# Biology 2010: Cell Biology and Biochemistry, Fall 2020
# Section 1 (3 units lecture + 1 unit lab)

Instructor: Dr. Mike Dorrell (Phone: 619-849-2962 (ext. 2962), E-mail: mdorrell@pointloma.edu)

Time and place: Monday/Wednesday/Friday, 1:30 pm – 2:30 pm; zoom / virtual

Text: Brooker et al., **Principles of Biology (3rd edition)**.

3 options for purchase: (All Can be ordered through the bookstore or online).

1) Biology, Bio – Chem, and Environmental Science majors, along with most pre-med students, will need the text for multiple courses. Loose leaf printed version of the text (for multiple semesters) with a Connect code (needed for Bio2010): ***ISBN = 9781264079803***
2) Applied health, diatetics, chemistry, or other majors who only need 1 semester of biology (Bio2010). 1 semester Connect access with Etext: ***ISBN = 9781260708288***

***Note that even if you obtain the text from a separate source, you will still need to purchase the 1 semester Connect access for this course.***

Lab manual: No lab manual this semester. All resources are found on canvas

Office hours: Office Hours (most days): M,W,F 8:30 – 11:30; W 3 – 5 PM.
I am here for you! Feel free to schedule a meeting via zoom, or contact me for a time.

## PLNU Mission: To Teach ~ To Shape ~ To Send

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

**Learning objectives:** *The overarching goal of this course is to prepare students for subsequent in-depth coursework in Biology, Biology-Chemistry, and health sciences.*

**Specific learning outcomes; Students will be able to:**

1) Understand basic principles of the inner function of cells, including how cells obtain and use energy through cellular respiration and/or photosynthesis, how membranes regulate cellular composition, how cells organize and communicate within a multicellular organism, and how genetic material is copied and converted to phenotypic information. (Program learning outcome #1)
2) Apply content to various scenarios in order to describe how a cell would react under changing environmental conditions, and relate problems associated with malfunctions in various important cellular processes. (Program learning outcome #1)
3) Evaluate current bioethical issues from an understanding of science and our moral responsibilities as Christians. (Program Learning Outcome #3)
4) Utilize skills and techniques critical to experimentation in a cell and molecular biology laboratory setting. (Program learning outcome #1)
5) Design scientific experiments with appropriate controls and analyze scientific data, demonstrating knowledge of the purpose, experimental method, data, and basic statistical interpretation. (Program learning outcome #1)
6) Demonstrate critical thinking skills related to scientific methods, data analysis, and conclusions. (FELO 1d; *Select questions on the final exam will be used to assess FELO 1d. Critical Thinking: Students will be able to examine, critique, and synthesize information in order to arrive at reasoned conclusions).*

**Foundational Explorations Mission:** PLNU provides a foundational course of study in the liberal arts informed by the life, death, and resurrection of Jesus Christ. In keeping with the Wesleyan tradition, the curriculum equips students with a broad range of knowledge and skills within and across disciplines to enrich major study, lifelong learning, and vocational service as Christ-like participants in the world's diverse societies and culture.

**Course Description:**

An introduction to the principles of cell biology, molecular biology, and biochemistry. Topics include the chemical basis of life, basic membrane functions and membrane transport, basic metabolic pathways including cellular respiration and photosynthesis, cell division, and expression of the genetic material. Lecture and lab.

**Specific content covered:**

1) Scientific method (Chapter 1 and laboratory work)
2) Basic chemistry of molecular bonding and interactions. (Chapter 2)
    - electronegativity, bond polarity, hydrophobic and hydrophilic properties
    - covalent, hydrogen, ionic, and disulfide bonds, and Van der Waals interactions
3) Biological properties of cellular macromolecules (Chapter 3)
    - chemistry of lipids, carbohydrates, proteins, and nucleic acids
    - dehydration reactions / monomer polymerization
    - protein folding and side chain interactions
4) Systems biology (Chapter 4, chapter 12)
    - cellular organization / organelle purposes and function
    - protein synthesis and targeting pathways (endomembrane system)
5) Cell membranes, cellular compartmentalization, and membrane transport (Chapter 5)
    - selective permeability for diffusion of components across the membrane
    - cellular gradients, membrane proteins, and membrane transport
6) Cellular respiration and photosynthesis (Chapters 6 – 7)
    - properties and functions of enzymes, thermodynamics and energy of activation
    - glycolysis, Citric Acid cycle, and oxidative phosphorylation
    - aerobic and anaerobic respiration
    - Light reactions (cyclic and linear photosynthesis) and the Calvin Cycle
7) Cell communication and cell signaling (chapter 8)
    - ligand – receptor binding and the concept of threshold
    - intracellular signaling cascades and signal amplification.
8) DNA structure and replication (chapter 9)
    - bi-directional replication, Okazaki fragments
    - roles of various enzymes during replication
9) Gene expression (Protein synthesis); (Chapter 10)
    - transcription, RNA processing, and translation
    - introduction to mutations
10) Mitosis and meiosis (Chapter 14)
    - stages of mitosis and meiosis, and chromosomal movements during each
    - normal cell cycle controls
11) Introduction to genetics (Chapter 15)
    - Mendelian and non-Mendelian genetics
    - Principles of inheritance

