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| <b>Philadelphia University</b>       |  <b>PHILADELPHIA UNIVERSITY</b><br>THE WAY TO THE FUTURE | <b>Approval date:</b>  |
| <b>Faculty: Science</b>              |                                                                                                                                           | <b>Issue:</b>          |
| <b>Department: General Biology 1</b> |                                                                                                                                           | <b>Credit hours: 3</b> |
| <b>Academic year: 2022/2023</b>      |                                                                                                                                           | <b>Bachelor</b>        |

### Course information

| Course#                                                                                                                                                                                                                     | Course title      | Prerequisite                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------------|
| 0240101                                                                                                                                                                                                                     | General biology 1 |                               |
| Course type                                                                                                                                                                                                                 |                   | Room #                        |
| <input type="checkbox"/> University Requirement <input checked="" type="checkbox"/> Faculty Requirement<br><input type="checkbox"/> Major Requirement <input type="checkbox"/> Elective <input type="checkbox"/> Compulsory |                   | 61303                         |
|                                                                                                                                                                                                                             |                   | <b>Mon, Wed: 9:45 – 11:15</b> |

### Instructor Information

| Name         | Office No. | Phone No. | Office Hours                                      | E-mail                      |
|--------------|------------|-----------|---------------------------------------------------|-----------------------------|
| Ayat Al-Azab | 1018       | 2475      | Sun, Tue: ٩:٤٥ – ١١:٠٠<br>Mon, Wed: ١٤:٠٠ – 13:00 | aalazab@philadelphia.edu.jo |

### Course Delivery Method

| Course Delivery Method                       |                                 |                                  |          |
|----------------------------------------------|---------------------------------|----------------------------------|----------|
| <input checked="" type="checkbox"/> Physical | <input type="checkbox"/> Online | <input type="checkbox"/> Blended |          |
| Learning Model                               |                                 |                                  |          |
| Percentage                                   | Synchronous                     | Asynchronous                     | Physical |
|                                              |                                 |                                  |          |

### Course Description

This course involves studying the major concepts of biology including the structural and functional basics of the cell, metabolism and conversion of energy in respiration, cell division and DNA replication, transcription and translation, the basic principles of biotechnology in terms of hybridization, PCR and sequencing. In addition, the course covers the nervous, circulatory and immunity systems in human.

### Course Learning Outcomes

| Number    | Outcomes                                                                     | Corresponding Program outcomes |
|-----------|------------------------------------------------------------------------------|--------------------------------|
| Knowledge |                                                                              |                                |
| K001      | 2.1 Distinguish between element and compound                                 | Kp1                            |
| K002      | 3.2 Explain the major properties of water                                    | Kp1                            |
| K003      | 4.2.1 Identify the major chemical functional groups                          | Kp1                            |
| K004      | 4.2.2 Understand the properties of each chemical group                       | Kp1                            |
| K005      | 5.1.1 List the different biological macromolecules found in living organisms | Kp1                            |
| K006      | 5.1.2 Identify the monomers of each macromolecules                           | Kp1                            |
| K007      | 5.2.1 Explain the importance of carbohydrate                                 | Kp1                            |

