Course Overview

*Big Questions* is the fall introductory biology course for first year and sophomore students. This course uses a conceptual and integrated approach to learning fundamental concepts in biology, with an emphasis on scientific practice, and use of teaching methodologies consistent with how students learn. *Big Questions* is being implemented by eight faculty, each teaching one section in the context of an interesting and topical “big question” in their area of expertise. Thus, biological concepts and content will be introduced in the context of current scientific ideas or research topics that promote an active, engaged learning environment.

Course Outcomes

The contextual learning used by *Big Questions* will allow students to see how understanding different levels of organization and approaches in biology are needed to find solutions to contemporary problems such as climate change, infectious diseases, and the origin of life. In addition to foundational knowledge, students will learn process skills, such as critical analysis, while developing a framework on which to scaffold other biological information. This framework will help students retain knowledge and make connections amongst topics in other courses, but especially during the second, spring introductory biology course, *Molecules to Ecosystems*.

Course Requirements

Core goals of *Big Questions* include not only acquisition of fundamental biological knowledge and understanding, but also integration of intellectual virtues - academically, the right way to think and act - to emphasize that the approach used in science is critical for effective biological study. Such intellectual virtues are important for the development of both good (pursues knowledge, truth, and understanding) and successful (fulfills one’s potential and accomplishes aims) students. Consequently, *Big Questions* will require students to develop and apply many intellectual virtues. For example, students will need to be inquisitive, asking deep and meaningful questions, while searching for understanding. Students will also need to be self-directed and independent in their thinking, going beyond what is learnt in the classroom in order gain deeper understanding. Furthermore, students will need to take intellectual risks, continuing to think and ask questions despite uncertainty about the outcomes. Finally, students will need to be receptive to new ideas and perspectives, especially those contrary to conventional wisdom or their existing knowledge.

Core Concepts & Learning Goals

Each module in *Big Questions* will integrate a set of core biological concepts:

1. **Evolution**: populations evolve through genetic change as a result of mutation, selection, drift and migration
2. **Biological Information and Flow**: Expression of genetic information controls the growth and behavior of organisms
3. **Structure-Function**: Basic units of structure define the function of all living things
4. **Transformations of Energy and Matter**: Biological systems grow and change using chemical transformation pathways governed by the laws of thermodynamics
5. **Systems**: Living systems are interconnected and interacting
By the end of the course, students will be able to:

1. Apply/analyze core concepts as they relate to two Big Questions in Biology
2. Articulate integration between core concepts
3. Draw inferences from qualitative and quantitative data
4. Apply an equation, model or quantitative technique to solve a biological problem
5. Develop proficiency in reading a scientific paper
6. Identify limitations in published material
7. Distinguish between valid versus opinion science
8. Speak proficiently about a science issue
9. Articulate how biology solves societal problems
10. Identify ethical implications of research
11. Approach a problem from a biological perspective

Course Details

- 3-credit course, MWF 12:50 -1:40 PM,
- Pre-requisites: None
- Text: Course packets by each instructor
- Course Assessment: Your final grade will be the combination of your two module grades and module-independent activities

The fall semester is divided into two half-semester modules. Students will indicate their preferences for the modules in the first week of the semester after hearing about the themes of the different modules from the professors and will begin Module I the second week.

Textbook

The format of this course, and the diverse content in each module, is supported by assigned readings taken from a variety of sources. There is no required textbook for Big Questions. Readings will be provided by the instructor in each module. We urge you to read all assigned material to reinforce the topics and examples we cover in lectures.

Course Web Site

General information on the Big Questions course can be found on the ND Biology Department website (https://biology.nd.edu/undergraduate/introductory-biology/). Each module will maintain a website in the Sakai system. These sites contain the syllabus and the daily program for each module. Lecture material and assigned readings are found in the Resources tab. In addition, Sakai sites will allow you to access your assignment, quiz and exam scores.
Assessments

Your grade in this course will be determined by the combination of points from the two modules (equally weighted) and an additional small set of module-independent activities focused on integration across all of biology and intellectual virtues.

