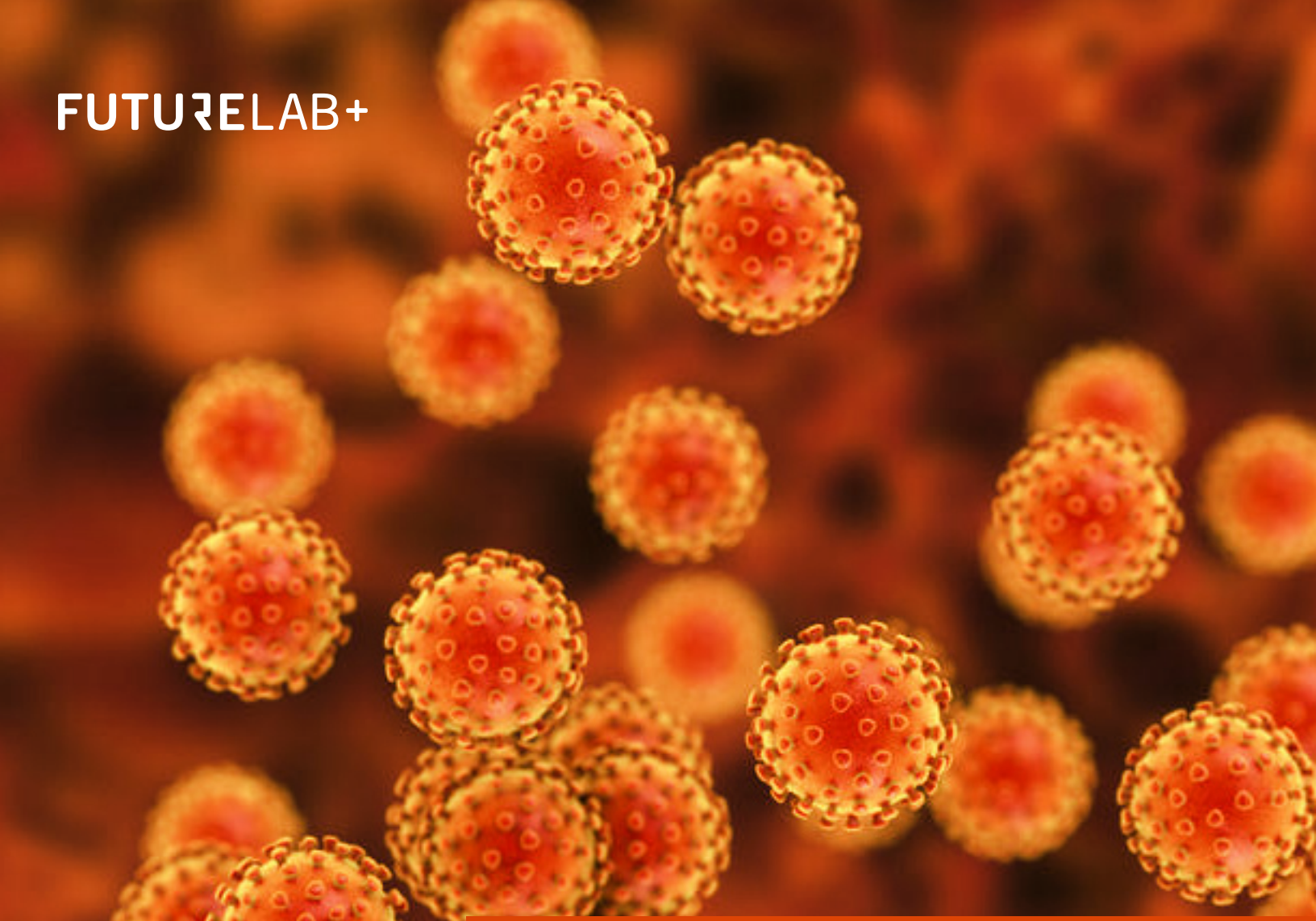
FUTURELAB+



BIOMED

Taking Action in Your Community: Health Equity

Unit Overview

Developed in partnership with:

Discovery Education and Ignited

BIOMED / TAKING ACTION IN YOUR COMMUNITY: HEALTH EQUITY

Unit Overview

FINAL PROJECT PRODUCT

Social Media Awareness Campaign

OVERVIEW

In this unit, students will learn about infectious diseases and how scientists work to create vaccines to help prevent or end local outbreaks and global pandemics. They will discover which current diseases have the potential to become pandemics and what gives them the potential to spread. They will look at the important role that epidemiologists play in understanding and researching human disease, compare how various types of disease are treated, and learn about the steps of vaccine production from research to development to testing and into production. They will also discover the role that public health agencies play in the distribution of and access people have to vaccines. For their final project for Unit 2, students will work together to create an interactive website that will serve as the platform for a social media awareness campaign that aims to give all people information and access to health care in a pandemic.

STUDENT-FACING UNIT TASK

You are part of a group that is tasked with creating a social awareness campaign to inform and influence a community that struggles with equity in health care. The campaign will focus on an infectious disease facing the community. Your social awareness campaign should address issues related to disparities in health care and access to treatments or prevention associated with your disease. In your role as a project manager, community education specialist, web design specialist, or media specialist, you will choose a community profile. You will work with your group to research information challenges the community faces related to disease and health-related issues. The group will create a website that will serve as the platform for your social awareness campaign. The website will provide community members with education about infectious diseases, treatments, and healthcare availability and provide data on disparities in healthcare for the community. An informative ad or infographic, a public service announcement (PSA) video calling community members to action, and a mock social media channel will be added to the campaign website.

Lesson 1: Epidemiology

DRIVING QUESTION

How does epidemiology affect and determine the prevalence of endemics, epidemics, and pandemics throughout the world?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Examine the general principles and purposes of epidemiology. **Explore** epidemiological principles using historical cases. **Assess** the impact of social, economic, and cultural factors on epidemiology throughout history and today. **Calculate** epidemiological statistics for specific outbreaks. **CTE:** A1.1	Students will be introduced to careers in the field of **epidemiology**. Students will learn about the **development** phase of the product life cycle.	Computers with internet access Calculators 4 to 1 images Epidemiologic classification assignment Disease Detective Capture Sheet Poster presentation Markers Notecards Poster board Writing tools Measures of Disease Frequency Capture Sheet Future Outbreak Prediction Student Video Rubric Design journal	In this lesson, students will act as epidemiologist "disease detectives" to find out the "who," "when," and "where" of negative health events. They will also use data to determine which populations and communities are more vulnerable to adverse health events and predict when and where the events may take place in the future.	The knowledge and understanding of disease pathology and transmission is crucial in the development of effective treatments, such as vaccines.

Lesson 2: Current Infectious Diseases

DRIVING QUESTION

What type of infectious diseases are likely to cause a pandemic?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Identify and describe various infectious diseases. **Assess** the impact of infectious diseases on human populations. **Recommend** preventive measures for risk factors of infectious diseases. **CTE:** A6.1	Students will be introduced to careers in the fields of **infectious disease epidemiology, zoology,** and **field biology**. Students will explore the **discovery** phase of the product life cycle, in which new product ideas are researched.	Computers with internet access Student Infectious Disease Self-Survey Infectious Disease PowerPoint Presentation Rubric Infectious Disease Oral Presentation Rubric Multiplying Microbes data sheet Introduction to Inequity in Healthcare Jigsaw Capture Sheet Community profiles **Materials and equipment needed for the Disease Transmission Lab:** Filter paper (or coffee filters) Scissors Paperclips or small envelopes Baking soda Water Measuring cup Red cabbage Pot Kitchen knife Jar or test tubes or paper cups **During lab/class:** Distribution Data Record and Question Capture Sheet Strips of paper Pen or pencil Indicator solution (red cabbage juice; may stain clothing) Markers Notecards Poster board Writing tools Design journal	In this lesson, students will act as epidemiologist "disease detectives" to find out the "who," "when," and "where" of negative health events. They will also use data to determine which populations and communities are more vulnerable to adverse health events and predict when and where the events might take place in the future.	In this lesson, students will gain an understanding of how diseases develop and spread among populations and how this information is crucial to determining the steps needed to prevent and mitigate the effects of present and future epidemics.

