/F questions are self-explanatory.

Final Exam [150 pts] The Final Exam will be comprehensive. Approx. 50% of the exam will consist of material to which you were exposed prior to Exam 3. If you fared poorly on one of the three hourly exams, then a solid performance on the Final will work strongly in your favor.

Research proposal [125 pts] MICB 404/504 is a senior-level course. Given the nature of the field and the realities of the job market, most MICB 404 students will require post-graduate training. It is my responsibility to help you prepare for this next stage of your career. That next stage will require you to think critically and write cogently. Writing a Research Proposal provides one of the best ways of honing your skills in these areas.

In consultation with your instructor, you will define a research question of interest in microbial genetics. You will write an NSF-style proposal that will include the following sections (*i*) ABSTRACT (<250 words), (*ii*) SPECIFIC AIMS (1-2 pages), (*iii*) BACKGROUND AND SIGNIFICANCE (5-6 pages), (*iv*) RESEARCH APPROACH (4-5 pages), (*v*) TIMELINE (0.5 page), (*vi*) BUDGET AND BUDGET JUSTIFICATION (1 page) and (*vii*) LITERATURE CITED (at least 15 references from the primary literature). The meat of the proposal – Sections (*i*) through (*iv*) will consist of no less than 10 and no more than 14 pages, You will use double-spaced, 12 pt font, one inch margins.

Your grade on the research proposal will have FOUR components. (1) **10 pts**. You will propose a project to your instructor during the last week in February. This will be done in a one-to-one conference where you hand in a 1-page summary specifying your research aims and hypotheses. (2) **20 pts**. Four weeks later you will turn in a detailed 2-3 page outline that fleshes out this proposal and provides at least 5 references. (3) **30 pts**. Four weeks later you will turn in a rough draft and comprehensive bibliography. (4) **65 pts**. Your final proposal is due the last week of class. Electronic submission of the rough and final drafts is mandatory. This procedure will ensure that you stay on task and get useful feedback from your instructor every step of the way. **MICB404 qualifies as a course that satisfies the University General Writing Requirement.**

Precis of research articles [75 pts] Another measure of how well you are mastering the material in MICB404 is your ability to review and critically evaluate the primary literature. Accordingly, you are assigned to write three précis of articles in the primary literature. Most of the journal articles assigned for MICB404 are short review articles that provide a window on the primary literature. Before you embark on your précis, you must clear the paper with your instructor. When you turn in your précis, you will also turn in a reprint of the journal article. One of these *must* be a paper that you use for your research project.

Microbiology 404 Microbial Genetics Spring 2003

Instructor: Frank Rosenzweig, Assoc. Prof. Microbiology
GTA: Margie Kinnersley
Text: L. Snyder & W. Champness. 2003. *Molecular Genetics of Bacteria.* ASM Press
Room/Time: Journalism 306 MWF 11:10 – 12:00N

SYLLABUS – Our syllabus is tentative. Adjustments will be made to accommodate student interest, breakthroughs in the field, or the need to prolong discussion of certain topics.

