Biotechnology I

Subject: Career and Technical Education
Grade: 11
Expectations: 70
Breakouts: 245

(a) Introduction.

1. Career and technical education instruction provides content aligned with challenging academic standards, industry-relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and emerging professions.

2. The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services such as laboratory and testing services and research and development services.

3.

b.

(vi) present oral communication in an effective manner

(D) demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results; and

(i) demonstrate time-management skills in prioritizing tasks in a way that produces efficient results

(ii) demonstrate time-management skills in following schedules in a way that produces efficil3e9.1 (n)-6.1 (t)-3.4 (s)-1.

(iv) use appropriate safety practices during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(v) use appropriate safety practices during classroom investigations as outlined in Texas Education Agency-approved safety standards

(vi) use appropriate safety practices during field investigations as outlined in Texas Education Agency-approved safety standards

(D) use appropriate tools such as microscopes, thermocyclers, pH meters, hot plate stirrers, glass bulb thermometers, timing devices, electronic balances, vortex mixers, autoclaves, micropipettes, centrifuges, gel and capillary electrophoresis units, cameras, data collection probes, spectrophotometers, transilluminators, incubators, water baths, laboratory glassware, biosafety cabinets, and chemical fume hoods;

(i) use appropriate tools

(E) collect quantitative data using the International System of Units (SI) and United States customary units and qualitative data as evidence;

(i) collect quantitative data using the International System of Units (SI)

(ii) collect quantitative data using United States customary units

(iii) collect qualitative data as evidence

(F) organize quantitative and qualitative data using laboratory notebooks, written lab reports, graphs, charts, tables, digital tools, diagrams, scientific drawings, and student-prepared models;

(i) organize quantitative data using laboratory notebooks

(ii) organize quantitative data using written lab reports

(iii) organize quantitative data using graphs

(iv) organize quantitative data using charts

(v) organize quantitative data using tables

(vi) organize quantitative data using digital tools

(vii) organize quantitative data using diagrams

(viii) organize quantitative data using scientific drawings

(ix) organize quantitative data using student-prepared models

(x) organize qualitative data using laboratory notebooks

(xi) organize qualitative data using written lab reports

(xii) organize qualitative data using graphs

(xiii) organize qualitative data using charts

(xiv) organize qualitative data using tables

(xv) organize qualitative data using digital tools

(xvi) organize qualitative data using diagrams

(xvii) organize qualitative data using scientific drawings

(xviii) organize qualitative data using student-prepared models

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

(i) develop models to represent phenomena, systems, processes, or solutions to engineering problems

(ii) use models to represent phenomena, systems, processes, or solutions to engineering problems

(H) distinguish between scientific hypotheses, theories, and laws.

(i) distinguish between scientific hypotheses, theories, and laws

(3) The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

(i) identify advantages of models

(ii) identify limitations of models

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

(i) analyze data by identifying significant statistical features

(ii) analyze data by identifying patterns

(iii) analyze data by identifying sources of error

(iv) analyze data by identifying limitations

(C) use mathematical calculations to assess quantitative relationships in data; and

(i) use mathematical calculations to assess quantitative relationships in data

(D) evaluate experimental and engineering designs.

(i) evaluate experimental designs

(ii) evaluate engineering designs

(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(i) develop explanations supported by data and consistent with scientific ideas

(ii) develop explanations supported by data and consistent with scientific principles

(iii) develop explanations supported by data and consistent with scientific theories

(iv) develop explanations supported by models and consistent with scientific ideas

(v) develop explanations supported by models and consistent with scientific principles

(vi) develop explanations supported by models and consistent with scientific theories

(vii) propose solutions supported by data and consistent with scientific ideas

(viii) propose solutions supported by data and consistent with scientific principles

(ix) propose solutions supported by data and consistent with scientific theories

(x) propose solutions supported by models and consistent with scientific ideas

(xi) propose solutions supported by models and consistent with scientific principles

(xii) propose solutions supported by models and consistent with scientific theories

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(i) communicate explanations individually in a variety of settings

(ii) communicate explanations individually in a variety of formats

(iii) communicate explanations collaboratively in a variety of settings

(iv) communicate explanations collaboratively in a variety of formats

(v) communicate solutions individually in a variety of settings

(vi) communicate solutions individually in a variety of formats

(vii) communicate solutions collaboratively in a variety of settings

(viii) communicate solutions collaboratively in a variety of formats

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

(i) engage respectfully in scientific argumentation using applied scientific explanations

(ii) engage respectfully in scientific argumentation using empirical evidence

(5) The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student;

(i) analyze scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(ii) analyze scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(iii) analyze scientific explanations and solutions by using experimental testing so as to encourage critical

(i) identify applications in forensic biotechnology

(J) identify solutions to waste through bioremediation and non-biotechnological standard solutions such as landfills, incineration, absorbent materials, and catalytic materials.

