COURSE OUTLINE : BIOL 141
D Credit – Degree Applicable
COURSE ID 010548
Created: February 2021

COURSE DISCIPLINE : BIOL

COURSE NUMBER : 141

COURSE TITLE (FULL) : Applied Biotechnology I with Laboratory

COURSE TITLE (SHORT) : Applied Biotech I

CALIFORNIA STATE UNIVERSITY SYSTEM C-ID : BIOT 150X - Applied Biotechnology with Laboratory

CCC ACADMIC SENATE DISCIPLINE: Biological Science and Biotech

CATALOG DESCRIPTION

BIOL 141 prepares students for the biotechnology industry by emphasizing the core concepts practiced in a bioscience laboratory. Topics include laboratory math, basic chemistry of buffers, laboratory safety, quality control, biological molecules, gene expression, cell structure and molecular biology techniques. This course introduces students to standard biotechnology laboratory skills including laboratory measurements, preparation of media and solutions, data collection and evaluation, basic separation methods, molecular techniques, aseptic techniques and documentation. Good communication and collaborative work are emphasized. This course is intended for, but not limited to, students preparing for a career in biotechnology.

CATALOG NOTES

Student will not receive unit credit if BIOL 298 has been taken with a grade of “C” or better.

Total Lecture Units: 2.00

Total Laboratory Units: 2.00

Total Course Units: 4.00

Total Lecture Hours: 36.00

Total Laboratory Hours: 108.00

Total Laboratory Hours To Be Arranged: 0.00

Total Contact Hours: 144.00

Total Out-of-Class Hours: 72.00

Recommended Preparation: MATH 100, ENGL 101, BIOL 140 or BIOL 101 or BIOL 112 or BIOL 122, and CHEM 110 or CHEM 120, or equivalent.

ENTRY STANDARDS

	Subject	Number	Title	Description	Include
1	BIOL	101	General Biology I	Identify the properties of lipids, carbohydrates, proteins, and nucleic acids;	Yes
2	BIOL	101	General Biology I	describe the structure of prokaryotic and eukaryotic cells;	Yes
3	BIOL	101	General Biology I	explain cell respiration and photosynthesis;	No
4	BIOL	101	General Biology I	describe and identify the different stages in mitosis;	Yes
5	BIOL	101	General Biology I	describe the relationships between meiosis and Mendelian genetics;	No
6	BIOL	101	General Biology I	solve Mendelian genetics problems, including autosomal, X-linked genes and dihybrid crosses;	No
7	BIOL	101	General Biology I	describe the processes of DNA replication, transcription, and translation;	Yes
8	BIOL	101	General Biology I	explain the basic mechanisms of gene regulation in prokaryotes and eukaryotes.	Yes
9	BIOL	101	General Biology I	demonstrate proper use of laboratory equipment including the microscope, spectrophotometer, and micropipettes;	Yes
10	BIOL	101	General Biology I	demonstrate proficiency with data collection, analysis, and graphical representation.	Yes
11	BIOL	112	Microbiology	demonstrate a general understanding of the taxonomy and major characteristics of the various microorganisms	No
12	BIOL	112	Microbiology	demonstrate general knowledge of the physical and chemical structure of prokaryotes and eukaryotes	Yes
13	BIOL	112	Microbiology	demonstrate an understanding of the biochemical processes of the cell, including cell respiration, DNA replication, genetic recombination, transcription, translation, and cellular transport	Yes
14	BIOL	112	Microbiology	demonstrate an understanding of the physical and chemical methods and mechanisms used to control microbial growth	Yes
15	BIOL	112	Microbiology	demonstrate an understanding of the disease process of various microorganisms	No
16	BIOL	112	Microbiology	demonstrate proper aseptic techniques and proficiency in performing various staining procedures and biochemical tests on microorganisms	Yes

