Syllabus – Fall 2021

BIOLOGY 111 (16): Introduction To Cell and Molecular Biology
(CRN 11039.202210)
Asynchronous

INSTRUCTOR:
Mrs. Emily Giarrocco, M.S.
giarroccoea@cofc.edu

Note: Please make sure to use your CofC email only when emailing me; I do my best to reply the same day if the email is received before 5 p.m., but I do not check my emails after 5 p.m. or over the weekend. Also, please include your course number and section number.

OFFICE LOCATION: 65 Coming St., Rm. 214  (across Coming St. from the loading dock area of RITA)
OFFICE HOURS: Mondays & Wednesdays 2 p.m. - 3 p.m via zoom. These are optional. Feel free to “drop by” at any time during the hour. You are also welcome to email me to schedule an appointment.

Course Description
Introduction to Cell and Molecular Biology is a foundation course for those intending to major in science, and therefore emphasizes critical thinking skills while delving into the basic concepts of biology including structure and function at molecular and cellular levels. Topics covered include the scientific process, biochemistry, molecular biology, cell structure and function, respiration, photosynthesis and genetics. There are no prerequisites, but Biology 111 Laboratory (BIOL111L) is a corequisite. Although this is an online course, you are expected to attend the lab in person.

Supplemental Instruction (SI):
Supplemental Instruction, or SI, is a collaborative, peer-assisted group study session. It is for everyone and is not remedial. Your SI leader for this course is Maryam Jafri, attendance to her sessions is strongly encouraged.
https://csl.cofc.edu/supplemental-instruction/

Required Course Materials

1. Textbook:  Free online open access text Open Stax Biology 2e
   https://openstax.org/details/books/biology-2e (please set up a student account)

2. Computer and online access:  All students must have access to a computer equipped with a web camera, microphone, and Internet access. You will be required to download, install and use Respondus Lockdown Browser and Monitor for certain quizzes and possibly exams. Further instructions will be provided about this. Resources are available to provide students with these essential tools if they need assistance - please let me know if you need help accessing those resources. If you need a reminder of laptop requirements, please visit: https://it.cofc.edu/laptops/

Class materials require online access through MyCharleston to both OAKS and Voice Thread; make sure you’re familiar with both. If you’re new to OAKS, start here: http://blogs.cofc.edu/oaks/students/getting-started/. Another
good resource for technology questions or help is: http://blogs.cofc.edu/sits/. The Remind app will also be used occasionally as backup to reach you.

**Suggested Course Material**

The *Study Guide* for *Biological Science* by Freeman, 7th Edition, (Pearson Publishers). This is not required, but it is usually available in the book store and is very helpful for many students. The Mastering Biology website that goes with the text also offers additional resources.

A physical notebook with paper and a writing utensil is strongly encouraged while you are taking notes from the lectures. If you need convincing: https://www.scientificamerican.com/article/a-learning-secret-don-t-take-notes-with-a-laptop/.

The *Center for Student Learning* (CSL) also has resources to facilitate peer education through tutoring, supplemental education and development of skills that contribute to academic success. It’s also free to you! For more information, please visit the CSL website at http://csl.cofc.edu or drop by their location (first floor of the Addlestone Library).

**COVID-19**

The College of Charleston is committed to promoting the health and safety of our campus community. To that end, all faculty and students must abide by current COVID-19 protocols. At the commencement of this school year, in accordance with the Centers for Disease Control (CDC) and S.C. DHEC guidelines, the College of Charleston requires face coverings for all members of the campus community, regardless of vaccination status, while around others indoors in all of its campus facilities, including classrooms and laboratories. The mask requirement does not apply in a student’s own residence hall room, a faculty or staff member’s private office (if alone) or while eating/drinking indoors on campus. If you are taking this course asynchronously, be sure to stay updated on COVID policies for your lab section.

Should an individual test positive for COVID-19 during the semester, communication with the instructor will be essential so that alternate plans can be arranged, and it is imperative that, even if ill or in difficult circumstances, the student finds a way to communicate in a timely manner. If you think you may be sick or have had a close contact, the communication rule also applies so I may communicate to SI leaders & lab instructors.