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| K008 | 5.2.2 Identify the linkage formed between two sugar molecules                                                                                                          | Kp1 |
| K009 | 5.2.3 Compare between different polysaccharides (starch, glycogen, and cellulose)                                                                                      | Kp1 |
| K010 | 5.3 Identify the structure of lipids                                                                                                                                   | Kp1 |
| K011 | 5.4.1 List the functions of proteins and example of each one                                                                                                           | Kp1 |
| K012 | 5.4.2 Explain the formation of peptide bond                                                                                                                            | Kp1 |
| K013 | 5.4.3 Identify the different structures of protein                                                                                                                     | Kp1 |
| K014 | 5.5.1 Describe the structure of nucleic acids                                                                                                                          | Kp1 |
| K015 | 5.5.2 Explain the formation of DNA double helix                                                                                                                        | Kp1 |
| K016 | 6.2.1 Distinguish between prokaryotic and eukaryotic cells.                                                                                                            | Kp1 |
| K017 | 6.2.2 Explain why there are both upper and lower limits to cell size. Be able to calculate the surface area to volume ratio of a cube.                                 | Kp1 |
| K018 | 6.2.3 Explain the advantage of compartmentalization in eukaryotic cells.                                                                                               | Kp1 |
| K019 | 6.2.4 Compare and contrast plant and animal cells.                                                                                                                     | Kp1 |
| K020 | 6.3.1 Describe the structure and function of the nuclear envelope, including the role of the pore complex.                                                             | Kp1 |
| K021 | 6.3.2 Briefly explain how the nucleus controls protein synthesis in the cytoplasm.                                                                                     | Kp1 |
| K022 | 6.3.3 Explain the role of the nucleolus in protein synthesis.                                                                                                          | Kp1 |
| K023 | 6.3.4 Distinguish between free and bound ribosomes in terms of location and function.                                                                                  | Kp1 |
| K024 | 6.4.1 List the components of the endomembrane system, and describe the structure and function of each component.                                                       | Kp1 |
| K025 | 6.4.2 Describe the path that a protein destined for the organelles of the endomembrane system, the plasma membrane or the outside of cell would follow.                | Kp1 |
| K026 | 6.4.3 Compare the structure and functions of smooth and rough ER.                                                                                                      | Kp1 |
| K027 | 6.4.4 Explain the significance of the <i>cis</i> and <i>trans</i> sides of the Golgi apparatus.                                                                        | Kp1 |
| K028 | 6.4.5 Describe three examples of intracellular digestion by lysosomes.                                                                                                 | Kp1 |
| K029 | 6.4.6 Name three different kinds of vacuoles, giving the function of each kind.                                                                                        | Kp1 |
| K030 | 6.5.1 Briefly describe the energy conversions carried out by mitochondria / chloroplasts.                                                                              | Kp1 |
| K031 | 6.5.2 Describe the structure and function of mitochondria and chloroplasts.                                                                                            | Kp1 |
| K032 | 6.5.3 Describe the evidence that mitochondria (and chloroplasts) evolved from a prokaryotic endosymbiont.                                                              | Kp1 |
| K033 | 6.5.4 Explain the roles of peroxisomes in eukaryotic cells.                                                                                                            | Kp1 |
| K034 | 6.6.1 Compare the structure, monomers, and functions of microtubules, microfilaments, and intermediate filaments.                                                      | Kp1 |
| K035 | 6.7.1 Describe the basic structure of a plant cell wall. Distinguish between the primary cell wall, middle lamella, and secondary cell wall.                           | Kp1 |
| K036 | 6.7.2 Describe the structure and roles of the extracellular matrix in animal cells.                                                                                    | Kp1 |
| K037 | 6.7.3 Explain how the extracellular matrix may act to integrate changes inside and outside the cell. Describe the proteins and glycoproteins involved in this process. | Kp1 |
| K038 | 6.7.4 Name the intercellular junctions found in plant and animal cells and described the differences between the intercellular junctions in animal tissues.            | Kp1 |

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| K039 | 7.1.1 Explain the meaning of the statement that phospholipids and most other membrane constituents (e.g., proteins) are amphipathic molecules.            | Kp1 |
| K040 | 7.1.2 Describe the fluidity of the components of a cell membrane and explain how membrane fluidity is influenced by temperature and membrane composition. | Kp1 |
| K041 | 7.1.3 Explain how cholesterol resists changes in membrane fluidity as temperatures change.                                                                | Kp1 |
| K042 | 7.1.4 Distinguish between peripheral and integral membrane proteins.                                                                                      | Kp1 |
| K043 | 7.1.5 List six major functions of membrane proteins.                                                                                                      | Kp1 |
| K044 | 7.1.6 Explain the role of membrane carbohydrates in cell-cell recognition.                                                                                | Kp1 |
| K045 | 7.2.1 Explain how hydrophobic molecules cross cell membranes.                                                                                             | Kp1 |
| K046 | 7.2.2 Distinguish between channel proteins and carrier proteins.                                                                                          | Kp1 |
| K047 | 7.2.3 Explain how aquaporins facilitate the passage of water through membranes.                                                                           | Kp1 |
| K048 | 7.3.1 Define diffusion. Explain why diffusion is a passive and spontaneous process.                                                                       | Kp1 |
| K049 | 7.3.2 Explain why a concentration gradient of a substance across a membrane represents potential energy.                                                  | Kp1 |
| K050 | 7.3.3 Distinguish between solutions that are hypertonic, hypotonic, and isotonic to cell contents.                                                        | Kp1 |
| K051 | 7.3.4 Define osmosis and predict the direction of water movement based on differences in solute concentrations.                                           | Kp1 |
| K052 | 7.3.5 Describe how living cells with and without cell walls regulate water balance.                                                                       | Kp1 |
| K053 | 7.3.6 Explain how transport proteins facilitate diffusion.                                                                                                | Kp1 |
| K054 | 7.3.7 Distinguish between osmosis, facilitated diffusion, and active transport.                                                                           | Kp1 |
| K055 | 7.4.1 Describe the two forces that combine to produce an electrochemical gradient.                                                                        | Kp1 |
| K056 | 7.4.2 Explain how electrogenic pump creates voltage across membrane. Name two electrogenic pumps.                                                         | Kp1 |
| K057 | 7.4.3 Describe the process of cotransport.                                                                                                                | Kp1 |
| K058 | 7.5.1 Explain how large molecule are transported across a cell membrane.                                                                                  | Kp1 |
| K059 | 7.5.2 Distinguish between exocytosis and receptor-mediated endocytosis.                                                                                   | Kp1 |
| K060 | 8.1.1 Explain the role of catabolic and anabolic pathways in cellular metabolism.                                                                         | Kp1 |
| K061 | 8.1.2 Distinguish between Kinetic and potential energy.                                                                                                   | Kp1 |
| K062 | 8.2.1 Distinguish between exergonic and endergonic reactions in terms of available energy change.                                                         | Kp1 |
| K063 | 8.3.1 List three main kinds of cellular work and provide examples of each. Explain in general terms how cells obtain the energy to do cellular work.      | Kp1 |
| K064 | 8.3.2 Describe the structure of ATP and identify the major class of macromolecules to which ATP belongs.                                                  | Kp1 |
| K065 | 8.3.3 Explain how ATP performs cellular work.                                                                                                             | Kp1 |
| K066 | 8.4.1 Describe the function of enzymes in biological systems.                                                                                             | Kp1 |
| K067 | 8.4.2 Explain how enzyme structure determines enzyme specificity.                                                                                         | Kp1 |
| K068 | 8.4.3 Explain the induced-fit model of enzyme function.                                                                                                   | Kp1 |