(i) identify solutions to waste through bioremediation

(ii) identify solutions to waste through non-biotechnological standard solutions

(7) The student summarizes biotechnology laboratory procedures and their applications in the bio (g)6.2 (y l)5.1t0.0027252tanshe so

(iii) compare and contrast the structures of DNA and ribonucleic acid (RNA), including the helical nature of DNA

(iv) compare and contrast the structures of DNA and ribonucleic acid (RNA), including hydrogen bonding between purines and pyrimidines

(v) compare and contrast the functions of DNA and ribonucleic acid (RNA), including nitrogen bases

(vi) compare and contrast the functions of DNA and ribonucleic acid (RNA), including nucleotides

(vii) compare and contrast the functions of DNA and ribonucleic acid (RNA), including the helical nature of DNA

(viii) compare and contrast the functions of DNA and ribonucleic acid (RNA), including hydrogen bonding between purines and pyrimidines

(C) distinguish between nuclear and mitochondrial DNA and their gamete sources;

(i) distinguish between nuclear and mitochondrial DNA and their gamete sources

(D) describe the DNA replication process in eukaryotic cells and prokaryotic cells, including leading and lagging strands, and Okazaki strands;

(i) describe the DNA replication process in eukaryotic cells, including leading and lagging strands

(ii) describe the DNA replication process in eukaryotic cells, including lagging strands

(iii) describe the DNA replication process in eukaryotic cells, including Okazaki fragments

(iv) describe the DNA replication process in prokaryotic cells, including leading strands;

(v) describe the DNA replication process in prokaryotic cells, including lagging strands;

(vi) describe the DNA replication process in prokaryotic cells, including Okazaki strands;

(E) illustrate the process of protein synthesis, including ribosomal subunits and the role of tRNA;

(i) illustrate the process of protein synthesis, including ribosomal subunits

(ii) illustrate the process of protein synthesis, including the role of tRNA

(F) describe the structures and functions of proteins, including three-dimensional folding, enzymes, and antibodies;

(i) describe the structures of proteins, including three-dimensional folding

(ii) describe the structures of proteins, including enzymes

(iii) describe the structures of proteins, including antibodies

(iv) describe the functions of proteins, including three-dimensional folding

(v) describe the functions of proteins, including enzymes

(vi) describe the functions of proteins, including antibodies

(G) explain the molecular structures of genes, including enhancers, promoters, exons, introns, and coding regions;

(i) explain the molecular structures of genes, including enhancers

(ii) explain the molecular structures of genes, including promoters

(iii) explain the molecular structures of genes, including exons

(iv) explain the molecular structures of genes, including introns

(v) explain the molecular structures of genes, including coding regions

(H) describe the different types of mutations, including inversions, deletions, duplications, and substitutions;

(i) describe the different types of mutations, including inversions

(ii) describe the different types of mutations, including deletions

(iii) describe the different types of mutations, including duplications

(iv) describe the different types of mutations, including substitutions

(I) explain the effects of mutation types on phenotype and gene function; and

(i) explain the effects of mutation types on phenotype

(ii) explain the effects of mutation types on gene function

(J) describe unique elements of the molecular structure of a chromosome such as short tandem repeats (STR), transposons, and methylation and acetylation of DNA.

(i) describe unique elements of the molecular structure of a chromosome

(9) The student analyzes the importance of recombinant DNA technology and genetic engineering. The student is expected to:

(A) describe the fundamental steps in recombinant DNA technology;

(i) describe the fundamental steps in recombinant DNA technology

(B) explain how recombinant DNA technology such as nuclear transfer cloning is used to clone genes and create recombinant proteins;

(i) explain how recombinant DNA technology is used to clone genes

(ii) explain how recombinant DNA technology is used to create recombinant proteins

(C) explain the role of tissue cultures in genetic modification procedures;

(i) explain the role of tissue cultures in genetic modification procedures

(D) describe plant- and animal-tissue culture procedures;

(i) describe plant-tissue culture procedures

(ii) describe animal-tissue culture procedures

(E) compare and contrast growing conditions for plant and animal tissue cultures;

(i) compare and contrast growing conditions for plant and animal tissue cultures

(F) explain the role of restriction enzymes; and

(i)

(10) The student examines federal, state, local, and industry regulations as related to biotechnology. The student is expected to:

(A) discuss the relationship between the local, state, and federal agencies responsible for regulation of the

(iii) store microbial cultures safely

(H) prepare seed inoculum; and

(i) prepare seed inoculum

(I) perform plating techniques such as streak plating, spread plating, and the Kirby-Bauer method.

(i) perform plating techniques

(12) The student prepares solutions and reagents for the biotechnology laboratory. The student is expected to:

(A) demonstrate aseptic techniques for establishing and maintaining a sterile work area;

(i) demonstrate aseptic techniques for establishing a sterile work area

(ii) demonstrate aseptic techniques for maintaining a sterile work area

(B) prepare, dispense, and monitor physical properties of stock reagents, buffers, media, and solutions;

(i) prepare stock reagents

(ii) prepare buffers

(iii) prepare media

(iv) prepare solutions

(v) dispense stock reagents

(vi) dispense buffers

(vii) dispense media

(viii) dispense solutions

(ix) monitor physical properties of stock reagents

(x) monitor physical properties of buffers

(xi) monitor physical properties of media

(xii) monitor physical properties of solutions

(C) calculate and prepare a dilution series; and

(i) calculate a dilution series

(ii) prepare a dilution series

(D) determine optimum conditions of reagents for experimentation.

(i) determine optimum conditions of reagents for experimentation

(13) The student conducts quality-control analysis while performing biotechnology laboratory procedures. The student is expected to:

(A) perform validation testing on laboratory reagents and equipment; and

(i) perform validation testing on laboratory reagents

(ii) perform validation testing on laboratory equipment

(B) analyze data and perform calculations and statistical analysis on results of quality-control samples.

(i) analyze data on results of quality-control samples

(ii) perform calculations on results of quality-control samples

(iii) perform statistical analysis on results of quality-control samples