

BILD1 GENERAL COURSE INFORMATION

BILD1: THE COMPONENTS OF LIFE, THE CELL AND GENETICS

UNIVERSITY OF CALIFORNIA, SAN DIEGO

SUMMER 2017



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Instructor: Dr. Raquel Espin Palazon

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Lectures: CENTER HALL 105, M-Th 9:30p-10:50am. No podcasts.

Office hours: Thursdays 11:30am-12:30pm. Natural Sciences Building (NSB), room 6326.

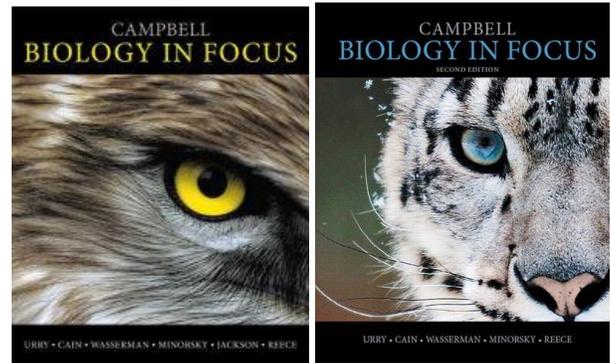
Course Description: BILD1 is an introductory course on the molecular and cellular biology of microbes, plants and animals for Biology majors. The course focuses on structures and mechanisms of action required for the smallest unit of life – the cell.

Course Reading

Campbell, Biology in Focus. First or second edition.

Urry, Cain, Wasserman, Minorsky, Jackson, Reece.

Chapters 1-17.



Instructional assistants

Deng, Kaiyue; Teaching Assistant.

Office hours: Mondays 1-2pm, Hi Thai Lounge.

Contact information: kadeng@ucsd.edu

Deng, Yalin; Tutor.

Office hours: Tuesdays 6-7pm and Thursdays 8:30-9:30am, Biomedical library room 106.

Contact information: y3deng@ucsd.edu

Discussion sessions

- A01 Tuesdays, 11:00am-12:50pm, CENTR 217A
- A02 Wednesdays, 11:00am-12:50pm, CENTR 218
- A03 Wednesdays 03:00pm-04:50pm, CENTR 218

Midterm Exam

Monday, August 21st, 9:30am - 10:50pm. Center Hall105

Final Exam

Friday, September 8th, 8:00am-11:00am. (*Place to be determined*)

Power point policy

I will use power point slides during lectures that I will share with the students. These slides will be available on the course website in Ted.

Learning Outcomes (general)

- 1) This basic cell & molecular biology course will teach you the concepts and prepare you for your future biology courses (and for life).
- 2) Learn how the key biological molecules look like and how all reaction can be stripped down to their molecular level. Learn how cells look like and how to describe their main functions and connect them to life's every day phenomena. Learn how the information in genes is transcribed and translated into functional proteins and how this information is inherited from one individual to another.
- 3) Learn the scientific way of thinking and other useful skills. Learn how to estimate outcomes from basic molecular reactions and how to reason like a scientist. Learn how to interpret a representation encountered in biology textbooks and how to develop competence using scientific reasoning and data.

Learning Outcomes (specific)

At the end of this course, you will be able to ...

Chapter 1. Introduction.

- Recognize the characteristics that define the cell, the smallest unit of life.
- Identify the three domains of life.

Chapter 2. The chemical context of life.

- Atoms and elements:
 - ✓ List the main elements that conform life and their relative abundance.
 - ✓ Recognize the subatomic particles that conform the atom.
 - ✓ Identify the atomic and mass numbers of an element and calculate the number of protons and neutrons that conform it.
 - ✓ Understand the distribution of the elements in the periodic table of the elements.
 - ✓ Recognize the different energy levels of an atom's electrons.
 - ✓ Based on the number of electrons in a specific atom, predict the reactivity of the atom.
- Chemical bonds:
 - ✓ Name the types of chemical bonds.
 - ✓ Predict the type of chemical bond that 2 given atoms will likely form.
 - ✓ Order in a strength manner the types of chemical bonds.
 - ✓ Identify if a specific pH value is acidic, neutral, or basic.

