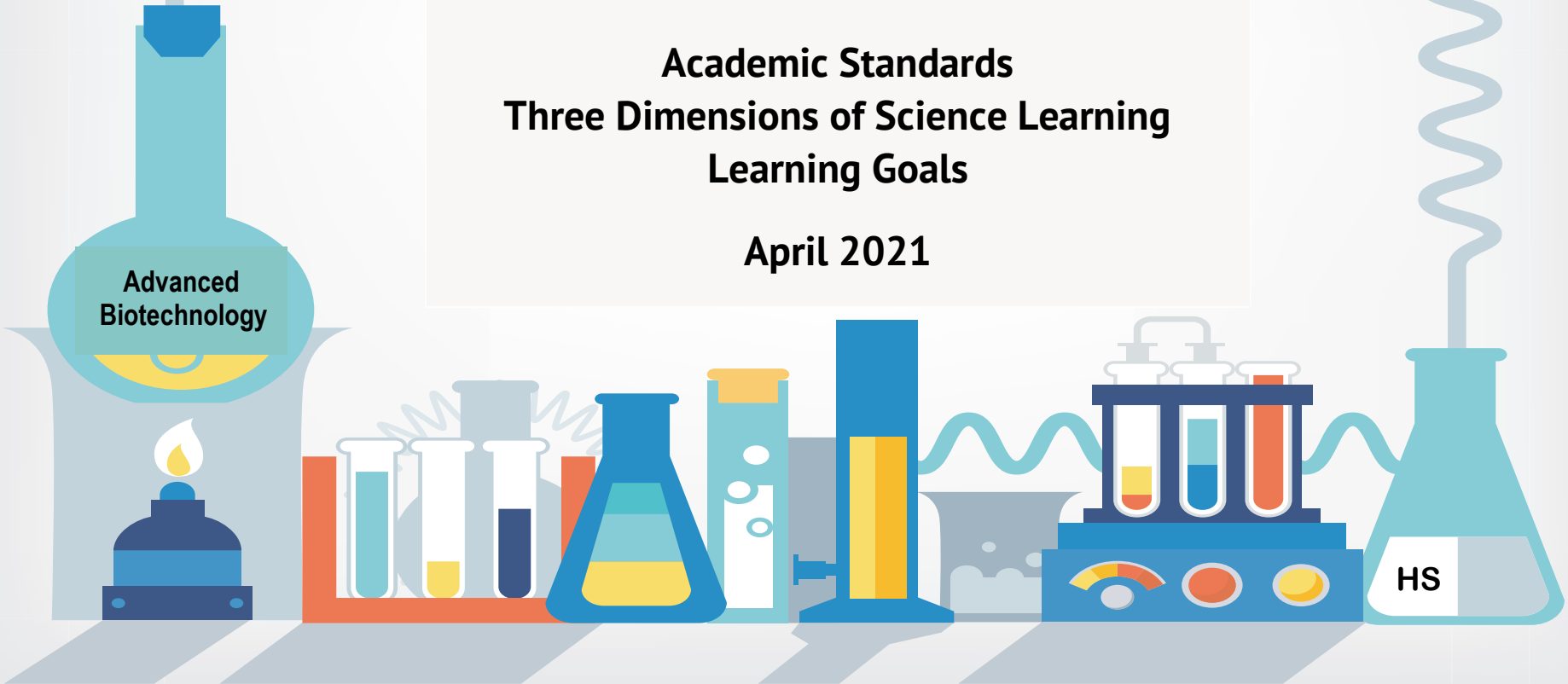
ENVISION 21

DEEP LEARNING • CFSD

SCIENCE

Academic Standards
Three Dimensions of Science Learning
Learning Goals

April 2021



HIGH SCHOOL
ADVANCED BIOTECHNOLOGY

CATALINA FOOTHILLS SCHOOL DISTRICT

HIGH SCHOOL ADVANCED BIOTECHNOLOGY OVERVIEW

High School Advanced Biotechnology is a dual enrollment advanced laboratory course that emphasizes the role that biotechnology plays in research and industry. Students will apply previously developed knowledge and skills in biotechnology to an industry-based laboratory setting. The course utilizes the foundations of chemistry, biology, and biotechnology to study current issues in the field. Topics of study include bioethics, organisms in biotechnology, genetic engineering, and development of biotechnology products. Emphasis on laboratory practices, along with independent research, will culminate in a self-selected research project that will be presented by the student in a scientific environment. Options for internships in the community along with guided research mentors will enable students to apply their skills in a biotechnology lab. Students will conduct challenging experiments including isolation of muscle protein, DNA screening, designing and using PCR primers, completing microarrays to determine the differences between cancer and normal cells, and advanced isolation work using a variety of gel electrophoresis techniques.