However, students should be aware that extended periods of inactivity on OAKS for any reason cannot be accommodated in every course. Missed assignments and assessments may result in poor or failing grades. If a student is absent from class for an extended period, a withdrawal (W) before the deadline should be strongly considered. In all cases, assigning course grades is the responsibility of the instructor consistent with the grading policy published on the syllabus.

**Inclement Weather, College Closure, and the Class Schedule**

If the College of Charleston closes and members of the community are evacuated due to inclement weather or for any other reason, students are responsible for taking course materials with them in order to continue with course assignments consistent with instructions provided by faculty. In cases of extended periods of institution-wide closure where students have relocated, instructors may articulate a plan that allows for supplemental academic engagement despite these circumstances.

**Teaching Philosophy**
Student engagement and effective communication of both students and instructor are essential to a successful learning experience. In college, your responsibility toward your classes can be fueled by a variety of motivators, from enjoyment of the material, desire to succeed, or even simply worldview expansion. Whatever your motivator, it is your responsibility to learn the material, ask questions and explore available resources. As an instructor, I am here as a resource and guide.

**Course Policies and Requirements**

**Accommodations**

Any student in this class who has a documented disability should speak to me as soon as possible, as well as contact the Center for Disability Services (CDS/SNAP program), located on the first floor of the Lightsey Center, Suite 104, (843) 953-1431, SNAP@cofc.edu

The College of Charleston community is enriched by students of many faiths that have various religious observances, practices, and beliefs. We value student rights and freedoms, including the right of each student to adhere to individual systems of religion. The College prohibits discrimination against any student because of such student's religious belief or any absence that results from held beliefs. Please contact me if this course’s schedule directly conflicts with one of your observances. Please see: https://academicaffairs.cofc.edu/documents/procedures-and-practices/statement-of-accommodation.pdf

**Class Delivery Format**

This class will be administered through OAKS, the College of Charleston’s learning management system. To access OAKS go to http://my.cofc.edu and login to My Charleston. The OAKS icon is the acorn located in the upper righthand corner of the screen.

I expect you to regularly login to OAKS to check for course updates, complete quizzes, etc. Please also check your email regularly as I will send e-mail updates to the class through OAKS to update you on class events and assignments.

**Class Attendance**

Keeping up with classwork each week when lectures are released is your responsibility. Obviously I do not take attendance, but I will use tools that will allow me to see if you are keeping up with your weekly work. Content will be released regularly in sync with my in-person class.

It is important to remember that distance education is a course format that requires students to be self-motivated, disciplined, organized and task-driven. **Some students are under the impression that distance education classes are easier than traditional face-to-face classes. This is not true. In fact, distance education courses are often more challenging than traditional classes and you should be prepared to spend several hours on this class each day, including additional time on the weekends.** It is critical that you complete work for this class each day and not wait until the day before a deadline to begin working on a module.

This class is being presented in an **asynchronous** format - you will be able to complete lectures and quizzes when it is most convenient to you—you are not required to login to the Internet at a specific time each day to interact with your classmates or me. **However, you must have regular access to a computer with a reliable high-speed internet connection and computer with a microphone and/or web-cam throughout the duration of this course. Computer failure/unavailability does not constitute an excuse for not completing work by the due dates.** So please do not wait until the last minute to complete work for a module.
This class will be administered through OAKS, the College of Charleston’s learning management system. To access OAKS go to http://my.cofc.edu and login to My Charleston. The OAKS icon is the acorn located in the upper righthand corner of the screen.

If you are someone who feels uncomfortable with technology, the College offers a number of resources to help you develop your technological competency, in general, but specifically within the context of this online class. Visit http://blogs.cofc.edu/studentreadinessforonlinelearning/ to access those resources.

