Welcome to genetics, a field of study which gives us compelling insights into nearly every aspect of biology! This is a new lecture course designed for you: the undergraduate student who already has an introductory level background in molecular genetics and transmission genetics, but wants more. Together, we will go deeper into transmission genetics and molecular genetics, and also explore other topics such as populations genetics, epigenetics, and genomics. You will develop a stronger understanding of key concepts, and you will gain skills to help you interpret a variety of genetic experimental results and observations. You’ll have the structure and background provided by a strong genetics textbook, but we will also go beyond the textbook to interrogate real data together during class time. By the end of the semester, you will have conquered new challenges and become a more self-aware learner. And then, if you still want more of this fascinating field of study, you will be ready to learn even more genetics, through graduate-level courses or research.

**The Big Learning Goals** for this course:

- Understand the molecular and cellular mechanisms that result in phenotypes and biological inheritance, both in individuals and in populations. You will be able to:
  - Explain genetic phenomena or observations in terms of broader concepts and theories
  - Integrate multiple concepts in order to explain biological observations

- Know logical, hypothesis-based approaches to interpret genetic observations and experimental results. You will be able to:
  - Interpret experiments from the primary research literature in transmission genetics, molecular genetics, population genetics, and genomics.
  - Analyze and interpret data using quantitative approaches, when appropriate.
  - Devise an experimental plan to address a research question through genetics.

- Understand and drive your own learning. You will be able to:
  - Develop strategies to achieve learning goals
  - Identify strengths and weaknesses in your own learning process

- Understand that genetic information and research can have broad implications: not only scientific, but also ethical, social, and environmental. You will be able to:
  - Discuss the responsibilities of genetics and geneticists to humanity.

Please notice that, although recalling key facts and concepts of genetics is not listed as a learning goal, it is actually a prerequisite to developing most of these big goals. You will be given guidance on this, but it will be your responsibility to be make sure to learn enough of the facts that you can do the work in class!

**Prerequisite:** BIOL 14a or similar. This course is designed for students who already have some background in molecular genetics and transmission genetics. If you haven’t taken BIOL 14, but think you’re ready for genetics at this level, please discuss your background with me (Prof. Woodruff) before enrolling in the course.
Course structure:
Lecture!  To succeed in this class, you'll need to not only come to class, but also participate as an active problem-solver, questioner, and listener, and supportive member of the learning community. We will frequently engage together in questioning and analysis. You will be expected to collaborate with your classmates and to help each other as you each construct your own understanding of genetics. Everyone in the room is responsible for maintaining a productive learning environment for all of us, so if another student distracts you during class by doing something other than the class work or by other non-supportive behavior, please speak to them or to me about it so that we can collectively do our best to support one another.

Homework: Preparation and Practice are essential! In general, there will be written homework due the day before each class day. This assignment structure is designed to help you succeed, by encouraging you to do a little bit almost every day, which will help you to develop sound skills and conceptual understanding.

Success in this 4 credit-hour course is based on the expectation that students will spend a minimum of 9 hours of study time per week in preparation for class (readings, papers, discussion sections, preparation for exams, etc.).

Homework includes:

- **Textbook Readings** from the textbook Genetics: A Conceptual Approach, 6th edition (2017), and from other sources (posted on LATTE). You should read the assigned sections before the class in which we will be working on them, though you may also find it helpful to re-read them afterward. Successful textbook reading in this class is more involved than you might expect. It includes carefully reading the assigned pages before they will be discussed in class, both text and figures; answering in-text questions as you go; solving the starred problems at the back of the chapter, and checking your work on these (answers are given in the back of the book).

- **Problem sets** will give you practice both inside and outside of class in applying concepts and strengthening your skills as a questioner and a problem-solver.

- **Genetics-In-The-News Readings** will be read and discussed periodically.