TOTAL POINTS FOR EACH MODULE: 100
MODULE-INDEPENDENT POINTS: 5
TOTAL POINTS FOR COURSE: 205

In each module, points will be determined through a variety of assignments, quizzes and an exam. The breakdown of points is given below. All modules will follow this general format for the number of assignments and the points for each. If needed, final grades may be standardized across modules at the end of the semester. The content and details for these assignments will be unique to the material presented in each module.

1) Quizzes/Problem Sets (32 pts) - 4 total. Some assignments may be completed in class and others out of class.
2) Concept Checks (10 pts) - Short assignments designed to assess knowledge and engagement. Graded on a credit / no credit basis.
3) Paper analysis (8 pts) - This assignment is designed to improve your skills in critical evaluation of peer-reviewed articles.
4) Writing/Video assignment (20 pts) - The details for this individual assignment will be presented in each module.
5) Exam (30 pts) - At the end of each module there will be an exam covering the content of the module. These will be a mixed format, including multiple choice, short answer, etc. The final exam will include 2-3 synthesis questions that evaluate your ability to integrate concepts across modules and areas of Biology and a question that asks you to reflect on your personal development of intellectual virtues.

Module-independent points will be earned through participation in and completion of assignments associated with an initial class session covering intellectual virtues and a mid-semester day focused on synthesis across modules. Final exam questions focused on synthesis and intellectual virtues will also be included in these module-independent points.

Anticipated Course Grading Scale

<table>
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<tr>
<th>Points</th>
<th>Grade</th>
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<tbody>
<tr>
<td>190.7 - 205</td>
<td>A</td>
</tr>
<tr>
<td>184.5 - 190.69</td>
<td>A-</td>
</tr>
<tr>
<td>178.4 - 184.49</td>
<td>B+</td>
</tr>
<tr>
<td>170.2 - 178.39</td>
<td>B</td>
</tr>
<tr>
<td>164.0 - 170.19</td>
<td>B-</td>
</tr>
<tr>
<td>157.9 - 163.99</td>
<td>C+</td>
</tr>
<tr>
<td>149.7 - 157.89</td>
<td>C</td>
</tr>
<tr>
<td>143.5 - 149.69</td>
<td>C-</td>
</tr>
<tr>
<td>123.0 - 143.49</td>
<td>D</td>
</tr>
<tr>
<td>0.0 - 122.99</td>
<td>F</td>
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**Schedule**

Below is an outline of the main dates for the course. The first two days are an introduction to the course structure and modules and an exercise in Intellectual Virtues. The process for module selection will be described the first day. Module I will begin on September 2\(^{nd}\). Module II will begin immediately following the fall break on October 28\(^{th}\).

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>August 28 &amp; 30</td>
<td>2-day introduction to Big Questions, Selection of Modules, and Intellectual Virtues</td>
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<tr>
<td>September 2 - October 11</td>
<td>18 sessions for Module I</td>
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<tr>
<td>October 14</td>
<td>Review Session</td>
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<td>October 16</td>
<td>In class Exam for Module I</td>
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<td>October 18</td>
<td>Synthesis Day with in class exercises</td>
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<tr>
<td>October 19 - 27</td>
<td>Fall Break</td>
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<tr>
<td>October 28 - November 25</td>
<td>13 sessions for Module II</td>
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<tr>
<td>November 27 - December 1</td>
<td>Thanksgiving Day Break</td>
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<tr>
<td>December 2 - December 11</td>
<td>5 sessions for Module II</td>
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<tr>
<td>December 17</td>
<td>Final Exam (1:45 - 3:45)</td>
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**How to be a good and successful Big Questions student**

1. Attend class regularly. Be courageous and participate in classroom discussions and activities in order to master the material. In-class exercises and active learning activities are essential tools to reinforce key concepts.
2. Use the resources available to you. Instructors, teaching assistants, and Learning Resource Center tutors are here to help you build knowledge and think like a biologist. The more you talk about the material with other students and your instructors, the more comfortable you will be with the concepts.
3. Be an autonomous and responsible student. Finish assigned readings before lectures as described and complete all assignments on time and to the best of your abilities.
4. Be open minded and engage with your fellow students. Contribute to meaningful group discussions in class and strive to go over the day’s lecture each day with a study partner. Cramming to learn the material for exams will not be successful!
5. Embrace your inner wonder. This course is designed to spark your biological curiosity and hone your ability to ask and answer biological questions. Go beyond memorizing facts, and endeavor to understand and apply concepts.

