



Learning that works for Washington

Spokane Public Schools Institute of Science & Technology Genomic Research

Course: Genomic Research		Total Framework Hours up to: 360
CIP Code: 260104	<input type="checkbox"/> Exploratory <input checked="" type="checkbox"/> Preparatory	Date Last Modified: 12/01/2015
Career Cluster: Health Science		Cluster Pathway: Biotechnology Research and Development

Course Description:

Genomic Research immerses student-scientists into self-directed, relevant and novel molecular research involving genomics. Modeled after the experiences a person receives as they pursue a post graduate degree in STEM related fields, students design and implement authentic and novel research. The student-scientists analyze, evaluate and synthesize understanding from complex data they have generated through persistent and rigorous laboratory research. They collaborate with other scientists within their research area and communicate their findings to the collaborators and other scientist through electronic collaborations, published DNA genomic sequence, poster sessions, symposiums and peer reviewed published journal articles. Most of the research strands have strong field research components and all include a thorough literature exploration. Genomic Research can be a one or two year experience that does not live within the “Bell to Bell” school schedule as it dramatically expands the school day and investment of the learner.

Unit 1

Standard/Unit:

IST I: DNA is the genetic material for all living organisms. Segments of DNA, called genes, encode information critical for development and life functions. DNA is organized into structures called chromosomes
(LS1 E)

Performance Assessments:

- Isolate genomic DNA, amplify specific regions and identify the differences between individuals and populations using a variety of molecular tools (sequencing, RFLP, CAPS, ELISA, Western Blots, RAPD)
- Create a Phylogenetic map using data from authentic research
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

Students lead and participate in Socratic Seminars on theory, current events, and protocols.
Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
Students write research paper components for the whole lab (all the lab groups)

21st Century Skills

Creativity and Innovation:

Think Creatively

- 1.A.1 Use a wide range of idea creation techniques (such as brainstorming)

Critical Thinking and Problem Solving:

Reason Effectively

- 2.A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Make Judgments and Decisions

- 2.C.1 Effectively analyze and evaluate evidence, arguments, claims and beliefs
- 2.C.2 Analyze and evaluate major alternative points of view
- 2.C.3 Synthesize and make connections between information and arguments
- 2.C.4 Interpret information and draw conclusions based on the best analysis
- 2.C.5 Reflect critically on learning experiences and processes

Use Systems Thinking

- 2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Solve Problems

- 2.D.1 Solve different kinds of non-familiar problems in both conventional and innovative ways
- 2.D.2 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

- 4.A.1 Access information efficiently (time) and effectively (sources)
- 4.A.2 Evaluate information critically and competently

Use and Manage Information

- 4.B.1 Use information accurately and creatively for the issue or problem at hand
- 4.B.2 Manage the flow of information from a wide variety of sources
- 4.B.3 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Initiative and Self-Direction

Manage Goals and Time

- 8.A.1 Set goals with tangible and intangible success criteria

8.A.2 Balance tactical (short-term) and strategic (long-term) goals

8.A.3 Utilize time and manage workload efficiently

Work Independently

8.B.1 Monitor, define, prioritize and complete tasks without direct oversight

Be Self-Directed Learners

8.C.1 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise

8.C.2 Demonstrate initiative to advance skill levels towards a professional level

8.C.3 Demonstrate commitment to learning as a lifelong process

8.C.4 Reflect critically on past experiences in order to inform future progress

Communication and Collaboration

Collaborate with Others:

3. B.1 Demonstrate ability to work effectively and respectfully with diverse teams.

3. B.2 Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal.

3. B.3 Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.

- Extract, purify, and quantify DNA
- Field collection: fin snips
- Grade school presentations

Standards and Competencies

Competencies

Total Learning Hours for Unit: 20

- Analyze, and evaluate DNA sequence generated by self-generated research
- Evaluate the application of the best molecular tools and protocols to analyze and define DNA and Protein composition to optimize research results (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots)

**Foundational NCHSE Standards
National Consortium for Health Science Education**

**Standard 4:
Employability Skills**

4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.

- Apply employability skills in healthcare
- Compare careers within the health science career pathways (diagnostic services, therapeutic services, health informatics, support

	<p>services, or biotechnology research and development)</p> <ul style="list-style-type: none"> • Develop components of a personal portfolio • Identify innovative strategies for obtaining employment
<p>Standard 7: Safety Practices</p>	<p>7. Safety Practices: <i>Healthcare professionals will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.</i></p> <ul style="list-style-type: none"> • Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations • Apply principles of body mechanics • Apply safety techniques in the work environment • Recognize Safety Data Sheets (SDSs). (www.osha.gov) • Comply with safety signs, symbols, and labels • Practice fire safety in a healthcare setting • Apply principles of basic emergency response in natural disasters and other emergencies
<p>Standard 8: Teamwork</p>	<p>8. Teamwork: <i>Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p>11. Information Technology Application: <i>Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Describe appropriate methods to correct inaccurate information/errors personally entered into an electronic medical records (EMR) • Apply basic computer concepts and terminology in order to use computers and other mobile devices. • Demonstrate basic computer operating procedures • Demonstrate use of file organization and information storage.

**NCHSE Biotechnology and Research Development Standards:
National Consortium for Health Science Education**

<p align="center">Standard 2: Academic Foundations</p>	<p>Biotechnology R& D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology</p> <ul style="list-style-type: none"> • Mathematical Concepts – Illustrate the concepts of percentages and ratios using a biotechnology application • Mathematical Concepts – Contract weight-to-weight and weight- to-volume calculations for solutions • Organic Chemistry – Create an equation of two organic substrates leading to a product
<p align="center">Standard 3: Introduction to Biotechnology Knowledge Areas and Techniques</p>	<p>Biotechnology R&D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (product recombinant DNAC products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics</p> <ul style="list-style-type: none"> • Techniques – Describe the following techniques: recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products and bioprocessing • Knowledge Areas – Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities
<p align="center">Standard 4: Laboratory Protocols and Procedures</p>	<p>Biotechnology R& D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculums development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.</p> <ul style="list-style-type: none"> • Procedures – Describe how molarity relates to solution preparation • Procedures – Calculate the molarity of a given solution and measure pH of this solution • Protocols – Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team
<p align="center">Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Examine the role of a Quality Assurance person in this process • Regulation – Define cGMP and why it is important in biotech production

Aligned Washington State Standards

<p>Educational Technology</p>	<p>2.2.2 Use a variety of hardware to support learning. 2.2.1 Develop skills to use technology effectively.</p>
--------------------------------------	---

Math	S-ID 2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
Reading	<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4)</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS4-5)</p>
Science	<p>HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</p> <p>HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p> <p>LS3.A: Inheritance of Traits</p> <p>Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)</p> <p>Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)</p> <p>HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p>
Writing	<p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4)</p> <p>WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS4-6)</p> <p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS4-6)</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5)</p>

Unit 2

Standard/Unit:

IST II: Genes exist in different forms called alleles. The combination of different alleles in single gene traits leads to predictable inheritance patterns (Mendel). Polygenic traits show continuous variation and are less predictable.
(LS1 H)

Performance Assessments:

- Compare and contrast DNA replication, PCR and Dideoxy-cycle sequencing
- Use molecular tools to Analyze inheritance patterns – both Mendelian and non-Mendelian inherited and synthesize multi-generational pedigrees
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Presentations: EWU, school board, Safa iClub Int., Department of Wildlife, Grayling Foundation Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)

Critical Thinking and Problem Solving

Solve Problems:

2. D.1 Solve different kinds of non-familiar problems in both conventional and innovative ways.
2. D.2 Identify and ask significant questions that clarify various points of view and lead to better solutions.

- Optimize molecular bioscience protocols
- Continuous improvement projects and solution implementations

Communication and Collaboration

Communicate Clearly:

3. A.1 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts.
3. A.2 Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions.
3. A.3 Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade).
3. A.4 Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact.
3. A.5 Communicate effectively in diverse environments (including multi-lingual).

- Optimize molecular bio-science protocols to better acquire and evaluate allele frequencies
- Organize and participate in seminar (speakers) series
- Presentations: School board, EWU, Rocky Mt. Lab Tour & Presentation (Montana)
- Continuous improvement projects and solution implementations

Work Independently

8.B.1 Monitor, define, prioritize and complete tasks without direct oversight

Be Self-Directed Learners

8.C.5 Go beyond basic mastery of skills and/or curriculum to explore and expand one’s own learning and opportunities to gain expertise

8.C.6 Demonstrate initiative to advance skill levels towards a professional level

8.C.7 Demonstrate commitment to learning as a lifelong process

8.C.8 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies

Total Learning Hours for Unit: 20

- Evaluate and develop the best molecular bio-science tools to evaluate allele frequencies supporting novel discovery (PCR, Restriction Digest, Gel electrophoresis, Bradford’s, ELISA, DNA Sequencing, Western Blots)
- Continued acquisition of the best molecular bio-science protocols to optimize results

**Foundational NCHSE Standards
National Consortium for Health Science Education**

**Standard 2:
Communication**

2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.

