

**Biology 4345-001**  
**Biology 5346-001**  
**Microbial Physiology**

**General information:**

Instructor: Dr. Thomas Chrzanowski

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Office Hours: Tuesday and Thursday 2:00 – 3:00 pm

Textbook: The Physiology and Biochemistry of Prokaryotes (4th ed.) by David White, James Drummond, and Clay Fuqua. Oxford University Press.

Other reading: You are responsible for reading assigned from sources other than your textbook.

Meeting times: The class meets in LS 101 T, Th 9:30 am – 10:50 am

**Description of the course and learning outcomes:** The goal of this course is to conduct an in-depth review of cellular structure, function, and regulation. You should be able to integrate information about cell function sufficient to develop and argument that defends a position.

**Prerequisites:** Biology 2451 (General Microbiology) or equivalent

**Attendance Policy:** The University does not require monitoring your attendance; each faculty member is free to establish course-specific policies on attendance. With the exceptions of exam dates, you are not required to attend lectures; however, you are responsible for all material covered in lecture including changes to the syllabus.

**Evaluation:** Your performance will be assessed through four examinations of equal value. Our progress will determine scheduling and exams will be announced at least one-week before the exam date. The following grading scale will be used to determine your grade for the course; A - 90 to 100%, B - <90 but greater than or equal to 80%, C - <80 but greater than or equal to 70%, D - <70 but greater than or equal to 60%, F - less than 60%. The form of examinations may be multiple choice, short essay, long essay, or whatever is best suited to the material and is solely at my discretion. *Degreed students may expect additional assignments.* You may not have personal belongings at your desk during an exam. You will not be allowed to take an exam if you do not comply.

**Late to or Absence from exams:** You are required to be present for all examinations. You will be considered absent from an exam if you enter the room after one person has completed the exam and turned it in. Absences will be excused only with written request by a physician, other responsible professional, or with proof of jury duty. If you miss an exam, you will be given an exam score of zero. Exams missed due to excused absence must be taken within one day of your return to class. No other make-up exams will be given.

**Final Review Week:** A period of five class days prior to the first day of final examinations in the long sessions is designated as Final Review Week. The purpose of this week is to allow you sufficient time to prepare for final exams. During this week, there shall be no scheduled activities such as required field trips or performances; and no themes, research problems or exercises of similar scope that have a completion date during or following this week shall be assigned *unless specified in the class syllabus*. During Final Review Week, no examinations constituting 10% or more of the final grade will be given, except makeup tests and laboratory examinations. In addition, no portion of the final examination will be given during Final Review Week. During this week, classes are held as scheduled and new concepts will be introduced as appropriate.

**Drop Policy:** You may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, you must see an academic advisor to drop a class or withdraw. If you have not declared a major, you must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is your responsibility to officially withdraw if you do not plan to attend after registering. **You will not be automatically dropped for non-attendance.** Repayment of certain types of financial

aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/ses/fao>).

**Expectations for Out-of-Class Study:** Beyond the time required to attend each class meeting, you should expect to spend at least an additional 9 hours per week in course-related activities, including reading required materials, completing assignments, preparing for exams, etc.

**Academic Integrity:** You are expected to adhere to the UT Arlington Honor Code:

*I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.*

*I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

"Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts."

Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Possession of any exams used in prior sessions of this course will be considered as academic dishonesty. Those in possession of such exams will be assigned a grade of zero for that exam. Other violations will be disciplined in accordance with University policy, which may result in suspension or expulsion from the University.

**Americans with Disabilities:** The University of Texas Arlington is committed to both the spirit and letter of federal equal opportunity legislation (Public Law 93112--The Rehabilitation "Act of 1973 as amended; Americans with Disabilities Act - (ADA)). It is your responsibility to inform me of your disability at the beginning of the semester and to provide authorized documentation through designated administrative channels. If you require and accommodation based on disability, I would like to meet with you in my office the first week of class to discuss your special needs. If you believe your academic performance suffers due to a disability please contact: The Office for Students with Disabilities, (OSD) [www.uta.edu/disability](http://www.uta.edu/disability) (817-272-3364) or Counseling and Psychological Services, (CAPS) [www.uta.edu/caps/](http://www.uta.edu/caps/) (817-272-3671).

