BIO 412: MICROBIAL PHYSIOLOGY
Spring 2009: MWF at 11:30 AM
Room: Sowa Hall 233
Laboratory: W 1:30 PM – 4:30 PM Albertus Magnus 212
Credit Hours: 4.00

INSTRUCTOR:
Name: Fr. Nicanor Pier Giorgio Austriaco, O.P., Ph.D.
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I am generally in my office (Sowa 229B) or in my laboratory (Hickey 181) from 9:00 AM - 5:00 PM daily and am easily available with a prior appointment. To make an appointment, call me at 865-1906. You may also contact me via email. I will keep Tuesday afternoons from 2:00 PM to 4:30 PM for drop-in appointments. Please feel free to talk to me about any issue relating either to the course or to your life as a student here at Providence College.

A PRAYER BEFORE STUDY
St. Thomas Aquinas, O.P.

O God, Creator of all things, true source of light and wisdom, graciously let a ray of your light penetrate the darkness of my understanding. Give me a keen intellect, a retentive memory, and the ability to grasp things correctly and fundamentally. Give me the talent of being exact in my explanations and the ability to express myself with thoroughness and charm. Point out the beginning, direct the progress, and perfect my work. We ask you this through Jesus Christ Our Lord. Amen.

COURSE DESCRIPTION:

This course is designed to introduce students to the physiology of prokaryotic and eukaryotic microbes emphasizing several key model systems: *E. coli*, *B. subtilis,* and *S. cerevisiae*. Emphasis is placed on the molecular underpinnings of microbial physiology and will include the following possible topics: microbial growth and development, genome dynamics including transcriptional, translational, and post-translational regulation, DNA repair and mutagenesis, stress responses, colony dynamics, biofilms, and drug resistance. A significant component of this course will involve learning the methods and logic of biology using, what I call, the Methods & Logic approach to reading primary scientific papers. The laboratory will introduce students to experimental protocols used in studies involving several microbial model systems.

READING MATERIAL:

We will be reading papers from the primary scientific literature. These papers are listed on the syllabus and have been posted to the class website on ANGEL. One student will lead the class discussion for each research article we critique. Please be sure to read each paper before class.

ACADEMIC EXPECTATIONS:

There will be a midterm and a final for this course. Each examination will be an open-book examination. In other words, you are free to consult any textbooks, reviews, or scientific papers. However, if you do so, please reference your sources and note them in your response. You may also discuss your responses with your classmates when this is permitted on the exam. However, I expect the responses to be written independently. Furthermore, if you do discuss your responses with your classmates, please note this on your exam and list the names of your collaborators.

During the course of the semester, each student will be responsible for submitting five (5) method & logic analyses of any three papers discussed in the course including the two assigned papers. A methods & logic analysis is due on the day that we discuss a particular paper in class. A template for these analyses is available on the ANGEL website for the course.

Regular attendance is expected. Please email the instructor in advance if you expect to miss a class. More than two unexcused absences during the semester may lead to a final grade reduction of a full letter grade (e.g., B+ to C+).

GRADING POLICY:

Grades will be calculated as follows:

Midterm & Final Exam	40%
Method & Logic (M&L) Analyses	25%
Laboratory	20%
Class Presentation/Participation	15%

Academic dishonesty, cheating, and plagiarism ("the stealing and passing off of the ideas or words of another as one's own without crediting the source") are not tolerated in the professional world of scientific and medical research and will not be tolerated in this class. For the first offense, the student will receive a zero for the examination or the assignment. If a student aids another student during the exam, both parties will receive a zero. For the second offense, the student will receive an F for the course. Please consult the current Providence College Undergraduate Catalogue for its statement on "Academic Honesty."

WORKING SYLLABUS

Week of January 19, 2009
Prokaryotic and Eukaryotic Cells – Model Systems

C. Gimeno and G.R. Fink, "Induction of pseudohyphal growth by overexpression of PHD1, a Saccaromyces cerevisiae gene related to transcriptional regulators of fungal develoment," *Mol Cell Biol* 14 (1994): 2100-2112.

Week of January 26, 2009
Growth, Log Phase, and Stationary Phase

S.W. Lazar et al., "Role of the *Escherichia coli* SurA Protein in Stationary-Phase Survival," *J. Bact.* 180 (1998): 5704-5711.

R. Tal et al., "Aup1p, a yeast mitochondrial protein phosphatase homolog, is required for efficient stationary phase mitophagy and cell survival," *J. Biol Chem* 282 (2006): 5617-5624.

Week of February 2, 2009
Regulation of Cell Division

[REQUIRED METHODS & LOGIC PAPER] F.J. Gueiros-Filho and R. Losick, "A widely conserved bacterial cell division protein that promotes assembly of the tubulin-protein FtsZ," *Genes Dev* 16 (2002): 2544-2556.