- Interpret verbal and nonverbal communication
- Report subjective and objective information
- Interpret the elements of communication using a basic sender-receiver-feedback model
- Apply speaking and active listening skills
- Use roots, prefixes, and suffixes to communicate information
- Use medical abbreviations to communicate information

**Standard 4:
Employability Skills**

4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.

- Classify the personal traits and attitudes desirable in a member of the healthcare team
- Summarize professional standards as they apply to hygiene, dress, language, confidentiality and behavior
- Apply employability skills in healthcare
- Discuss levels of education, credentialing requirements, and employment trends in healthcare

	<ul style="list-style-type: none"> • Compare careers within the health science career pathways (diagnostic services, therapeutic services, health informatics, support services, or biotechnology research and development) • Develop components of a personal portfolio • Identify innovative strategies for obtaining employment
<p>Standard 7: Safety Practices</p>	<p>7. Safety Practices: <i>Healthcare professionals will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.</i></p> <ul style="list-style-type: none"> • Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations • Apply principles of body mechanics • Apply safety techniques in the work environment • Recognize Safety Data Sheets (SDSs). (www.osha.gov) • Comply with safety signs, symbols, and labels • Practice fire safety in a healthcare setting • Apply principles of basic emergency response in natural disasters and other emergencies
<p>Standard 8: Teamwork</p>	<p>8. Teamwork: <i>Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p>11. Information Technology Application: <i>Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Describe appropriate methods to correct inaccurate information/errors personally entered into an electronic medical records (EMR) • Apply basic computer concepts and terminology in order to use computers and other mobile devices.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	

<p>Standard 3: Introduction to Biotechnology Knowledge Areas and Techniques</p>	<p>Biotechnology R&D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (product recombinant DNAC products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics</p> <ul style="list-style-type: none"> • Techniques – Describe the following techniques: recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products and bioprocessing • Knowledge Areas – Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities
<p>Standard 4: Laboratory Protocols and Procedures</p>	<p>Biotechnology R& D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculums development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.</p> <ul style="list-style-type: none"> • Procedures – Calculate the molarity of a given solution and measure pH of this solution
<p>Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Implement Quality Assurance in this process • Regulation – Apply cGMP in biotech production
<p><i>Aligned Washington State Standards</i></p>	
<p>Communications</p>	<p>1.2.1 Communicate and collaborate to learn with others. 1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p>
<p>Educational Technology</p>	<p>2.1.1 Practice personal safety. 2.2.1 Develop skills to use technology effectively. 2.2.2 Use a variety of hardware to support learning.</p>
<p>Math</p>	<p>S ID 1: Represent data with plots on the real number line (dot plots, number lines, histograms, and box plots)</p>
<p>Reading</p>	<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS3-1),(HS-LS3-2) RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-LS3-1)</p>
<p>Science</p>	

	HS-LS3-1. HS-LS3-2. HS-LS3-3. HS-LS4-3. HS-LS4-4.	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
--	---	--

Unit 3

Standard/Unit:

IST III: The expression of genetic information generally flows from DNA to RNA to protein through the processes of Transcription, Translation, and various editing events. Gene expression is regulated within systems. This leads to different types of cells and different cell functions. There are inheritable changes in gene expression caused by mechanisms other than changes in the underlying DNA sequence (Epigenetics).
(LS1 G)

Performance Assessments:

- Synthesize a understanding of the history and evolution involving the central Dogma of Molecular Bioscience and its relationship to biomedical/biotechnology applications
- Use molecular tools such as DNA sequencing to generate DNA sequence and analyze for change in amino acid composition of described protein by using a variety of bioinformatics and statistical tools.
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Step into STEM Seminar Planning Design and implement CI projects in the field and modify as needed - document in Foundations. EWU Symposium Presentation
- Field experiments and data collection must challenge but maintain valid protocols
- Authentic research projects: grayling, deer, wolf, bee studies
- Community Service: ie -- Cup of Cool Water, NEYC Anti-Bullying campaign, Food Drive Neighborhood Pick-up
- Science Nights at Elementary Schools
- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)

21st Century Skills

Creativity and Innovation:

Think Creatively

- 1.A.2 Use a wide range of idea creation techniques (such as brainstorming)

Critical Thinking and Problem Solving:

Communicate Clearly

- 3.A.1 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- 3.A.2 Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions
- 3.A.3 Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)
- 3.A.4 Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact
- 3.A.5 Communicate effectively in diverse environments (including multi-lingual)

Reason Effectively

- 2.A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Make Judgments and Decisions

- 2.C.6 Effectively analyze and evaluate evidence, arguments, claims and beliefs
- 2.C.7 Analyze and evaluate major alternative points of view
- 2.C.8 Synthesize and make connections between information and arguments
- 2.C.9 Interpret information and draw conclusions based on the best analysis
- 2.C.10 Reflect critically on learning experiences and processes

Use Systems Thinking

- 2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Solve Problems

- 2.D.3 Solve different kinds of non-familiar problems in both conventional and innovative ways
- 2.D.4 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

- 4.A.3 Access information efficiently (time) and effectively (sources)
- 4.A.4 Evaluate information critically and competently

Use and Manage Information

- 4.B.4 Use information accurately and creatively for the issue or problem at hand
- 4.B.5 Manage the flow of information from a wide variety of sources
- 4.B.6 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Initiative and Self-Direction

Manage Goals and Time

- 8.A.4 Set goals with tangible and intangible success criteria

8.A.5 Balance tactical (short-term) and strategic (long-term) goals

8.A.6 Utilize time and manage workload efficiently

Work Independently

8.B.1 Monitor, define, prioritize and complete tasks without direct oversight

Be Self-Directed Learners

8.C.9 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise

8.C.10 Demonstrate initiative to advance skill levels towards a professional level

8.C.11 Demonstrate commitment to learning as a lifelong process

8.C.12 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies

Total Learning Hours for Unit: 20

- Explore and analyzing the various modes of gene expression
- Continued exploration of the mechanisms beyond the DNA code that determine outcomes that are different for individuals (Epigenetics)

**Foundational NCHSE Standards
National Consortium for Health Science Education**

**Standard 1:
Academic Foundation**

1. Academic Foundations: Healthcare professionals will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role. The following competencies are considered essential for students in a health science program of study.

- Classify the basic structural and functional organization of the human body (tissue, organ, and system)

**Standard 4:
Employability Skills**

4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.

- Accurately document procedures and results in a lab notebook
- Observe the personal traits and attitudes desirable in a member of the healthcare team
- Implement professional standards as they apply to hygiene, dress, language, confidentiality and behavior
- Apply employability skills in healthcare

	<ul style="list-style-type: none"> • Develop components of a personal portfolio • Identify innovative strategies for obtaining employment
Standard 7: Safety Practices	<p>7. Safety Practices: Healthcare professionals will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.</p> <ul style="list-style-type: none"> • Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations • Apply principles of body mechanics • Apply safety techniques in the work environment • Recognize Safety Data Sheets (SDSs). (www.osha.gov) • Comply with safety signs, symbols, and labels • Practice fire safety in a healthcare setting • Apply principles of basic emergency response in natural disasters and other emergencies
Standard 8: Teamwork	<p>8. Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</p> <ul style="list-style-type: none"> • Apply effective techniques for managing team conflict
Standard 11: Information Technology Application	<p>11. Information Technology Application: Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Use basic word processing, spreadsheet, and database applications. • Evaluate the validity of web-based resources.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
Standard 4: Laboratory Protocols and Procedures	<p>Biotechnology R& D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculums development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.</p>

	<ul style="list-style-type: none"> Procedures – Calculate the molarity of a given solution and measure pH of this solution
<p>Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> Regulation – Employ Quality Assurance in this process Regulation – Observe cGMP and why it is important in biotech production
<i>Aligned Washington State Standards</i>	
Communications	SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS-LS4-1),(HS-LS4-2)
Educational Technology	2.2.1 Develop skills to use technology effectively. 2.2.2 Use a variety of hardware to support learning.
Math	MP.2 Reason abstractly and quantitatively
Science	<p>HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p> <p>HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</p> <p>HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.</p> <p>LS4.C: Adaptation</p> <p>Evolution is a consequence of the interaction of four factors:</p> <p>(1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)</p> <p>Natural selection leads to adaptation to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3),(HS-LS4-4)</p> <p>Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)</p> <p>Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the</p>

	extinction—of some species. (HS-LS4-5),(HS-LS4-6)
Writing	WHST9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
	WHST. 9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5)

Unit 4

Standard/Unit:

IST IV: Mutations in DNA of the sex cells, and sorting and recombination during meiosis result in genetic variation. Mutations may help, harm, or have little effect on an organism. Harmful mutations can lead to Genetic Diseases.
(LS1 1)

Performance Assessments:

- Compare and contrast variables that lead to genetic diversity in populations
- Compare and contrast the DNA, Genes, and chromosomes
- Analyze DNA sequence for maladaptive SNPs and relate to shifts in metabolic processes
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
- Students utilize external research to inform protocol and data evaluation and assessment
- Students prepare DNA sequence for publication
- Students utilize National Center for Biotechnology Information tools for sequence annotation prior to publishing

