

SLCC Biology department assessment report for Biology 1090

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Biology 1090 is a general education course with the LS designation. The primary tool for course-wide assessment of content-based learning outcomes is a department-wide final exam. This exam uses different questions each semester, but it has been used to examine student understanding of the same 50 course objectives since the spring semester of 2013.

In this report, student performance on the department final has been analyzed longitudinally, for five different semesters between spring of 2013 and fall of 2015, with the goal of answering three questions.

- 1) Do students perform differently in online sections of the class than in traditional lecture sections?
- 2) In general, have we changed over the years?
- 3) Are there individual objectives that we have taught very well or very poorly over the years?

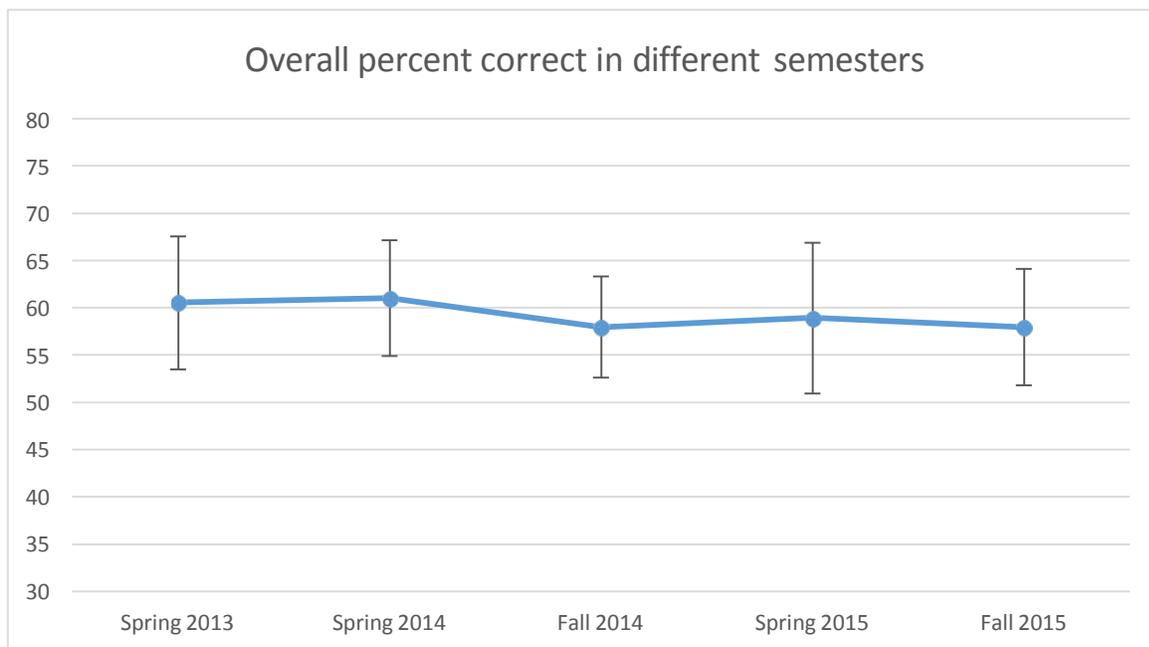
The data includes responses of 1699 total students, 1142 of which were in traditional lecture sections, and 557 in online sections.

1) Do students perform differently in online sections of the class than in traditional lecture sections?

To answer this question, student data for all 50 exam questions was combined from all five semesters. In traditional sections, the average correct response percentage was 60 +/- 10%. In online sections, the average correct response percentage was 58 +/- 10%. This suggests that neither modality is greatly superior to the other.

2) In general, have we changed over the years?

To answer this question, combined data from each semester was compared.



This data suggests that there have not been major changes in our teaching of objectives overall over the last 3 years.

3) Are there individual objectives that we have taught very well or very poorly over the years?

To answer this question, data from all students over the five semesters was separated by objective. The objectives are listed below, with the overall percent of correct responses shown. Questions about 33 objectives were answered correctly by between 50 and 70% of students. Questions about nine objectives were answered correctly less than half the time. Those are highlighted in red font. Questions about eight objectives were answered correctly more than 70% of the time. Those are highlighted in green font.