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| K069 | 8.4.4 Describe the mechanisms by which enzymes lower activation energy.                                                                                                                                                                                                                                        | Kp1 |
| K070 | 8.4.5 Explain how substrate concentration affects the rate of an enzyme-catalyzed reaction.                                                                                                                                                                                                                    | Kp1 |
| K071 | 8.4.6 Explain how temperature, pH, cofactors, and enzyme inhibitors can affect enzyme activity.                                                                                                                                                                                                                | Kp1 |
| K072 | 8.4.7 Distinguish between a competitive and noncompetitive inhibitors.                                                                                                                                                                                                                                         | Kp1 |
| K073 | 8.5.1 Describe how allosteric regulators may inhibit or stimulate the activity of an enzyme.                                                                                                                                                                                                                   | Kp1 |
| K074 | 8.5.2 Explain how the binding of oxygen to hemoglobin illustrates cooperativity.                                                                                                                                                                                                                               | Kp1 |
| K075 | 8.5.3 Explain how feedback inhibition prevents a cell from wasting chemical resources.                                                                                                                                                                                                                         | Kp1 |
| K076 | 8.5.4 Describe how localization of enzymes within a cell may help order metabolism.                                                                                                                                                                                                                            | Kp1 |
| K077 | 9.1.1 Distinguish, in general terms, between fermentation and aerobic respiration.                                                                                                                                                                                                                             | Kp1 |
| K078 | 9.1.2 Define oxidation and reduction. Be able to identify oxidizing agents and reducing agents as well as identify which molecules are being oxidized/reduced in an equation.                                                                                                                                  | Kp1 |
| K079 | 9.1.3 Explain in general terms how redox reactions are involved in energy exchanges.                                                                                                                                                                                                                           | Kp1 |
| K080 | 9.1.4 Describe the structure and the role of NAD <sup>+</sup> in cellular respiration.                                                                                                                                                                                                                         | Kp1 |
| K081 | 9.1.5 Explain, in general terms, the role of the electron transport in cellular respiration.                                                                                                                                                                                                                   | Kp1 |
| K082 | 9.2.1 Name the three stages of cellular respiration and state the region of the eukaryotic cell where each stage occurs. State the net amount of ATP generated by each stage and the type of phosphorylation that occurs. Be able label or draw a representation of cellular respiration in a eukaryotic cell. | Kp1 |
| K083 | 9.2.2 Describe how the carbon skeleton of glucose changes as it proceeds through glycolysis (comparing glucose and pyruvate).                                                                                                                                                                                  | Kp1 |
| K084 | 9.3.1 What is the energy yield of the citric acid cycle?                                                                                                                                                                                                                                                       | Kp1 |
| K085 | 9.4.1 Distinguish between substrate level phosphorylation and oxidative phosphorylation.                                                                                                                                                                                                                       | Kp1 |
| K086 | 9.4.2 In general terms, explain how the exergonic “slide” of electrons down the electron transport chain is coupled to the endergonic production of ATP by chemiosmosis.                                                                                                                                       | Kp1 |
| K087 | 9.4.3 Explain where and how the electron transport chain creates a proton gradient.                                                                                                                                                                                                                            | Kp1 |
| K088 | 9.5.1 Distinguish between fermentation and anaerobic respiration.                                                                                                                                                                                                                                              | Kp1 |
| K089 | 9.5.2 State the basic function of fermentation.                                                                                                                                                                                                                                                                | Kp1 |
| K090 | 9.5.3 Compare the fate of pyruvate in alcohol fermentation and lactic acid fermentation.                                                                                                                                                                                                                       | Kp1 |
| K091 | 9.6.1 Describe how food molecules other than glucose can be oxidized to make ATP.                                                                                                                                                                                                                              | Kp1 |
| K092 | 9.6.2 Explain how we regulate catabolic pathways.                                                                                                                                                                                                                                                              | Kp1 |
| K093 | 10.1 Explain the process of photosynthesis                                                                                                                                                                                                                                                                     | Kp1 |
| K094 | 10.2 Understand the reactions associated with photosynthesis                                                                                                                                                                                                                                                   | Kp1 |
| K095 | 10.3 Understand Calvin cycle                                                                                                                                                                                                                                                                                   | Kp1 |