Optional summer internship opportunities are available for students who wish to continue performing scientific research. Students who are interested in earning college credit for UA MCB 102 must register and pay reduced tuition to the University of Arizona. Scholarships are available from Pima JTED. See course instructor for more information.

The standards for high school Advanced Biotechnology are categorized according to the topics listed below. The list does not imply the instructional sequence or how the standards will be organized for instruction. Educators will make decisions about instructional sequence and how standards will be grouped by units for classroom instruction and assessment to best meet student needs.

High School Advanced Biotechnology Topics:

- Biotechnology
    - Industry Safety Standards
    - Bioscience Research and Bioethics
    - Investigative and Laboratory Skills
    - Bacteria/Microbiology
    - Organisms in Biotechnology
    - Genetic Engineering
    - Independent Research Project
    - Careers in Biotechnology
    - Development of Biotechnology Products
- Arizona Professional Skills (Career & Technical Education)

High school students continue the pattern from previous years by engaging in the science and engineering practices to apply their knowledge of core ideas to understand how scientists continue to build an understanding of phenomena and see how people are impacted by natural phenomena or to construct solutions. The crosscutting concepts support their understanding of patterns, cause and effect relationships, and systems thinking as students make sense of phenomena in the natural and designed worlds.

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Navigating the Science Standards: Abbreviated Version

The standards serve as the basis for the design of instruction and assessment of the district's science curriculum.

- **Standards** are what a student needs to know, understand, and be able to do by the end of each grade or course. They build across grade levels in a progression of increasing understanding and through a range of cognitive demand levels.
- **Curriculum** refers to the resources used for teaching and learning the standards (units, lessons, texts, materials, tech apps, assessments, etc.).
- **Instruction** refers to the methods or methodologies used by teachers to teach their students. Instructional techniques are employed by individual teachers in response to the needs of students in their classes to help them progress through the curriculum to achieve the standards.

Grade Level or Course and **Topic Area** for standard.

Standard – What is Assessed
Describes what students should be able to do at the end of instruction to show what they have learned. Combines Science and Engineering Practices, Core Ideas, and Crosscutting Concepts.

Learning Goals
Indicators or evidence of learning at the end of a lesson or unit as aligned to the standard.

Core Ideas for Knowing and Using Science
"Understandings" or big ideas for physical, earth and space, and life sciences that build in complexity across grade levels and students develop over time.

Background Information (Content) is provided under each Core Idea.

Science and Engineering Practices
Skills and knowledge that scientists and engineers engage in to either understand the world or solve a problem.

KINDERGARTEN

LIFE SCIENCE: LIVING AND NON-LIVING THINGS

Students develop an understanding that the world is comprised of living and non-living things. They investigate the relationship between structure and function in living things; plants and animals use specialized parts to help them meet their needs and survive.

Science Standard: K.L2U1.8 **Observe, ask questions, and explain the differences between the characteristics of living and non-living things.**

Learning Goals

I can:

- Based on prior experiences, ask questions about living and non-living things.
- Make direct or indirect observations about living and non-living things:
  - Identify traits of living and non-living things.
  - Record observations (*e.g., through pictures and/or words*).
  - Make inferences about the characteristics of living and non-living things.
- List the characteristics of living things (*i.e., move, reproduce, react to stimuli*).
- Use evidence to explain how the characteristics of living things differ from the characteristics of non-living things.

Core Ideas

Knowing Science

L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

- There is a wide variety of living things (organisms), including plants and animals. They are distinguished from non-living things by their ability to move, reproduce, and react to certain stimuli.

Using Science

U1: Scientists explain phenomena using evidence obtained from observations and/or scientific investigations. Evidence may lead to developing models and/or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised.