Lesson 3: Treating Bacterial and Viral Disease

DRIVING QUESTION

How are infectious diseases treated?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Distinguish among prokaryotic, eukaryotic, cellular, and viral reproduction. **Define** "antibiotic" and **describe** its use in treating infections. **Define** "antiviral" and **describe** its use in treating infections. **Describe** various treatments for viral disease. **CTE:** 4.3, 5.1, 5.6	Students will be introduced to the careers of **infectious disease specialist** and **virologist**. This lesson explains how therapies are created to target these pathogens in the **discovery** phase of the product life cycle.	Computers with internet access How Do Pathogens Reproduce? Bacterial Infectious Diseases Poster Assignment Bacterial Infectious Diseases Poster Rubric Marker Poster board Ruler Sticky notes How do antivirals work? Copies of scientific journal articles Antiviral and Antibiotic Review Disparities in the Treatment of Infectious Diseases Rubric Design journal	In this lesson, students will learn how viruses, prokaryotes, and eukaryotes cells reproduce. They will also learn how bacterial and viral infections are treated. Students will be better informed on the science of infectious disease as well as the social issues surrounding the treatment of bacterial and viral infections.	Students will discover that vaccines are useful tools used in healthcare to prevent diseases. They can be used for both viral and bacterial diseases. However, because fewer treatments are available for viral diseases compared to bacterial diseases, prevention through vaccination is of particular importance for viral diseases.

Lesson 4: New Production Methods

DRIVING QUESTION

How do vaccines activate our adaptive immune system?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Identify the components and function of our adaptive immune system. **Apply** knowledge of vaccines to compare different types of vaccines. **CTE:** A3.1, A9.3	Students will be introduced to the **medical science liaison** and **histology technician** career paths. This lesson focuses on the immune response that occurs when our bodies detect pathogens. This reaction is studied during the **development** phase of the product life cycle.	Functions of the Adaptive Immune System Capture Sheet Functions of the Adaptive Immune System Key Microbiologist Tasks Concept Map Why are There Different Types of Vaccines? Research and Discovery DNA and RNA Modeling Capture Sheet Colored pencils Design journal	In this lesson, students learn about the adaptive immune system and the role vaccines play in that system. They will take the role of microbiologist to explore different vaccine types and how they work in the body. Students will summarize their learning by exploring differences in new vaccine development for COVID-19.	In this unit, students will discover that scientists have recently come forward with new vaccines based on viral genetic material capable of recruiting cells into producing a protein belonging to a virus. The protein or viral toxin serves as an antigen to trigger an immune reaction, which provides protection against the infection by the virus. These vaccines are powerful tools against novel viruses, such as coronavirus, and help curb pandemics.

Lesson 5: Manufacturing Medicine

DRIVING QUESTION

What are the methods used to reproduce a virus and produce a vaccine efficient enough to protect against the associated disease?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Identify the stages toward the manufacturing of vaccines. **Apply** knowledge of cell division to the production of viruses. **Examine** which cells can be used for mass production of viruses of interest for vaccines. **Understand** the risks associated with each step in vaccine making. **Develop** techniques to maximize quality control and assurance during the manufacturing of a vaccine. **CTE:** A9.1, A9.2, A9.3	Students will be introduced to the career of **supervisor of a pilot plant**. This lesson is centered in the **manufacturing** phase of the product life cycle, in which drugs are made and tested.	Computers with internet access Career Profile Butcher paper Markers Vaccine Project Scenario Failure Modes and Effects Analysis (FMEA) Capture Sheet How Are Pathogens Grown? Capture Sheet Stages of Vaccine Production Scissors Glue or tape What Can Go Wrong? Capture Sheet Revised Vaccine Manufacturing Process Design journal	In this lesson, students will review the methods used to replicate a virus and produce the vaccine. They will identify the challenges associated with vaccine production. Taking on the role of quality assurance engineer, students will produce a revised vaccine manufacturing process.	Vaccines prevent diseases from spreading from one individual to the other, and therefore control pandemics. However, there have been concerns about the safety of vaccines, specifically, that people may become infected through contaminated vaccines. Nevertheless, effective protection by vaccines outweighs the risk of contracting and spreading disease itself if strict preparation guidelines are followed.