**Course Credit Hour Information:**

In the interest of providing sufficient time to accomplish the stated Course Learning Outcomes, this class meets the PLNU credit hour policy for a 4 unit class delivered over 15 weeks. It is anticipated that students will spend a minimum of 37.5 participation hours per credit hour on their coursework. For this course, students will spend an estimated 150 total hours meeting the course learning outcomes. The time estimations are provided in the Canvas modules.

# Evaluation and grading:

**Point breakdown (tentative; may be altered slightly)**

| | |
|---|---|
| 3 midterm exams | 38% |
| 1 final exam | 17% |
| SmartBook assignments and other homework | 10% |
| peer teaching assignments / Team Learning activities | 10% |
| Laboratory grade | 20% |
| Class attendance and participation | 5% |
| TOTAL | 100% |

***Exams*** – While Bio2010 can be taken as a course that meets the Foundational Explorations requirement for science, and is a requirement for the allied health sciences, it is most commonly the first Biology course for students with declared majors in Biology or Biology-Chemistry. The content and concepts introduced in this course are foundational to virtually all subsequent courses in the program, thus it is essential that you maximize retention of the content and concepts beyond the exams.

There will 3 midterms (~100 pts each) and a final exam (~150 pts). Each exam will consist of multiple choice and short answer questions and/or calculation problems. All of science is cumulative such that scientific knowledge must build and expand upon previous knowledge. The same is true when learning science, you must remember and apply all that you have previously learned in order to completely understand and apply newer material. Thus, although the focus of each midterm will be on recent material, each should be thought of as a cumulative exam.

**If you have a conflict with an exam date/time, you must let the instructor know well in advance.** Makeup exams will be at the discretion of the instructor.

**The final exam must be taken at the scheduled place and time.**

***Homework:*** -- Homework, including the SmartBook assignments, will be assigned periodically throughout the semester. Late work will lose 20% per late class up to 1 week late (3 classes) at which point a 0 will be given.

***SmartBook assignments* 10 x ~10 - 15 pts each** – Your textbook comes with excellent, individualized learning tools to help you master the material.

To hold students accountable for the assigned reading, SmartBook assignments are on assigned reading that we have not yet covered in class. Having already been introduced to key terms and concepts, we will be ready to work together and focus on concepts and application of knowledge in class. There are also optional practice work through SmartBook that I have designed to provide additional opportunities to practice applying key concepts. These mirror concepts and higher order learning assessment that you will see in exams.

***Peer teaching*** – Teaching is a great way to learn. On some days, for 10 - 15 minutes at the beginning of class, we will break into peer groups, where one student in the group will teach the others a particular topic, usually describing a key historical experiment that has allowed us to understand current biology related to our course. Topics are listed in the tentative course schedule. **The teaching student will be required to turn in their teaching slides / outline of the topic.** Points are awarded according to the degree of preparedness, student evaluations, and the quality of the study guide / outline. **You are allowed to swap weeks with another student in your group, assuming you both agree, but you must inform me of the swap ahead of time.**

***Team Activities:*** On some days, we will do Team Activities to practice higher level learning and application. The topic is listed in the schedule. Each student is responsible for reading and preparing any background materials in advance. There may be a short, individual quiz taken on the material prior to the activity to ensure that students are completing the required background work.