- Students ask questions to frame their exploration of living and non-living things.
- Students make observations about living and non-living things.
- Students use the evidence from their observations to make inferences about the characteristics of living and non-living things.

Science and Engineering Practices

Asking Questions and Defining Problems

- Ask questions based on observations of the natural and/or designed world.

Constructing Explanations and Designing Solutions

- Use information from direct or indirect observations to construct explanations.
- Distinguish between opinions and evidence in one's own explanations.

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

Systems and System Models

- Objects and organisms can be described in terms of their parts.

Life Science
Description of what students will learn for the area of science under study (K-8 only).

Three Dimensions (3-D) of Science:
The Practices, Core Ideas, and Crosscutting Concepts that were used to create the standards.

Crosscutting Concepts
Concepts that cut across all disciplines and help students deepen their understanding of core ideas.

BIOTECHNOLOGY

INDUSTRY SAFETY PROCEDURES

BIOSCIENCE RESEARCH AND BIOETHICS

INVESTIGATIVE AND LABORATORY SKILLS

BACTERIA/MICROBIOLOGY

ORGANISMS IN BIOTECHNOLOGY

GENETIC ENGINEERING

RESEARCH PROJECT

CAREERS IN BIOTECHNOLOGY

DEVELOPMENT OF BIOTECHNOLOGY PRODUCTS

HIGH SCHOOL ADVANCED BIOTECHNOLOGY

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INDUSTRY SAFETY PROCEDURES (CTE Correlation: 1.1-1.10, 2.1, 2.2, 5.0-5.6, 6.1-6.3, 9.1, 9.2, 9.7, 11.1, 11.2, 11.3, 11.4,11.6)

Science Standards:

- Adhere to health practices and industry safety standards in the classroom and laboratory setting for personal health and safety and the health and safety of others *(i.e., SOPs for biological, biohazardous, and chemical materials, appropriate personal protective equipment [PPE] for the situation, emergency equipment).*
- Safely operate and perform care and routine maintenance of equipment *(e.g., maintain equipment log, report unsafe and nonfunctioning equipment, storage of chemicals, reagents and compounds, and maintenance of equipment).*
    - manufacturing practices pertaining to quality control (QC)
    - control inventory process for materials and supplies
- Apply compliancy procedures for state, local, and industry regulations *(e.g., OSHA [occupational safety and health administration] SDS [safety data sheets], EPA [Environmental Protection Act], FDA [Federal Drug Administration], NIH [National Institute for Health], AZDEQ [Arizona Department of Educational Quality], safety data sheets [SDSs] for chemicals*).

Learning Goals

I can:

- Comply with safety signs and symbols and utilize appropriate lab attire and protective equipment *(e.g., safety glasses, gloves*).
- Interpret safety data sheets (SDS) and apply practices for the safe use of hazardous chemicals according to standards from the Occupational Safety and Health Administration, Environmental Protection Agency, Federal Drug Administration, National Institute for Heath, and the Arizona Department of Educational Quality.
- Identify appropriate emergency contacts and perform drills for emergency protocols *(e.g., fire procedure, evacuation protocol, hazardous chemical contact).*
- Explain appropriate handling of biological and biohazardous materials and distinguish between the biosafety levels (BSL-1 to BSL-4).
- Perform and document tests for quality control *(i.e., accuracy of balances, concentration of chlorine in bleach, pH, spectrophotometry).*

Core Ideas

Knowing Science

L1: Organisms are organized on a cellular basis and have a finite life span.

L3: Genetic information is passed down from one generation of organisms to another.

- Biotechnology is defined by the US government as any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants and animals, or to develop microorganisms for specific uses.
- ADE/CTE content focus: fermentation technology, cell culturing, protein purification, biologic synthesis, assaying and testing, quality control, industrial microbiology, bioprocessing, chromatography and bio separation, genetic technology, laboratory and hazardous materials safety, computer applications, and test equipment operation and maintenance.

Using Science

U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.

U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.

- Students apply scientific principles and technical skills in support of biologists and biotechnologists in research, industrial, and government settings.
- Students research and investigate the positive and negative ethical, social, economic, and political implications of bioscience/biotechnology related techniques and technologies. Some applications of biotechnology can be controversial, so it is important to evaluate claims and evidence to determine their scientific validity.