Lab: Using ELISA in Vaccine Trials

DRIVING QUESTION

Could results obtained from an ELISA for IgG antibodies provide evidence that a COVID-19 vaccine works?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Obtain and **communicate** information as students construct explanations about how vaccines trigger an immune response and how the production of antibodies protects against future infection. **Collect** data using laboratory protocols. Use ELISA to create a standard curve and use that standard curve to **analyze** and **interpret** data about the level of antibodies in vaccine clinical trial participant blood samples. **Support** an argument regarding the correlate of protection for COVID-19 vaccines with evidence from data collected during experimentation. **CTE:** A3.4, A4.7, A6.3, A6.4, A8.1, A8.6, A8.7	In this lab, students will play the role of **vaccine researcher**. After developing a new vaccine, further monitoring and **research** is conducted to determine vaccine effectiveness.	Preparing the Classroom for the Lab **(for teacher)** Background Reading: Vaccines and the Immune System **(one per student)** Background Reading: ELISA **(one per student)** Vocabulary tool **(one per student)** Student Guide **(one per student)** Student Protocol—Part 1: Serial Dilution and ELISA **(one per pair)** Student Protocol—Part 2: Color Signal and Standard Curve **(one per pair)** 96-well plate template **(one per pair)** Six empty 1.5mL tubes **(one per pair)** Water **(one for every two pairs)** Standards stock (1ug/mL) **(one for every two pairs)** Blood plasma antibody **(one for every two pairs)** Spike protein antigen **(one for every two pairs)** Substrate **(one for every two pairs)** Labeled antibody **(one for every two pairs)** Participant samples a–f **(one for every two pairs)** Permanent marker **(one per pair)** Gloves (optional) **(one per pair)** **Other:** Smartphone with a free microplate reader e.g., Spotxel app **(one per pair)** Computer with spreadsheet software **(one per student)** **For Building Lab Skills stand-alone days:** Building Lab Skills: Micropipetting Reference Guide and Practice **(one per student)** Precision Pipetting Practice Cards **(one set per student)** **Optional:** Micropipetting Practice: ROY GEE BIV **(one per student)** Building Lab Skills: Serial Dilutions and the Standard Curve **(one per student)** **Lab Equipment and Reagents:** Waste bucket **(one per pair)** p20 micropipette **(one per pair)** p200 micropipette **(one per pair)** Micropipette tips **(one per pair)** Microtube rack **(one per pair)** 96-well plate **(one per pair)** 96-well template card **(one per pair)**	In this lab, students will conduct research on an approved COVID-19 vaccine to identify the level of antibodies that confers immunity. Working in pairs, students will determine the concentration of IgG antibodies against SARS-CoV-2 virus in six clinical trial participant samples one month post vaccination. They will be using a mock ELISA test to measure this concentration of antibodies in their participant samples (this lab uses BSA protein and Lowry reagent to simulate ELISA results).	Vaccines work by priming the immune response, i.e,. memory T and B cells and antibody production, to defend the body against a pathogen. We can measure antibody concentration as a potential measure of vaccine efficacy.