J. Chant et al., "Role of Bud3p in producing the axial budding pattern of yeast," *J Cell Biol* 129 (1995): 767-778.

Week of February 9, 2009
Programmed Cell Death

M.A. Kohanski et al., "Mistranslation of Membrane Proteins and Two-Component System Activation Trigger Antibiotic-Mediated Cell Death," *Cell* 135 (2008): 679-690.

S. Ahn et al., "Sterile 20 Kinase Phosphorylates Histone H2B at Serine 10 during Hydrogen Peroxide-Induced Apoptosis in *S. cerevisiae*," *Cell* 120 (2005): 25-36.

Week of February 16, 2009
Genome Dynamics, DNA Replication, and Chromosomal Segregation

[REQUIRED METHODS & LOGIC PAPER] Michael A. Fogel and Matthew K. Waldor, "A dynamic, mitotic-like mechanism for bacterial chromosome segregation," *Genes Dev.* 20 (2008): 3269-3282.

R. Mercier et al., "The MatP/*matS* Site-Specific System Organizes the Terminus Region of the *E. coli* Chromosome into a Macrodomain," *Cell* 135 (2008): 475-485.

Week of February 23, 2009
Transcriptional Control in Bacteria

M. Jishage et al., "Regulation of sigma factor competition by the alarmone ppGpp," *Genes Dev.* 16 (2002): 1260-1270.

H. Hsu et al., "Role of the Sigma Factor in Transcription Initiation in the Absence of Core RNA Polymerase," *Cell* 127 (2006): 317-327.

Week of March 2, 2009 **-- MIDTERM EXAM ASSIGNED --**
Translational Control

A. Balandina et al., "The *Escherichia coli* histone-like protein HU regulates rpoS translation," *Mol. Microbiol* 39 (2001): 1069-1079.

P.F. Miller and A.G. Hinnebusch, "Sequences that surround the stop codons of upstream open reading frames in *GCN4* mRNA determine their distinct functions in translational control," *Genes Dev* 3 (1989): 1217-1225.

Week of March 9, 2009 **-- SPRING BREAK --**

Week of March 16, 2009
Post-Translational Control and Protein Degradation

E. Chapman et al., "Global aggregation of newly translated proteins in an *Escherichia coli* strain deficient of the chaperonin, GroEL," *PNAS* 103 (2008): 15800-15805.

R. Swanson et al., "A conserved ubiquiting ligase of the nuclear envelope/endoplasmic reticulum that functions in both ER-associated and Matα2 repressor degradation," *Genes Dev* 15 (2001): 2660-2674.

Week of March 23, 2009
Signaling Pathways

Franziska Mika and Regina Hengge, "A two-component phosphotransfer network involving ArcB, ArcA, and RssB coordinates synthesis and proteolysis of sigmaS (RpoS) in E. coli.," *Genes Dev.* 19 (2005): 2770-2781.

J.G. Cook et al., "Inhibitory and activating functions for MAPK Kss1 in the S. cerevisiae filamentous-growth signalling pathway," *Nature* 390 (1997): 85-88.

Week of March 30, 2009
Nutrient Regulation and Signaling

S.B. Schawalder et al., "Growth-regulated recruitment of the essential yeast ribosomal protein gene activator Ifh1," *Nature* 432 (2004): 1058-1061.

J.T. Wade et al., "The transcription factor Ifh1 is a key regulator of yeast ribosomal protein genes," *Nature* 432 (2004): 1054-1058.

Week of April 6, 2009 **-- EASTER BREAK --**
Responses to Stress

D.F. Ackerley et al., "Effect of chromate stress on Escherichia coli K-12," *J Bacteriol.* 188 (2006): 3371-3381.

L.E. Cowen and S. Lindquist, "Hsp90 potentiates the rapid evolution of new traits: drug resistance in diverse fungi," *Science* 309 (2005): 2185-2189.

Week of April 13, 2009
Quorum sensing, Colony Dynamics, and Biofilms

B.A Lazazzera et al., "An exported peptide functions intracellularly to contribute to cell density signaling in B. subtilis," *Cell* 89 (1997): 917-925.

T.B. Reynolds and G.R. Fink, "Baker's yeast, a model for fungal biofilm formation," *Science* 291 (2001): 878-881.

Week of April 20, 2009
Sporulation

Dan H. Broder and Kit Pogliano, "Forespore Engulfment Mediated by a Ratchet-Like Mechanism," *Cell* 126 (2006): 917-928.

J. Li et al., "SSP2 and OSW1, two sporulation-specific genes involved in spore morphogenesis in Saccharomyces cerevisiae," *Genetics* 175 (2007): 143-154.

Week of April 27, 2009 **-- FINAL EXAM ASSIGNED --**
Drug Resistance

S. Murakami et al., "Crystal structures of a multidrug transporter reveal a functionally rotating mechanism," *Nature* 443 (2006): 173-179.

V. Fardeau et al., "The central role of PDR1 in the foundation of yeast drug resistance," *J Biol Chem* 282 (2007): 5063-5074.