Science and Engineering Practices	Crosscutting Concepts
Planning and Carrying Out Investigations • Design and conduct investigations and test design solutions in a safe and ethical manner including considerations of environmental, social, and personal impacts.	**Cause and Effect: Mechanism and Prediction** • Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

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BIOTECHNOLOGY

BIOSCIENCE RESEARCH AND BIOETHICS (CTE Correlation: 4.1-4.4, 5.0-5.6, 7.2, 7.3)

Science Standards:

- Summarize findings from scientific and technical literature *(e.g., patents, peer-reviewed articles, white papers, and technical bulletins*).
  - evaluate the scientific merit and commercial viability of prior work and its relevance to experimental design
- Critically analyze the interaction between biotechnology research and society *(e.g., genetically modified foods, cloning, bioterrorism, gene therapy, stem cells, and animal research*).
  - compare and contrast attitudes about the use of biotechnology regionally, nationally, and internationally
  - differentiate between moral, ethical, and legal biotechnology issues
- Describe codes of ethics and protocols used by various organizations that apply to confidentiality and security.
- Evaluate the regulatory policies impacting biotechnology research *(e.g., use of animals in research, applications of recombinant DNA).*
- Adhere to standards for harassment, labor, and employment laws as well as other legal and regulatory codes *(e.g., EPA, FDA, OSHA, NIH, AZDEQ).*

Learning Goals

I can:

- Identify and access relevant scientific and technical literature, including patents, peer-reviewed articles, white papers, and technical bulletins.
- Concisely summarize findings from scientific papers using relevant terminology while taking care to prevent plagiarism.
- Determine the features of experimental design in prior scientific research that led the research to be successful.
- Explain the implications of bioethical issues for society *(e.g., GMOs and HeLa privacy issue).*
- Describe local, state, and federal standards of practice for treatment, care, and maintenance of living organisms.
- Describe practices (including negligence) that could result in liability and how these situations can be avoided *(i.e., risk management and incident reporting).*

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- It is important to examine multiple lines of empirical evidence. Not all evidence is equally valid, however, so students must evaluate the information, findings, and studies contained in the sources they explore.

Science and Engineering Practices	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. • Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or the process of development and the design and performance of a proposed process or system.	**Cause and Effect: Mechanism and Prediction** • Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable.

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INVESTIGATIVE AND LABORATORY SKILLS (CTE Correlation: 2.2, 2.3, 3.1-3.6, 4.0-4.4, 6.1, 6.2, 6.4, 8.0-8.8, 8.11-8.14, 14.3, 14.4)

Science Standards:

- Apply industry-recognized scientific methods to develop knowledge and understanding of scientific ideas and how scientists study the natural world.
  - ask or respond to scientifically-oriented questions
  - develop a testable question or hypothesis based on evidence of scientific principles, probability and/or modeling appropriate to the scientific domain being investigated
  - identify independent and dependent variables and controls
  - select appropriate tools to collect, record, analyze, and evaluate data
  - analyze data using statistics and graphs *(e.g., Excel and other software)*
  - formulate explanations based on evidence and connect explanations to prior scientific knowledge
  - communicate results and justify explanations
- Apply standard operating procedures (SOPs) in the laboratory.
- Operate lab equipment properly and safely *(i.e., centrifuges, gel electrophoresis apparatus, autoclave, glassware, balances, micropipettes, spectrophotometer, fume hoods, incubators, hot plates, water baths, pH meter, etc.*).

Learning Goals

I can:

- Develop and test a research question (scientific process).
- Design experiments using best practices *(i.e., control groups, constants, multiple trials, adequate sample size, detailed procedure*).
- Make observations and collect data using industry-recognized methods *(i.e., contemporaneous notebook).*
- Demonstrate reproducibility from an SOPs (Standard Operating Procedures).
- Operate lab equipment properly and safely.
- Analyze data (graphs and statistical analyses) using spreadsheet software *(e.g., Excel).*
- Explain the implications of the research and how it connects with prior scientific knowledge.
- Communicate results of experiments with others using representations that include graphs, pictures, and written descriptions.