21st Century Skills

Creativity and Innovation:

Think Creatively

1.A.3 Use a wide range of idea creation techniques (such as brainstorming)

Critical Thinking and Problem Solving:

Reason Effectively

2.A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Make Judgments and Decisions

2.C.11 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.12 Analyze and evaluate major alternative points of view

2.C.13 Synthesize and make connections between information and arguments

2.C.14 Interpret information and draw conclusions based on the best analysis

2.C.15 Reflect critically on learning experiences and processes

Use Systems Thinking

2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Solve Problems

2.D.5 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.6 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

4.A.5 Access information efficiently (time) and effectively (sources)

4.A.6 Evaluate information critically and competently

Use and Manage Information

4.B.7 Use information accurately and creatively for the issue or problem at hand

4.B.8 Manage the flow of information from a wide variety of sources

4.B.9 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Initiative and Self-Direction

Manage Goals and Time

8.A.7 Set goals with tangible and intangible success criteria

8.A.8 Balance tactical (short-term) and strategic (long-term) goals

8.A.9 Utilize time and manage workload efficiently

Work Independently

8.B.1 Monitor, define, prioritize and complete tasks without direct oversight

Be Self-Directed Learners

- 8.C.13 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise
- 8.C.14 Demonstrate initiative to advance skill levels towards a professional level
- 8.C.15 Demonstrate commitment to learning as a lifelong process
- 8.C.16 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies	Total Learning Hours for Unit: 20
<ul style="list-style-type: none"> • Design, optimize and apply the use of molecular tools to screen populations for genetic mutations (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots) • Calculate from self-generated data and research • Use molecular tools to screen populations for genetic mutations (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots) 	

**Foundational NCHSE Standards
National Consortium for Health Science Education**

Standard 4: Employability Skills	<p><i>4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</i></p> <ul style="list-style-type: none"> • Apply employability skills in healthcare • Develop components of a personal portfolio
Standard 7: Safety Practices	<p><i>7. Safety Practices: Healthcare professionals will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.</i></p> <ul style="list-style-type: none"> • Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations • Apply safety techniques in the work environment • Recognize Safety Data Sheets (SDSs). (www.osha.gov) • Comply with safety signs, symbols, and labels • Practice fire safety in a healthcare setting • Apply principles of basic emergency response in natural disasters and other emergencies
Standard 8: Teamwork	<p><i>8. Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the</i></p>

	<p><i>healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p><i>11. Information Technology Application: Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Apply basic computer concepts and terminology in order to use computers and other mobile devices. • Demonstrate basic computer operating procedures • Demonstrate use of file organization and information storage. • Use basic word processing, spreadsheet, and database applications. • Demonstrate use of appropriate e-mail and social media usage.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
<p>Standard 3: Introduction to Biotechnology Knowledge Areas and Techniques</p>	<p>Biotechnology R&D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (product recombinant DNAC products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics</p> <ul style="list-style-type: none"> • Techniques – Describe the following techniques: recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products and bioprocessing • Knowledge Areas – Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities
<p>Standard 4: Laboratory Protocols and Procedures</p>	<p>Biotechnology R&D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculums development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.</p> <ul style="list-style-type: none"> • Procedures – Calculate the molarity of a given solution and measure pH of this solution
<p>Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-</p>

	<p>clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Implement the role of a Quality Assurance person in this process • Regulation – Observe cGMP in biotech production
--	--

Aligned Washington State Standards

Educational Technology	2.2.1 Develop skills to use technology effectively. 2.2.2 Use a variety of hardware to support learning.
Math	A1.6.B Make valid inferences and draw conclusions based on data.
Science	HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Unit 5

Standard/Unit:

IST V: Genetic variation and the phenotypic variation it leads to are the basis of evolution. The process of evolution occurs at the population level and takes place over multiple generations. Evolution by Natural Selection is a process by which inheritable traits influence how likely an organism is to survive, reproduce, and pass those traits to an offspring.
(LS3 ASPs)

Performance Assessments:

- Assess genetic diversity with multiple tools such as RFLP, CAPS, AFLP, microsatellite analysis, DNA sequencing, and synthesize conclusions from the resulting data sets
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
- Perform a laboratory safety assessment (mid-year self check)
- Apply best practices to assure SOP application pertaining to safety and laboratory LEAN strategies

21st Century Skills

Creativity and Innovation:

Think Creatively

1.A.4 Use a wide range of idea creation techniques (such as brainstorming)

Critical Thinking and Problem Solving:

Reason Effectively

2.A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Make Judgments and Decisions

2.C.16 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.17 Analyze and evaluate major alternative points of view

2.C.18 Synthesize and make connections between information and arguments

2.C.19 Interpret information and draw conclusions based on the best analysis

2.C.20 Reflect critically on learning experiences and processes

Use Systems Thinking

2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Solve Problems

2.D.7 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.8 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

4.A.7 Access information efficiently (time) and effectively (sources)

4.A.8 Evaluate information critically and competently

Use and Manage Information

4.B.10 Use information accurately and creatively for the issue or problem at hand

4.B.11 Manage the flow of information from a wide variety of sources

4.B.12 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Initiative and Self-Direction

Manage Goals and Time

8.A.10 Set goals with tangible and intangible success criteria

8.A.11 Balance tactical (short-term) and strategic (long-term) goals

8.A.12 Utilize time and manage workload efficiently

Work Independently

8.B.1 Monitor, define, prioritize and complete tasks without direct oversight

Be Self-Directed Learners

- 8.C.17 Go beyond basic mastery of skills and/or curriculum to explore and expand one’s own learning and opportunities to gain expertise
- 8.C.18 Demonstrate initiative to advance skill levels towards a professional level
- 8.C.19 Demonstrate commitment to learning as a lifelong process
- 8.C.20 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies	Total Learning Hours for Unit: 20
---------------------	--

- Design, optimize and apply the use of molecular tools to correlate phenotypic traits (PCR, Restriction Digest, Gel electrophoresis, Bradford’s, ELISA, DNA Sequencing, Western Blots)
- Construct mathematical and statistical analysis to analyze and evaluate gene frequency trends in novel independent research

**Foundational NCHSE Standards
National Consortium for Health Science Education**

Standard 1: Academic Foundation	<p><i>1. Academic Foundations: Healthcare professionals will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role. The following competencies are considered essential for students in a health science program of study.</i></p> <ul style="list-style-type: none"> • Apply mathematical computation related to healthcare procedures (metric and household, conversions and measurements) • Analyze diagrams, charts, graphs, and tables to interpret healthcare results
Standard 2: Communication	<p><i>2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.</i></p> <ul style="list-style-type: none"> • Report and clarify subjective and objective information • Apply speaking and active listening skills • Use medical abbreviations to communicate information
Standard 4: Employability Skills	<p><i>4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</i></p> <ul style="list-style-type: none"> • Apply employability skills in healthcare • Develop components of a personal portfolio

<p>Standard 7: Safety Practices</p>	<p>7. Safety Practices: <i>Healthcare professionals will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.</i></p> <ul style="list-style-type: none"> • Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations • Apply principles of body mechanics • Apply safety techniques in the work environment • Recognize Safety Data Sheets (SDSs). (www.osha.gov) • Comply with safety signs, symbols, and labels • Practice fire safety in a healthcare setting • Apply principles of basic emergency response in natural disasters and other emergencies
<p>Standard 8: Teamwork</p>	<p>8. Teamwork: <i>Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p>11. Information Technology Application: <i>Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Apply basic computer concepts and terminology in order to use computers and other mobile devices. • Demonstrate basic computer operating procedures • Demonstrate use of file organization and information storage. • Use basic word processing, spreadsheet, and database applications. • Demonstrate use of appropriate e-mail and social media usage.