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| K096 | 16.1.1 Explain why researchers originally thought protein was the genetic material.                                                                                                                                                                                    | Kp1 |
| K097 | 16.1.2 Explain how the experiments performed by the following scientists provided evidence that DNA is the genetic material:<br>a. Frederick Griffith<br>b. Oswald Avery, Maclyn McCarty, and Colin Macleod<br>c. Alfred Hershey and Martha Chase<br>d. Erwin Chargaff | Kp1 |
| K098 | 16.1.3 Explain how Watson and Crick deduced the structure of DNA and describe the evidence they used. Explain the significance of the research of Rosalind Franklin.                                                                                                   | Kp1 |
| K099 | 16.1.4 Describe the structure of DNA. Explain the base-pairing rule and describe its significance.                                                                                                                                                                     | Kp1 |
| K100 | 16.2.1 Describe the semiconservative model of replication and the significance of the experiments of Matthew Meselson and Franklin Stahl.                                                                                                                              | Kp1 |
| K101 | 16.2.2 Describe the process of DNA replication, including the role of the origins of replication and replication forks.                                                                                                                                                | Kp1 |
| K102 | 16.2.3 Explain the role of DNA polymerases in replication.                                                                                                                                                                                                             | Kp1 |
| K103 | 16.2.4 Explain the energy source drives the polymerization of DNA.                                                                                                                                                                                                     | Kp1 |
| K104 | 16.2.5 Distinguish between the leading strand and the lagging strand.                                                                                                                                                                                                  | Kp1 |
| K105 | 16.2.6 Explain how the lagging strand is synthesized even though DNA polymerase can add nucleotides only to the 3' end. Describe the significance of Okazaki fragments.                                                                                                | Kp1 |
| K106 | 16.2.7 Explain the role of DNA ligase, primer, primase, helicase, topoisomerase, and single strand binding proteins.                                                                                                                                                   | Kp1 |
| K107 | 16.2.8 Define “antiparallel” and explain why continuous synthesis of both DNA strands is not possible.                                                                                                                                                                 | Kp1 |
| K108 | 16.2.9 Explain the roles of DNA polymerase, mismatch repair enzymes, and nuclease in DNA proofreading and repair.                                                                                                                                                      | Kp1 |
| K109 | 16.2.10 Describe the structure and function of telomers.                                                                                                                                                                                                               | Kp1 |
| K110 | 16.2.11 Explain the possible significance of telomerase in germ cells and cancerous cells.                                                                                                                                                                             | Kp1 |
| K111 | 16.3.1 Compare bacterial chromosome and eukaryotic chromosome.                                                                                                                                                                                                         | Kp1 |
| K112 | 16.3.2 Describe how the packing of chromatin changes during the course of the cell cycle.                                                                                                                                                                              | Kp1 |
| K113 | 16.3.3 Distinguish between heterochromatin and euchromatin.                                                                                                                                                                                                            | Kp1 |
| K114 | 17.1.1 Explain the reasoning that led Archibald Garrod to suggest that genes dictate phenotypes through enzymes.                                                                                                                                                       | Kp1 |
| K115 | 17.1.2 Describe Beadle and Tatum’s experiments with <i>Neurospora</i> and explain the contribution they made to our understanding of how genes control metabolism.                                                                                                     | Kp1 |
| K116 | 17.1.3 Distinguish between the “one gene-one enzyme” hypothesis and the “one gene-one polypeptide” hypothesis and explain why the original hypothesis was changed.                                                                                                     | Kp1 |
| K117 | 17.1.4 Explain how RNA differs from DNA.                                                                                                                                                                                                                               | Kp1 |
| K118 | 17.1.5 Briefly explain how information flows from gene to protein. Is the central dogma ever violated?                                                                                                                                                                 | Kp1 |
| K119 | 17.1.6 Distinguish between transcription and translation.                                                                                                                                                                                                              | Kp1 |