Core Ideas

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Science and Engineering Practices	Crosscutting Concepts
Asking Questions and Defining Problems • Ask questions that arise from careful observation of phenomena, models, theory, or unexpected results. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. **Planning and Carrying Out Investigations** • Design and conduct investigations and test design solutions in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Design and conduct an investigation individually and collaboratively, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Select appropriate tools to collect, record, analyze, and evaluate data. • Use investigations to gather evidence to support explanations or concepts. **Analyzing and Interpreting Data** • Use tools, technologies, and/or models (e.g., computational, mathematical) to generate and analyze data in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Consider limitations (e.g., measurement error, sample selection) when analyzing and interpreting data.	**Cause and Effect: Mechanism and Prediction** • Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. **Scale, Proportion, and Quantity** • In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

HIGH SCHOOL ADVANCED BIOTECHNOLOGY

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BACTERIA/MICROBIOLOGY (CTE Correlation: 7.1-7.5, 8.7, 8.9, 8.12 9.0-9.7)

Science Standards:

- Demonstrate microbiology skills such as culturing bacteria and preparing microscopic specimens.
- Explain the differences in types of cultures *(i.e., bacterial, mammalian, tissue vs. cell).*
- Transform and maintain hosts *(e.g., E. coli).*
- Determine what types of living organisms are used in biotechnology research (model organisms, cell lines) and conduct experiments with selected organisms.
- Illustrate different types of microorganisms based on morphology, color, and edge margins.

Learning Goals

I can:

- Prepare microscopic specimens and observe using a microscope *(i.e., dissecting, compound, digital).*
- Maintain lab equipment and practice appropriate hygiene (aseptic technique) in the lab environment.
- Identify, prepare, sterilize, dispense, and store media.
- Identify, propagate, and quantify microorganisms and cells.
- Identify techniques for short and long-term cultures *(e.g., stabs, slants, liquid nitrogen, glycerol stocks*).
- Isolate, maintain, and store pure cultures.
- Perform transformation of bacteria.
- Compare and contrast mammalian cell culture, bacterial cell culture, and culture of tissues.
- Determine the best cell lines and/or model organism for experiments and the proper use and limitation of living organisms.

Core Ideas

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ORGANISMS IN BIOTECHNOLOGY (CTE Correlation: 8.15-8.16, 12.012.9, 13.1-13.11)

Science Standards:

- Describe the characteristics and life cycles of model organisms used in biotechnology, including bacteria *(e.g., E. coli),* fungi *(e.g., yeasts and Aspergillus),* and animals *(e.g., C. elegans, fruit flies, and rodents).*
- Distinguish between prokaryotic cells, eukaryotic cells, and non-living entities such as viruses.
- Monitor how environmental factors affect the growth of cells and model organisms in the laboratory.
- Apply the basic concepts of cell growth to manipulate cultures under aseptic conditions in the laboratory.
- Perform transformations, including competency, selection, antibiotic resistance, and analysis of transformation efficiency.
- Utilize electrophoresis, chromatography, microscopy and spectrophotometry to identify, separate and draw conclusions about biological molecules.
- Use antibody specificity for antigens to test for the presence of protein *(e.g., ELISA, Western Blot, antibody staining).*

Learning Goals

I can:

- Compare common model organisms used in biotechnology.
- Describe the primary differences between prokaryotes and eukaryotes.
- Explain the role that environmental factors have on the effects of cellular growth.
- Demonstrate aseptic technique while working with model organisms.
- Describe the process of transformation.
- Apply the process of selective transformations.

Core Ideas

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GENETIC ENGINEERING (CTE Correlation: 8.15-8.16, 12.1-12.9, 13.1-13.9)

Science Standards:

- Describe the function of DNA, RNA, and protein in living cells and the Central Dogma.
- Demonstrate how the structure of DNA influences its function, analysis, and manipulation.
- Explain the role of enzymes *(e.g., restriction enzymes, DNA polymerases, and nucleases)* in the production and manipulation of DNA molecules.
- Determine and analyze the effect of qualitative and quantitative changes of specific proteins on cell function.