<p>Standard 2: Academic Foundations</p>	<p>Biotechnology R& D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology</p> <ul style="list-style-type: none"> Statistics – Compare the standard deviation and the mean of efficacy testing data of two biotechnology products
<p>Standard 4: Laboratory Protocols and Procedures</p>	<p>Biotechnology R& D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculums development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.</p> <ul style="list-style-type: none"> Procedures – Calculate the molarity of a given solution and measure pH of this solution
<p>Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> Regulation – Implement the role of a Quality Assurance person in this process Regulation – Apply cGMP in biotech production
<p><i>Aligned Washington State Standards</i></p>	
<p>Math</p>	<p>8.3.F Determine probabilities for mutually exclusive, dependent, and independent events for small sample sizes.</p>
<p>Reading</p>	<p>9-10.RST.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.</p> <p>9-10.RST.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.</p>
<p>Science</p>	<p>9-11 LS3B Random changes in the genetic makeup of cells and organisms (mutations) can cause changes in their physical characteristics or behaviors. If the genetic mutations occur in eggs or sperm cells, the changes will be inherited by offspring. While many of these changes will be harmful, a small minority may allow the offspring to better survive and reproduce.</p> <p>HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</p> <p>HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</p> <p>HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p>
<p>Social Studies</p>	<p>3.1.1 Analyze information from geographic tools, including computer-based mapping systems, to draw conclusions on an issue or</p>

	event. (12)
Writing	WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Unit 6

Standard/Unit:

IST VI: Organisms are an integrated and interacting network of genes, proteins and biochemical reactions which give rise to life. (Systems Biology) (SYSTEMS BIOLOGY) (SYSC)

Performance Assessments:

- Evaluate the frequency of metabolic disorders of various metabolic pathways and assess role of genomic variation and genomic conservation
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- EWU Symposium Presentation
- Field experiments and data collection must challenge but maintain valid protocols
- Authentic research projects: grayling, deer, wolf, bee studies
- Community Service: ie -- Cup of Cool Water, NEYC Anti-Bullying campaign, Food Drive Neighborhood Pick-up
- Science Nights at Elementary Schools
- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
- Students participate in Spokane STEMposium presentations
- Students partner with EWU Masters students to sample current instrumentation protocols and data analysis tools

21st Century Skills

Creativity and Innovation:

Think Creatively

1.A.5 Use a wide range of idea creation techniques (such as brainstorming)

Critical Thinking and Problem Solving:

Reason Effectively

2.A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Make Judgments and Decisions

- 2.C.21 Effectively analyze and evaluate evidence, arguments, claims and beliefs
- 2.C.22 Analyze and evaluate major alternative points of view
- 2.C.23 Synthesize and make connections between information and arguments
- 2.C.24 Interpret information and draw conclusions based on the best analysis
- 2.C.25 Reflect critically on learning experiences and processes

Use Systems Thinking

- 2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Solve Problems

- 2.D.9 Solve different kinds of non-familiar problems in both conventional and innovative ways
- 2.D.10 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

- 4.A.9 Access information efficiently (time) and effectively (sources)
- 4.A.10 Evaluate information critically and competently

Use and Manage Information

- 4.B.13 Use information accurately and creatively for the issue or problem at hand
- 4.B.14 Manage the flow of information from a wide variety of sources
- 4.B.15 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Initiative and Self-Direction

Manage Goals and Time

- 8.A.13 Set goals with tangible and intangible success criteria
- 8.A.14 Balance tactical (short-term) and strategic (long-term) goals
- 8.A.15 Utilize time and manage workload efficiently

Work Independently

- 8.B.1 Monitor, define, prioritize and complete tasks without direct oversight

Be Self-Directed Learners

- 8.C.21 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise
- 8.C.22 Demonstrate initiative to advance skill levels towards a professional level
- 8.C.23 Demonstrate commitment to learning as a lifelong process
- 8.C.24 Reflect critically on past experiences in order to inform future progress

Standards and Competencies	
Competencies	Total Learning Hours for Unit: 20
<ul style="list-style-type: none"> • Recognize that their data does not stand alone, that there are many different influencers that inform their research • Continually place their experimental design in the context of complex systems 	
Foundational NCHSE Standards National Consortium for Health Science Education	
Standard 2: Communication	<p><i>2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.</i></p> <ul style="list-style-type: none"> • Report subjective and objective information • Apply speaking and active listening skills • Use medical abbreviations to communicate information
Standard 4: Employability Skills	<p><i>4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</i></p> <ul style="list-style-type: none"> • Apply employability skills in healthcare • Discuss levels of education, credentialing requirements, and employment trends in healthcare • Develop components of a personal portfolio
Standard 7: Safety Practices	<p><i>7. Safety Practices: Healthcare professionals will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.</i></p> <ul style="list-style-type: none"> • Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations • Apply principles of body mechanics • Apply safety techniques in the work environment • Recognize Safety Data Sheets (SDSs). (www.osha.gov) • Comply with safety signs, symbols, and labels

	<ul style="list-style-type: none"> • Practice fire safety in a healthcare setting • Apply principles of basic emergency response in natural disasters and other emergencies
Standard 8: Teamwork	<p>8. Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Apply effective techniques for managing team conflict
Standard 11: Information Technology Application	<p>11. Information Technology Application: Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Apply basic computer concepts and terminology in order to use computers and other mobile devices. • Demonstrate basic computer operating procedures • Demonstrate use of file organization and information storage.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
Standard 3: Introduction to Biotechnology Knowledge Areas and Techniques	<p>Biotechnology R&D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (product recombinant DNAC products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics</p> <ul style="list-style-type: none"> • Techniques – Describe the following techniques: recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products and bioprocessing • Knowledge Areas – Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities
Standard 5: Product Design and Development	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p>

- Regulation – Implement the role of a Quality Assurance person in this process
- Regulation – Apply cGMP in biotech production

Aligned Washington State Standards

Educational Technology	HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
Math	<p>Using Mathematics and Computational Thinking</p> <p>Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <p>Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)</p>
Reading	<p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1),(HS-ETS1-3)</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3)</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1),(HS-ETS1-3)</p>
Science	<p>Constructing Explanations and Designing Solutions</p> <p>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.</p> <p>Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2)</p> <p>Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)</p>
Writing	WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-ESS2-5)

Unit 7

Standard/Unit:

IST VII: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible

Performance Assessments:

- Define multiple variables in modeling DNA polymorphism to actual organism phenotype
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
- Students lead the assessment and analysis (mid-year analysis) of lab productivity
- Interview researchers about their research and best practices

Critical Thinking and Problem Solving

Use Systems Thinking

2. B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.

- Design experiments with knowledge that complex systems
- Lean / continuous improvement seminars that link process to performance

Flexibility and Adaptability

Adapt to Change:

7. A.1 Adapt to varied roles, jobs responsibilities, schedules and contexts.
7. A.2 Work effectively in a climate of ambiguity and changing priorities.

Test, revise, and occasionally discard theories as new evidence comes to light.

Embrace successful failures as a means of applying lessons learned to optimize protocols to better understand experimental design and issues (Grit factor)

Initiative and Self-Direction

Manage Goals and Time:

8. A.1 Set goals with tangible and intangible success criteria.
8. A.2 Balance tactical (short-term) and strategic (long-term) goals.
8. A.3 Utilize time and manage workload efficiently.

Work Independently:

8. B.1 Monitor, define, prioritize and complete tasks without direct oversight.

Be Self –Directed Learners:

8. C.1 Go beyond basic mastery of skills and/or curriculum to explore and expand one’s own learning and opportunities to gain expertise.
8. C.2 Demonstrate initiative to advance skill levels towards a professional level.

- 8. C.3 Demonstrate commitment to learning as a lifelong process.
- 8. C.4 Reflect critically on past experiences in order to inform future progress.
 - Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.
 - Embrace successful failures as a means of applying lessons learned to optimize protocols to better understand experimental design and issues (Grit factor)

Standards and Competencies

Competencies	Total Learning Hours for Unit: 20
---------------------	--

- Synthesis of multiple disciplines into the design of their novel research involving complex systems (sociology, history, mathematics, statistics, technical writing, biology, chemistry)

**Foundational NCHSE Standards
National Consortium for Health Science Education**

**Standard 1:
Academic Foundations**

1. Academic Foundations: Healthcare professionals will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role. The following competencies are considered essential for students in a health science program of study.

- Analyze diagrams, charts, graphs, and tables to interpret healthcare results

**Standard 2:
Communication**

2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.

- Interpret verbal and nonverbal communication
- Identify barriers to communication
- Report subjective and objective information
- Interpret the elements of communication using a basic sender-receiver-feedback model
- Apply speaking and active listening skills
- Use roots, prefixes, and suffixes to communicate information
- Use medical abbreviations to communicate information

Standard 4:

4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment

Employability Skills	<p><i>opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</i></p> <ul style="list-style-type: none"> • Apply employability skills in healthcare • Develop components of a personal portfolio
Standard 8: Teamwork	<p><i>8. Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education	
Standard 2: Academic Foundations	<p>Biotechnology R&D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology</p> <ul style="list-style-type: none"> • Statistics – Compare the standard deviation and the mean of efficacy testing data of two biotechnology products
Standard 5: Product Design and Development	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Implement the role of a Quality Assurance person in this process • Regulation – Apply cGMP in biotech production
<i>Aligned Washington State Standards</i>	
Math	Using Mathematical and Computational Thinking

	<p>Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <p>Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4)</p>
Reading	RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically
Science	<p>Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <p>Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS1-2)</p> <p>Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (HS-ESS1-6)</p>
Writing	<p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS2-6)</p> <p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>

Unit 8

Standard/Unit:

IST VIII: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and representing the data.
(INQ B)

Performance Assessments:

- Independently design experimental protocols based on peer reviewed literature and analysis and evaluation of laboratory-generated data
- Optimize protocol design to improve accuracy and efficiency
- Using “Lean” strategies, design models to improve laboratory flow and efficiencies
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Step Into STEM Seminar Planning Design and implement CI projects in the field and modify as needed
- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)

Use Systems Thinking

2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Solve Problems

2.D.11 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.12 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

4.A.11 Access information efficiently (time) and effectively (sources)

4.A.12 Evaluate information critically and competently

Use and Manage Information

4.B.16 Use information accurately and creatively for the issue or problem at hand

4.B.17 Manage the flow of information from a wide variety of sources

4.B.18 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Initiative and Self-Direction

Manage Goals and Time

8.A.16 Set goals with tangible and intangible success criteria

8.A.17 Balance tactical (short-term) and strategic (long-term) goals

8.A.18 Utilize time and manage workload efficiently

Work Independently

8.B.1 Monitor, define, prioritize and complete tasks without direct oversight

Be Self-Directed Learners

8.C.25 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise

8.C.26 Demonstrate initiative to advance skill levels towards a professional level

- 8.C.27 Demonstrate commitment to learning as a lifelong process
- 8.C.28 Reflect critically on past experiences in order to inform future progress

Think Creatively:

- 1. A.1 Use a wide range of idea creation techniques (such as brainstorming).
- 1. A.2 Create new and worthwhile ideas (both incremental and radical concepts).
- 1. A.3 Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Information Literacy

Access and Evaluate Information

- 4. A.1 Access information efficiently (time) and effectively (sources).
- 4. A.2 Evaluate information critically and competently.

