Lecture: TH, 10:45 AM - 12:05 PM, ASB 210

Instructor:
Dr. John S. (Sandy) Parkinson  parkinson@biology.utah.edu  ASB 322A
Office hours by appointment; drop-ins welcome, circumstances permitting.

Course administrator:
Karen Zundel  ASB 308
Office hours: Monday-Friday: 8:00-10:30 AM; 1:00-4:00 PM

Teaching assistants:
Krystal Chung  krystal.chung@path.utah.edu  EEJMRB 2520
Madison (Madi) Smith  madison.smith@utah.edu  SC 120C

The TAs will run discussion sections and respond to e-mail queries. The TAs can also arrange to meet with students individually or in small groups for personalized help sessions.

Prerequisites:
BIOL 2020 (Principles of Cell Biology) or equivalent. In particular, the following knowledge is vital to, but not explicitly covered in, the present course:
- Structures of amino acids, nucleotides, proteins, and nucleic acids
- Structures and workings of prokaryotic and eukaryotic cells
- Structures of chromosomes and the processes of DNA replication and mitosis
- Enzymes and biochemical pathways for energy production and synthesis of biomolecules
- Transcription and translation and the proteins and other factors involved

Course objectives:
- to provide a basic introduction to hereditary mechanisms in microbes and higher organisms
- to develop skills for analyzing genetic experiments and data
- to illustrate ways in which genetic logic and approaches can answer biological questions

Text / Canvas:
Course materials are available as PDF files on the course Canvas site.
There is NO required text for this course. The knowledge and analytical skills needed to pass this course will be based entirely on the material presented in lectures, lecture notes, problem sets, and practice exams. Annotated lecture notes with high-resolution figures and accompanying problem sets for each class lecture are available on Canvas.

Students who want supplementary background coverage of course topics should consult an introductory genetics text. Two recommended ones are: “An Introduction to Genetic Analysis”, Griffiths et al., W.H. Freeman & Co.; and “Genetics from Genes to Genomes”, Hartwell et al., McGraw Hill. Copies are available on 24-hour reserve in the Marriott Library.