17	BIOL	122	Introduction to Biology	Describe the structure of atoms, the properties of water and structure and function of biological macromolecules;	Yes
18	BIOL	122	Introduction to Biology	describe the flow of information from DNA to protein;	Yes
19	BIOL	122	Introduction to Biology	describe the mechanisms of evolution including natural selection;	No
20	BIOL	122	Introduction to Biology	describe basic ecological principles and the impact of humans on the environment;	No
21	BIOL	122	Introduction to Biology	identify the defining characteristics of major groups of organisms;	No
22	BIOL	122	Introduction to Biology	compare prokaryotic and eukaryotic cells, and describe the structure and function of eukaryotic organelles;	Yes
23	BIOL	122	Introduction to Biology	describe the principles of inheritance and solve basic Mendelian genetics problems;	No
24	BIOL	122	Introduction to Biology	describe basic principles of mammalian physiology.	No
25	CHEM	110	Elements of General Chemistry	Use dimensional analysis to solve quantitative problems and check answers to make sure they are physically reasonable as applied to areas such as unit conversions, stoichiometry, and gas laws for example;	No
26	CHEM	110	Elements of General Chemistry	apply IUPAC naming rules to acids, salts, and molecular compounds;	No
27	CHEM	110	Elements of General Chemistry	clearly explain qualitative chemical concepts and trends;	Yes
28	CHEM	110	Elements of General Chemistry	perform laboratory experiments correctly using appropriate techniques and safety procedures;	Yes
29	CHEM	110	Elements of General Chemistry	describe, model, and analyze microscopic behavior to explain macroscopic properties as applied to such areas as chemical bonding, gas laws, atomic theory, acids, bases, nuclear chemistry, and oxidation-reduction.	Yes
30	CHEM	120	Fundamentals Of College Chemistry (Inorganic)	Use dimensional analysis method to calculate medication dosage based on body mass in both English and metric units	No
31	CHEM	120	Fundamentals Of College Chemistry (Inorganic)	analyze supposed scientific reasoning as logical or not	No
32	CHEM	120	Fundamentals Of College Chemistry (Inorganic)	evaluate scientific statements and develop an opinion as to their validity	Yes

33	CHEM	120	Fundamentals Of College Chemistry (Inorganic)	identify and describe basic chemical data, rules, and laws.	Yes
34	ENGL	101	Introduction to College Reading and Composition	Read, analyze, and evaluate a variety of primarily non-fiction readings for content, context, and rhetorical merit with consideration of tone, audience, and purpose;	No
35	ENGL	101	Introduction to College Reading and Composition	apply a variety of rhetorical strategies in writing unified, well-organized essays directed by a well-reasoned thesis statement with persuasive support;	No
36	ENGL	101	Introduction to College Reading and Composition	develop varied and flexible strategies for generating, drafting, and revising essays;	No
37	ENGL	101	Introduction to College Reading and Composition	analyze stylistic choices in their own writing and the writing of others;	No
38	ENGL	101	Introduction to College Reading and Composition	write timed, in-class essays exhibiting acceptable college-level control of mechanics, organization, development, and coherence;	Yes
39	ENGL	101	Introduction to College Reading and Composition	integrate the ideas of others through paraphrasing, summarizing, and quoting without plagiarism;	Yes
40	ENGL	101	Introduction to College Reading and Composition	find, evaluate, analyze, and interpret primary and secondary sources, incorporating them into written essays using appropriate documentation format;	Yes
41	ENGL	101	Introduction to College Reading and Composition	proofread and edit essays for presentation so they exhibit no disruptive errors in English grammar, usage, or punctuation.	Yes
42	MATH	100	College Algebra	Analyze the following functions: polynomial, rational, radical, absolute value, exponential and logarithmic (including definitions, evaluation, and domain and range);	Yes
43	MATH	100	College Algebra	graph functions, including asymptotic behavior, intercepts, vertices and transformations;	Yes
44	MATH	100	College Algebra	perform operations on functions;	Yes
45	MATH	100	College Algebra	find inverses of functions;	No
46	MATH	100	College Algebra	solve equations including: linear, polynomial, radical, rational, absolute value, exponential and logarithmic;	Yes

47	MATH	100	College Algebra	solve linear, absolute value, and non-linear inequalities;	No
48	MATH	100	College Algebra	solve linear and non-linear systems of equations and inequalities;	No
49	MATH	100	College Algebra	apply the Fundamental Theorem of Algebra and related theorems to find the roots of a polynomial;	No
50	MATH	100	College Algebra	model and solve STEM application problems;	Yes
51	MATH	100	College Algebra	graph and algebraically analyze conic sections;	No
52	MATH	100	College Algebra	apply the binomial theorem and use formulas to find sums of finite and infinite series.	No
53	BIOL	140	Introduction to Biotechnology	List the morphologic and chemical differences between prokaryotic and eukaryotic cells	Yes
54	BIOL	140	Introduction to Biotechnology	Define and distinguish among atoms, molecules, compounds, chemical bonds, mechanisms of chemical bond formation, and components of biological molecules	Yes
55	BIOL	140	Introduction to Biotechnology	Construct the flow diagram of gene expression from DNA to protein	Yes
56	BIOL	140	Introduction to Biotechnology	Translate the triplet code of DNA into primary protein structure	Yes
57	BIOL	140	Introduction to Biotechnology	Assess the role of basic Mendelian genetics	Yes
58	BIOL	140	Introduction to Biotechnology	Compare and contrast current applications of biotechnology to the areas of medicine, agriculture, diagnostics, and the environment	Yes
59	BIOL	140	Introduction to Biotechnology	Explain evolution from a genetic perspective	No
60	BIOL	140	Introduction to Biotechnology	Evaluate a recent development in thefield of biotechnology from an ethical perspective	Yes