Use and Manage Information

- 4. B.1 Use information accurately and creatively for the issue or problem at hand.
- 4. B.2 Manage the flow of information from a wide variety of sources.
- 4. B.3 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information.

- Apply mathematical and statistical analysis to analyze and evaluate gene frequency trends and synthesize understanding of a populations genetic health
- Use molecular tools to correlate phenotypic traits (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots)
- Formulate multiple hypotheses based on a model or theory of a causal relationship and lead research team through process toward confirmation or revision:
- Miner Lake Fin Snips
- Electrofishing Washington State Department of Water
- School Board Presentations
- Synthesis Methods

Standards and Competencies

Competencies

Total Learning Hours for Unit: 30

- Evaluating that the experimental design contains the appropriate statistical tools used to verify the data
- Evaluating the importance of maintaining the integrity of the process from research design to sampling to data analysis

**Foundational NCHSE Standards
National Consortium for Health Science Education**

**Standard 2:
Communication**

2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.

	<ul style="list-style-type: none"> • Interpret verbal and nonverbal communication • Identify barriers to communication • Report subjective and objective information • Interpret the elements of communication using a basic sender-receiver-feedback model • Apply speaking and active listening skills • Use roots, prefixes, and suffixes to communicate information • Use medical abbreviations to communicate information
<p>Standard 4: Employability Skills</p>	<p>4. Employability Skills: <i>Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</i></p> <ul style="list-style-type: none"> • Employ the personal traits and attitudes desirable in a member of the healthcare team • Apply employability skills in healthcare • Develop components of a personal portfolio
<p>Standard 7: Safety Practices</p>	<p>7. Safety Practices: <i>Healthcare professionals will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.</i></p> <ul style="list-style-type: none"> • Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations
<p>Standard 8: Teamwork</p>	<p>8. Teamwork: <i>Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p>11. Information Technology Application: <i>Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels.

	<ul style="list-style-type: none"> • Describe appropriate methods to correct inaccurate information/errors personally entered into an electronic medical records (EMR) • Apply basic computer concepts and terminology in order to use computers and other mobile devices. • Demonstrate use of file organization and information storage. • Evaluate the validity of web-based resources. • Demonstrate use of appropriate e-mail and social media usage.
--	---

**NCHSE Biotechnology and Research Development Standards:
National Consortium for Health Science Education**

Standard 2: Academic Foundations	<p>Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology</p> <ul style="list-style-type: none"> • Mathematical Concepts – Illustrate the concepts of percentages and ratios using a biotechnology application • Mathematical Concepts – Contract weight-to-weight and weight- to-volume calculations for solutions •
-------------------------------------	---

Standard 5: Product Design and Development	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Implement the role of a Quality Assurance person in this process • Regulation – Observe cGMP in biotech production
---	--

Aligned Washington State Standards

Math	<p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. (HS-PS4-1),(HS-PS4-3)</p> <p>HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS4-1),(HS-PS4-3)</p>
-------------	---

Reading	<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4)</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS4-1),(HS-PS4-4)</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4)</p>
----------------	---

Science	<p>Obtaining, Evaluating, and Communicating Information: Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and</p>
----------------	---

	<p>reliability of the claims, methods, and designs.</p> <p>Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats</p> <p>Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4)</p> <p>Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS4-5)</p>
--	--

Writing	<p>WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS4-4)</p>
----------------	--

Unit 9

Standard/Unit:

IST IX: Conclusions must be logical, based on evidence, and consistent with prior established knowledge. (INQ C)

- Performance Assessments:**
- Analyze and evaluate deep data sets generated in the laboratory to develop inferences and conclusions. Utilize those inferences and conclusions to synthesize understanding
 - Evaluate data using mathematical tools including graphing and statistical analysis
 - Identify and apply all appropriate laboratory safety protocols

- Leadership Alignment:**
- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
 - Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
 - Students write research paper components for the whole lab (all the lab groups)
- Critical Thinking and Problem Solving**
- Make Judgments and Decisions:
Reason Effectively (Examples Below)
2. A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation.

Use Systems Thinking:

2. B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.

Make Judgments and Decisions:

2. C.1 Effectively analyze and evaluate evidence, arguments, claims and beliefs.

2. C.2 Analyze and evaluate major alternative points of view.

2. C.3 Synthesize and make connections between information and arguments.

2. C.4 Interpret information and draw conclusions based on the best analysis.

2. C.5 Reflect critically on learning experiences and processes.

- Analyze and evaluate deep data sets generated in the lab to develop inferences and conclusions
- Organize and participate in seminar (speakers) series
- Continuous improvement projects and solution implementations

Information, Communications and Technology (ICT) Literacy

Apply Technology Effectively:

6. A.1 Use technology as a tool to research, organize, evaluate and communicate information.

6. A.2 Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access, manage, integrate, evaluate and create information to successfully function in a knowledge economy.

6. A.3 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.

- Synthesize opinions based upon “good science” in the context of the constraints of a modern world
- For the purpose of publishing results:
- Analyze a societal issue that may be addressed through science and/or technology. Compare alternative solutions by considering trade-offs and unintended consequences
- Use molecular tools to screen populations for genetic mutations (PCR, Restriction Digest, Gel electrophoresis, Bradford’s, ELISA, DNA Sequencing, Western Blots)
- Sample collections in the field

Social and Cross-Cultural Skills

Interact Effectively with Others:

9. A.1 Know when it is appropriate to listen and when to speak.

9. A.2 Conduct themselves in a respectable, professional manner.

Work Effectively with Diverse Teams:

9. B.1 Respect cultural differences and work effectively with people from a range of social and cultural backgrounds.

9. B.2 Respond open-mindedly to different ideas and values.

9. B.3 Leverage social and cultural differences to create new ideas and increase both innovation and quality of work.

- Analyze, evaluate and synthesize the alternative explanations and decide which best fits the data and evidence
- Question and answer sessions at external presentations

Standards and Competencies

Competencies

Total Learning Hours for Unit: 20

- Analyze that the conclusions of the novel research are supported by the preponderance of the evidence from the investigation and consistent with established scientific knowledge / practice
- Analyze, evaluate, synthesize and challenge the alternative explanations and decide which best fits the data and evidence

**Foundational NCHSE Standards
National Consortium for Health Science Education**

**Standard 2:
Communication**

2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.

- Interpret verbal and nonverbal communication
- Identify barriers to communication
- Report subjective and objective information
- Interpret the elements of communication using a basic sender-receiver-feedback model
- Apply speaking and active listening skills
- Use roots, prefixes, and suffixes to communicate information
- Use medical abbreviations to communicate information

**Standard 4:
Employability Skills**

4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.

- Apply employability skills in healthcare
- Develop components of a personal portfolio

**Standard 8:
Teamwork**

8. Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.