***Laboratory experience*** – An essential part of any science curriculum is hands-on experience in the lab. The Bio210 lab is designed to expose the student to some of the essential tools of the scientist in a safe, controlled environment. Please see the separate lab syllabus for details. ***Note that there will be alternating weeks for some labs in order to maintain safe social distancing during the lab.***

***Class participation*** **-** Class attendance and participation will be based on iClicker Reef participation, attitude, and preparation / contribution in peer teaching and group activities. ***This is true for both in-class participation and participation while you are attending the course online.*** I require **iclicker Reef** and have questions throughout the course that are answered through this polling method. **Generally I am looking for thought and participation, not whether or not you answered the question correctly**. **Everyone must have their own iClicker and it must be registered with your student ID number.**

**Approximate grade breakdown**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 93-100% | = | A | 90-93% | = | A- |
| 87-90% | = | B+ | 83-87% | = | B | 80-83% | = | B- |
| 77-80% | = | C+ | 73-77% | = | C | 70-73% | = | C- |
| 67-70% | = | D+ | 63-67% | = | D | 60-63% | = | D- |
| ≤ 59% | = | F | | | | | | |

***A minimum grade of C in this course is required to advance to Genetics. (A grade of $C^-$ (C minus) or lower is not acceptable for advancement to Genetics.)***

**Respect** for one another and for the instructor is essential for an effective classroom environment. You are expected to show respect to your classmates and instructors by:

- listening when others are speaking,
- refraining from discussing non-related issues during class,
- Respecting the opinions of others, even when you disagree.

Behavior intended to embarrass or ridicule others will not be tolerated.

## Tips for reading a textbook:

- Keep the big picture in mind. Before reading, look at chapter organization. Read the subheadings and get a feel for the breadth and arrangement of topics covered.
- Go over the figures and special topics sections very closely. Be sure you can explain the "take-home message" and main ideas of each. These are critical to understanding biology and should not be considered "pages to skip".
- Highlight words, phrases, and statements you know you will want to find again.
- Write comments to yourself that will help you study the material later.
- When you've finished a chapter, sometime before the exam, create a study guide that outlines the contents. This can then serve as a checklist for future studying.
- Your book has online materials that are very useful to help you learn; animations, videos, practice tests and quizzes, etc. Use these online resources.

### PLNU COPYRIGHT POLICY

Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

### PLNU ACADEMIC HONESTY POLICY

Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

### PLNU ACADEMIC ACCOMMODATIONS POLICY

While all students are expected to meet the minimum standards for completion of this course as established by the instructor, students with disabilities may require academic adjustments, modifications or auxiliary aids/services. At Point Loma Nazarene University (PLNU), these students are requested to register with the Disability Resource Center (DRC), located in the Bond Academic Center. (DRC@pointloma.edu or 619-849-2486). The DRC's policies and procedures for assisting such students in the development of an appropriate academic adjustment plan (AP) allows PLNU to comply with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. Section 504 (a) prohibits discrimination against students with special needs and

guarantees all qualified students equal access to and benefits of PLNU programs and activities. After the student files the required documentation, the DRC, in conjunction with the student, will develop an AP to meet that student's specific learning needs. The DRC will thereafter email the student's AP to all faculty who teach courses in which the student is enrolled each semester. The AP must be implemented in all such courses.
If students do not wish to avail themselves of some or all of the elements of their AP in a particular course, it is the responsibility of those students to notify their professor in that course. PLNU highly recommends that DRC students speak with their professors during the first two weeks of each semester about the applicability of their AP in that particular course and/or if they do not desire to take advantage of some or all of the elements of their AP in that course.

## PLNU ATTENDANCE AND PARTICIPATION POLICY⊛

Regular and punctual attendance at all **synchronous** class sessions is considered essential to optimum academic achievement. If the student is absent for more than 10 percent of class sessions (virtual or face-to-face), the faculty member will issue a written warning of de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. In some courses, a portion of the credit hour content will be delivered **asynchronously** and attendance will be determined by submitting the assignments by the posted due dates. See Academic Policies in the Undergraduate Academic Catalog. If absences exceed these limits but are due to university excused health issues, an exception will be granted.

### Asynchronous Attendance/Participation Definition

A day of attendance in asynchronous content is determined as contributing a substantive note, assignment, discussion, or submission by the posted due date. Failure to meet these standards will result in an absence for that day. Instructors will determine how many asynchronous attendance days are required each week.

## SPIRITUAL CARE

Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith.

If students have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Development

## USE OF TECHNOLOGY⊛

In order to be successful in the online environment, you'll need to meet the minimum technology and system requirements; please refer to the *Technology and System Requirements* information. Additionally, students are required to have headphone speakers compatible with their computer available to use. If a student is in need of technological resources please contact student-tech-request@pointloma.edu.

Problems with technology do not relieve you of the responsibility of participating, turning in your assignments, or completing your class work.