**Honor Code**

Students are required to adhere to the guidelines outlined by the Honor Board in the Student Handbook (please see http://deanofstudents.cofc.edu/policies-and-procedures/honor-code-and-code-of-conduct.php)  **This includes lying, which will not be tolerated in this course.** All work that you turn in for this course (whether for assignments, quizzes, or exams) must be your own independent scholarship. **Students should be aware that unauthorized collaboration—working together without permission—is a form of cheating; this includes collaborating with classmates or other individuals on online quizzes or exams.** Other forms of cheating include possessing or using an unauthorized study aid (which could include accessing information via a cell phone or computer), copying from others’ exams, fabricating data, and giving unauthorized assistance. Any form of plagiarism (intentional and unintentional), cheating, or presenting someone else’s work as one’s own will be treated as a serious academic transgression and will be communicated accordingly by the instructor as an honor code violation to Student Affairs. Be especially cautious of plagiarism when using Internet sources. **Cheating, attempted cheating, or plagiarism will result in a grade of zero on that assignment, quiz or exam and may result in a final overall grade of F or XXF (failure due to academic dishonesty) for the course.**

**Quizzes**

Multiple choice quizzes will be given weekly and conducted through OAKS. They are intended to help students in keeping up with the large amount of information in this course by encouraging them to prepare and study/read/review EVERY day.  **It is your responsibility to keep up with due dates and times!** A missed quiz will result in a 0 for that quiz, unless you talk to me to explain the situation (serious illness, including but not limited to COVID-19, family responsibilities, other extreme circumstances). It is imperative that you communicate with me and tell me the truth, so that I can work with you. **Your lowest 3 quiz scores will be dropped in the final grade calculation.** All cell phones, Apple watches, pagers, iPods, iPads, tablets, laptops, etc. are to be turned off and put away during each quiz, and you are expected to take them by yourself without other people, notes, books or websites. **The use of any wireless communication device during a quiz, test, or final exam is a violation of the Honor Code.**

**Exams**

In this course, there are 3 regular exams scheduled during the semester (see calendar below for dates) and 1 cumulative final exam scheduled during the final examination period. Anyone who misses an exam will receive a 0, unless you talk to me to explain the situation (serious illness, including but not limited to COVID-19, family responsibilities, other extreme circumstances). If you have any conflicts with the scheduled exams, you must see me ahead of time, well before the exam date. All cell phones, Apple watches, pagers, iPods, iPads, tablets, laptops, etc. are to be turned off and put away completely during each exam. **The use of any wireless communication device during a quiz, test or final exam is a violation of the Honor Code.**
**Grading/Exams**

You may check the Gradebook on OAKS throughout the semester. If you see a discrepancy or error in your grades, please contact me as early as possible. The sooner you bring it to my attention, the easier it is to fix.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weight (% of total grade)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quizzes/Homework (lowest 3 scores dropped)</td>
<td>20</td>
</tr>
<tr>
<td>Exams (3)</td>
<td>60</td>
</tr>
<tr>
<td>Cumulative Final</td>
<td>20</td>
</tr>
</tbody>
</table>

**EXAMS**

There will be four exams (including the final) spaced throughout the semester. **Due to the online nature of this course, all exams will be given online through OAKS.** Anyone who misses an exam will receive a 0, unless you talk to me to explain the situation (serious illness, including but not limited to COVID-19, family responsibilities, other extreme circumstances). The final exam will be comprehensive (and will be given during finals week) but will emphasize topics covered after Exam III. Exams will be mostly in multiple choice format but may also include some short answer/discussion questions. As a reminder, all students must have access to a computer equipped with a web camera, microphone, and Internet access. **You will be required to download, install and use Respondus Lockdown Browser and Monitor for certain quizzes and exams.**

**QUIZZES**

There will be weekly quizzes or homework assignments over the course of the semester. Since the lowest 3 quiz/assignment grades will be dropped, there will be **no make-up quizzes or homework assignments.**

Letter grades are determined as follows:

- ≥93% = A
- 90-92 = A-
- 87-89 = B+
- 83-86 = B
- 80-82 = B-
- 77-79 = C+
- 73-76 = C
- 70-72 = C-
- 67-69 = D+
- 63-66 = D
- 60-62 = D-
- ≤59 = F
- 0 due to acad. dishonesty = XXF

**Expectations**

Students are expected to be respectful of your teacher and other students as outlined in the Code of Conduct. Just because you are online does not mean you abandon proper deportment. Be respectful and courteous of other students in your section.