- Understand roles and responsibilities of team members
- Recognize characteristics of effective teams
- Differentiate creative methods for building positive team relationships

	<ul style="list-style-type: none"> Analyze attributes and attitudes of an effective leader Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p>11. Information Technology Application: Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</p> <ul style="list-style-type: none"> Use health record data collection tools (such as input screens, document templates) Create documentation in the health record that reflects timeliness, completeness, and accuracy. Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. Describe appropriate methods to correct inaccurate information/errors personally entered into an electronic medical records (EMR) Apply basic computer concepts and terminology in order to use computers and other mobile devices. Demonstrate use of file organization and information storage. Evaluate the validity of web-based resources. Demonstrate use of appropriate e-mail and social media usage.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
<p>Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> Regulation – Implement the role of a Quality Assurance person in this process Regulation – Observe cGMP in biotech production
<p>Aligned Washington State Standards</p>	
<p>Math</p>	<p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context</p> <p>HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression</p> <p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-1),(HS-LS2-2),(HS-LS2-7)</p> <p>HSS-ID.A.1 Represent data with plots on the real number line. (HS-LS2-6)</p> <p>HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. (HS-LS2-6)</p> <p>HSS-IC.B.6 Evaluate reports based on data. (HS-LS2-6)</p>

Reading	<p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4)</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS4-1),(HS-PS4-4)</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4)</p>
Science	<p>HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.</p>
Writing	<p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes</p> <p>WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS4-4)</p>

Unit 10

Standard/Unit:

IST X: The essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions. (INQ E)

Performance Assessments:

- Use multiple literature sources coupled with laboratory-generated data to develop, modify, accept or reject hypothesis
- Apply mathematical models to laboratory generated data sets to assist in acceptance or rejection of self-generated hypothesis
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Step Into STEM Seminar Planning Design and implement CI projects in the field and modify as needed
- Students practice Step Into STEM presentations with lower levels and coach lower level teams about proper presentation protocols.
- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
-

21st Century Skills

Use Systems Thinking

2.B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Solve Problems

2.D.13 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.14 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

4.A.13 Access information efficiently (time) and effectively (sources)

4.A.14 Evaluate information critically and competently

Use and Manage Information

4.B.19 Use information accurately and creatively for the issue or problem at hand

4.B.20 Manage the flow of information from a wide variety of sources

4.B.21 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Initiative and Self-Direction

Manage Goals and Time

8.A.19 Set goals with tangible and intangible success criteria

8.A.20 Balance tactical (short-term) and strategic (long-term) goals

8.A.21 Utilize time and manage workload efficiently

Work Independently

8.B.1 Monitor, define, prioritize and complete tasks without direct oversight

Be Self-Directed Learners

8.C.29 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise

8.C.30 Demonstrate initiative to advance skill levels towards a professional level

8.C.31 Demonstrate commitment to learning as a lifelong process

8.C.32 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Evaluating the data to accept or reject one or more hypotheses based on a novel idea and theory of these causal relationships.
- Refinement of the novel ideas and critical thinking to analyze and continual evaluation of the research components

<p>Standard 2: Communication</p>	<p>2. Communication: <i>Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.</i></p> <ul style="list-style-type: none"> • Interpret verbal and nonverbal communication • Identify barriers to communication • Report subjective and objective information • Interpret the elements of communication using a basic sender-receiver-feedback model • Apply speaking and active listening skills • Use roots, prefixes, and suffixes to communicate information • Use medical abbreviations to communicate information
<p>Standard 4: Employability Skills</p>	<p>4. Employability Skills: <i>Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</i></p> <ul style="list-style-type: none"> • Apply employability skills in healthcare
<p>Standard 8: Teamwork</p>	<p>8. Teamwork: <i>Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p>11. Information Technology Application: <i>Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Demonstrate use of file organization and information storage. • Use basic word processing, spreadsheet, and database applications. • Evaluate the validity of web-based resources.

- Demonstrate use of appropriate e-mail and social media usage.

**NCHSE Biotechnology and Research Development Standards:
National Consortium for Health Science Education**

**Standard 5:
Product Design and
Development**

Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).

- Regulation – Examine the role of a Quality Assurance person in this process
- Regulation – Plan for cGMP in biotech production

Aligned Washington State Standards

Science

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

Design, evaluate, and/or refine a solution to a complex, real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations

- HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
- HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Writing

- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-ESS2-5)

Reading	<p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1),(HS-ETS1-3)</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3)</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
---------	--

Unit 11

Standard/Unit:

IST XI: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.
(INQ F)

Performance Assessments:

- Accept successful failures and independently/collaboratively identify factors and variables that can be tested to modify protocols for collection of new evidence
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
- Students critically evaluate their Socratic Seminar skills relating to process, protocols and participation

21st Century Skills

Flexibility and Adaptability

Adapt to Change:

7. A.1 Adapt to varied roles, jobs responsibilities, schedules and contexts.
7. A.2 Work effectively in a climate of ambiguity and changing priorities.

Test, revise, and occasionally discard theories as new evidence comes to light.

Embrace successful failures as a means of applying lessons learned to optimize protocols to better understand experimental design and issues (Grit factor)

Initiative and Self-Direction

Manage Goals and Time:

8. A.1 Set goals with tangible and intangible success criteria.
8. A.2 Balance tactical (short-term) and strategic (long-term) goals.
8. A.3 Utilize time and manage workload efficiently.

Work Independently:

8. B.1 Monitor, define, prioritize and complete tasks without direct oversight.

Be Self –Directed Learners:

8. C.1 Go beyond basic mastery of skills and/or curriculum to explore and expand one’s own learning and opportunities to gain expertise.

8. C.2 Demonstrate initiative to advance skill levels towards a professional level.

8. C.3 Demonstrate commitment to learning as a lifelong process.

8. C.4 Reflect critically on past experiences in order to inform future progress.

- Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.
- Embrace successful failures as a means of applying lessons learned to optimize protocols to better understand experimental design and issues (Grit factor)

Leadership and Responsibility

Guide and Lead Others:

11. A.1 Use interpersonal and problem-solving skills to influence and guide others toward a goal.

11. A.2 Leverage strengths of others to accomplish a common goal.

11. A.3 Inspire others to reach their very best via example and selflessness.

11. A.4 Demonstrate integrity and ethical behavior in using influence and power.

Be Responsible to Others:

11. B.1 Act responsibly with the interests of the larger community in mind.

- Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.
- Planning, documenting, and implementing CI projects
- Work in teams on research and presentations: EWU, Whitworth, Stemposium, Montana Genomics Fieldwork Research Symposium
- Maintain valid data collection protocols in the field and cite research sources

Standards and Competencies

Competencies

Total Learning Hours for Unit: 20

- As a means of continued improvement and analysis we will always recognize and embrace our successful failures as a means of applying lessons learned to optimize protocols to better understand experimental design and our research (True Science Grit!)

**Foundational NCHSE Standards
National Consortium for Health Science Education**

Standard 2:

<p>Communication</p>	<p>2. Communication: <i>Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.</i></p> <ul style="list-style-type: none"> • Interpret verbal and nonverbal communication • Identify barriers to communication • Report subjective and objective information
<p>Standard 4: Employability Skills</p>	<p>4. Employability Skills: <i>Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</i></p> <ul style="list-style-type: none"> • Apply employability skills in healthcare • Develop components of a personal portfolio
<p>Standard 8: Teamwork</p>	<p>8. Teamwork: <i>Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p>11. Information Technology Application: <i>Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Demonstrate use of file organization and information storage. • Use basic word processing, spreadsheet, and database applications. • Evaluate the validity of web-based resources. • Demonstrate use of appropriate e-mail and social media usage.

<p>Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Examine the role of a Quality Assurance person in this process • Regulation – Consider cGMP and why it is important in biotech production
---	---

Aligned Washington State Standards

<p>Science</p>	<p>The NGSS standards do not explicitly address the concept of continuous improvement in authentic research or outside of engineering and the iterative engineering design process. Thus, 4 engineering standards are borrowed from the NGSS standards here to address the required focus on continuous improvement processes and systems thinking as it relates to seeking new knowledge (research context) as opposed to labs in which the answers are ultimately known targets that students can achieve in a given time via defined procedures.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena:</p> <p>A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate the theory is generally modified in light of the new evidence</p> <p>ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</p> <p>ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</p> <p>ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p>
-----------------------	---

Unit 12

Standard/Unit:

IST XII: The technological design process begins by defining a problem in terms of criteria and constraints, conducting research, and generating several different solutions.

Performance Assessments:

- Design complex laboratory investigations in context of past and developing knowledge and awareness of laboratory constraints
- Scope and sequence laboratory flow and necessities in relationship to protocol development
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- EWU Symposium Presentation
- Field experiments and data collection must challenge but maintain valid protocols
- Authentic research projects: grayling, deer, wolf, bee studies
- Community Service: ie -- Cup of Cool Water, NEYC Anti-Bullying campaign, Food Drive Neighborhood Pick-up
- Science Nights at Elementary Schools
- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
- Students volunteer at Family Nights for younger students and their families. Older students coach younger students and families about STEM.

21st Century Skills

Creativity and Innovation

Work Creatively with Others:

1. B.1 Develop, implement and communicate new ideas to others effectively.
1. B.2 Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work.
1. B.3 Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas.
1. B.4 View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes.

Critical Thinking and Problem Solving

Make Judgments and Decisions:

Reason Effectively (Examples Below)

2. A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation.

Use Systems Thinking:

2. B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.

Make Judgments and Decisions:

- 2. C.1 Effectively analyze and evaluate evidence, arguments, claims and beliefs.
- 2. C.2 Analyze and evaluate major alternative points of view.
- 2. C.3 Synthesize and make connections between information and arguments.
- 2. C.4 Interpret information and draw conclusions based on the best analysis.
- 2. C.5 Reflect critically on learning experiences and processes.