Objective	Percent correct responses
1. Describe the scientific process. Distinguish between a hypothesis and a theory. Recognize these key theories in biology: cell theory, the germ theory of disease, and the theory of evolution. Define the following experimental terms: independent variables, dependent variables, control, correlation, and causation.	78
2. Illustrate the difference between anecdotal evidence and valid scientific evidence. Describe the importance of peer review.	68
3. List the commonalities shared by living organisms (growth, metabolism, cells, DNA, response to stimuli, adaptation to changing environments). Describe how the following properties of water make it critical to biology: its abundance, its role as a solvent for biological molecules, and its polarity, which allows it to dissolve polar molecules, and participate in some reactions.	62
4. State the four biological macromolecules. Identify the building blocks and explain the function of each.	65
5. Describe the basic concept of pH and the pH scale. Recognize the normal human blood pH range of 7.35 to 7.45.	54
6. Recognize that cells are the basic unit of life. Identify major cell components and describe their functions. Describe the classification scheme used to organize life. Recognize the three domains (archaea, bacteria, and eukaryotes) and the four kingdoms of eukaryotes (plants, animals, protists, and fungi).	52
7. Recognize that we eat to 1) get structural materials for building cells and extracellular structures, 2) to get energy molecules, and 3) to get other materials (e.g. water, minerals and vitamins) required for the function of cells. List carbohydrates, proteins, lipids and water as the major macronutrients in a human diet. Also, compare and contrast diffusion, osmosis, and active transport.	69
8. Illustrate the role of enzymes in metabolism and recognize that enzymes are proteins.	59
9. Describe the function of ATP as an energy source for chemical work, mechanical work, and transport work in cells. Describe cellular respiration as the process enabling cells to make ATP. Recognize that we perform cellular respiration to transfer the energy stored in food molecules into ATP, and use ATP to power the chemical reactions that keep us alive.	57
10. Recognize the overall equation for cellular respiration and generally describe each step: glycolysis, citric acid cycle, oxidative phosphorylation. Describe where cellular respiration occurs and explain the role of oxygen.	41
11. Describe CO ₂ (carbon dioxide) as a greenhouse gas, due to its ability to absorb and emit energy in the thermal (heat) range and discuss the environmental implications. Identify "driving a more fuel efficient vehicle" as the most significant way most people could reduce their contribution to greenhouse emissions. Define photosynthesis. Recognize that plants both photosynthesize and perform cellular respiration, whereas animals rely on photosynthetic organisms as an energy source.	72
12. Describe the process of DNA replication. Recognize that genes are portions of DNA that code for proteins (primarily). Define a mutation and explain why mutations can result in genetic disease. Define alleles.	53

13. Briefly describe the basic events of the normal mitotic cell cycle (that is, at a basic level, what happens in interphase [G1, S, G2], mitosis and cytokinesis [M]). Explain why mutations specifically in genes that code for cell cycle checkpoint proteins can lead to the formation of cancer cells.	49
14. Describe mitotic cell division (mitosis) as the process that generates the vast majority of cells in a human. Describe meiosis as the type of cell division that occurs in testes and ovaries, and generates sex cells (gametes).	57
15. Recognize that two daughter cells are generated when a cell performs mitosis. Recognize that four cells are generated from one cell undergoing meiosis. Recognize the starting and ending chromosome numbers for both normal mitotic and meiotic cell division. Recognize that allele pairs are separated into different gametes during meiosis.	51
16. Describe the relationship between chromosomes, genes and alleles. Define the main processes contributing to genetic diversity in sexually reproducing organisms (independent assortment, random fertilization, crossing over).	56
17. Define the terms homozygous, heterozygous, dominant and recessive with respect to alleles on chromosomes. Use examples to contrast phenotype and genotype. Use a Punnett square to predict the inheritance of a simple recessive (or dominant) trait in a monohybrid cross.	63
18. Recognize that simple Mendelian genetics are critical to understanding inheritance, but that most human traits have more complex inheritance patterns. Recognize that many traits are controlled by multiple genes interacting (polygenic inheritance) and that the environment interacts with genotype and can affect phenotype. Define heritability.	56
19. Define codominance and incomplete dominance. Describe ABO blood type as an example of codominant alleles (the department final will not require you to be able to solve problems regarding the genotypes and phenotypes of ABO blood typing).	63
20. Describe sex determination in humans (XX, XY). Define sex-linked traits and explain why recessive sex-linked traits (such as hemophilia or colorblindness) are more common in males than females.	47
21. Explain how DNA codes for proteins. Diagram the flow of information from DNA to protein. Recognize that the process of transcription makes an mRNA copy of a portion of the DNA (a gene) and translation is the process by which the genetic information in the mRNA is used to build the protein coded for by a specific gene.	42
22. Define the term genetically modified organism. Briefly describe how biotechnology techniques are used to create genetically modified organisms. Discuss the benefits, concerns and ethical issues of genetic engineering.	49
23. Define natural selection. Describe why natural selection can only act on heritable traits, not on traits acquired during an organism's lifetime.	62
24. Define Macroevolution. Define the concept of common descent. Recognize why the theory of evolution is supported by the following kinds of evidence: The presence of useless traits in modern species, the distribution of organisms on earth, fossil evidence, DNA evidence, and patterns of homologies between organisms that suggest common ancestry.	55
25. Recognize that natural selection requires variation in populations and describe how mutation is the ultimate source of this variation. Recognize that mutations occur randomly and may be beneficial or not, depending on the current environmental conditions. Illustrate the role of natural selection in the rise of antibiotic-resistant bacteria.	65
26. Summarize the concept of human races and the effects of cultural influence. Summarize evolutionary mechanisms that have led to differences between human populations. Recognize that there are not significant biological differences between human races.	65
27. State the basic characteristics of each domain of life (Bacteria, Archaea, Eukarya). Describe the basic characteristics of the four kingdoms in the Eukaryote domain (plants, animals, fungi, protists). Describe in detail the biological classification of human beings. Explain how an evolutionary tree represents the relatedness of different organisms.	62
28. State the basic functions of the four different types of tissues, and name major examples of each type.	67

