

Biology 2020: *Principles of Cell Biology* explores the relationship between cell structure and function and the experimental foundation underlying the science of cell biology, using examples from both prokaryotes and eukaryotes. Students successfully completing *Biology 2020 Principles of Cell Biology* will understand:

- Theories and evidence for important milestones in the evolution of cells;
- The structure, function, and assembly of important cellular macromolecules, including proteins, lipids and membranes, mono-, di-, and polysaccharides, and nucleic acids;
- How cells harvest, store, and use chemical energy, and the enzymes and organelles used in these processes;
- The storage, flow, and regulation of genetic information in cells, in the contexts of cell function and inheritance;
- The processes of exocytosis, endocytosis, and phagocytosis in eukaryotes, and the signals and mechanisms for targeting proteins and vesicles to the correct intracellular targets;
- The structure and function of the cytoskeleton in eukaryotes and prokaryotes;
- The regulation and mechanisms of cell proliferation and cell division in eukaryotes and prokaryotes;
- The processes and mechanisms related to the organization and function of cells in multicellular communities and organisms, including: (1) cell communication, signal transduction, and signaling cascades; (2) cell adhesion and cell junctions, and (3) cell and tissue renewal, stem cells, and cancer.

Lectures: Tu/Th from 10:45 AM -12:05 PM in ASB 220 (a ~3-5' break be provided mid-class most days).

Biology 2020 is a 3 hour class. The University defines one credit hour as "...approximately three clock hours of the student's time a week for one semester." A typical 2020 student should expect to spend approximately nine hours per week on this course, including in-class time and time spent outside of class.

Enforced prerequisites: BIOL 1210 and CHEM 1210. Permission codes should be requested through <http://www.biology.utah.edu/undergraduate/requests/requests.php>

Instructor: David L. Gard **Office:** 101 Building 44 **Phone:** 801-581-7365 **E-mail:** gard@biology.utah.edu

Office hours: I am available to meet with students most Tues & Thurs from 1-2:00 PM. I also conduct a discussion section Wednesday 10:45 - 12:05 in 2002 HEB.

Open office policy: I am in my office most weekdays (please remember that I will be prepping for lecture on Tues and Thurs mornings!). If my office door is open, I am happy to meet with students... feel free to drop-in.

Teaching Assistants: I will be assisted by 10 undergraduate and graduate Teaching Assistants (TAs). TAs lead weekly discussion sessions (schedule and locations below) and conduct tutoring sessions in the Biology Learning Center (103 BIOL; see schedule below). For additional help, please contact one of your TAs.

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|-------------------|--------------|----------------------------|
| Peter Ahorukomeye | 801-708-1800 | peterahorukomeye@gmail.com |
| Allison Astill | 801-540-2337 | allison.astill@gmail.com |
| Sam Eitenbichler | 970-449-2334 | u1000298@utah.edu |
| Anderson Fackler | 801-259-6843 | andersonfackler@gmail.com |
| Shilpa Gupta | 801-703-7546 | u0878193@utah.edu |
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| Zoe Praggastis | 303-359-7479 | zoe.praggastis@utah.edu |
| Emily Tippetts | 208-901-9578 | emily.tippetts@utah.edu |

Problem solving/discussion sessions: Weekly “Discussion sessions” will be conducted by the TAs (see schedule below). Attendance at these sessions is optional, but **HIGHLY RECOMMENDED!**

| Time/date | Monday | Tuesday | Wednesday | Thursday |
|-------------|------------------------------------|--|--|---------------------------------------|
| 8:35-9:25 | | | Tutoring BIOL 103 Allison | Tutoring BIOL 103 Makenzie |
| 9:40-10:30 | Discussion LS 111 Makenzie | Tutoring BIOL 103 Peter | Tutoring BIOL 103 Zoe | Discussion JTB 130 Peter |
| 10:45-11:35 | Discussion HEB 2002 Emily | Lecture 10:45A - 12:05P ASB 220 | Discussion 10:45-12:05P HEB 2002 Gard | Lecture 10:45A - 12:05P ASB 220 |
| 11:50-12:40 | Discussion HEB 2002 Allison | | | |
| 12:55-1:45 | Discussion HEB 2002 Shilpa | Tutoring BIOL 103 Anderson | Discussion HEB 2010 Zoe | Discussion AEB 310 Zoe |
| 2:00-2:50 | Discussion HEB 2002 Shilpa | Tutoring BIOL 103 Michael | Discussion HEB 2010 Sam | Discussion LS 111 Michael |
| 3:05-3:55 | Discussion Anderson HEB 2002 | Exam reviews 19 Sept, 24 Oct, & 14 Nov 3:30 - 5:00 ASB 220 Gard | Tutoring BIOL 103 Sam | Tutoring BIOL 103 Shilpa |
| 4:10-5:00 | Discussion HEB 2002 Alya | | | |
| 5:00-6:00 | Tutoring 103 BIOL Emily | Tutoring BIOL 103 Alya | | |

TA Tutoring: One-on-one/small group tutoring will be held in 103 BIOL or the 1st floor foyer of BIOL (see schedule above). Additional one-on-one tutoring for BIOL 2020 is available through the Biology Learning Center.