- Analyze and evaluate deep data sets generated in the lab to develop inferences and conclusions
- Organize and participate in seminar (speakers) series
- Presentations: School board, EWU, Rock Mt. Lab (Montana), Jackson School District
- Continuous improvement projects and solution implementations

Productivity and Accountability

Manage Projects:

- 10. A.1 Set and meet goals, even in the face of obstacles and competing pressures.
- 10. A.2 Prioritize, plan and manage work to achieve the intended result.

Produce Results:

- 10.B.1 Demonstrate additional attributes associated with producing high quality products including the abilities to:
 - 10. B.1a Work positively and ethically.
 - 10. B.1b Manage time and projects effectively.
 - 10. B.1c Multi-task.
 - 10. B.1d Participate actively, as well as be reliable and punctual.
 - 10. B.1e Present oneself professionally and with proper etiquette.
 - 10. B.1f Collaborate and cooperate effectively with teams.
 - 10. B.1g Respect and appreciate team diversity.
 - 10. B.1h Be accountable for results.

Standards and Competencies

Competencies

Total Learning Hours for Unit: 30

- Continued synthesis and application of the knowledge gained from research papers, past experimental procedures and results, collaborative discussions into appropriate strategies to refine and inform next steps
- The technological design process begins by defining a problem in terms of criteria and constraints, conducting research, and generating several different solutions.
- Design complex field laboratory investigations in context of past and developing knowledge and awareness of laboratory constraints.
- Design and implement CI projects in the field and modify as needed - document in Foundations

**Foundational NCHSE Standards
National Consortium for Health Science Education**

**Standard 2:
Communication**

2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.

	<ul style="list-style-type: none"> • Interpret verbal and nonverbal communication • Identify barriers to communication • Report subjective and objective information • Interpret the elements of communication using a basic sender-receiver-feedback model • Apply speaking and active listening skills • Use roots, prefixes, and suffixes to communicate information • Use medical abbreviations to communicate information
<p>Standard 4: Employability Skills</p>	<p><i>4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</i></p> <ul style="list-style-type: none"> • Apply employability skills in healthcare • Develop components of a personal portfolio
<p>Standard 8: Teamwork</p>	<p><i>8. Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p><i>11. Information Technology Application: Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Describe appropriate methods to correct inaccurate information/errors personally entered into an electronic medical records (EMR) • Evaluate the validity of web-based resources. • Demonstrate use of appropriate e-mail and social media usage.

**NCHSE Biotechnology and Research Development Standards:
National Consortium for Health Science Education**

<p align="center">Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Examine the role of a Quality Assurance person in this process • Regulation – Define cGMP and why it is important in biotech production
--	---

Aligned Washington State Standards

Educational Technology	2.2.1 Develop and use technology effectively
Reading	<p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1),(HS-ETS1-3)</p> <p>RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3)</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
Science	<p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>ETS1.B: Developing Possible Solutions : When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)</p> <p>Analyzing and Interpreting Data :</p> <p>Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.</p> <p>Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5)</p>

Unit 13

<p>Standard/Unit: IST XIII: Choosing the best solution involves comparing alternatives with respect to criteria and constraints, then building and testing a model or other representation</p>
--

of the final design.
(APPC)

Performance Assessments:

- Critically evaluate a variety of protocol options for similarities and differences and then project most effective protocol, including rationale
- Identify and apply all appropriate laboratory safety protocols
- Draft reports (implement technical writing, implement industry terminology)

Leadership Alignment:

- Organize and participate in seminar (speakers) series
- Presentations: School board, EWU, Rock Mt. Lab (Montana), Jackson School District, Washington State Department of Fish and Wildlife
- Continuous improvement projects and solution implementations
- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
- Students lead evaluations of SOP procedures

21st Century Skills

Critical Thinking and Problem Solving

Make Judgments and Decisions:

Reason Effectively (Examples Below)

2. A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation.

Use Systems Thinking:

2. B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.

Make Judgments and Decisions:

2. C.1 Effectively analyze and evaluate evidence, arguments, claims and beliefs.

2. C.2 Analyze and evaluate major alternative points of view.

2. C.3 Synthesize and make connections between information and arguments.

2. C.4 Interpret information and draw conclusions based on the best analysis.

2. C.5 Reflect critically on learning experiences and processes.

- Analyze and evaluate deep data sets generated in the lab to develop inferences and conclusions

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Synthesis of multiple optimization steps via the best molecular tools, statistical analysis, and cross curricular influences to inform and direct the research

Foundational NCHSE Standards
National Consortium for Health Science Education

**Standard 2:
Communication**

2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.

- Interpret verbal and nonverbal communication
- Identify barriers to communication
- Report subjective and objective information
- Interpret the elements of communication using a basic sender-receiver-feedback model
- Apply speaking and active listening skills
- Use roots, prefixes, and suffixes to communicate information
- Use medical abbreviations to communicate information

**Standard 4:
Employability Skills**

4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.

- Apply employability skills in healthcare
- Develop components of a personal portfolio

**Standard 7:
Safety Practices**

7. Safety Practices: Healthcare professionals will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.

- Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations
- Apply safety techniques in the work environment
- Recognize Safety Data Sheets (SDSs). (www.osha.gov)
- Comply with safety signs, symbols, and labels
- Practice fire safety in a healthcare setting

**Standard 8:
Teamwork**

8. Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.

	<ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p><i>11. Information Technology Application: Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Describe appropriate methods to correct inaccurate information/errors personally entered into an electronic medical records (EMR) • Apply basic computer concepts and terminology in order to use computers and other mobile devices. • Demonstrate basic computer operating procedures • Demonstrate use of file organization and information storage. • Use basic word processing, spreadsheet, and database applications. • Evaluate the validity of web-based resources. • Demonstrate use of appropriate e-mail and social media usage.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
<p>Standard 3: Introduction to Biotechnology Knowledge Areas and Techniques</p>	<p>Biotechnology R&D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (product recombinant DNAC products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics</p> <ul style="list-style-type: none"> • Techniques – Describe the following techniques: recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products and bioprocessing • Knowledge Areas – Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities
<p>Standard 4: Laboratory Protocols and Procedures</p>	<p>Biotechnology R& D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculums development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.</p> <ul style="list-style-type: none"> • Procedures – Describe how molarity relates to solution preparation

	<ul style="list-style-type: none"> • Procedures – Calculate the molarity of a given solution and measure pH of this solution • Protocols – Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team
Standard 5: Product Design and Development	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Examine the role of a Quality Assurance person in this process • Regulation – Define cGMP and why it is important in biotech production
<i>Aligned Washington State Standards</i>	
Communications	<p>Presentation of Knowledge and Ideas:</p> <p>4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>
Educational Technology	2.2.1 Develop and use technology effectively
Math	<p>HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-4),(HS-ESS3-5)</p> <p>MP.4 Model with mathematics. (HS-ESS2-3),(HS-ESS2-6)</p> <p>HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-4)</p>
Reading	<p>RST 6 11-12. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>RST 7 11-12. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST 8 11-12. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>RST 9 11-12. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible</p>
Science	<p>HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can</p>

	<p>be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts</p>
<p>Writing</p>	<p>WHST11-12</p> <p>2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.</p> <p>b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.</p> <p>WHST11-12</p> <p>5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.</p>

Unit 14

Standard/Unit:

IST XIV: Perfect solutions do not exist. All technological solutions involve tradeoffs in which decisions to include more of one quality means less of another. All solutions involve consequences, some intended, others not.
(APP E)

Performance Assessments:

- Identify, mitigate, and understand constraints on models and use this knowledge of laboratory model limitations to evaluate outside generated protocols and data
- Synthesize laboratory SOPs utilizing understanding of tradeoffs.
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)
- Student teams evaluate uncontrolled variables and how they affect data and data analysis.
- Students create models of shortcomings related to variables and analysis

21st Century Skills

Creativity and Innovation

Work Creatively with Others:

1. B.1 Develop, implement and communicate new ideas to others effectively.
1. B.2 Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work.
1. B.3 Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas.
1. B.4 View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes.

- EWU Symposium Presentation
- Field experiments and data collection must challenge but maintain valid protocols
- Authentic research projects: grayling, deer, wolf, bee studies
- Community Service: ie -- Cup of Cool Water, NEYC Anti-Bullying campaign, Food Drive Neighborhood Pick-up
- Science Nights at Elementary Schools

Critical Thinking and Problem Solving

Make Judgments and Decisions:

Reason Effectively (Examples Below)

2. A.1 Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation.

Use Systems Thinking:

2. B.1 Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.

Make Judgments and Decisions:

2. C.1 Effectively analyze and evaluate evidence, arguments, claims and beliefs.
2. C.2 Analyze and evaluate major alternative points of view.
2. C.3 Synthesize and make connections between information and arguments.
2. C.4 Interpret information and draw conclusions based on the best analysis.
2. C.5 Reflect critically on learning experiences and processes.

- Analyze and evaluate deep data sets generated in the lab to develop inferences and conclusions
- Organize and participate in seminar (speakers) series
- Presentations: School board, EWU, Rock Mt. Lab (Montana), Jackson School District
- Continuous improvement projects and solution implementations

Media Literacy

Analyze Media:

5. A.1 Understand both how and why media messages are constructed, and for what purposes.
5. A.2 Examine how individuals interpret messages differently, how values and points of view are included or excluded, and how media can influence beliefs and behaviors.
5. A.3 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of media.