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| K120 | 17.1.7 Compare where transcription and translation occur in bacteria and in eukaryotes.                                                                                                  | Kp1 |
| K121 | 17.1.8 Define “codon” and explain the relationship between the linear sequence of codons on mRNA and the linear sequence of amino acids in a polypeptide.                                | Kp1 |
| K122 | 17.1.9 Explain the early techniques used to identify what amino acids are specified by the triplets UUU, AAA, GGG, and CCC.                                                              | Kp1 |
| K123 | 17.1.10 Explain why polypeptides begin with methionine when they are synthesized.                                                                                                        | Kp1 |
| K124 | 17.1.11 Explain what it means to say that the genetic code is redundant and unambiguous.                                                                                                 | Kp1 |
| K125 | 17.1.12 Explain the significance of the reading frame during translation.                                                                                                                | Kp1 |
| K126 | 17.1.13 Explain the evolutionary significance of nearly universal genetic code.                                                                                                          | Kp1 |
| K127 | 17.2.1 Explain how RNA polymerase recognizes where transcription should begin. Describe the role of the promoter, the terminator and the transcription unit.                             | Kp1 |
| K128 | 17.2.2 Explain the general process of transcription, including the three major steps of initiation, elongation and termination.                                                          | Kp1 |
| K129 | 17.3.1 Explain how RNA is modified after transcription in eukaryotic cells.                                                                                                              | Kp1 |
| K130 | 17.3.2 Define and explain the role of ribozyme. What three properties allow some RNA molecules to function as ribozymes?                                                                 | Kp1 |
| K131 | 17.3.3 Describe the functional and evolutionary significance of introns.                                                                                                                 | Kp1 |
| K132 | 17.3.4 Explain why, due to alternative RNA splicing, the number of different protein products an organism can produce is much greater than its number of genes.                          | Kp1 |
| K133 | 17.4.1 Describe the structure and function of tRNA.                                                                                                                                      | Kp1 |
| K134 | 17.4.2 Explain the significance of wobble.                                                                                                                                               | Kp1 |
| K135 | 17.4.3 Explain how tRNA is joined to the appropriate amino acid.                                                                                                                         | Kp1 |
| K136 | 17.4.4 Describe the structure and functions of ribosomes.                                                                                                                                | Kp1 |
| K137 | 17.4.5 Explain the statement, “A ribosome can be regarded as one colossal ribozyme”.                                                                                                     | Kp1 |
| K138 | 17.4.6 Describe the process of translation (including initiation, elongation, and termination) and explain which enzymes, protein factors, and energy sources are needed for each stage. | Kp1 |
| K139 | 17.4.7 Describe the significance of polyribosomes.                                                                                                                                       | Kp1 |
| K140 | 17.4.8 Explain what determines the primary structure of a protein and describe how a polypeptide must be modified before it becomes fully functional.                                    | Kp1 |
| K141 | 17.4.9 Describe what determines whether a ribosome will be free in the cytosol or attached to the rough endoplasmic reticulum.                                                           | Kp1 |
| K142 | 17.5.1 Define “point mutations”. Distinguish between base-pair substitutions and base-pair insertions. Give an example of each and note the significance of such changes.                | Kp1 |
| K143 | 17.5.2 Distinguish between a missense and a nonsense mutation.                                                                                                                           | Kp1 |
| K144 | 17.5.3 Why is an insertion or deletion more likely to be deleterious than a substitution?                                                                                                | Kp1 |