61	BIOL	140	Introduction to Biotechnology	Demonstrate pipetting skills	Yes
62	BIOL	140	Introduction to Biotechnology	Explain the importance of Good Laboratory Practices and record keeping	Yes
63	BIOL	140	Introduction to Biotechnology	Prepare and analyze graphs	Yes
64	BIOL	140	Introduction to Biotechnology	Explain how an antibody-based assay works (e.g. ELISA)	Yes
65	BIOL	140	Introduction to Biotechnology	Perform bacterial transformation	Yes
66	BIOL	140	Introduction to Biotechnology	Use of aseptic techniques in lab procedures, such as handling of bacteria, microbiology and molecular biology work.	Yes
67	BIOL	140	Introduction to Biotechnology	Demonstrate proficiency in basic molecular techniques (e.g. DNA and protein analysis techniques)	Yes
68	BIOL	140	Introduction to Biotechnology	Identify parts of a microscope	Yes
69	BIOL	140	Introduction to Biotechnology	Use a microscope to view specimens	Yes
70	BIOL	140	Introduction to Biotechnology	Employ a lab protocol and explain deviations from the protocol	Yes

EXIT STANDARDS

1 Describe cell structure
2 Apply principals of basic chemistry of buffers and pH to biological molecules
3 Define and distinguish among biological molecules
4 Construct the flow diagram of gene expression from DNA to protein
5 Explain recombinant DNA
6 Convert between metric units
7 Perform basic dilutions
8 Perform calculations related to reagents, solutions and media formulations
9 Demonstrate Good Laboratory Practices (as defined by industry) and record keeping ina laboratory notebook
10 Prepare and analyze graphs
11 Grow cells using aseptic techniques
12 Demonstrate ability to use measurement instrumentation properly
13 Perform a concentration assay for DNA or Protein
14 Successfully perform a basic bio-separation technique such as column chromatography
15 Perform a molecular technique such as DNA sizing electrophoresis
16 Demonstrate work-readiness skills

STUDENT LEARNING OUTCOMES

1 Apply and demonstrate good laboratory safety and aseptic techniques to make appropriate solutions and culture media to grow cells.
2 Apply knowledge of cell, molecular, and microbiology to isolate, quantify, and study the important biomolecules of cells.
3 Properly record and document data and data analyses in an organized lab notebook.

COURSE CONTENT WITH INSTRUCTIONAL HOURS

	Description	Lecture	Lab	Total Hours
1	Scientific method	1.5	0	1.5
2	Biotechnology overview	1.5	0	1.5
3	Molecular and cell biology • Biological molecules (proteins, carbohydrates, lipids, nucleic acids) • Cell structures (prokaryotes and eukaryotes) • Gene expression • DNA technology and analysis • Cell culture and fermentation • Bioseparation (protein purification, agarose gel, etc.)	18	0	18
4	Bacterial cell culture methods • Preparation and sterilization of bacterial media • Growth and maintenance of bacterial cultures	1.5	0	1.5
5	Mammalian cell culture method • Preparation and sterilization of media for mammalian cells • Growth and maintenance of mammalian cultures	1.5	0	1.5

6	Laboratory math • Units of measurement and converting between units (metric system) • Graphical methods of analysis and data display • Various methods for expressing concentration • Calculation for molar and percent solution • Dilutions • Reagents, solutions and media formulations	6	0	6
7	Basic chemistry of buffers and pH	1	0	1
8	Common Laboratory Measurements • Weight • Volume • pH • Temperature • Spectrophotometry	2	0	2
9	Health and Safety • MSDS/SDS • Personal Protection Equipment • Contamination	1	0	1
10	Laboratory basic skills • Application of laboratory math	0	3	3
11	Laboratory basic skills • Micropipetting and serological pipetting skills	0	4	4
12	Laboratory basic skills • Laboratory safety practices	0	2	2
13	Laboratory basic skills • Aseptic techniques	0	3	3
14	Laboratory basic skills • Good manufacturing practices	0	3	3
15	Laboratory basic skills • Preparation of various solutions at different concentrations	0	6	6