**COURSE CALENDAR**

*As asynchronous students, pay special attention to exam dates. How you work through the material each week is up to you.*
<table>
<thead>
<tr>
<th>Module</th>
<th>Weekly Topic</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz A</td>
<td>Will cover separate material, and will have its own due date on the course calendar.</td>
<td></td>
</tr>
<tr>
<td>Module 1</td>
<td>Welcome! Exploring Life &amp; the Chemical Context of life. Chapters 1-2</td>
<td>Opens: Wed. 8/25 at 10 a.m EDT Quiz 1 closes: Tues. 8/31 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 2</td>
<td>Biological Macromolecules Chapter 3</td>
<td>Opens: Wed. 9/1 at 10 a.m. EDT Quiz 2 closes: Tues. 9/7 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 3</td>
<td>Biological Macromolecules &amp; Basics of Cells Chapter 3, Chapter 4 (4.1-4.3)</td>
<td>Opens: Wed. 9/8 at 10 a.m. EDT Quiz 3 closes: Tues. 9/14 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 4</td>
<td>Cell Structure &amp; Cell-Cell Interactions Chapter 4 (4.4-4.6), Chapter 9</td>
<td>Opens: Wed. 9/15 at 10 a.m. EDT Quiz 4 closes: Tues. 9/21 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>EXAM</td>
<td><em><strong>Exam 1</strong></em> over material in Modules 1, 2, 3 &amp; 4</td>
<td>Opens: Wed. 9/22, time TBD Closes: Thurs. 9/23, 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 5</td>
<td>Cell Membranes &amp; Intro. to Energy &amp; Metabolism Chapter 5 &amp; Chapter 6 (6.1-6.3)</td>
<td>Opens: Wed. 9/22 at 10 a.m. EDT Quiz 5 closes: Tues. 9/28 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 6</td>
<td>Energy, Metabolism &amp; Cellular Respiration Chapter 6 &amp; Chapter 7 (7.1-7.4)</td>
<td>Opens: Wed. 9/30 at 10 a.m. EDT Quiz 6 closes: Tues. 10/6 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 7</td>
<td>Cellular Respiration &amp; Photosynthesis Chapter 7 (7.5-7.7) &amp; Chapter 8</td>
<td>Opens: Wed. 10/6 at 10 a.m. EDT Quiz 7 closes: Tues. 10/12 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 8</td>
<td>Photosynthesis (FALL BREAK WEEK! Pay attention, due dates are adjusted &amp; Exam 2 is released Thurs.) Chapter 8</td>
<td>Opens: Wed. 10/13 at 10 a.m. EDT Quiz 8 closes: Wed. 10/20 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>EXAM</td>
<td><em><strong>Exam 2</strong></em> over material in Modules 5, 6, 7 &amp; 8</td>
<td>Opens: Thurs., 10/21 time TBD Closes: Fri., 10/22 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 9</td>
<td>Cell Cycle and Mitosis Chapter 10 (10.1-10.3)</td>
<td>Opens: Thurs. 10/21 at 10 a.m. EDT Quiz 9 closes: Tues. 10/26 at 11:30 p.m. EDT</td>
</tr>
<tr>
<td>Module 10</td>
<td>Mitosis and Cancer Chapter 10 (10.4-10.5)</td>
<td>Opens: Wed. 10/27 at 10 a.m. EDT</td>
</tr>
</tbody>
</table>
| Module 11 | Meiosis, Inheritance & Genetic Disease  
Chapter 11, Chapter 13 | Quiz 10 closes: Tues. 11/2 at 11:30 p.m. EDT  
Opens: Wed. 11/3 at 10 a.m. EDT  
Quiz 11 closes: Tues. 11/9 at 11:30 p.m. EDT |
|--------------------------|----------------------------------------------------------|
| Module 12 | Mendelian Genetics  
Chapter 12 | Quiz 11 closes: Tues. 11/16 at 11:30 p.m. EDT  
Opens: Wed. 11/10 at 10 a.m. EDT |
| EXAM | ***Exam 3*** over material in Modules 9, 10, 11 & 12 | Opens: Wed., 11/17 time TBD  
Closes: Thurs., 11/18 11:30 p.m. EDT |
| Module 12 | DNA Structure & Function  
Chapter 14 | Quiz 12 closes: Tues. 11/23 at 11:30 p.m. EDT  
Opens: Wed. 11/17 at 10 a.m. EST |
| OFF - Nov. 24, 25, 26 | Happy Thanksgiving!!!! | |
| Module 13 | Biotechnology  
Chapter 17 | Quiz 13 closes: Sun. 12/5 at 11:30 p.m. EST  
Opens: Mon. 11/29 at 10 a.m. EST |
| Mon., Dec 6th | Official last day of classes for the fall semester | STUDY, STUDY, STUDY! |
| Wed., Dec 8 | Final exams begin | |
| Thurs., Dec. 9th | Study and take your final exam on OAKS! | (Will probably open the Final Exam on OAKS today - I will definitely let you know!) |
| Sat., Dec 11th | FINAL CUMULATIVE EXAM on OAKS will be due by 11:30 p.m. TODAY! It will close and not reopen. | |