Chapter 3. Carbon and the molecular diversity of life.

- Define polymer and monomer.
- Explain how polymers are built/disassembled and predict how many molecules of water are required/released.
- Name the four types of biomolecules and the monomers that conform them.
- Carbohydrates.
 - ✓ Recognize the structural unit (monomer) of carbohydrates and the chemical groups that

- conform them.
- ✓ Draw the glycosidic linkage.
- ✓ Describe the main functions of polysaccharides and cite examples of each.
- ✓ Understand the differences among polysaccharides.
- ✓ Justify why animals are not able to digest cellulose.
- Lipids.
 - ✓ Cite the different types of lipids.
 - ✓ Describe the components of fats and phospholipids.
 - ✓ Recognize if a fatty acid is saturated or unsaturated and predict if it will be solid or liquid at room temperature.
 - ✓ Understand the hydrogenation process and why it is not beneficial for human health.
 - ✓ Recognize the basic structure of steroids.
 - ✓ Cite the main type of steroid found in animals and describe its function.
 - ✓ Understand what are the functions of lipids in the cell.
- Proteins.
 - ✓ Recognize the structural unit (monomer) of proteins and the chemical groups that conform them.
 - ✓ Predict if an amino acid is hydrophobic, hydrophilic, basic or acidic.
 - ✓ Understand the unique properties of the amino acids glycine, proline and cysteine.
 - ✓ Draw how peptide bonds are formed.
 - ✓ Identify each type of protein structure and the bond types that form them.
 - ✓ Define chaperonin.
 - ✓ Understand why each protein has its own three-dimensional structure and why this is key for their function.
 - ✓ Identify the chemical and physical conditions that can denaturalize a protein.
 - ✓ Understand the functions of proteins.
- Nucleic acids.
 - ✓ Name the two types of nucleic acids.
 - ✓ Recognize the structural unit (monomer) of nucleic acids.
 - ✓ Describe the differences between DNA and RNA.
 - ✓ Draw how polynucleotides are formed.
 - ✓ Understand the differences between pyrimidines and purines.
 - ✓ Understand the concepts of complementary pairing and directionality of nucleic acids.
 - ✓ Explain and draw how the genetic information ultimately translates to proteins.
 - ✓ Predict the sequence and directionality of a complementary nucleic acid strand.

Chapter 4. The Cell.

- Identify the unit of life, and define its properties.
- Numerate the differences between eukaryotes and prokaryotes.
- Identify the differences between animal and plant cells.
- Microscopy.
 - ✓ Understand the concept of magnification, resolution and contrast.
 - ✓ Identify the different types of microscopes based on the light source.
 - ✓ Explain the differences between fluorescence and confocal microscopy.
 - ✓ Identify which types of microscopes can be utilized for live or fixed samples.
 - ✓ Identify the type of microscope used to take a specific picture.

- Eukaryote cells: organelles.
 - ✓ Understand the function of the nucleus and nucleoli.
 - ✓ Explain why the nucleus is limited by an envelope consistent in two membranes.
 - ✓ Define chromosome and chromatin.
 - ✓ Explain the function of the ribosomes and name their components.
 - ✓ Explain the function of the endoplasmic reticulum.
 - ✓ Deduce if a given picture is showing RER or REL and explain their differences.
 - ✓ Explain the functions of the golgi apparatus.
 - ✓ Identify the cis and trans regions of the golgi apparatus.
 - ✓ Explain the functions of the lysosomes.
 - ✓ Understand the differences between phagosomes, autophagosomes and endosomes.
 - ✓ Explain the function of the peroxysome.
 - ✓ Explain the function of the central vacuole.
 - ✓ Name the components of the endomembrane system.
 - ✓ Describe the pathway in the cell that a particular protein must follow from its synthesis.
 - ✓ Explain the function of the mitochondria and draw its structure.
 - ✓ Explain the function of the chloroplast and draw its structure.
 - ✓ In a particular cell, identify where nucleic acids can be found.
 - ✓ Explain the endosymbiont theory.
- Eukaryote cells: cytoskeleton.
 - ✓ Understand the function of the cytoskeleton, types of structures that form the cytoskeleton and examples of each type.