Course organization:
The course material will be covered in five units. Each unit has a corresponding study guide (available on Canvas) that lists new terms and concepts to be covered and the explicit learning goals for that unit. In addition, for each unit there are numerous practice problems and practice exam questions (available on Canvas) for honing analytical skills and assessing comprehension of the material.
<table>
<thead>
<tr>
<th>date</th>
<th>day</th>
<th>#</th>
<th>lecture topic</th>
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<tbody>
<tr>
<td>Jan 7</td>
<td>T</td>
<td></td>
<td>intro to course: genetic reasoning; using probabilities</td>
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<tr>
<td>Jan 9</td>
<td>H</td>
<td>1</td>
<td>Mendelian genetics</td>
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<td>Jan 14</td>
<td>T</td>
<td>2</td>
<td>chromosomes &amp; meiosis: sex determination; nondisjunction [Golic]</td>
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<td>Jan 16</td>
<td>H</td>
<td>3</td>
<td>genes in populations: Hardy-Weinberg; genes with multiple alleles [Golic]</td>
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<td>Jan 21</td>
<td>T</td>
<td></td>
<td>review and practice for Exam #1</td>
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<td>Jan 23</td>
<td>H</td>
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<td>Exam #1 (covering lectures 1-3)</td>
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<td>Jan 28</td>
<td>T</td>
<td>4</td>
<td>genotype to phenotype: biochemical genetics; pathways; gene interactions</td>
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<td>Jan 30</td>
<td>H</td>
<td>5</td>
<td>linkage: crossovers, chromosome maps; tetrad analysis</td>
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<tr>
<td>Feb 4</td>
<td>T</td>
<td>6</td>
<td>tetrad analysis: centromere mapping, interference</td>
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<td>Feb 6</td>
<td>H</td>
<td>7*</td>
<td>chromosome changes: recombination effects; gamete consequences</td>
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<td>Feb 11</td>
<td>T</td>
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<td>review and practice for Exam #2</td>
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<td>Feb 13</td>
<td>H</td>
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<td>Exam #2 (covering lectures 4-7)</td>
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<td>Feb 18</td>
<td>T</td>
<td>8</td>
<td>bacteria &amp; phage: life cycles, mutations, mutants; phenotypes</td>
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<td>Feb 20</td>
<td>H</td>
<td>9*; 10-1</td>
<td>DNA as the genetic material; phage crosses</td>
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<tr>
<td>Feb 25</td>
<td>T</td>
<td>10-2</td>
<td>bacterial crosses: conjugation, transformation, transduction</td>
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<td>Feb 27</td>
<td>H</td>
<td>11</td>
<td>extrachromosomal genetic elements: plasmids &amp; episomes; lysogeny</td>
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<td>Mar 3</td>
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<td>review and practice for Exam #3</td>
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<td>Mar 5</td>
<td>H</td>
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<td>Exam #3 (covering lectures 8-11)</td>
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<td>Mar 8-15</td>
<td>SPRING BREAK</td>
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<td>Mar 17</td>
<td>T</td>
<td>12</td>
<td>defining genes: T4rII system; fine structure, complementation; colinearity</td>
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<td>Mar 19</td>
<td>H</td>
<td>13</td>
<td>genetic code: triplet code; reading frames; degeneracy, wobble, nonsense</td>
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<td>Mar 24</td>
<td>T</td>
<td>14</td>
<td>central dogma: DNA mutational changes &amp; their protein consequences</td>
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<td>Mar 26</td>
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<td>15</td>
<td>central dogma: mechanisms of reversion &amp; suppression</td>
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<td>Mar 31</td>
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<td>review and practice for Exam #4</td>
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<td>Apr 2</td>
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<td>Exam #4 (covering lectures 12-15)</td>
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<td>Apr 7</td>
<td>T</td>
<td>16</td>
<td>gene regulation in prokaryotes: lac operon, global control</td>
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<td>Apr 9</td>
<td>H</td>
<td>17*</td>
<td>gene regulation in eukaryotes</td>
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<td>Apr 14</td>
<td>T</td>
<td>18</td>
<td>gene and operon fusions</td>
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<td>Apr 16</td>
<td>H</td>
<td>19</td>
<td>transposons</td>
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<td>Apr 21</td>
<td>T</td>
<td>20</td>
<td>genetic engineering; DNA sequence analysis</td>
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<td>April 23</td>
<td>H</td>
<td></td>
<td>Final Exam [10:30 AM-12:30 PM] ASB 210</td>
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* no problem sets for these lectures
Discussion sections:

Discussion sessions, staffed by the TAs, will illustrate problem-solving techniques, review difficult concepts, practice for exams, and answer questions about problem sets, lectures, etc. **Students may attend any or all of the discussion sessions; they are not mandatory.**

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<tr>
<th>section</th>
<th>day</th>
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<th>building &amp; room</th>
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<tbody>
<tr>
<td>2030-008</td>
<td>T</td>
<td>12:55 PM - 1:45 PM</td>
<td>LS 101</td>
<td>Krystal</td>
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<td>2030-009</td>
<td>T</td>
<td>2:00 PM - 2:50 PM</td>
<td>JTB 110</td>
<td>Krystal</td>
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<td>2030-010</td>
<td>W</td>
<td>9:40 AM - 10:30 AM</td>
<td>AEB 306</td>
<td>Madi</td>
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<tr>
<td>2030-011</td>
<td>W</td>
<td>11:50 AM - 12:40 PM</td>
<td>ST 209</td>
<td>Madi</td>
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Grades:

The course will be graded on an **absolute** (*i.e.*, non-curved) 400 point scale:

- ≥360 points: A
- <360 points: A-, B+, B, B-
- <320 points: C+, C, C-
- <280 points: D
- <240 points: E

Students can accumulate course points from:

- “hourly” exams: four exams (100 points each)
- final exam: 100 points, but various weighting options (see below)

Each student’s point total will be determined by the maximum value among five scoring options:

- option #1: [sum of four “hourly” exams];
- option #2: [sum of three highest “hourly” exams plus 1X final];
- option #3: [sum of two highest “hourly” exams plus 2X final];
- option #4: [sum of the highest “hourly” exam plus 3X final] - **4 point penalty**
- option #5: [4X final] - **8 point penalty**.