Learning Goals

I can:

- Explain and apply the principles involved in DNA analysis via agarose gel electrophoresis.
- Identify and troubleshoot common gel electrophoresis errors from a gel image.
- Isolate genomic and recombinant DNA from cells and solutions and analyze its purity and concentration.
- Describe prior and current DNA sequencing technologies.
- Explain the types of BLAST searches, compare homologous sequences using BLAST, and interpret E-values and scores.
- Utilize protein data bank (RCSB PDB) for protein structure analysis *(e.g., structure data for Cn3D, RCSB).*
- Identify sources of genetic variation *(e.g., SNP, inversion, translocation, copy number variant).*
- Isolate nucleic acids and explain the structure of DNA.
- Model how the DNA code is transferred to the ribosome for protein synthesis.
- Perform PCR in the lab using a thermocycler *(i.e., design primers, optimize and perform protocols).*
- Compare and contrast PCR to the cellular process of DNA replication.
- Perform and explain the process of vertical and horizontal gel electrophoresis.
- Prepare a standard curve based on a DNA or protein ladder to estimate DNA length or protein size.
- Describe DNA sequencing methods, including basic and next-generation, and compare the advantages and disadvantages of each method.

Core Ideas

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Using Science

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- Students apply scientific principles and technical skills in support of biologists and biotechnologists in research, industrial, and government settings.
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INDEPENDENT RESEARCH PROJECT (CTE Correlation: 3.2, 3.3, 3.4, 3.5, 3.6, 4.1-4.4,14.1-14.4)

Science Standards:

- Design and carry out a research project that relates to biotechnology.
- Identify and structure a series of controlled questions showing evidence of observation and connections to prior knowledge.
- Locate and identify appropriate control groups for the project, both positive and negative.
- Synthesize scientific literature to produce a literature review.
- Evaluate the scientific merit and viability of prior work and its relevance to science.
- Present research project with other scientists at a conference *(e.g., SARSEF, school science fair).*

Learning Goals

I can:

- Create a plan for a research project related to biotechnology.
- Develop a research question to formulate testable conditions.
- Carry out the investigation in a safe and ethical manner.
- Use identified tools and/or technologies to generate and analyze data in order to make valid and reliable scientific claims.
- Maintain a legal scientific notebook of research to follow ethical guidelines.
- Create an appropriate method to share my work in a formal setting.
- Present my research at a scientific conference or venue.

Core Ideas

Knowing Science

L1: Organisms are organized on a cellular basis and have a finite life span.
L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.
L3: Genetic information is passed down from one generation of organisms to another.

- Biotechnology is defined by the US government as any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants and animals, or to develop microorganisms for specific uses.
- ADE/CTE content focus: fermentation technology, cell culturing, protein purification, biologic synthesis, assaying and testing, quality control, industrial microbiology, bioprocessing, chromatography and bio separation, genetic technology, laboratory and hazardous materials safety, computer applications, and test equipment operation and maintenance.

Using Science

U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.
U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.

- Students apply scientific principles and technical skills in support of biologists and biotechnologists in research, industrial, and government settings.
- Students research and investigate the positive and negative ethical, social, economic, and political implications of bioscience/biotechnology related techniques and technologies. Some applications of biotechnology can be controversial, so it is important to evaluate claims and evidence to determine their scientific validity.

- It is important to examine multiple lines of empirical evidence. Not all evidence is equally valid, however, so students must evaluate the information, findings, and studies contained in the sources they explore.

Science and Engineering Practices	Crosscutting Concepts
Asking Questions and Defining Problems • Ask questions that arise from careful observation of phenomena, models, theory, or unexpected results. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. **Planning and Carrying Out Investigations** • Design and conduct investigations and test design solutions in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Design and conduct an investigation individually and collaboratively, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Select appropriate tools to collect, record, analyze, and evaluate data. • Use investigations to gather evidence to support explanations or concepts. **Analyzing and Interpreting Data** • Use tools, technologies, and/or models (e.g., computational, mathematical) to generate and analyze data in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Consider limitations (e.g., measurement error, sample selection) when analyzing and interpreting data.	**Patterns** • Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. **Cause and Effect: Mechanism and Prediction** • Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. **Structure and Function** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

HIGH SCHOOL ADVANCED BIOTECHNOLOGY

BIOTECHNOLOGY

CAREERS IN BIOTECHNOLOGY

Science Standards:

- Describe the educational requirements and responsibilities for various positions within the biotechnology industry.
- Compare and contrast careers in biotechnology within academic, government, and private sectors.
- Describe the role of student organizations (e.g., HOSA, FBLA, Key Club, and BETA) and their importance in leadership development.
- Explain the nature of employer-employee relationships.