Chapter 5: Membrane transport and cell signaling

- Identify the main components of the plasma membrane.
- Understand that phospholipids can move within the plasma membrane and describe the types of movement.
- Understand the role of phosphatidylserine as a component of the plasma membrane and its applications in research.
- Based on the amphipathic, hydrophobic, or hydrophilic nature of a given protein, predict its location within the bilayer of the plasma membrane.
- Describe the experiments to analyze if proteins within the plasma membrane move.
- Understand the functions of the proteins of the plasma membrane.
- Given several membranes, order them based on their fluidity.
- Understand the concepts of passive transport (diffusion) and osmosis.
- Predict the result of an animal/plant cell released in a hypotonic, hypertonic or isosmotic solution.
- Distinguish the concepts of diffusion and facilitated diffusion.
- Describe passive transport and active transport.
- Define co-transport.
- Understand the processes of endocytosis and exocytosis.
- Distinguish pinocytosis, phagocytosis and receptor-mediated endocytosis.
- Cite examples of the three types of communication between cells within a multicellular organism: direct contact, local signaling and long-distance signaling.
- Describe the three stages of cell signaling.
- Understand why mutations in the protein Ras can lead to cancer.

]Chapter 6: Metabolism

- Define metabolism.
- Understand what is a metabolic pathway and define its types (catabolic and anabolic).
- Understand the laws of thermodynamic.
- Define free-energy change.
- Predict if a reaction will be spontaneous (exergonic) or non-spontaneous (endergonic) knowing its free-energy change.
- Understand the concept of energy coupling.
- Understand why ATP is the cell's energy shuttle.
- Draw the hydrolysis of ATP.
- Understand how ATP hydrolysis couples with biological reactions in the cell.
- Define enzyme and understand how they work to allow metabolic reactions.
- Define active site, cofactor and coenzyme.
- Differentiate between competitive and noncompetitive inhibitors.
- Explain allosteric activation and inhibition, cooperativity and feedback inhibition.

Chapter 7: Cellular respiration and fermentation.

- Understand the concepts of autotrophs and heterotrophs and define their types.
- Learn the differences and similarities of aerobic respiration, anaerobic respiration and fermentation.
- Explain redox-reactions.
- Know the steps of cellular respiration and the subcellular location where take place.
- There is no need to memorize all the specific enzymes in each pathway but remember what goes into which pathway and what are the resulting products.
- Explain the electron transport chain.
- Understand how proton gradient is formed and maintained and how it is linked to ATP production.
- Know which components of fats and amino acids are added into the cellular respiration pathway and where in the cycle.

Chapter 8: Photosynthesis.

- What goes into photosynthesis and what comes out?
- Explain how energy from sunlight is turned into energy in 3-carbon sugar.
- Name the different parts of photosynthesis.
- What are photosystems and where are they located in plant cells?
- What are the products of light reactions and Calvin cycle?
- How is the proton gradient established?
- Explain the difference between cyclic and linear electron flow.
- Describe the connection between cellular respiration and photosynthesis.

Chapter 9: The cell cycle.

- Understand the concepts of chromatin, chromatids, chromosome, centromeres, centrosomes, genome and genes.
- Explain cytokinesis and mitosis.

- Explain the differences between animal and plant cells during cytokinesis.
- Describe how the genetic material is organized into the nucleus, and recognize which level of organization is present during mitosis.
- Distinguish haploid and diploid cells.
- Describe the phases of interphase.
- Recognize the phases of mitosis and explain the cellular events that characterize each one.
- Predict the DNA content of a cell in each cell cycle phase.
- Explain the external and internal factors that control the cell cycle.
- Identify the checkpoints during the cell cycle.

Chapter 10: Meiosis and sexual life cycles

- Compare and contrast the advantages and disadvantages of asexual and sexual reproduction.
- Identify the number of chromosomes and chromatids at each stage of the human life cycle.
- Draw the stages of meiosis, and compare these stages to mitosis, including how chromosomes line up in metaphase, and how the chromosomes look like at each stage of these processes.
- Predict if a cell is haploid or diploid based upon the stage of meiosis or mitosis, and be able to calculate the relative amount of DNA in the cell in these stages.
- Explain the mechanisms that contribute to genetic variation.