These grading options have some important implications:

- **There are no make-up exams in this course.** If you are ill or otherwise unable to take an exam at the designated time, the missed exam will be scored as zero. With prior approval of the instructor, you may arrange to take an exam in advance of the scheduled exam time to accommodate scheduling conflicts or other hardships.

- **You need not take the final exam, if you’re satisfied with your point total from the “hourly” exams** (option #1).

- **You can miss up to two of the “hourly” exams without jeopardizing your final grade** (options #2 and #3).

- **You can miss or botch three (option #4) or even all four (option #5) of the “hourly” exams without greatly jeopardizing your final grade.** However, options #4 and #5, which involve heavily weighting the value of the final exam, incur point penalties: a 1% deduction in total points possible for option #4 and a 2% deduction in total points possible for option #5. These modest penalties are intended to encourage students to keep up with the course material throughout the semester, but won’t greatly disadvantage students who master the course material and concepts by the final.
“Hourly” exams:

There will be four (4) exams during the semester, each worth a total of 100 points. Each exam will focus on material covered since the previous exam, but will also include concepts, facts, and analytical skills from previous course units. Practice exams, similar in content and difficulty to the real ones, will be posted on the course web site. Analytical approaches and answers to some practice exam questions will be discussed in the course lectures and help/review sessions. Answer keys to the practice exams will be posted on the course web site immediately after the Tuesday review sessions.

All exams will occur on Thursdays and cover material through the preceding Tuesday lecture, which will be mainly a review and practice session. Graded exams will be returned to students at the end of lecture on the following Tuesday. Students who do not pick up their exam at that time may obtain them from Karen Zundel (308 ASB). Answer keys will be posted on Canvas. Grading mistakes should be brought to the instructor’s attention before the next scheduled exam. Submit your appeal, with all relevant info, to Sandy by e-mail.

Final exam:

The final exam will be comprehensive, but with some emphasis on course material covered since the last “hourly” exam. Students who have performed well on the “hourly” exams may elect not to take the final exam, in which case their final grade will be determined by the “hourly” exams (see grading option #1 above). Otherwise, final exam scores will be worth 100-400 points, depending on which scoring option maximizes each student’s point total.

Exam content and format:

The exams will test student command of genetic terminology and concepts and their ability to analyze and solve genetics problems. Calculators, phones, etc. may not be used in exams. All numerical answers should be given in the form of simple expressions, fractions, percentages, etc. No complicated arithmetic operations will be needed.

Exams are closed-book, closed-notes format. Calculations and final answers should be printed legibly on the exam sheets. Scratch paper will be provided, but should not be attached to or returned with the exam; the graders will only score answers that are on the exam sheet.

Withdrawals and audits:

This course will adhere to the University policy on withdrawals and incompletes, i.e., the instructor will not approve any course withdrawals. Students who have completed and passed at least 80% of the course material are eligible for an incomplete grade, if extenuating circumstances prevent them from completing the course.