Note: Discussion sections and TA tutoring sessions begin Monday 28 August.

Required text and assigned reading: *Alberts et al., Essential Cell Biology, 4th edition; (ECB4; Garland Publishing). I do NOT recommend using earlier editions of ECB! Reading from this text will be assigned for each lecture. Copies will be on general reserve at Marriot library (2 hr and 24 hr reserve).*

Course website and lecture notes: PDF and PPT files containing key slides from the lecture can be downloaded from the course website: www.courses.biology.utah.edu/gard/cell/. A username and password allowing access to web materials will be provided the first week of class. This website will NOT show in your CANVAS classes!

Study questions: Questions are included in the page margins and at the end of each chapter of ECB4. A subset of those questions are assigned for each lecture. Students are encouraged to work those problems. To help you focus your studying, additional “study questions” pertaining to lecture are available on the course website. Many of these problems are taken or adapted from old exams, and students are encouraged to solve/answer them. Answers are provided on the course website. **Note:** These study questions (ECB4 and web) may introduce new

material or consolidate/synthesize concepts from lecture. You are responsible for all material/topics covered in these problem sets.

Old exams: Finally, exams (with solutions) from my 2020 class from Spring 2017 are available (as PDF files) from the course website (scroll down from the “problem sets”). These old exams provide good examples of the sorts of questions that might appear on exams. Students are encouraged to work the problems in the old exams in preparation for their exams. **Note:** the order of presentation and scheduling of exams vary slightly from year to year, so material may be covered on different exams in different years.

Electronics: Laptops and tablets may be used in class for following lecture powerpoints or note taking. Non-programmable calculators may be used in exams when appropriate. Use of cell phones in class will not be tolerated. Please turn off all cell phones prior to entering the classroom or exam.

Exams, Quizzes, and Grading

Exams: There will be four in-class exams (three mid-terms and a final exam). All exams are closed book/notes. A non-programmable calculator can be used (no PDAs, tablets, cell phones, etc). All exams will be counted towards your final grade. Review sessions will be scheduled before each exam.

Exams #1-3 are scheduled during regular class periods on **Thursdays 21 Sept, 26 Oct, and 16 Nov**. Exams #1-3 will each include 100 total points. Exams 1-3 are comprehensive only in that material presented later in the semester builds on material presented earlier.

Exam #4 (the “FINAL”) is scheduled for **Monday 11 Dec from 10:30AM - 12:30 PM** (note the time! Final exam times are scheduled by the University, and the time and date CANNOT be changed). Exam #4 will be worth 125 points, and will include up to 25 points of material drawing together concepts covered throughout the semester.

Please note: I try to write exams that can be completed within the allotted class time. However, students are sometimes provided with additional time (at the beginning and/or end of the period) to complete the exam. Please plan your schedule accordingly.

Rescheduled, make-up, or missed exams: Requests to reschedule an exam will only be granted for medical, legal, or religious reasons (requiring a written note from a medical doctor, officer of the law/court, or clergy), or for official University business (as per chapter VII section 15 of the University's Policies and Procedures). You must notify Dr. Gard in writing (or e-mail) BEFORE the exam that will be missed. Rescheduled/make-up exams must be completed within one week of the original exam date. Rescheduled or make-up exams may be given orally, at my discretion. **If you know that you will miss an exam for any other reason, I recommend taking BIOL 2020 in a different semester.**

Re-scoring exams: If a student believes their exam score to be in error, they may submit their exam for re-scoring, subject to the following conditions:

- Exams written in pencil are NOT eligible for re-scoring.
- Re-scores MUST be requested in writing prior to the date announced in class (typically one week after exams are returned). Correction of addition errors must be requested prior to the deadline for final exam re-score requests.
- Do NOT write ANYTHING on your exam! Exams will not be re-scored if they have been altered in any way (a random subset of exams will be photocopied before they are returned to students).
- Include a brief explanation on a separate piece of paper (stapled to your exam) of why your answer should have been awarded more points (“my answer deserves more points” is not sufficient justification).
- Exams will then be re-scored in their entirety. Re-scoring is final, and your new score (higher or lower) will be used at the end of the semester in determining your grade.