- **Written responses and short papers** of a few varieties will be assigned, including:
  - **Thoughts and Questions**: After thoughtfully reading and working on assigned material, you will write out your responses and questions. This allows us to begin our conversation about the ideas before we even walk into the classroom. Relate the readings to other ideas of experiences.
  - **Predictions Narrative**: Given some information about a biological situation, you will predict outcomes of specified situations. In some cases, this will involve quantitative analysis and probabilities. Considering more than one possible interpretation of the information is valued.
  - **Learning Reflection**: Reflect on your learning and your learning process. Identify specific strengths, weaknesses, goals, and plans.
  - **Create Experimental Design**: Given a complex research question that requires more than one type of experiment to answer, you will devise an experimental plan and explain your approach.
  - **Implications Discussion Paper**: Consider and discuss the responsibilities of genetics and geneticists to humanity: You will write a short essay discussing the broad implications (not just scientific, but also social, societal, ethical, or environmental) of particular genetic information or research. Considering multiple perspectives is valued.
  - **Mechanisms Analysis Narrative (“MAN”)**: You will be given a description or data regarding a complex situation that can be explained only by considering multiple different concepts (for example, both epigenetic regulation and Mendelian inheritance). You will explain what
molecular and cellular mechanisms could be involved, and how each would contribute.
Considering more than one possible interpretation of the information is valued.

**Assessments:** In place of longer exams, you will have frequent short quizzes (or other assessment activities, if more appropriate), six of them over the course of the semester. There will be no make-up quizzes, but you can miss one quiz without penalty (the other 5 will just be counted as a higher proportion of your grade). If you miss two quizzes, we should talk, it is often advisable to drop the course if you’re missing that much of it. If you think any quiz has been graded incorrectly, you may make a re-grade request by returning your paper to Prof. Woodruff. You do not need to write a reason for your request.

**The Final:** A final project on a specific genetic phenomenon or research story. Details depend on class size, and will be shared after class enrollment is known.

**Resources:**

**Course website:** Essential resources are posted for you on LATTE. Check the course website on LATTE frequently for course announcements, lecture notes, readings from outside the textbook, assignments, practice problems and answer keys, and updates to the course schedule.

**Office Hours:** You can drop in 11am to noon on weekdays. My office is Bassine 202. Please come! Office hour changes/updates will be listed at the top of the course LATTE page. You are also welcome to set up appointments with me outside of office hours if needed.

**Textbook:** Pierce: Genetics, A Conceptual Approach, 6th edition (2017). Doing the readings and problems from the textbook is essential. If you have trouble obtaining a textbook, contact Prof. Woodruff for assistance!

**Standards of behavior:**

**Academic Integrity:** For goodness’ sake do not cheat! It will only hurt your own learning, and probably your grades and credibility for the future. You are expected to be familiar with and to follow the University’s policies on academic integrity (see http://www.brandeis.edu/studentlife/sdc/ai). Faculty may refer any suspected instances of alleged dishonesty to the Office of Student Development and Conduct. Instances of academic dishonesty may result in sanctions including but not limited to failing grades being issued. Furthermore, I cannot write a decent letter of recommendation for anyone whose integrity is in doubt.

**Cell phones and laptops** should only be used in class when they are part of a classroom activity. Please turn off your cell phone, as you would do in a theater, so that you can achieve your own best focus. Use common sense, and don’t waste your class time or distract your classmates by trying to multitask. If anyone in class is using their device in a way that distracts you, even a little, it is entirely appropriate for you to ask them to put it away, or ask the instructor to tell them to do so. Similarly, if anyone asks you to change what you are doing, please be considerate and responsive to their request. If a situation arises in which you must take time out to communicate with someone by text etc, please step out of the classroom to do so.