## Dorrell Fall Schedule

| Time | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| 7:30 | | At The Lowy Medical Research Institue for research (CAN BE REACHED BY EMAIL OR PHONE (858-249-7108) FOR EMERGENCIES) | | Bio3050: Advanced Cell Biology lab | |
| 8:00 | | | | | |
| 8:30 | | | | | **Office hours** |
| 9:00 | | | | | |
| 9:45 | Chapel 9:45 - 10:30 | | Chapel 9:45 - 10:30 | | Chapel 9:45 - 10:30 |
| 10:00 | | | | | |
| 10:30 | **Office hours** | | **Office hours** | | |
| 11:00 | | | | | |
| 11:30 | | | **Faculty lunch** | | |
| 12:00 | Bio3050 Advanced Cell | | Bio3050 Advanced Cell | | Bio3050 Advanced Cell |
| 12:30 | | | | | |
| 1:00 | | | | | |
| 1:30 | Bio2010 Cell Biology and Biochemistry | | Bio2010 Cell Bio and Biochem | **Bio2010 Lab, section 2** | Bio2010 Cell Bio and Biochem |
| 2:00 | | | | | |
| 2:30 | | | | | |
| 3:00 | Bio2010L Cell Biology and Biochemistry lab (section 1) | | **office hours / faculty meetings (email me to inquire about my availability)** | | **Office hours /committee meetings (email me to inquire about my availability)** |
| 3:30 | | | | | |
| 4:00 | | | | | |
| 4:30 | | | | | |
| 5:00 | | | | | |
| 5:30 | | | | | |
| 6:00 | | | | | |
| 7:00 | | | | | |
| 8:00 | | | | | |
| 9:00 | | | | | |

****Office hours also available by appointment or drop-in ****

## Tentative Class Schedule:

| Week | day | Topic (tentative) | Pre-class video | Assignment due |
|---|---|---|---|---|
| Week 1 (Aug. 17-21) | Mon **(A)** | Syllabus and course introduction | Course introduction video | |
| | Wed **(S)** | Ch. 1; Scientific method; hypotheses vs. predictions. Dependent and independent variables | Scientific methods; the basics | |
| | Fri **(S)** | Ch. 1; Data statistics and scientific testing | Data graphs and statistics / design a Covid-19 vaccine trial | |
| Week 2 (Aug. 24-28) | Mon **(A)** | Ch. 2; Valence and chemical bonding | Scale in biology & the periodic table | Connect; SmartBook Ch. 2 (due before class) |
| | Wed **(S)** | Ch. 2; Electronegativity and polar covalent bonds | Intro to the basics of electronegativity | |
| | Fri **(S)** | Ch. 3; Macromolecules; lipids and carbohydrates | Polymerization of biological macromolecules | |
| Week 3 (Aug. 31 – Sept. 4) | Mon **(A)** | Ch. 3; peptide bonds, amino acids, and proteins | Functions and characteristics of proteins | Connect; SmartBook Ch. 3 (due before class) |
| | Wed **(S)** | Ch. 3; Protein structure | Intro to protein structure | |
| | Fri **(S)** | Ch. 3; Molecular structure<br>Team activity #1.<br>Possible pre-activity quiz on chapter 3 concepts | | Molecular modeling part 1 (assignment on canvas) due before class.<br>Peer teaching #1 (Feature Invest., Pgs 51-53). Peers #1 teaching. Copy of slides / handout due on canvas before class. |
| Week 4 (Sept. 7-11) | Mon **(A)** | Ch. 4; Genomes and proteomes | Cell theory & basic properties of cells | Connect; SmartBook Ch. 4 (due before class) |
| | Wed **(S)** | Ch. 4; Organelles and protein targeting | Major aspects of organelles | Organelle matrix (assignment on canvas) due before class |
| | Fri **(A)** | **Exam #1; Chapters 1 – 4** | | |