**Honor Code**

The Notre Dame Academic Code of Honor Pledge is observed in this course. “As a member of the Notre Dame community, I acknowledge that it is my responsibility to learn and abide by principles of intellectual honesty and academic integrity, and therefore I will not participate in or tolerate academic dishonesty.” Thus, you are bound by the Honor Code in recording answers to quizzes and exams.
Accommodations for Students with Disabilities

If you require any special accommodations for the Big Questions course, please let us know as soon as possible. It is the policy and practice of the University of Notre Dame to provide reasonable accommodations for students with properly documented disabilities. Students who have questions about Sara Bea Disability Services or who have, or think they may have, a disability are invited to contact Sara Bea Disability Services for a confidential discussion in the Sara Bea Center for Students with Disabilities or by phone at 574-631-7157. Because the University’s Academic Accommodations Processes generally require students to request accommodations well in advance of the dates when they are needed, students who believe they may need an accommodation for this course are encouraged to contact Sara Bea Disability Services at their earliest opportunity. Additional information about Sara Bea Disability Services and the process for requesting accommodations can be found at sarabea/disabilityservices.nd.edu

Attendance

Attendance in lecture is mandatory. You will be held responsible for lecture material on quizzes, assignments, and exams. Not all of this material will be posted on the class website. For example, video clips, figures, and information may be provided during class and you are responsible for that information. Active learning exercises in class are an essential component of this course and cannot be made-up outside of class.

Late Assignments and Make-up Exams

Assignments turned in late without a University-approved excuse will be penalized on a sliding scale:
- up to 24 hours late will lose 25% of points earned
- 24 to 48 hours late will lose 50% of points earned
- 48 to 72 hours late will lose 75% of points earned
- over 72 hours late will receive no credit

If you can’t make it to class – submit the assignment early.

Make-up exams will be given only for students who notify their Professor prior to the exam and who provide an official university-approved excuse from your Dean’s office. We will require appropriate documentation for the legitimate absence (such as a letter from a treatment provider within 2 days following the absence). Thus, a makeup exam would be scheduled only for extraordinary reasons. Again, for emergencies and medical problems, we must be informed of this in advance of the exam. This means an e-mail or phone call stating that you will miss the exam. Subsequent confirmation will be required from your Dean’s office.

Questions and concerns on graded assignments or exams must be addressed within one week of the return of the assignment or exam.
Biology I: Big Questions Modules for Fall 2019

Will Gene Editing Change the World?
Patricia Champion

Blindness: Can We See Potential Gene and Stem Cell Therapies?
David Hyde

Have Humans Changed the Rules? Biology in the Anthropocene
Stuart Jones

Hero or Villain: How Might Earth’s Ecosystem Resolve the Climate Question?
David Medvigy

What Powers Life on Earth?
Jeanne Romero-Severson

Harnessing Our Immune System to Fight Disease: To Be or Not to Be?
Jeff Schorey

Humans: How Did We Get Here, and Why Are We Like This?
Mike Pfrender

Natural Selection: The Reason Why We Haven’t Cured Cancer?
Zach Schafer
INTRODUCTORY BIOLOGY
CONCEPTUAL FRAMEWORK

BUILD FOUNDATIONAL KNOWLEDGE

THINK LIKE A BIOLOGIST

DEVELOP ENTHUSIASM FOR BIOLOGY

Acquire, integrate, and synthesize core biological concepts across different levels of biological organization.

Apply quantitative techniques to investigate biological systems.

Recognize the societal context and ethical implications of scientific research and knowledge.

Communicate science effectively and be critical consumers of scientific information.

Contribute to the creation of biological knowledge.

Engage in the practices of biological inquiry, including all its complexity and uncertainty.

BIOLOGICAL SCIENCES