Learning Goals

I can:

- Describe the major categories of employment positions within the biotechnology industry.
- Identify the educational requirements for the primary positions within the biotechnology industry.
- Describe the knowledge and skills that are necessary for a variety of different opportunities in a biotechnology company.
- Explain the differences in biotechnology careers found in academia, government, or private sectors.

Core Ideas

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Using Science

U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.

U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.

- Students apply scientific principles and technical skills in support of biologists and biotechnologists in research, industrial, and government settings.

Science and Engineering Practices	Crosscutting Concepts
Not applicable	**Not applicable**

HIGH SCHOOL ADVANCED BIOTECHNOLOGY

BIOTECHNOLOGY

DEVELOPMENT OF BIOTECHNOLOGY PRODUCTS

Science Standards:

- Explain the basis for biotechnology products and how these products affect the quality of life.
- Describe the implications of genomics and proteomics on biotechnology and current healthcare.

Learning Goals

I can:

- Describe the major scientific discoveries that lead to development of recombinant DNA technology, including those in the fields of biology, chemistry, genetics, and microbiology.
- Explain how advances in DNA technology are used today.
- Identify past and current discoveries and developments in fields such as, agriculture, diagnostics, medical devices, pharmaceuticals, and research and development.
- Justify the steps in production and delivery of a product made using recombinant DNA technology.

Core Ideas

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Science and Engineering Practices	Crosscutting Concepts
Not applicable	**Not applicable**

ARIZONA PROFESSIONAL SKILLS

CAREER AND TECHNICAL EDUCATION

HIGH SCHOOL ADVANCED BIOTECHNOLOGY
BIOTECHNOLOGY
PROFESSIONAL SKILLS: PROFESSIONALISM & ORGANIZATIONAL CULTURE (CTE Correlation: 4A – 4F, 6B, 7.A - 7.C)
Conducts oneself in a professional manner appropriate to organizational expectations.

Professional Skills Standards:

- Demonstrate professionalism in the workplace (being on time, proper dress, courteousness).
- Represent the school [organization] in a positive manner, demonstrating the school's [or organization's] mission and core values.
- Demonstrate respect for personal and professional boundaries (distinguish between personal and work-related matters).
- Interact respectfully with others; act with integrity.
- Produce high quality work that reflects professional pride and contributes to organizational success.
- Take initiative to develop skills and improve work performance.

Learning Goals

I can:

- Communicate the mission and core values of the school [or organization].
- Follow protocol(s) related to behavior, appearance, and other expectations.
- Perform my work with a positive attitude.
- Explain the importance of "dress for success."
- Demonstrate proper etiquette for introductions with clients.
- Create work products in a timely manner that are high quality and positively represent the organization.
- Identify and apply strategies to improve my performance.

HIGH SCHOOL ADVANCED BIOTECHNOLOGY
BIOTECHNOLOGY
PROFESSIONAL SKILLS: COMPLEX COMMUNICATION (TRADITIONAL AND DIGITAL) (CTE Correlation: 1A – 1D, 6A, 6C)
Employs complex communication skills in a manner that adds to organizational productivity. Complex Communication refers to the need to combine traditional communication skills with technical workplace content transmitted via rapidly evolving technologies to increasingly diverse audiences.

Professional Skills Standards:

- Communicate effectively in a diverse work environment *(i.e., style, format, and medium appropriate to audience/culture/generation, purpose and context; accuracy; use of appropriate technical/industry language; to resolve conflicts; address intergenerational differences/challenges; persuade others).*
- Use documentation *(e.g., itineraries and schedules)* to plan and meet client needs.
- Use appropriate technologies and social media to enhance or clarify communication.
- Use a variety of interpersonal skills, including tone of voice and appropriate physical gestures *(e.g., eye contact, facing the speaker, active listening*) during conversations and discussions to build positive rapport with others.
- Pose and respond to questions, building upon others' ideas in order to enhance the discussion; clarify, verify, or challenge ideas and conclusions with diplomacy.