Quizzes: In addition to the exams, seven “pop” quizzes will be administered in lectures throughout the semester. Each quiz will consist of a single question with a short answer (True/False, multiple choice, or 1-2 word answers). Each quiz will be worth 2 pts for a correct answer, 1 pt for an incorrect answer, 0 pts for no answer/no quiz. Students should bring a 3" x 5" file card to EVERY lecture for taking quizzes. The dates and times of quizzes will

NOT be announced in advance, and there will be NO MAKE-UPS for missed quizzes. A maximum of 10 quiz points will be counted towards the final grade. Quizzes will NOT be returned to students.

Grading: *The scores of all four in-class exams (max 425 points) and quizzes (max 10 points) will be added to yield a "point total" for each student (max 435 pts). Grades will be assigned according to a "curve" generated from the point totals of all students with four exam scores (students with fewer than four exams will not be included during generation of the curve, but their grades will be based on the curve). The break point between a C+ and B- will be set at or near the median (half above/half below) of the class point totals. I reserve the right to adjust the curve based on my evaluation of the classes overall performance. Based on past years, I expect ~18-20% of the students will receive As (A and A-), ~30% Bs (B+, B, and B-), ~30% (or more) Cs (C+, C, and C-), and ~10% Ds (this does NOT include students with fewer than four exam scores*). I do not assign grades of D+ and D-.*

Miscellaneous Policies

Content accommodations: *The content of this course fulfills legitimate pedagogical goals. Students are responsible for ALL material presented in the lectures, problem sets, and assigned reading. I do NOT grant content accommodations. Attendance accommodations are made according to University policies and procedures (chapter VII section 15; see above): "Students absent from class to participate in officially sanctioned University activities (e.g., band, debate, student government, intercollegiate athletics) or religious obligations, or with instructor's approval, shall be permitted to make up both assignments and examinations..." See my policies regarding rescheduling exams (above).*

Drops and Withdrawals: *The drop policy of this class is consistent with that of the University: the last day to drop (delete) classes is Friday 1 Sept. Classes dropped before this date will not appear on transcripts. The last day to withdraw from classes is Friday 20 Oct. After 20 Oct, withdrawal requires approval of the cognizant Dean, which is only granted for compelling non-academic reasons.*

Incompletes: *University policy allows assignment of a grade of incomplete (I) if 80% of the class has been completed (20% or less of the course work remains unfinished). An "I" grade cannot be used to avoid paying tuition to retake a class! I will consider assigning an "incomplete (I)" only under EXCEPTIONAL circumstances unrelated to academic performance, and only if a student is passing the course with a C- or better when the "Incomplete" is requested.*

Cr/NC option: *Registering under the Cr/NC option does not require instructor approval. However, University policies may require specific levels of achievement for this grade to be administratively assigned (CR requires a grade of C-).*

Audits: *I will not approve requests to audit (V) this course.*

A.D.A. : *The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the instructor and to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD) to make arrangements for these accommodations. All written information in this course can be made available in alternative format with prior notification.*

Wellness: *Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness: www.wellness.utah.edu or call 801-581-7776.*

Letters of Recommendation: *BIOL 2020 is a HUGE class. It is very difficult for me to get to know individual students, making it very difficult and unsatisfying to write letters of recommendation for even the best of students when all I can say is "They took my class and got an A." I will not write those letters! If you expect to ask me to write a letter for you, you will need to go out of your way to make yourself known to me... Just introducing yourself at the beginning of the term is a start, but is NOT sufficient! A good way is to frequent one of the discussion sections I lead each week.*

The following schedule of lectures, discussions, and assigned reading is tentative. Major changes/additions will be announced in class and/or posted on the course website.