Lesson 6: Vaccine Production and Safety Testing

DRIVING QUESTION

Do the adverse effects of a vaccine outweigh the benefits?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Explain the role of the VAERS. **Examine** ethical dilemmas in vaccination. **Investigate** enrollment of people of color in clinical trials. **Create** a report on the adverse effects of typical vaccines and their commonalities. **Describe** the steps taken before a vaccine is approved for use in the United States. **CTE:** A5.1, A5.4, A5.6, A7.1, A7.2	Students will learn about careers in **quality control for vaccine production**. This lesson focuses on quality control and testing, which are important components of the **manufacturing** step of the product life cycle.	An off-brand comparable drink Paper cups Clinical Trials Capture Sheet Diverse Enrollment Capture Sheet Letter to Clinical Trial Rubric VAERS graphic organizer Vaccine Compensation Response Exit Ticket Would You Rather? Capture Sheet Vaccine Dilemma journal response Vaccine Poster Rubric Poster paper Sticky notes Design journal	In this lesson, students will learn the stages potential vaccines must progress through in order to be approved for public use and the continued monitoring they undergo after approval. Topics will range from the clinical trial process, the importance of including a range of ethnic groups in medical research, and the monitoring systems in place after approval is acquired.	When looking at the use of vaccines to combat pandemics, it is necessary to understand the required safety testing, even in the face of rising death tolls. It may be tempting to rush the safety testing process when under pressure, but all steps are important to assure public health. If issued vaccines were ineffective or caused a high number of adverse events, public trust in the system would fail and events like pandemics would be more severe.

Lesson 7: Public Health Agencies

DRIVING QUESTION

Why is it important for regulatory agencies to maintain independence and not be infused by politics or private interests?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Distinguish between the roles of the FDA and the CDC in vaccine regulation and monitoring. **Investigate** barriers to vaccination for low-income families. **Create** a flow chart detailing the vaccine approval process. **CTE:** A2.5, A7.1, A7.2	Students will learn about the career of **health service officer** for the FDA or CDC. The vaccine approval process includes clinical trials, FDA review and approval, technical operations, and commercial, medical, and government affairs. These include the **manufacturing** and **commercialization** stages of the product life cycle.	FDA vs. CDC Capture Sheet FDA vs. CDC Skit Rubric Skit Response Exit Ticket Medical Research Initiative Capture Sheet Pipeline Vaccines Chart Pipeline Vaccines Chart Rubric Encourage Vaccination Rubric Politics in Vaccines Anticipation Guide Vaccination Flow Chart Rubric Large pieces of paper Markers or colored pens Design journal	In this lesson, students will learn which government agencies are involved in vaccine development, testing, and monitoring. They will examine the importance of accessibility and the hurdles that exist for many families. Students will learn about the importance of keeping vaccine policy unencumbered by politicization or private interest groups' influence. The class will conclude this lesson by crafting a flow chart detailing the process of vaccine approval and the government agencies that oversee each step.	While vaccines are most often a routine prevention of the spread of infectious disease, they can become paramount in defending a population. As vaccine development fights against the clock to save lives, it becomes even more important to have strong support and safety nets for their development to protect citizens.

Lesson 8: Social Awareness Campaign Project

DRIVING QUESTION

What needs to be done so that all people can have equal access to healthcare?

Student Objectives	Connections to Careers and the Product Life Cycle	Lesson Materials	Lesson Overview	Phenomena and Connection to the Unit Storyline
Determine ways to address issues related to disparities in healthcare and access to treatment or prevention. **Research** and **propose** solutions to a real-world issue by **developing** a social awareness campaign. **CTE:** A1.1, A1.4	Students will role-play the following career paths: **project manager, community educator specialist, web design specialist**, and **media specialist**. This lesson focuses on the **commercialization** phase of the product life cycle, during which regulatory agencies and providers work to make treatments safe and available to the public.	Design journal (that has been completed throughout the unit) Computers with internet access Elements of Effective Social Awareness Campaigns Division of Labor chart Social Awareness Campaign Guidelines and Planning	As a culmination of the Unit 2 lessons, students will form groups to take the role of marketing groups trying to solve the problem of inequity in healthcare and medical treatment in a community faced with disease.	This lesson requires students to think like the public health leaders they have learned about in order to develop a social awareness campaign. They must consider dynamics, such as varying health literacy rates and uneven social determinants of health, to build a campaign that resonates with a community.