Chapter 11: Mendel and the gene idea

- Understand the basic concepts of genetics, including character, trait, homozygous, heterozygous, allele, gene.
- Explain phenotype and genotype.
- Differentiate dominant from recessive traits
- Predict the phenotypes and genotypes of the offspring of a specified parental phenotype/genotype.
- Predict the probability that the offspring will inherit a particular trait.
- Know the symbols used in human pedigrees.

Chapter 12: The chromosomal basis of inheritance.

- Explain the exceptions to Mendelian genetics, including incomplete dominance, codominance, multiple alleles, pleiotropy, epistasis and polygenic inheritance.
- Given a particular pedigree, identify:
 - ✓ If the trait is a sex-linked disorder.
 - ✓ If the trait is dominant or recessive.
 - ✓ If it is mitochondrial inheritance.
- Explain the alterations in number and structure that chromosomes can suffer.
- Deduce if a particular karyotype is polyploidy (triploid, tetraploid).
- Explain the consequences of a non-disjunction process and identify the meiosis phases in which this can happen.
- Understand how the environment can affect the phenotype.
- Explain how sex-linked traits are inherited.
- Given a particular pedigree identify if the trait is a sex-linked disorder.
- Explain Barr body.
- Explain the chromosomal basis of sex and cite examples.

- Draw a linkage map based on recombination frequencies.

Chapter 13: The molecular basis of inheritance.

- Understand how DNA was defined as the genetic material.
- Describe the structure of DNA and name all the parts.
- Define what antiparallel and complementary mean.
- Explain the meaning of semiconservative replication.
- Name the proteins that function in the replication forks and know their functions.
- Explain how the leading and lagging strands replicate.

Chapter 14: Gene expression, from gene to protein.

- Describe the differences between prokaryotic and eukaryotic transcription and translation.
- Learn how to read leading DNA strand and mRNA nucleotide sequences
- Define codon and anticodon.
- Explain promoter and transcription factors and how transcription is initiated.
- Explain how RNA can be modified before translation.
- Interpret the genetic code table.
- Describe the parts of a ribosome and its function.
- Identify the different types of point mutations.
- Explain how point mutations in DNA can lead to a disease (nonfunctional protein).

Chapters 15-16: Regulation of gene expression. Development, stem cells and cancer.

- Understand the concept of operon and its elements.
- Explain the differences between repressive and inducible operons.
- Predict if a particular operon is repressive or inducible.
- Explain the difference between euchromatin and heterochromatin
- Cite the chemical modification that histones and DNA can suffer and the result in the gene expression.
- Name two major forms of transcriptional regulation and explain how they function
- Describe the roles of transcription factors.
- Explain epigenetics.
- Explain what are the Yamanaka factors and their application in medical research.
- Explain the genetic changes that can lead to cancer.

Invited lecturer

Clyde A. Campbell, PhD student, will explain how new research is allowing *in vivo* reprogramming to ultimately cure diabetes and how the Waddington model can be manipulated.

Quizzes

There will be weekly quizzes taken and completed during discussion sessions, once per week, except for the first week of class. These quizzes will cover key questions about the material explained the previous week to the discussion session. The quizzes will not be graded. The goal of the quizzes is to encourage good study practices to help keep-up with the large amount of reading material covering a vast range of topics.

Course Requirements & Grading Exams:

Exams: 80% (20% midterm and 60% final exam).

Quizzes and discussion sessions attendance: 10%. 2.5% per discussion session.

Note: The quizzes will be done during discussion sessions. To earn the quiz/discussion session points, you will have to attend to the Discuss Section once a week (4 discussion sessions in total).

i-Clickers:

You are required to bring the clicker to each lecture and you are responsible to ensure that the clicker is working properly.

- **Attendance to lectures: up to 10%**

Only participation points. I will discard 10% of your answers. This means if a student clicks 90% of the time, the student receives full participation points. There are no make-up assessments for missed days or for misplaced, malfunctioning, or forgotten i-clickers but by discarding 10% of the clicks there is built in protection for all such occurrences.