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|---|---|---|---|---|
| Week 5 (Sept. 14-18) | Mon **(A)** | Ch. 5; Membrane fluidity, selective permeability, and membrane proteins | General membrane structure and the fluid mosaic model | Connect; SmartBook Ch. 5 (due before class) |
| | Wed **(S)** | Ch. 5; Channels and membrane transport | Osmosis | |
| | Fri **(S)** | Finish Ch. 5 concepts<br>Team activity #2; review of exam 1. | | Molecular modeling #2; aquaporin (assignment in canvas) due before class<br>Peer teaching #2 (Feature Invest., Pgs 107-109). Peers #2 teaching. Copy of slides / handout due on canvas before class. |
| Week 6 (Sept. 21-25) | Mon **(A)** | Ch. 6; Coupled transport, endergonic vs. exergonic reactions. | Laws of thermodynamics and potential vs. kinetic energy | Connect; SmartBook Ch. 6 (due before class) |
| | Wed **(S)** | Ch. 6; Enzymes and cellular energy diagrams | Introduction to enzymes | |
| | Fri **(S)** | Ch. 6; Oxidative phosphorylation | Introduction to cellular respiration | Bioethics 1 discussion (assignment and discussion board on canvas). Due by midnight |
| Week 7 (Sept. 28 – Oct. 2 | Mon **(A)** | Ch. 6; Glycolysis and Tricarboxylic Acid (TCA) Cycle | Oxidation / reduction reactions and energy | Oxidation of glucose matrix (review; not graded) |
| | Wed **(S)** | Ch. 6; Fermentation and Cell respiration activity<br>Team Activity #3; Fermentation and Cell Respiration activity | Electron transport train review video | Bioethics 1 discussion (responses to peers on discussion board due). |
| | Fri **(S)** | Team Activity #3; (cont.)<br>Catch-up & Review for exam #2 | | Peer teaching #3 (Feature Invest., Pgs 143-145). Peers #3 teaching. Copy of slides / handout due on canvas before class. |
| Week 8 (Oct. 5-9) | Mon **(A)** | **Exam #2; Chapters 5 – 6** | | |
| | Wed **(S)** | Ch. 7; Photosynthesis; light reactions (linear and cyclic) | Introduction to photosynthesis | Connect; Ch. 7 (due before class) |
| | Fri **(S)** | Ch. 7; Photosynthesis; Calvin cycle and generating sugars | | |

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| Week 9 (Oct. 12-16) | Mon **(A)** | Ch. 8; threshold and cell signaling concepts | Introduction to cell signaling; leptin | Connect; SmartBook Ch. 8 (due before class) |
| | Wed **(S)** | Ch. 8; Signaling cascades and secondary messengers | 5 modes of cell signaling | |
| | Fri **(S)** | Team Activity #4; Identifying DNA as the genetic material | Griffith's experiments | |
| Week 10 (Oct. 19-23) | Mon **(A)** | Ch. 9; Semi-conservative replication and Meselson and Stahl experiments | The structure of the DNA helix | Connect; SmartBook Ch. 9 (due before class) |
| | Wed **(S)** | Ch. 9; DNA polymerase restrictions and bi-directional synthesis | How to make replication rapid | |
| | Fri **(S)** | Bi-directional synthesis activity | Mutations and proofreading | |
| Week 11 (Oct. 26-30) | Mon **(A)** | **Exam #3; Chapters 8 – 9** | | |
| | Wed **(S)** | Team Activity #5; Introduction to Molecular Biology | | |
| | Fri **(S)** | Ch. 10; Transcription | Overview of central dogma and gene expression stages | |
| Week 12 (Nov. 2-6) | Mon **(A)** | Ch. 10; Transcription and translation | RNA processing | Connect; SmartBook Ch. 10 (due before class) |
| | Wed **(S)** | Ch. 10; Translation | EPA sites in translation | Introduction to Molecular Biology assignment (in-class and additional homework) due prior to class |
| | Fri **(S)** | Ch. 10; Catch-up and discuss mutations | Mutations and effects on phenotype | Peer teaching #4 (Feature Invest., Pgs 218-220). Peers #4 teaching. Copy of slides / handout due on canvas before class. |
| Week 13 (Nov. 9-13) | Mon **(A)** | Ch. 14; Chromosomes and sister chromatids | Karyotyping | Connect; SmartBook Ch. 14 (due before class) |
| | Wed **(S)** | Ch. 14; Cell, cycle, cancer, and mitosis | Overview of cell cycle and CDKs | |
| | Fri **(S)** | Ch. 14; Meiosis | Overview of meiosis | Creating a need for meiosis (due before class) |

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|---|---|---|---|---|
| Week 14 (Nov. 16-20) | Mon **(A)** | Introduction to Mendelian Genetics and Punnett squares | | Connect; Smartbook Ch. 15 (due before class) |
| | Wed **(S)** | Relating genetic inheritance to events in meiosis | | |
| | Fri **(S)** | Non-Mendelian inheritance | | Bioethics discussion #2; initial posts due Friday night |
| Week 15 Nov. 23 | Mon **(A)** | Catch-up and Review for the final exam<br>- Bioethics discussion board responses to peers due | | |
| Final Exam (Bio2010 section 1) | | | Monday, November 30th; 1:30 – 4:00 | |

**FINAL EXAMINATION POLICY**

Successful completion of this class requires taking the final examination **on its scheduled day**. The final examination schedule is posted on the Class Schedules site.