| Date | Lecture topic and assigned reading: |
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| 22 Aug | 1: Course organization. What are cells? The "Cell theory" of life. The diversity of cell form and function. <i>ECB4</i> Ch 1:1-36. |
| 24 Aug | 2: How we see cells: Microscopes. Cell evolution. <i>ECB4</i> Ch 7:253-257. |
| 29 Aug | 3: The chemistry of cells. <i>ECB4</i> Ch 2:39-69; incl panels 2-1 (pp66-67) & 2-2 (pp68-69). |
| 31 Aug | 4: Amino acids & proteins. <i>Review ECB4</i> Ch 2:55-56, 60-61 & panel 2-5 (pp74-75); Ch 4:121-168, incl panels 4-3 thru 4-6. |
| 5 Sept | 5: Lipids and biological membranes. Membrane proteins and membrane transport. <i>Review ECB4</i> Ch 2:53-55, incl panel 2-4 (pp70-71); Ch 11:359-381; and Ch 12:383-403. |
| 7 Sept | 6: Intro to carbs, thermodynamics, and metabolism. <i>Review ECB4</i> Chs 2:52-53, incl panel 2-3 (pp70-71); 3:83-116; and 4:144-154 (not panel 4-2). |
| 12 Sept | 7: Carbos and energy (continued): Glycolysis and the TCA cycle. <i>ECB4</i> Ch 13:419-444, incl panel 13-1 and 13-2. |
| 14 Sept | 8: Mitochondria and oxidative phosphorylation. <i>ECB4</i> Ch 14:447-469. |
| 19 Sept | 9: Chloroplasts and photosynthesis... <i>ECB4</i> Ch 14:469-483. |
| 19 Sept | Review for exam #1. 3:30-5:00 PM in 220 ASB. |
| 21 Sept | Exam #1. I try to write exams that can be completed within the allotted class time. However, students are occasionally provided with additional time. Please plan your schedule accordingly. |
| 26 Sept | 10: The "Central Dogma: from DNA to RNA to protein;" DNA structure, replication, and repair. <i>Review ECB4</i> Ch 2:56-58 and panel 2-6 (pp76-77); Ch 5:171-195. |
| 28 Sept | 11: DNA replication, and repair. <i>ECB4</i> Ch 6:197-220. |
| 3 Oct | 12: From DNA to RNA: RNA structure and transcription. <i>ECB4</i> Ch 7:224-238; review pp 253-257; and essential transcription concepts in pp256-258. |
| 5 Oct | 13: Nucleic acid techniques: Recombinant DNA technology. <i>ECB4</i> Ch 10:325-356. |
| Oct 8-15 Fall Break. No classes! | |
| 17 Oct | 14: The regulation of gene expression. <i>ECB4</i> Ch 8:261-285. |
| 19 Oct | 15: The evolution of genes and genomes. <i>ECB4</i> Ch 9:289-321. |
| 24 Oct | 16: From RNA to protein: translation, folding, and degradation. <i>ECB4</i> Ch 7:238-253; and essential translation concepts in pp256-258. |
| 24 Oct | Review for exam #2. 3:30-5:00 PM in 220 ASB. |

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| 26 Oct | Exam #2. I try to write exams that can be completed within the allotted class time. However, students are occasionally provided with additional time. Please plan your schedule accordingly. |
| 31 Oct | 17: Translation (continued). Targeting proteins to membranes and organelles. <i>ECB4</i> Ch 15:488-498; and appropriate essential concepts pp520-522. |
| 2 Nov | 18: The "Signal Hypothesis:" translation of secretory and membrane proteins. Vesicle trafficking: budding, targeting, and fusion. <i>ECB4</i> Ch 15:498-515; and appropriate essential concepts pp520-522. |
| 7 Nov | 19: Vesicle trafficking: budding, targeting, and fusion (<i>continued</i>). |
| 9 Nov | 20: Endocytosis and phagocytosis. <i>ECB4</i> Ch 15:515-522; and appropriate essential concepts pp520-522. Introduction to the cytoskeleton: Intermediate filaments. <i>ECB4</i> Ch 17:565-571 & appropriate essential concepts in pp599-600. |
| 14 Nov | 21: Actin and myosin in muscle cells. <i>ECB4</i> Ch 17:583-599 & appropriate essential concepts in pp599-600. |
| 14 Nov | Review for exam #3. 3:30-5:00 PM in 220 ASB. |
| 16 Nov | Exam #3. I try to write exams that can be completed within the allotted class time. However, students are occasionally provided with additional time. Please plan your schedule accordingly. |
| 21 Nov | 22: Microtubules and flagellae. <i>ECB4</i> Ch 17:571-584; appropriate essential concepts in pp599-600. |
| 23-24 Nov | Thanksgiving holiday... no classes Thursday or Friday! |
| 28 Nov | 23: Cell proliferation and the regulation of the cell cycle; Mechanisms of cell division; and Programmed cell death. <i>ECB4</i> Ch 18:603-642. |
| 30 Nov | 24: Cell division, continued. |
| 5 Dec | 25: Principles of cell signaling. <i>ECB4</i> Ch 16:525-563. |
| 7 Dec | 26: The organization of cells into tissues: the extracellular matrix and cell junctions; plant cell walls. Cell renewal and stem cells. Cancer. <i>ECB4</i> Ch 20:683-725. |
| 8 Dec | Review for final exam. 3:30-5:00 PM in 220 ASB. |
| 11 Dec | Final Exam (exam #4) 10:30 AM - 12:30 PM (note the time! Final exams are scheduled by the University, and the exam time and date cannot be changed). I try to write exams that can be completed within the allotted class time. However, students are occasionally provided with additional time. Please plan your schedule accordingly. |

I will send a class e-mail when exams are ready for pickup, providing times and places that exams will be available. Note that FERPA prohibits me from mailing or e-mailing exam results to students. Requests for regrades or addition corrections must be submitted 5 PM Friday 19 Jan 2018.