Career and Technical Education (CTE) Standards

Anchor Standards

4.0 Technology

Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Health Science and Medical Technology sector workplace environment. (Direct alignment with Writing Standards WS 11–12.6)

4.3
Use information and communication technologies to synthesize, summarize, compare, and contrast information from multiple sources.

5.0 Problem Solving and Critical Thinking

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Health Science and Medical Technology sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques. (Direct alignment with Writing Standards WS 11–12.7)

5.1
Use the internet and the world wide web to collect and share scientific information

5.4
Interpret information and draw conclusions, based on the best analysis, to make informed decisions.

5.6
Read, interpret, and extract information from documents.

Health Science and Medical Technology Standards

A1.0

Define and assess biotechnology and recognize the diverse applications and impact on society.

A1.1
Use data to explain how biotechnology fields such as pharmaceuticals, agriculture, diagnostics, industrial products, instrumentation, and research and development are impacting human life.

A1.4
Research and identify public misunderstandings related to biotechnology and discern the source of these misunderstandings.

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Career and Technical Education (CTE) Standards

Health Science and Medical Technology Standards

Continued

A2.0
Understand the ethical, moral, legal, and cultural issues related to the use of biotechnology research and product development.

A2.5
Describe the dilemma of health care costs related to advancements in biotechnology and public access to treatments.

A3.0
Demonstrate competencies in the fundamentals of molecular cell biology, including deoxyribonucleic acid (DNA) and proteins and standard techniques for their purification and manipulation.

A3.1
Define and describe the structure and function of DNA ribonucleic acid (RNA) and proteins, explain the consequences of DNA mutations on proteins.

A3.4
Employ standard protein techniques, including antibody production, enzyme assays, spectrophotometry, gel electrophoresis, and chromatography and document and evaluate results.

A4.0
Recognize basic concepts in cell biology and become familiar with the laboratory tools used for their analysis.

A4.7
Conduct indicator tests for the common macromolecules of the cell.

A5.0
Integrate computer skills into program components.

A5.1
Use the internet and world wide web to collect and share scientific information.

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Career and Technical Education (CTE) Standards

Health Science and Medical Technology Standards

Continued

A6.0
Implement use of the metric system, orders of magnitude, and the pH scale in preparation of reagents, analysis of data, and graphing.

A6.1
Apply knowledge of symbols, algebra, and statistics to a graphical data presentation.

A6.3
Calculate and prepare solutions of various molarity; calculate and prepare buffers of various pH; and prepare serial dilutions.

A6.4
Create data tables and graphs using Excel for the purpose of collecting and analyzing data.

A7.0
Understand the function of regulatory agencies for the biotechnology industry and the lasting impact of routine laboratory and communication practices on product development and manufacturing.

A7.1
Identify agencies at the local, state, and federal levels.

A7.2
Be aware of the role of agencies in promoting patient safety, quality control, and entrepreneurship.

A8.0
Follow sustainable and safe practices with high regard for quality control.

A8.1
Follow written protocols and oral directions to perform a variety of laboratory and technical tasks.

A8.6
Properly and safely use and monitor a variety of scientific equipment, including pH meters, microscopes, spectrophotometers, pipets, micropipettes, and balances.

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Career and Technical Education (CTE) Standards

Health Science and Medical Technology Standards

Continued

A8.7
Determine which equipment is appropriate to use for a given task and the units of measurement used.

A9.0
Understand that manufacturing represents inter-connectedness between science and production.

A9.1
Describe the major steps of a product's move through a company's product pipeline.

A9.2
Identify several products obtained through recombinant DNA technology.

A9.3
Outline the steps in production and delivery of a product made through recombinant DNA technology.