29. State the basic function of each organ of the GI tract. Diagram the path of food as it passes through the digestive system.	80
30. Explain the important interaction between the digestive and circulatory systems for absorption and distribution of nutrients. Explain the function of feedback systems, and describe the process of regulation of blood glucose levels by insulin and glucagon, as an example of negative feedback and homeostasis.	72
31. Describe the order, and basic structure and function of the respiratory tract structures. Name the anatomic and common names of respiratory tract structures, including: pharynx = throat, larynx = voice box, trachea = windpipe.	56
32. Describe the structure and function of alveoli, including their relationship with capillary beds.	63
33. Describe the basic structure and function of the heart, including the chambers and valves, and the basic sequence of events in a heartbeat.	43
34. Describe the systemic circuit and pulmonary circuit of the cardiovascular system. Describe the organization of veins, arteries and capillaries, and recognize that arteries carry blood away from the heart, while veins carry blood toward the heart. Describe the function of capillary beds.	71
35. Name these major arteries, and the body regions they supply: aorta (entire systemic circuit), common carotid (head and neck), subclavian (arms), renal (kidneys), superior and inferior mesenteric (intestines), common iliac (legs and pelvic cavity), femoral (legs).	46
36. Describe the basic structure and function of the urinary system.	59
37. Identify the category of pathogen that causes each of the following: colds, influenza, E. coli infection, Staph infection, Hepatitis, and malaria. Explain the difference between genetic and infectious disease.	64
38. Name and define the components of the three lines of defense and illustrate the functions of each. Recognize problems that result from defects in your immune system (ie, allergy, susceptibility to disease).	52
39. Describe the basic structure and function of the endocrine system, including the hypothalamus, pituitary, ovaries, testes, adrenal glands, and pancreas. Describe how hormones are chemical signals that travel in the blood, with secretory cells and target cells.	55
40. Describe the basic structure and function of the musculoskeletal system. This includes the basic properties of muscle cells, and the basic organization of bones.	58
41. Name the functions of the major axial muscles of the body.	50
42. Name the functions of the major appendicular muscles of the upper limbs.	71
43. Name the functions of the major appendicular muscles of the lower limbs.	52
44. Locate the major bones of the body. Examples: Humerus is in the arm. Radius and Ulna are in the forearm. Carpals are in the wrist.	81
45. Label a diagram of the male and female reproductive structures and describe the basic functions of the uterus, uterine tubes, and vagina in females, and the epididymis, ductus deferens (or vas deferens), and urethra and penis in males.	69
46. Describe the function of the testes and ovaries, and summarize the basic steps of gametogenesis in males and females, recognizing the role of meiosis in this process. Summarize the key stages of development from zygote to fetus, and describe the role of mitosis in this process. Recognize the complexity of cellular communication required for normal development.	71
47. Describe the parts of a neuron, and describe action potentials as signals that are transmitted in neurons along their axon, to convey meaning in the nervous system. Describe how neurotransmitters are the chemical signals that cross the synaptic gap between neurons and their target cells.	43
48. Describe the overall plan of the nervous system, including general and special senses, cognition and memory, and somatic and autonomic motor pathways, and the related ideas of sensory neurons, interneurons, and motor neurons.	47

49. Describe the basic functions of the lobes of the cerebral cortex, the thalamus and hypothalamus.	55
50. Describe the basic functions of the brainstem, the cerebellum and the spinal cord.	52

Learning Outcomes sorted by increasing Proficiency:

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13. Briefly describe the basic events of the normal mitotic cell cycle (that is, at a basic level, what happens in interphase [G1, S, G2], mitosis and cytokinesis [M]). Explain why mutations specifically in genes that code for cell cycle checkpoint proteins can lead to the formation of cancer cells.	49
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