DATE	TOPICS	READING
1. Jan 27 (M)	Introduction: Course mechanics	
2. Jan 29 (W)	*Why genetics in a post-genome era?*	Introduction, pp. 1-10 & p. 474-475.
3. Jan 31 (F)	Microbial genomes: *What are the sources of genetic variation?*	Arber 2000. *FEMS Microbiol Rev* **24:**1.
4. Feb 3 (M)	Nucleic acid structure I: *Fidelity & error in DNA replication*	Ch 1
5. Feb 5 (W)	Nucleic acid structure II: *Fidelity& error in DNA replication*	Ch 1
6. Feb 7 (F)	Bacterial mutants: *How do we talk about microbial genetics?*	Ch. 3
7. Feb 10 (M)	Mutagenesis: *How do we estimate mutation rate?*	Ch. 3
8. Feb 12 (W)	Isolating mutants: *How do we devise selections, screens, enrichments for specific categories of mutations?*	Ch. 14
9. Feb 14 (F)	Mechanisms of mutagenesis: *What do different mutagens do?*	Ch. 3 & Ch. 11 ***Precis of research article.1 due***
10. Feb 17 (M)	**PRESIDENT'S DAY, HOLIDAY**	
11. Feb 19 (W)	Reversion and suppression : *What can we learn by restoring functions lost by mutation?*	Ch. 3
12. Feb 21 (F)	**EXAM 1** [=100 pts]	***Schedule research conference***
13. Feb 24 (M)	Lateral gene transfer: *Overview & evolutionary implications*	Skim introductions to Ch. 5, 6, & 9 Ochman 2001. *Curr Opin Genet Dev* **11**:616.
14. Feb 26 (W)	Biology of plasmids: *I. Classification & structure*	Ch. 4
15. Feb 28 (F)	Biology of plasmids: *II. Modes of replication*	Ch. 4 ***Research topic due (10 pts)***
16. March 3 (M)	Conjugation: *Mechanisms of plasmid-mediated gene transfer*	Ch. 5
17. March 5 (W)	Transformation: *Food and sex in the microbial world.*	Ch. 6 Redfield et al. 1997. *Genetics* **146:**27-38.
18. March 7 (F)	Phage, lytic growth and restriction-modification systems	Ch. 7 Rocha et al. 2001. *Genome Res* **11**:946.
19. March 10 (M)	Transduction: *Generalized & specialized transduction*	Ch. 8
20. March 12 (W)	DNA repair: I. *Specific pathways*	Ch. 11
21. March 14 (F)	Homologous recombination I.	Ch. 10
22. March 17 (M)	Homologous recombination II.	Ch. 10
23. March 19 (W)	OPEN DATE: Catch-up & Review	***Precis of research article.2 due***
24. March 21 (F)	**EXAM 2** [=100 pts]	
	MARCH 24 – MARCH 28	***SPRING VACATION***

25. March 31 (M)	DNA repair: II. *RecA-dependent pathways*	Ch. 10 & 14 Radman 1999. *Nature* **401**:866 ***Outline of research proposal due (20 pts)***
26. April 2 (W)	DNA repair: III. *Evolutionary considerations*	Kuzimov 2001. *PNAS* (USA) **98**:8461. Chicurel 2001. *Science* **292**: 1824
27. April 4 (F)	Transposable elements: I. *Discovery & classification*	Ch. 9
28. April 7 (M)	Transposable elements: II. *Their regulation & utility*	Ch. 9 & Ch. 14
29. April 9 (W)	Transposable elements: III. *Med & evolutionary perspectives*	Dwyer 2001 *Science* **291**:252. Rowe-Magnus 2001. *Curr Opin Micro* **4**:565.
30. April 11 (F)	Operon and gene fusions I. *Genetic basis*	Ch. 2 & Ch. 11
31. April 14 (M)	Operon and gene fusions II. *Utility in study of gene regulation and transport*	Ch 14
32. April 16 (W)	OPEN DATE: Catch-up & Review	
33. April 18 (F)	**EXAM 3** [=100 pts]	
34. April 21 (M)	Gene expression: I. *Mechanics of transcription*	Ch. 2 & Ch. 12
35. April 23 (W)	Gene expression: II. *Regulation of transcription*	Ch. 12
36. April 25 (F)	Gene expression: III. *Regulation of transcription*	Ch. 12 ***Draft of research proposal due (30 pts)***
37. April 28 (M)	Global regulation I. *Nutritional stimuli*	Ch. 13 ***Precis of research article.3 due***
38. April 30 (W)	Global regulation II. *Heat shock, SOS & stringent response*	Ch. 13
39. May 2 (F)	**GRAD STUDENT PRESENTATION & DISCUSSION**	Hacker & Carniel *EMBO Rep* 2001. **2**:376. Oelschlaeger *et al.* 2002. *Curr Opin Urol* **12:**33
40. May 5 (M)	Comparative Genomics: Pathogenicity islands & the evolution of virulence	pp. 457-464 Hentschel & Hacker 2001. *Micr Infec* **3:**545.
41. May 7 (W)	Eukaryotic microbial genetics: I. *Analysis of the cell cycle in yeast*	Nurse, Matsui & Hartwell 1998. *Nat Med* **4**:1103 Hand-out from "Genes V"
42. May 9 (F)	OPEN DATE: Catch-up & Review	***Research proposal due (65 pts)***

MAY 12TH **COMPREHENSIVE FINAL EXAM [150 PTS]**