Learning Goals

I can:

- Use appropriate verbal and nonverbal modes of communication.
- Proof and edit all communications based on [organizational] standards.
- Verify the accuracy of information and authority of sources.
- Respond in a timely manner to communications.
- Address communications in a style that is appropriate to the audience and situation.
- Use professional etiquette and follow applicable laws and regulations for web-, email-, and social media-based communications.
- Demonstrate appropriate active listening skills.
- Ask questions to obtain accurate information.

HIGH SCHOOL ADVANCED BIOTECHNOLOGY
BIOTECHNOLOGY
PROFESSIONAL SKILLS: INITIATIVE AND SELF-DIRECTION (CTE Correlation: 5A-5E, 7C)
Exercises initiative and self-direction in the workplace.

Professional Skills Standards:

- Apply the skills and mindset of self-direction/self-regulation to accomplish a project.
- Adapt to organizational changes and expectations while maintaining productive and cooperative relationships with colleagues.
- Select and use appropriate technologies to increase productivity.
- Employ leadership skills that build respectful relationships and advance the *organization (e.g., recognize and engage individual strengths, plan for unanticipated changes, pursue solutions/improvements).*

Learning Goals

I can:

- Establish priorities and set challenging, achievable goals.
- Create a plan with specific timelines for completion to achieve the goals.
- Take initiative to select strategies, resources and/or learning opportunities to accomplish the task(s) in the plan.
- Identify the success criteria/metrics to determine the effectiveness of the outcome for each goal.
- Monitor my progress/productivity and self-correct during the learning process.
- Persist when faced with obstacles or challenges.
- Reflect upon my learning (strengths and weaknesses) and use feedback to modify work or improve performance.
- Use appropriate technology tools and resources to create and deliver a product.

HIGH SCHOOL ADVANCED BIOTECHNOLOGY
BIOTECHNOLOGY
PROFESSIONAL SKILLS: CRITICAL THINKING AND INNOVATION (CTE Correlation: 3A-3E)
Integrates expertise in technical knowledge and skills with thinking and reasoning strategies to create, innovate, and devise solutions.

Professional Skills Standards:

- Identify problems and use strategies and resources to innovate and/or devise plausible solutions.
- Take action or make decisions supported by evidence and reasoning.
- Transfer knowledge/skills from one situation/context to another.

Learning Goals

I can**:**

- Use relevant criteria to eliminate ineffective solutions or approaches and select those that are plausible; put selected alternatives through trials to determine their helpfulness or benefit.
- Evaluate sources of evidence, the accuracy and relevance of information, and the strengths of arguments.
- Demonstrate ethical reasoning and judgment by clearly sharing multiple perspectives on why the proposed course of action is ethically the best decision.
- Identify factors that affect one's objectivity or rationality (for example: prejudices, disposition, etc.).
- Apply my knowledge and skills in new contexts.

HIGH SCHOOL ADVANCED BIOTECHNOLOGY
BIOTECHNOLOGY
PROFESSIONAL SKILLS: COLLABORATION (CTE Correlation: 2A-2C)
Collaborates, in person and virtually, to complete tasks aimed at organizational goals.

Professional Skills Standards:

- Take responsibility for any role on a team and accurately describe and perform the duties of each role, including leadership.
- Integrate diverse ideas, opinions, and perspectives of the team and negotiate to reach workable solutions.
- Prioritize and monitor individual and team progress toward goals, making sufficient corrections and adjustments when needed.
- Submit high-quality products that meet the specifications for the assigned task.
- Utilize technologies that promote collaboration and productivity, as appropriate.

Learning Goals

I can:

- Assess project needs and work with a team in a positive manner to create a final project.
- Contribute personal strengths to a project.
- Respect contributions of others.
- Build team relationships.
- Proactively solicit feedback; accept and show appreciation for constructive feedback.
- Act upon feedback to achieve team goals.
- Critique and reflect on individual and collaborative strengths and weaknesses.
- Develop a plan for improving individual participation and group productivity.