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| K145         | 17.5.4 Define the term “mutation”. Give an example of a physical and a chemical agent of mutation.                                                                          | Kp1 |
| K146         | 17.5.5 Briefly, compare gene expression in bacteria, archaea, and eukarya. In general, is archaeal gene expression more similar to bacterial or eukaryotic gene expression? | Kp1 |
| K147         | 17.5.6 Describe the historical evolution of the concept of a gene.                                                                                                          | Kp1 |
| K148         | 19.1.1 Describe the structure of virus                                                                                                                                      | Kp1 |
| K149         | 19.1.2 List the different components of virus                                                                                                                               | Kp1 |
| K150         | 19.2 Describe the replication mechanism of virus                                                                                                                            | Kp1 |
| K151         | 20.1.1 Describe nucleic acid hybridization and how it is widely used in DNA technology                                                                                      | Kp1 |
| K152         | 20.1.2 Describe that DNA sequencing can be carried out using dideoxy sequencing method in automated sequencing machines.                                                    | Kp1 |
| K153         | 20.1.3 Explain the fast and inexpensive next-generation (high-throughput) techniques for sequencing DAN are based on sequencing by synthesis.                               | Kp1 |
| K154         | 20.1.4 Introduce the third sequencing methods including nanopore technology                                                                                                 | Kp1 |
| K155         | 20.1.5 Describe the natural function of restriction enzymes and explain how they are used in recombinant DNA technology.                                                    | Kp1 |
| K156         | 20.1.6 Explain how the creation of sticky ends by restriction enzymes is useful in producing a recombinant DNA molecule.                                                    | Kp1 |
| K157         | 20.1.7 Outline the procedures for cloning a eukaryotic gene in bacterial plasmid.                                                                                           | Kp1 |
| K158         | 20.1.8 Explain the rational for including a gene antibiotics resistance and a gene that codes for a hydrolytic enzyme in the plasmids.                                      | Kp1 |
| K159         | 20.1.9 Define and distinguish between genomic libraries using plasmids, phages, and cDNA.                                                                                   | Kp1 |
| K160         | 20.1.10 Describe the role of an expression vector.                                                                                                                          | Kp1 |
| K161         | 20.1.11 Describe two advantages of using yeast cells instead of bacteria as host for cloning or expression eukaryotic genes.                                                | Kp1 |
| K162         | 20.1.12 Describe the structure and function of a yeast artificial chromosome (YAC).                                                                                         | Kp1 |
| K163         | 20.1.13 Describe two techniques to introduce recombinant DNA into eukaryotic cells.                                                                                         | Kp1 |
| K164         | 20.1.14 Describe the polymerase chain reaction (PCR) and explain the advantages and limitations of this procedure.                                                          | Kp1 |
| Skills       |                                                                                                                                                                             |     |
| Competencies |                                                                                                                                                                             |     |
| C01          | 6.1 Tour a cell and become acquainted with its components.                                                                                                                  | Cp1 |
| C02          | 7.1 Learn how cellular membranes control the passage of substances, often with transport proteins.                                                                          | Cp1 |
| C03          | 7.2 Understand how the plasma membrane and its proteins enable cells to survive and function.                                                                               | Cp1 |
| C04          | 8.1 Understand how matter and energy flow during life's processes.                                                                                                          | Cp1 |
| C05          | 8.2 Understand how energy flow is regulated.                                                                                                                                | Cp1 |
| C06          | 9.1 Consider how cells harvest the chemical energy stored in organic molecules.                                                                                             | Cp1 |

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| C07 | 9.2 Know how energy is used it to generate ATP.                                                                                                                                                                                                                                       | Cp1 |
| C08 | 9.3 Know the pathways of respiration and fermentation.                                                                                                                                                                                                                                | Cp1 |
| C10 | 16.1 Discovering how biologists deduced that DNA is the genetic material and how Watson and Crick worked out its structure.<br>16.2 Learn how a molecule of DNA is copied and how cells repair their DNA.<br>16.3 Explore how a DNA is packed together with proteins in a chromosome. | Cp1 |
| C11 | 17.1 Describe the flow of information from gene to protein.                                                                                                                                                                                                                           | Cp1 |
| C12 | 17.2 Explain how genetic mutations affect organisms through their proteins.                                                                                                                                                                                                           | Cp1 |
| C13 | 17.3 Understand the processes of gene expression.                                                                                                                                                                                                                                     | Cp1 |
| C14 | 20.1 Describe the main techniques for sequencing and manipulating DNA.                                                                                                                                                                                                                | Cp1 |

### Learning Resources

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|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course textbook       | Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. (2014). <i>Campbell biology</i> (Vol. 9). Boston: Pearson.      |
| Supporting References |                                                                                                                                                             |
| Supporting websites   |                                                                                                                                                             |
| Teaching Environment  | <input checked="" type="checkbox"/> Classroom <input type="checkbox"/> laboratory <input type="checkbox"/> Learning platform <input type="checkbox"/> Other |