*Exam dates are firm. However, topics covered on certain days are subject to change.

** Please note: as stated in the Undergraduate Catalog:

http://catalog.cofc.edu/content.php?catoid=14&navoid=671#final-examinations

“Examinations must be taken at the time scheduled (https://registrar.cofc.edu/pdf/exam-schedule-fall2020.pdf), except when:

1. Two or more exams are scheduled simultaneously.
2. Legitimate AND documentable extenuating circumstances prevent the student from completing the examination at the scheduled time (e.g., burial services for an immediate family member).”

**Learning Goals and Objectives**
Learning Goals & Objectives for Biology 111 and 111L Introduction to Cell and Molecular Biology/ BIOL 112 & 112L Evolution, Form, and Function of Organisms

Department: Biology

This general education science sequence provides a background for understanding and evaluating contemporary topics in biology. Students develop a foundational understanding of core concepts to use and on which to expand in upper level courses. They also develop the critical competencies that form the bases for the practice of science and use of scientific knowledge.

Core Concepts

This 2-semester course sequence in general biology addresses fundamental principles in biology to prepare students for sophomore and upper level courses in biology:

- **EVOLUTION**: The diversity of life evolved over time by processes of mutation, selection, and genetic change. The theory of evolution by natural selection allows scientists to understand patterns, processes, and relationships that characterize the diversity of life.

- **STRUCTURE AND FUNCTION**: Basic units of structure define the function of all living things. Structural complexity, together with the information it provides, is built upon combinations of subunits that drive increasingly diverse and dynamic physiological responses in living organisms. Fundamental structural units and molecular and cellular processes are conserved through evolution and yield the extraordinary diversity of biological systems seen today.

- **INFORMATION FLOW, EXCHANGE, AND STORAGE**: The growth and behavior of organisms are activated through the expression of genetic information at different levels of biological organization and depend on specific interactions and information transfer.

- **PATHWAYS AND TRANSFORMATIONS OF ENERGY AND MATTER**: Biological systems grow and change by processes based upon chemical transformation pathways and are governed by the laws of thermodynamic and will be explored to understand how living systems operate, how they maintain orderly structure and function, and how physical and chemical processes underlie processes at the cellular level (i.e. metabolic pathways, membrane dynamics), organismal level (i.e. homeostasis) and ecosystem level (i.e. nutrient cycling).

- **SYSTEMS**: Living systems are interconnected and interacting and biological phenomena are the result of emergent properties at all levels of organization, from molecules to ecosystems to social systems. The course will explore the dynamic interactions of components at one level of biological organization to the functional properties that emerge at higher organizational levels.