Important Dates:

Friday, January 17 - last day to drop
Friday, March 6 - last day to withdraw

Accommodations Policy:

The instructor does not grant content accommodation requests because the course content fulfills legitimate pedagogical goals.
Course outcomes (taken from Unit Study Guides):

Conceptual Skills - By the end of this class you should understand
- the discrete nature of genetic characters and genotype inheritance patterns
- the relationship between genotype and phenotype
- the different genetic outcomes of mitosis and meiosis
- the significance of sex chromosomes and nondisjunction to inheritance
- the factors that influence the frequencies of genes in populations
- the basis for phenotypic interactions between pairs of alleles
- the basis for phenotypic interactions among multiple genes
- the relationship between chromosomes and linked genes.
- when and where recombination takes place during meiosis
- the consequences of recombination to chromosome segregation and parental genotypes
- the consequences of chromosome aberrations to meiosis and to the offspring
- the genetic and topological relationship between a gene and its protein product
- the chemical properties of DNA and common techniques for examining and manipulating DNA
- the relationship between genetic information and the primary structure of a gene’s protein product
- the kinds of mutational changes in the genetic code and their effects on protein and phenotype
- the chemical properties of DNA and common techniques for examining and manipulating DNA
- the origin, properties and reversion patterns of different kinds of mutations
- mechanisms by which gene expression can be regulated in eukaryotes and prokaryotes
- mechanisms and types of gene fusions and their experimental applications
- common techniques for examining and manipulating DNA molecules in vitro
- how recombinant DNA molecules are made in vitro and used in vivo
- the selective forces that drive evolution of transposable genetic elements
- the ways in which transposable genetic elements are used in genetic analyses

Analytical Skills - By the end of this course, you should be able to...
- deduce genotypes and modes of inheritance from cross results or pedigrees
- calculate progeny genotype and phenotype ratios and probabilities in crosses
- diagram movements of chromosomes through normal or nondisjunctional meiosis
- calculate gene, genotype, and phenotype frequencies in populations
- calculate inbreeding coefficients in consanguineous pedigrees
- analyze gene interactions in terms of protein properties and biochemical pathways
- determine the linkage relationships between marked loci in genetic crosses
- calculate recombination frequencies and construct genetic (linkage) maps from cross data
- diagram meiotic crossover patterns to account for recombinant gamete classes
- map genes relative to their centromeres; analyze unordered and ordered fungal tetrads
- interpret mutant phenotypes in terms of number and kinds of mutational defects
- construct genetic maps from bacterial conjugation, transduction, and transformation data
- construct deletion maps from deletion by deletion or point by deletion crosses
- determine gene assignments from complementation data
- apply central dogma principles to infer mutational and functional change(s) in a mutant organism
- use knowledge of the genetic code to identify open reading frames and analyze reversion patterns
- deduce gene control mechanisms from properties of regulatory mutants
- predict expression phenotypes of mutants from regulatory circuits
- construct restriction maps of DNA molecules
- analyze DNA sequences with web-based software programs (ORF-finders, etc.)
- use transposons as genetic markers in crosses

Important Terminology - By the end of this course, you should be able to recognize, distinguish, and define approximately 300 words and concepts central to classical and modern genetics.
University Policies and Information:

Academic Conduct

In order to ensure that the highest standards of academic conduct are promoted and supported at the University, students must adhere to generally accepted standards of academic honesty. Acts of academic misconduct include cheating, plagiarizing, research misconduct, misrepresenting one’s work, and inappropriately collaborating. Suspected cases of academic misconduct are dealt with according to the rules found in the Student Code, University Policy 6-400(V): http://www.regulations.utah.edu/academics/6-400.html. All instances of academic misconduct are recorded in a University database, which is shared by all academic units on campus.

Equal Access Provisions and the Americans with Disabilities Act

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 the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

Addressing Sexual Misconduct

Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677 (COPS).

Campus Safety

The University of Utah values the safety of all campus community members. To report suspicious activity, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

Wellness Statement

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 at www.wellness.utah.edu or 801-581-7776.

Veterans Center

If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: http://veteranscenter.utah.edu/. Please also let me know if you need any additional support in this class for any reason.

English Language Learners

If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include: the Writing Center (http://writingcenter.utah.edu/); the Writing Program (http://writing-program.utah.edu/); the English Language Institute (http://continue.utah.edu/eli/).