**Title IX:** The University of Texas Arlington ("University") is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit* [www.uta.edu/titleIX](http://www.uta.edu/titleIX) *or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or* [jmhood@uta.edu](mailto:jmhood@uta.edu).

**Bomb Threats:** If you are tempted to call in a bomb threat, be aware that the university will attempt to trace the phone call and prosecute all responsible parties. Every effort will be made to avoid cancellation of presentations/exams caused by bomb threats. Alternate classrooms or sites will be available in the event that your classroom is not available.

**Campus carry:** Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

**Recording Devices:** The use of electronic devices to record lectures is forbidden without exception.

**Smoking, food and drink in the lecture hall:** University regulations prohibit smoking, eating, and drinking in lecture halls.

**Cell Phones:** *Ringers must be turned off during class. If your phone rings during class, pick up your belongings and quietly leave the room. Do not return until the next class. THIS INCLUDES CLASSES DURING WHICH EXAMS ARE ADMINISTERED. IF YOUR PHONE DISTURBS EVERYONE IN THE CLASS AND YOU ARE ASKED TO LEAVE, SUBMIT WHAT YOU HAVE COMPLETED AND LEAVE. YOU WILL BE GRADED AS IF YOU SUBMITTED THE EXAM AS COMPLETE.*

**Electronic Communication Policy:** The University of Texas Arlington has adopted the University “MavMail” address as the sole official means of communication. All students are assigned a MavMail account. ***You are responsible for checking your MavMail regularly.*** Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>. There is no additional charge for using this account, and it remains active even after graduation.

**Student Support Services:** The University provides a variety of resources and programs designed to help you develop academic skills, deal with personal situations, and better understand concepts and information related to your courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, you may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to [resources@uta.edu](mailto:resources@uta.edu), or view the information at <http://www.uta.edu/universitycollege/resources/index.php>

**Student feedback survey:** At the end of the term, you will be asked to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to you through MavMail approximately 10 days before the end of the term. Your feedback via the SFS database is aggregated with that of others enrolled in the course. Your anonymity will be protected to the extent that the law allows. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

**After Hours Safety Escort:** The Sam Mav Escort service provides a service to assist students, faculty, staff and campus visitors to reach their destinations after regular business hours. The hours of service are 7:00 p.m. to 1:00 a.m., Sunday through Saturday. 817-272-3381. In case of an on-campus emergency, call the **UT Arlington Police Department at 817-272-3003 (non-campus phone), 2-3003 (campus phone). You may also dial 911.**

**Emergency Exit Procedures:** Should we experience an emergency that requires us to vacate the building, you should exit the room and move toward the nearest exit, which is located to the right as you exit the lecture hall. When exiting the building during an emergency, never take an elevator...use the stairwells. I will assist you in selecting the safest route for evacuation and will arrange to assist non-ambulatory individuals.

**Changes to the syllabus:** The following serves only as an outline. Our progress in covering material may warrant changes in this outline. I reserve the right to adjust this schedule in any way necessary to meet the course objectives.

## **Detailed summary of course topics**

### Introduction

- A brief comparison of prokaryotes and eukaryotes
- A brief comparison of Gram positives and Gram negatives
- The macromolecular composition of a cell

### Surface polysaccharides and the S-layer

- Defined
- Functions
- Attachment to membranes
- Types of surface polysaccharides
  - S-Layers

- Structure
- Functions
- Assembly

### Fimbriae and Pili

- Defined
- Morphology
- Types
- Structural features

### Cell Walls

- Comparison of Gram positive to Gram negative
- Backbone components of peptidoglycan
- Descender chains and orientation of helices
- Major types of polymer cross-linking
- Synthesis and turnover of peptidoglycan
- Monomers and membrane components
- Transglycosylation and transpeptidization
- Turnover in Gram negative and in Gram positives
- Arrangement of peptidoglycan strands
- Assembly
  - Models