**Disabilities:** If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please contact me during the first week of class.
**Preliminary Course Schedule:** The specific order and content of lectures and readings is subject to change. See online document, “Recommended work schedule”, for more details on readings and assignments. *Written homework is due every Monday and Wednesday before class meetings.*

<table>
<thead>
<tr>
<th>Week of</th>
<th>Lesson #s</th>
<th>Weekly Topics: Approximate Schedule</th>
<th>Reference readings</th>
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</table>
| 1 Jan 14 | 1 2       | Introduction and **Fundamental Principles of Heredity**
Course syllabus, group observation and discussion, learning strategies. | Syllabus (Chapter 1)
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Chapters 2 and 3 |
| 2 Jan 21 | 3 Thursday only | Genetics of sex determination, and extensions and variations on the principles of inheritance. | Chapter 4
Chapter 5 |
| 3 Jan 28 | 4 5       | Pedigree analysis, Genetic Linkage, Genetic Mapping. Genetics in the news. Quiz during class Thursday | Chapter 6
Chapter 7, through p191
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Chapter 7 |
| 4 Feb 4 | 6 7       | Chromosome Variants, Bacterial and Viral genetics. Predicting genetic outcomes | Chapter 8
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Chapter 9, through p264 |
| 5 Feb 11 | 8 9       | Chromosome structures. Mechanisms of DNA Replication and Transcription. Quiz during class Thursday | Chapter 10
Chapter 11, through p322
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Chapters 11
Chapter 12, through p356 |
| 6 Feb 25 | 10 11     | Mechanisms of recombination and Gene products. | Chapter 12
Chapter 13
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Chapters 14
Chapter 15, through p440 |
| 7 March 4 | 12 13     | Regulation of gene expression in prokaryotes, and in eukaryotes. Quiz during class Thursday | Chapter 15
Chapter 16
Chapter 17 |
<table>
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<tr>
<th>Date</th>
<th>March 11</th>
<th>March 18</th>
<th>March 25</th>
<th>April 1</th>
<th>April 8</th>
<th>April 15</th>
<th>April 29</th>
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<tbody>
<tr>
<td>Chapters</td>
<td>Chapter 18, through p542</td>
<td>Chapter 19, through p586</td>
<td>Chapter 20</td>
<td>Chapter 19</td>
<td>Chapter 23, through p704</td>
<td>Chapter 22</td>
<td>Chapter 21</td>
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**About the professor, Rachel Woodruff:**
I grew up in Texas with a lot of pets (parakeets, cats, hamsters, lizards…). My first, quite unsophisticated, genetics experiments involved my pet rabbits and pet rats. When I was in college, I almost majored in Chemistry and History before choosing to major in “Molecular Biophysics and Biochemistry” halfway through my Junior year. Ironically, I never took genetics as an undergrad! My first genetics course was in graduate school at MIT. Now that was a challenging course! But I loved it. The next year, I TA’d undergraduate genetics, and two years later I got to TA the graduate genetics course. And so my career in teaching genetics began. I was also lucky enough to be directly or tangentially involved in several different
kinds of genetics research over the years. This will be the first time I teach this course, though I’ve been teaching introductory genetics courses at Brandeis for 6 years now.

In addition to teaching, I enjoy playing with my kids, hiking, biking, and tea. When I get the chance, I enjoy a sail or a ride on a horse. I have fewer pets than I used to, but my pet Labrador retriever comes to my office often, and you are welcome to come and visit with her when you need a break. Though not a therapy dog, she kind of thinks she is! She would love to help you relieve your daily stress.

**Grading:** Your grades are not determined on a “curve” by competitive comparison with your classmates’ grades; rather, grades are set relative to ideals of achievement in the course. I would love nothing better than to have you all do so well that no one gets a poor grade!

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage of Final Grade</th>
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<tbody>
<tr>
<td>Participation and practice in class</td>
<td>15%</td>
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<tr>
<td>Homework, including very short assignments: TQs, surveys, etc, and short</td>
<td>15%</td>
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<tr>
<td>papers (some assignments have more points assigned to them than others)</td>
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<tr>
<td>Quizzes etc (average of ~6)</td>
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<tr>
<td>Final (one)</td>
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