16	Laboratory basic skills • Proper dilution of solutions, media	0	3	3
17	Laboratory basic skills • Preparation and analysis of buffers	0	3	3
18	Laboratory basic skills • Preparation of biological solutions (media preparation, autoclaving, pH determination and adjustments, measuring, balances, volumes)	0	6	6
19	Laboratory basic skills • Agarose gels testing	0	3	3
20	Laboratory basic skills • Uses of polyacrylamide gels	0	3	3
21	Laboratory basic skills • Spectrophotometry	0	3	3
22	General biotechnology and molecular techniques used in industry: DNA • Bacterial cell transformation	0	3	3
23	General biotechnology and molecular techniques used in industry: DNA • Plasmid isolation	0	3	3
24	General biotechnology and molecular techniques used in industry: DNA • Chromosome isolation	0	3	3
25	General biotechnology and molecular techniques used in industry: DNA • Gel electrophoresis	0	3	3
26	General biotechnology and molecular techniques used in industry: DNA • Restriction digestion and analysis	0	3	3

27	General biotechnology and molecular techniques used in industry: DNA • Cloning	0	6	6
28	General biotechnology and molecular techniques used in industry: DNA • PCR	0	3	3
29	General biotechnology and molecular techniques used in industry: Proteins • Protein isolation	0	3	3
30	General biotechnology and molecular techniques used in industry: Proteins • Protein quantification	0	2	2
31	General biotechnology and molecular techniques used in industry: Proteins • Western blot	0	6	6
32	General biotechnology and molecular techniques used in industry: Proteins • Column chromatography	0	3	3
33	General biotechnology and molecular techniques used in industry: Antibodies • ELISA (enzyme-linked immunosorbent assay) • Western Blot	0	3	3
34	Inoculation/growth of cell cultures	0	6	6
35	Lab safety	0	2	2
36	Documentation and record keeping • Physical lab notebook • E-notebook (e.g. Benchling.com)	0	3	3
37	Data collection and evaluation	0	3	3
38	Standard operating procedures (SOP)	0	3	3

39	Work-readiness skills • Oral communication, presentation • Written communication • Teamwork, team building exercises • Industry expert and/or career counselor workshops • Resume writing • Interview skills • Job searching	2	8	10
				144

OUT OF CLASS ASSIGNMENTS

1 Reading assigned chapters in course textbook(s), laboratory manual, and/or relevant scientific articles.
2 Homework assignment aimed at explaining and recognizing major concepts (e.g. making buffers, dilutions, constructing recombinant DNA, restriction enzyme analysis and gel electrophoresis.)
3 Maintaining lab notebook that contains laboratory protocols (e.g. a written protocol that includes the title, purpose, materials needed, procedures, and results) and test results.
4 Pre-lab quizzes.
5 Written lab report.

METHODS OF EVALUATION

1 Class presentation
2 Class and laboratory activities and experiments
3 Writing assignments that assess the ability to apply good laboratory practices to reports and lab notebooks (e.g. data collection and modifications to laboratory protocols, Standard Operating Procedures).
4 Laboratory practica that assess the ability to prepare and analyze graphs, follow a protocol, demonstrate basic lab skills and workplace competency, and explain deviations from the protocol.
5 Objective written examinations and quizzes that test for definitions and application of major concepts
6 Field trip

METHODS OF INSTRUCTION

☐ Lecture
☑ Laboratory
☐ Studio
☑ Discussion

- [x] Multimedia
- [ ] Tutorial
- [ ] Independent Study
- [x] Collaboratory Learning
- [x] Demonstration
- [x] Field Activities (Trips)
- [x] Guest Speakers
- [x] Presentations

TEXTBOOKS

Title	Type	Publisher	Edition	Medium	Author	IBSN	Date
Introduction to Biotechnology	Required	Pearson	4	print	Thienman, Willian J.	978-0134650197	2018
Campbell Essential Biology	Supplemental	Pearson	7	Print	Simon, Eric J.	978-0134812946	2018
Laboratory Manual for Biotechnology and Laboratory Science: The Basics. Boston	Supplemental	Pearson		Printed	Seidman, LisaA.	9780321644022	2011
. Biotechnology: A Laboratory Skills Course	Required	Bio-Rad	2	Print	Brown, J. Kirk	9780983239635, 0983239630	2018
Biomanufacturing Laboratory Manual	Required	Northeast Biomanufacturing Center		Online	Northeast Biomanufacturing Center and Collaborative		2012