Third Party Evaluator Evidence/Findings

Completed by: American Institutes for Research

Sponsored by Genentech, Futurelab+ brings together a coalition of partners to develop an innovative, modular, two-year biotechnology curriculum, including instructional materials, to expose students and educators to the breadth of education and career pathways across biotechnology. To increase adoption and access to such curricula in California and beyond, the modular curriculum was designed to align with the *California Career Technical Education (CTE) Model Curriculum Standards for Biotechnology*, meet at least one year of the *University of California science (D) subject requirement*, and incorporate some of the three-dimensional learning innovations of the *Next Generation Science Standards* (NGSS).

The two-year biotechnology curriculum provides four core units per year; each core unit has nine lessons and a lab that each take approximately one week to complete, or 9–10 weeks for the full unit. In total, the biotechnology curriculum has 72 lessons and eight labs that span two full instructional years. Because the Futurelab+ biotechnology curriculum is modular, teachers can select specific units and materials to design biotechnology courses that are relevant and appropriate for their students and teaching environment.

Unit 2: Taking Action in Your Community: Health Equity

Version Reviewed/Date: October 18, 2021
Version 1 Archive: *Archive*

Edits have been made to this collection post-report and are live on futurelabplus.com.

California (CTE) Model Curriculum Standards for Biotechnology

Full Report

[Futurelab+... priority to meet California CTE Biotech Standards...] Evidence of which California CTE Biotechnology standards are addressed within the curriculum and where they are addressed is included in the *full report*.

University of California Science (D)

Full Report

Because teachers and schools can choose which portions of the curriculum to include in their final course designs, this *report series* provides evidence of where each unit meets specific criteria for the UC science (D) subject requirement and, when incorporated into a full year-long course, where the curriculum could meet at least one year of the UC science (D) subject requirement, contingent upon review and approval by UC. Subsequently, the evidence provided within the report can be used by teachers for submitting Futurelab+ course materials for UC science (D) subject approval.

The purpose of this report is to provide evidence for alignment of Unit 2 of the Futurelab+ Biotechnology Curriculum with the UC science (D) subject requirement. To help educators submit their final courses for UC science (D) subject review, the American Institutes for Research (AIR) also provides a sample unit and lab summaries, which follow the guidelines for writing a UC science (D) course (March 17, 2021).

Specifically, AIR reviewed each unit for evidence of the extent to which they meet the eight Course Content Guidelines for the UC science (D) subject requirement. This report provides specific examples to demonstrate where and how materials satisfy these criteria. Based on our review, we believe there is a strong body of evidence that will translate to Unit 2 meeting the UC science (D) subject matter requirement.

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Third Party Evaluator Evidence/Findings

Continued

Next Generation Science Standards (NGSS)

Full Report

As an organizational partner, the American Institutes for Research (AIR) provided external feedback on alignment to the three sets of standards to Futurelab+ curriculum developers during the formative period of the biotechnology curriculum. AIR is now providing external feedback and evidence on the final curriculum's alignment to each set of standards: CTE, UC science (D) subject requirement, and NGSS in a series of three reports. The eight reports in the NGSS series provide feedback on aspects of NGSS in a sample of the curriculum (one lesson from each unit). AIR randomly selected Lesson 1 (Treating Bacterial and Viral Disease) from Unit 2 (Taking Action in Your Community: Health Equity) for this report.

Of note, because the primary design element of the curriculum was alignment to CTE, AIR used the NGSS Lesson Screener (not the Educators Evaluating the Quality of Instructional Products [EQuIP] Rubric) to identify aspects of the curriculum that incorporate NGSS. The EQuIP Rubric is typically used to determine whether a unit was designed for the NGSS. Because the curriculum was designed to align primarily to CTE standards, it was not expected that the curriculum would meet all NGSS criteria. Nevertheless, in their current form, the materials from Unit 2, Lesson 1, are approaching the six NGSS criteria. AIR created the approaching rating to indicate where a modification to materials would increase the rating to adequate. For more information, please see the *full report*.