### Cytoskeltons

- Cytoskeletal elements and penicillin binding proteins
- Cytoskeletal elements and role in cell wall synthesis
- Mre
- FtsZ
- MinD and others

### Cell Membranes

- General features
- Phospholipid structure and types
- Hopanoids
- Peripheral and integral proteins
- Archae membranes
- Synthesis of fatty acids
- Synthesis of phospholipids

### Outer membranes

- Review of Gram negative envelop
  - Lipopolysaccharide
  - Lipid A
  - Core oligosaccharide
  - Side chains
- Synthesis and assembly of each component
- The concept of Bayer's Junction
- Braun's lipoprotein
  - Structure
  - Synthesis and insertion
- Outer membrane proteins
  - Porins
    - Structure
    - OMP F 3-D rendition
  - Specific channels
  - OMP A
  - Some functions of OMPs

### Teichoic acids and lipoteichoic acids

- Functions

- Structure
- Peptidoglycan linkage units
- Synthesis
- Teichuronic acids

#### Motility and Chemotaxis

- Flagella
  - Detailed structure
  - Assembly
- Models of motor function
- Gliding Types of movement
  - *Myxococcus*
  - *Synechocystis*
  - *Cytophaga*
- Chemotaxis
- Membrane signaling
  - Cytoplasmic signaling proteins
  - Interaction of proteins with flagellar motor

#### DNA replication

- Simple review
  - Bases, strand orientation
  - Strand stabilizing polyamines
- Coiling, supercoiling and domains
- Topoisomerases
- Replication in bacteria
  - Initiation
    - The replication fork
  - Loop back models
    - The B-clamp
  - Termination
- Segregation of chromosomes
  - The Replicon model
  - Microtubules
  - Factory vs. train models

#### Transcription

- Overview
- Synthesis of RNA
  - Initiation
  - elongation
  - termination
- RNA stability and post-transcriptional modification
- Regulation of transcription
  - Frequency of initiation
  - Sigma factors
  - transcription factors

#### Translation

- Overview
- Stable RNA
- Steps in protein synthesis
  - Activating the tRNA
  - Initiating
  - Elongation
  - Termination
- Polysomes

#### Protein export and secretion

- General secretory pathway

- Leader sequences
- Chaperones and SEC proteins
- Membrane translocation
- A model for protein secretion
- Co-translation translocation
- Translocation and insertion of membrane bound proteins
- Extracellular protein secretion
- 4 major secretory systems

#### Central metabolic pathways

- Overview of metabolism
- Entry of glucose into the cell
- Embden-Meyerhof-Parnas Pathway
- Pentose Phosphate Pathway
- Entner-Doudoroff Pathway
- Phosphoketolase Pathway
- Post glycolytic Pathways
  - Re-supply of oxaloacetate
  - TCA pathway
  - Oxidative branch
  - Reductive branch
- Glyoxylate
  - Re-supply of phosphoenolpyruvate

#### Regulation

- Modes of enzymatic regulation
- Regulatory enzymes
  - Review of Michaelis-Menten kinetic
  - Sigmoidal kinetics
- Inhibitory regulation
- Promotional regulation
- Regulation of the EMP pathway
- The pyruvate dehydrogenase complex
- Regulation of the TCA cycle
- Regulation of the glyoxylate cycle
- Summary of regulation of central metabolic pathways

#### Electron transport

- Overview
- The classes of electron carriers
  - Flavoproteins
  - Fe/S proteins
  - Cytochromes
  - quinones
- The pattern of electron transport
- Q loops, Q cycles, and proton pumps
- Examples of the diversity of electron transport systems in bacteria

#### Growth and growth kinetics

- The mathematics of growth
- Factors influencing growth
- Monod kinetics explored
- $K_s$  and  $\mu_{max}$  discussed in detail
- Applications of kinetic data
- Other aspects of cell physiology related to growth
  - Macromolecular composition

- Functioning of the protein synthesizing system
- Cell size as a function of growth