- **Pre-class homework: extra credit up to 5%**

I will be using the “inverted” or “flipped” approach: Before each class, you will do something to learn the basics about that day’s topic. It might be reading an article, watching a video, etc. Then you will arrive in class with that knowledge fresh and activated in your mind so we can jump immediately into the interesting parts of the material. Normally, I will post this “pre-class homework” on our course website or send you email the day before the class. Once in the class, I will assess your understanding of the pre-class homework by i-clicker questions. These questions will be graded and points will only be obtained with correct answers.

An iClicker is required for this class and can be purchased at the UCSD bookstore along with your course text and can be sold back to the bookstore at the end of the quarter. On clickers and campus resources to help you with these, see: <http://acms.ucsd.edu/>

I use clickers to develop more meaningful engagement in lecture and to promote more inclusive learning. I will ask questions and solicit your responses several times each lecture and I will discuss the results with you in class. I will use iClickers to ask questions about 1) yesterday’s topics 2) the readings due for each day’s lecture and 3) questions about the topics covered in the ongoing lecture. I aim to use peer instruction in combination with the clicker questions. By explaining the reasoning behind your answer to a fellow student(s) you will stimulate your learning process. These daily questions will

be worth 10% extra credit of your final grade. I will give only participation points.

Clicker use begins in week 1, but no participation points will be given until lesson 3 (August 9th) which provides time for you to get your clicker, register it on <https://ted.ucsd.edu/> (click on Espin Palazon [S217] and then choose iClicker Registration and type in your remote ID and hit Submit), and become accustomed to using it during the first weeks of class. It is entirely your responsibility to ensure that it is working properly, that it is registered, and is with you during lecture. With any problems related to iClickers, please send an email to Treb Padula (tpadula@ucsd.edu) to schedule an appointment.

The same academic integrity standards apply to clicker assessments as to written assessments and you may not use any clicker other than your own. Violation of academic integrity standards, whether on a writing assignment, exam, or clicker assessment, will result in academic and non-academic consequences (See Standards of Academic Integrity).

To pass the course, you must satisfy all course requirements. The class will not be graded on a curve. The course grade is assigned from the total points at the end of the quarter. No grades will be assigned to the individual Quizzes, Midterm or Final Exam. Disputed exam scores will only be reconsidered if original work was done in pen (see Exams and Re-grading Policy below).

Office for Student Disabilities

Students requesting accommodations and services for this course due to a disability need to provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD) prior to eligibility for requests. Receipt of AFAs in advance is necessary for appropriate planning for the provision of reasonable accommodations. OSD Academic Liaisons also need to receive current AFA letters if there are any changes to accommodations. For additional information, contact the Office for Students with Disabilities: 858-534-4382 (V); 959.534.9709 (TTY) – reserved for people who are deaf or hard of hearing; or email: osd@ucsd.edu. OSD Website: <http://disabilities.ucsd.edu>

Standards of Academic Integrity

Each student is responsible to know and observe the UCSD rules concerning academic integrity and plagiarism. You should familiarize yourself with your responsibilities and rights under the UCSD Policy on Integrity of Scholarship: <http://senate.ucsd.edu/manual/appendices/appendix2.pdf>. Your responsibilities and rights under the UCSD Student Code of Conduct can be found at <http://students.ucsd.edu/student-life/organizations/student-conduct/index.html> Any student found to have violated the university's academic integrity standards will be subject to penalties ranging from failing the assignment or course to suspension or expulsion from the university. If you need clarification about the topic of plagiarism and strategies to avoid it, about proper citation and evaluating sources for credibility, or about any other pertinent issue, consult your instructor or Instructional Assistants. Ignorance of these standards will not be accepted as justification for their violation, so make sure to understand and abide by them.