The specific topics covered in each course include:

**Biology 111 & Biology 111L**

- Chemical and physical properties of life
- Cell form & function
- Energetics, metabolism, and photosynthesis
- The cell cycle
  - Mitosis and cell reproduction
  - Meiosis and sexual reproduction
- Mendelian genetics / Patterns of inheritance
- Human Inheritance
- The molecular basis of inheritance
- DNA and protein production
- Regulation of gene expression
- Some aspects of biotechnology

**Biology 112 & Biol 112 L**
- The development of evolutionary thinking
- Basic evolutionary processes
- Comparative plant form & function
- Comparative animal form & function

**Core Competencies**

- **Nature of Scientific Knowledge**
  - Understand the intellectual standards used by scientists to establish the validity of knowledge, evidence, and decisions about hypothesis & theory acceptance. These standards include: 1) science relies on external and naturalistic observations, and not internal convictions; 2) scientific knowledge is based on the testing of hypotheses and theories, which are under constant scrutiny and subject to revision based on new observations; 3) the validity of scientifically generated knowledge is established by the community of scientists through peer review and open publication of work.
  - Understand that new ideas in science are limited by the context in which they are conceived; are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly, through contributions from many investigators.
  - Understand that science operates in a world defined by the laws of chemistry and physics.
  - Understand the differences and relationships among scientific theories, hypotheses, facts, laws, & opinions.
  - Understand the differences between science and technology, but also their interrelations.
  - Understand the dynamic (tentative) nature of science.

- **Scientific Methods of Discovery**
  - [1] Understand the methods scientists use to learn about the natural world (observing; questioning; formulating testable deductive hypotheses; controlled experimentation when possible; observing a wide range of natural occurrences and discerning (inducing) patterns).
  - Apply physical/natural principles to analyze and solve problems.

- **Develop a Scientific Attitude**
  - Develop habits of mind that foster interdisciplinary and integrative thinking (within biology; between biology and other sciences; between science and other disciplines).
  - Develop an appreciation for the scientific attitude - a basic curiosity about nature and how it works.

- **Develop scientific analysis and communication skills**
  - Develop quantitative reasoning skills (quantitatively expressing the results of scientific investigations, or patterns in nature and using knowledge of biological concepts to explain quantitatively-expressed data or patterns).
  - Understand the probabilistic nature of science and the use/application of inferential statistics to test hypotheses.
  - Develop scientific information literacy (library, internet, databases etc...); find and evaluate the validity of science-related information.
Communicate scientific knowledge, arguments, and ideas in a variety of different contexts (scientific, social, cultural), utilizing a variety of different media (scientific articles, policy statements, editorials, oral presentations etc.).

Develop cooperative problem-solving skills (working effectively in teams), but also habits of mind and skills that foster autonomous learning.

- Develop an appreciation for the impact of science on society.
  - Develop an appreciation of humans as a part of the biosphere and the impact of biological science on contemporary societal/environmental concerns.
  - Knowledge of the history of the biological sciences and the influences of politics, culture, religion, race, and gender on the scientific endeavor.

Signature assignments for measuring learning outcomes

Learning Outcome 1: Students apply physical/natural principles to analyze and solve problems.

This learning outcome is assessed using the poster (or scientific article) generated in Biology 112 lab as part of the multi-week student-directed independent research project. In this project students use data they collect (or has been collected in actual research investigations) to test an hypothesis of their choosing. These projects may be themed, with all student groups addressing different aspects of a larger question, emphasizing the interdependence of various research groups needed to address complicated problems. This multi-week project begins the class identifying what questions need to be addresses in the larger problem. Individual student groups then become experts in these areas of the larger problem. The smaller research teams develop a hypothesis, and write a research proposal to test their hypothesis. Students collect (or use already collected data), summarize and statistically analyze the data, and draw conclusions.

Learning Outcome #2 - Students demonstrate an understanding of the impact that science has on society.

Biology 112 lab Students produce a written document based on one of the case-based labs (examples - policy statement, article, stake-holder professional letter or poster) that requires them to research and apply biological knowledge or evidence to defend or critique a proposed solution to a biology-related societal issue. Although the choice of the specific issue or proposed solution is course-section specific, some examples of potential issues include

- exploring environmental/health impacts of genetically modified organisms
- the use of performance enhancing drugs in sports
- the development of antibiotic resistance in disease organisms

[1] This learning goal will be measured as part of the general education assessment. The specific learning outcome to be measured is: Students can apply physical/natural principles to analyze and solve problems.

[2] This learning goal will be measured as part of the general education assessment. The specific learning outcome to be measured is: Students can demonstrate an understanding of the impact that science has on society.