### Meetings and subjects timetable

| Week | Topic                                                                                                                                                                                  | Learning Methods* | Tasks | Learning Material<br>Text book |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------|--------------------------------|
| 1    | <b>Introduction</b><br><b>The chemical context of life</b><br>2.1. Matter consists of chemical elements in pure form and in combinations called compounds.                             | Lectures          |       | P. 28-43                       |
| 2    | <b>Water and life</b><br>3.1. Polar covalent bonds in water molecules result in hydrogen bonding<br>3.2. Four emerging properties of water contribute to Earth's suitability for life. | Lectures          |       | P. 44-55                       |



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|     | <b>Carbon and the molecular diversity of life</b><br>4.2. Carbon atoms can form diverse molecules by bonding to four other atoms. Exploring some biologically important chemical groups.                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |  |            |
| 3,4 | <b>The structure and the function of large biological molecules</b><br>5.1. Macromolecules are polymers built from monomers<br>5.2. Carbohydrates serves as fuel and building material<br>5.3. Lipids are a diverse group of hydrophobic Molecules<br>5.4. Proteins include a diversity of structures, resulting in a wide range of functions<br>5.5. Nucleic acids store, transmit, and help express hereditary information.                                                                                                                                                                                                 | Lectures |  | P. 66-91   |
| 5,6 | <b>A tour of the cell</b><br>6.2. Eukaryotic cells have internal membranes compartmentalize the functions<br>6.3. The eukaryotic cell's genetic instructions are housed in the nucleus and carried out by the ribosomes<br>6.4. The Endomembrane system regulates protein traffic and performs metabolic functions.<br>6.5. Mitochondria and chloroplasts change energy from one form to another<br>6.6. The Cytoskeleton is a network of fibers that organizes structures and activities in the cell <b>(In Brief)</b> .<br>6.7. Extracellular components and connections between cells help coordinate cellular activities. | Lectures |  | P. 93-125  |
| 7   | <b>Membrane structure and function</b><br>7.1. Cellular membranes are fluid mosaics of lipids and proteins.<br>7.2. Membrane structures results in selective permeability<br>7.3. Passive transport is diffusion of a substance across a membrane with no energy investment<br>7.4. Active transport uses energy to move solutes against their gradients<br>7.5. Bulk transport across the plasma membrane occurs by exocytosis and endocytosis                                                                                                                                                                               | Lectures |  | P. 126-142 |
| 8   | <b>An introduction to metabolism</b><br>8.1. An Organism's metabolism transforms matter and energy subject to the laws of thermodynamics.<br>8.2 The Free energy change of a reaction tells us whether or not the reaction occurs spontaneously: Free energy and metabolism; Equilibrium and Metabolism.<br>8.3. ATP powers cellular work by coupling exergonic to endergonic reactions.<br>8.4. Enzymes speed up metabolic reactions by lowering energy barriers.<br>8.5. Regulation of enzyme activity helps control metabolism.                                                                                            | Lectures |  | P. 143-163 |
| 9   | <b>Midterm exam</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |  |            |
| 10  | <b>Cellular respiration and fermentation</b><br>9.1. Catabolic pathways yield energy by oxidizing organic fuels<br>9.2. Glycolysis harvests chemical energy by oxidizing glucose to pyruvate<br>9.3. After pyruvate is oxidized, the citric acid cycle completes the energy-yielding oxidation of organic molecules                                                                                                                                                                                                                                                                                                           | Lectures |  | P. 164-186 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |  |                             |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--|-----------------------------|
|    | 9.4. During oxidation phosphorylation, chemiosmosis couples electron transport to ATP synthesis<br>9.5. Fermentation and anaerobic respiration enable cells to produce ATP without the use of oxygen<br>9.6. Glycolysis and citric acid cycle connect to many other metabolic pathways                                                                                                                                                     |          |  |                             |
| 11 | <b>Photosynthesis</b><br>10.1. Photosynthesis converts light energy to the chemical energy of food<br>10.2. The light reactions convert solar energy to the chemical energy of ATP and NADPH<br>10.3. The Calvin cycle uses the chemical energy of ATP and NADPH to reduce CO <sub>2</sub> to sugar.                                                                                                                                       | Lectures |  | P.187-211                   |
| 13 | <b>The molecular basis of inheritance</b><br>16.1. DNA is the genetic material<br>16.2. Many proteins work together in DNA replication and repair<br>16.3 A chromosome consists of a DNA molecule packed together with proteins.                                                                                                                                                                                                           | Lectures |  | P. 314-334                  |
| 14 | <b>Gene expression: From gene to protein</b><br>17.1. Genes specify proteins via transcription and translation<br>17.2. Transcription is the DNA-directed synthesis of RNA: <i>a closer look</i><br>17.3. Eukaryotic cells modify RNA after transcription<br>17.4. Translation is the RNA-directed synthesis of a polypeptide: <i>a closer look</i><br>17.5. Mutations of one or few nucleotides can affect protein structure and function | Lectures |  | P. 335-363                  |
| 15 | <b>Viruses</b><br>19.1. A virus consists of a nucleic acid surrounded by a protein coat<br>19.2. Viruses replicate only in host cells.<br><br><b>DNA tools and biotechnology</b><br>20.1. DNA sequencing and DNA cloning are valuable tools for the genetic engineering and biological inquiry                                                                                                                                             |          |  | P. 398-414<br><br>P.415-423 |
| 16 | <b>Final exam</b>                                                                                                                                                                                                                                                                                                                                                                                                                          |          |  |                             |

\* includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

### Course Contributing to Learner Skill Development

|                                |
|--------------------------------|
| Using Technology               |
|                                |
| Communication skills           |
|                                |
| Application of concepts learnt |
|                                |

### Assessment Methods and Grade Distribution

| Assessment Methods    | Grade Weight | Assessment Time (Week No.) | Link to Course Outcomes |
|-----------------------|--------------|----------------------------|-------------------------|
| Mid Term Exam         | % 30         | 9                          | K001-K076<br>C01-C05    |
| Various Assessments * | % 30         | 2,4,6,7,8,11,13,14,15      | K001-K164<br>C01-C14    |
| Final Exam            | % 40         | 16                         | K001-K164<br>C01-C14    |
| <b>Total</b>          | <b>%100</b>  |                            |                         |

\* includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

### Alignment of Course Outcomes with Learning and Assessment Methods

| Number              | Learning Outcomes | Learning Method* | Assessment Method**      |
|---------------------|-------------------|------------------|--------------------------|
| <b>Knowledge</b>    |                   |                  |                          |
| <b>K001-K164</b>    | All outcomes      | Lectures         | <b>Quizzes and exams</b> |
| <b>Skills</b>       |                   |                  |                          |
| <b>Competencies</b> |                   |                  |                          |
| <b>C01-C14</b>      | All outcomes      | Lectures         | <b>Quizzes and exams</b> |

\* includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

\*\* includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

### Course Policies

| Policy               | Policy Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Passing Grade</b> | The minimum passing grade for the course is (50%) and the minimum final mark recorded on transcript is (35%).                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Missing Exams</b> | <ul style="list-style-type: none"> <li>Missing an exam without a valid excuse will result in a zero grade to be assigned to the exam or assessment.</li> <li>A Student who misses an exam or scheduled assessment, for a legitimate reason, must submit an official written excuse within a week from the exam or assessment due date.</li> <li>A student who has an excuse for missing a final exam should submit the excuse to the dean within three days of the missed exam date.</li> </ul> |
| <b>Attendance</b>    | The student is not allowed to be absent more than (15%) of the total hours prescribed for the course, which equates to six lectures days (M, W) and seven lectures (S,T,R). If the student misses more than (15%) of the total hours prescribed for the course without a satisfactory excuse accepted by the dean of the faculty, s/he will be prohibited from taking the final exam and the grade in that course is considered (zero), but if the absence is due to illness or a compulsive    |

|                         |                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | excuse accepted by the dean of the college, then withdrawal grade will be recorded.                                                                                                                                                                                                                                                                    |
| <b>Academic Honesty</b> | Philadelphia University pays special attention to the issue of academic integrity, and the penalties stipulated in the university's instructions are applied to those who are proven to have committed an act that violates academic integrity, such as: cheating, plagiarism (academic theft), collusion, and violating intellectual property rights. |

**Program Learning Outcomes to be assessed in this Course**

| Number | Learning Outcome | Course Title                | Assessment Method | Target Performance level |
|--------|------------------|-----------------------------|-------------------|--------------------------|
| 1      | Kp1              | Environmental biotechnology | Quizzes and exams |                          |
| 2      | Cp1              | Environmental biotechnology | Quizzes and exams |                          |

**Description of Program Learning Outcome Assessment Method**

| Number     | Detailed Description of Assessment |
|------------|------------------------------------|
| <b>Kp1</b> | Quizzes and exams                  |
| <b>Cp1</b> | Quizzes and exams                  |

**Assessment Rubric of the Program Learning Outcome**

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