Consideration for the Learning Environment

The "Golden Rule" is a useful guide here. Avoid any action that potentially disturbs the learning environment, such as talking in lecture, using your laptop for purposes other than note-taking which may distract your neighbors, and so forth. Attend lecture only if you are willing and able to pay attention and to respect the learning environment. In case of doubt, simply consider if an action contributes to

the purpose and benefit of the class as a whole. If it does not, avoid it. Here, civility counts. If this is too difficult, please stay home or get notes from a friend. Turn off cell phones to prevent disrupting the class. Exceptions will be made to cover emergency medical providers, active duty military personnel, child-care needs, or other critical issues. If you need clarification on "critical," please speak with me.

Contact and Correspondence

I am dedicated to undergraduate education. I am excited to speak with students in class, during office hours, or anywhere else where we may run into one another (though you may likely need to introduce yourself since there are so many of you).

If you wish to contact me by email, please do so, but note that this medium is best used for scheduling appointments or for other brief communication. Email is less ideal for substantive questions about course material. For the latter, visit office hours or schedule an appointment so that we can properly address the matter. I will try to answer all appropriate correspondence within three (3) business days (barring emergencies). For all correspondence by email, adhere to a standard courteous format such as the following:

Dear Dr. [Last Name]

Subject line should always say BILD1 (other emails will be discarded).

[Your Message, such as: "I would like to schedule an appointment to discuss meiosis. Do you have time this week on Monday or Tuesday?"]

Sincerely,

Your Name and Your Class BILD1/Your Section/ Instructional Assistants

PowerPoint Policy

I supplement lecture with PowerPoint slides, which I will post on <https://ted.ucsd.edu/> [click on 'BILD1 Espin Palazon [S217]']. They are only supplements to assist; they are not the substance of lecture. The PowerPoint slides will contain many questions, for which you will receive answers only by attending the lectures.

Course information will not be handed out in class.

Exams

Midterm Exam: To be determined.

Final Exam: To be determined.

Exams are closed book, no notes. Material covered in chapters 2-8 will be tested on the Midterm Exam. Material covered in the entire course will be tested on the Final Exam. Exams must be written in pen or will not be accepted for grading. Exams written in pen but having writing masked by any form of correction tape will not be accepted for re-grade. It is each student's responsibility to ensure that s/he

is available and able to complete the coursework and attend all exams. Alternate exams will not be given for reasons of travel convenience, family events, poor planning, or for other related reasons.

Additionally, no student shall

- 1) knowingly procure, provide, or accept any unauthorized material that contains questions or answers to any exam or assignment to be given at a subsequent time
- 2) complete, in part or in total, any examination or assignment for another person.
- 3) knowingly allow any examination or assignment to be completed, in part or in total, for himself or herself by another person.

Re-Grading Policy (see also Exams)

Since BILD1 Instructional Assistants are experienced and dedicated instructors, grade disputes are infrequent. Should such arise, here is the protocol to follow:

1. Take time. Carefully and thoroughly read all comments on the exam/assignment and reflect on these comments. The explanation there often resolves the problem. If it does not, then proceed to step 2.
2. Make an appointment with your Instructional Assistant to discuss your work, your IA's expectations, and why your work received the grade that it did. In general, I encourage you to keep your focus on learning and on improvement more than on any particular grade. These discussions typically resolve most problems. If it does not, proceed to step 3.
3. Make an appointment to discuss the situation with me. After our discussion, you must submit to me in writing a petition for a grade review with the following information: 1. A complete account, as you understand it, of the IA's explanation of why you received this grade and 2. Your evidence-based argument specifically addressing where and how there is any discrepancy.

Note: unhappiness with a grade is not evidence of error.

4. I will review your petition and meet with your Instructional Assistant to determine whether there is any reasonable justification to advance. If it merits reconsideration, I will regrade

your entire test/assignment, with the possible results being that your grade could be raised or lowered, if there truly was an error anywhere in the assessment, or remain the same, if, in fact, there was none.

Again, most such disputes are quickly resolved with steps 1 and 2 and rarely move beyond.

Administrative Questions

See Biology Student Affairs Undergraduate Office, Pacific Hall, Room 1128 for registration related questions. For questions about enrollment and prerequisites, please contact Biology Undergraduate Student and Instructional Services via email (biouis@ucsd.edu) or phone 858-534-0557. More info: <http://biology.ucsd.edu/education/undergrad/>