Create Media Products

5. B.1 Understand and utilize the most appropriate media creation tools, characteristics and conventions.

5. B.2 Understand and effectively utilize the most appropriate expressions and interpretations in diverse, multi-cultural environments.

- Perfect solutions do not exist. All technological solutions involve tradeoffs in which decisions to include more of one quality means less of another. All solutions involve consequences, some intended, others not - leverage alternative perspectives in seeking optimal solutions given current knowledge.
- Organize and participate in seminar (speakers) series
- Presentations: School board, EWU, Rocky Mt. Lab (Montana)
- Continuous improvement projects and solution implementations

Information, Communications and Technology (ICT) Literacy

Apply Technology Effectively:

6. A.1 Use technology as a tool to research, organize, evaluate and communicate information.

6. A.2 Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access, manage, integrate, evaluate and create information to successfully function in a knowledge economy.

6. A.3 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.

- Synthesize opinions based upon “good science” in the context of the constraints of a modern world
- For the purpose of publishing results:
- Analyze a societal issue that may be addressed through science and/or technology. Compare alternative solutions by considering trade-offs and unintended consequences
- Use molecular tools to screen populations for genetic mutations (PCR, Restriction Digest, Gel electrophoresis, Bradford’s, ELISA, DNA Sequencing, Western Blots)
- Sample collections in the field

Standards and Competencies

Competencies

Total Learning Hours for Unit: 90

- Intellectualize (contribute, present, discuss, publish, be subject to scientific peer review, respectfully interact on a regional, national and international level) our work and findings to expand authentically the world’s knowledge.

**Foundational NCHSE Standards
National Consortium for Health Science Education**

**Standard 2:
Communication**

2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.

	<ul style="list-style-type: none"> • Interpret verbal and nonverbal communication • Identify barriers to communication • Report subjective and objective information • Interpret the elements of communication using a basic sender-receiver-feedback model • Apply speaking and active listening skills • Use roots, prefixes, and suffixes to communicate information • Use medical abbreviations to communicate information
<p>Standard 4: Employability Skills</p>	<p>4. Employability Skills: Healthcare professionals will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.</p> <ul style="list-style-type: none"> • Classify the personal traits and attitudes desirable in a member of the healthcare team • Summarize professional standards as they apply to hygiene, dress, language, confidentiality and behavior • Apply employability skills in healthcare • Discuss levels of education, credentialing requirements, and employment trends in healthcare • Compare careers within the health science career pathways (diagnostic services, therapeutic services, health informatics, support services, or biotechnology research and development) • Develop components of a personal portfolio • Identify innovative strategies for obtaining employment
<p>Standard 8: Teamwork</p>	<p>8. Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
<p>Standard 11: Information Technology Application</p>	<p>11. Information Technology Application: Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</p> <ul style="list-style-type: none"> • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Describe appropriate methods to correct inaccurate information/errors personally entered into an electronic medical records

	<p>(EMR)</p> <ul style="list-style-type: none"> • Apply basic computer concepts and terminology in order to use computers and other mobile devices. • Demonstrate basic computer operating procedures • Demonstrate use of file organization and information storage. • Use basic word processing, spreadsheet, and database applications. • Evaluate the validity of web-based resources. • Demonstrate use of appropriate e-mail and social media usage.
--	--

<p>Standard 2: Communication</p>	<p>2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.</p> <ul style="list-style-type: none"> • Interpret verbal and nonverbal communication • Identify barriers to communication • Report subjective and objective information • Interpret the elements of communication using a basic sender-receiver-feedback model • Apply speaking and active listening skills • Use roots, prefixes, and suffixes to communicate information • Use medical abbreviations to communicate information
---	--

**NCHSE Biotechnology and Research Development Standards:
National Consortium for Health Science Education**

<p>Standard 4: Laboratory Protocols and Procedures</p>	<p>Biotechnology R& D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculums development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.</p> <ul style="list-style-type: none"> • Procedures – Describe how molarity relates to solution preparation • Procedures – Calculate the molarity of a given solution and measure pH of this solution
---	---

<p>Standard 5: Product Design and Development</p>	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Examine the role of a Quality Assurance person in this process • Regulation – Define cGMP and why it is important in biotech production
--	---

Educational Technology	2.3.2 9-12 Select and use online applications
Reading	<p>RST 3 11-12. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST 6 11-12. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>RST 7 11-12. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST 8 11-12. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>RST 9 11-12. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible</p>
Science	<p>HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p>
Writing	<p>WTS 9-10 Text Types and Purposes:</p> <p>1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.</p> <ul style="list-style-type: none"> a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns. c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from and supports the argument presented. <p>2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.</p> <ul style="list-style-type: none"> a. Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language and domain-specific vocabulary to manage the complexity of the topic. e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

Unit 15

Standard/Unit:

IRB & Ethics:

IRB I: Students will understand the history and the evolution of ethical principles that guide Biomedical/Biotechnology professionals currently

IRB II: Students will understand basic IRB regulations and the review process that guide Biomedical/Biotechnology professionals

IRB III: Students will understand the requirements and importance of Informed Consent when designing and implementing research studies

IRB IV: Students will understand the history and evolution of research involving vulnerable populations - Research with Minors

Performance Assessments:

IRB and Ethics:

- Contribute insightful written and/or oral dialog (indicating extended thought and understanding, evaluation and synthesis) in selected, related book/case studies (Books and case studies should directly relate to ethical practices and challenging legal positions that form current understandings)
- Develop a panel, paper, or study introduction that differentiates or validates the IRB and ethical considerations in your study
- Perform periodic team review of current practices and nominate potential subjects / topics for evaluation and protocol revision – ethical matrix, technical protocol revision, presentation of findings and actions

Leadership Alignment:

- Students train Biological Solutions and BioMed student teams on purpose of IRB and constraints of research requiring IRB approval
- Students lead and participate in Socratic Seminars on theory, current events, and protocols.
- Students present their research on a weekly basis for whole lab in preparation for external symposia (ie. Spokane STEMposium)
- Students write research paper components for the whole lab (all the lab groups)

21st Century Skills

Information Literacy:

Access and Evaluate Information (Examples Below)

4.A.1 Access information efficiently (time) and effectively (sources).

4.A.2 Evaluate information critically and competently.

Use and Manage Information (Examples Below)

4.B.1 Use information accurately and creatively for the issue or problem at hand.

4.B.2 Manage the flow of information from a wide variety of sources.

4.B.3 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information.

Information, Communications and Technology (ICT) Literacy:

Apply Technology Effectively (Examples Below)

- 6.A.1 Use technology as a tool to research, organize, evaluate and communicate information.
- 6.A.2 Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access, manage, integrate, evaluate and create information to successfully function in a knowledge economy.
- 6.A.3 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.

Leadership and Responsibility:

Guide and Lead Others (Examples Below)

- 11.A.1 Use interpersonal and problem-solving skills to influence and guide others toward a goal.
- 11.A.2 Leverage strengths of others to accomplish a common goal.
- 11.A.3 Inspire others to reach their very best via example and selflessness.
- 11.A.4 Demonstrate integrity and ethical behavior in using influence and power.

Be Responsible to Others (Examples Below)

- 11.B.1 Act responsibly with the interests of the larger community in mind.

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Demonstrate knowledge of and practice legal responsibilities and limitations
- Practice accurate documentation and use of electronic and print records (health)
- Observe the privacy and confidentiality of information (Health Insurance Portability and Accountability Act HIPAA)

**Standard IRB 1
History**

IRB I: Students will understand the history and the evolution of ethical principles that guide Biomedical/Biotechnology professionals currently

1. Discuss why ethics are necessary when conducting research involving human and other animal subjects.
2. Describe the major historical events that have influenced how research involving human subjects is conducted and identify problems with past studies that violated ethical standards. (Book study HeLa)
3. Apply the ethical standards for research that guide us today.

**Standard IRB / Ethics 2
Regulations**

IRB II: Students will understand basic IRB regulations and the review process that guide Biomedical/Biotechnology professionals

1. Describe the role, authority, and composition of the IRB.
2. List the IRB requirements for conducting research involving human subjects.
3. Describe the types of IRB review and the process of working with the IRB.

**Standard IRB / Ethics 3
Informed Consent**

IRB III: Students will understand the requirements and importance of Informed Consent when designing and implementing research studies

1. Describe the requirements for complying with informed consent regulations.

	2. Describe the process for obtaining informed consent and the regulations for waiving informed consent.
Standard IRB / Ethics 4 Vulnerable Populations	<p>IRB IV: Students will understand the history and evolution of research involving vulnerable populations - Research with Minors</p> <ol style="list-style-type: none"> 1. Describe the major historical events that influenced how research with children as subjects is currently conducted. 2. Identify problems with research involving children that may violate ethical standards. 3. Understand the assent and informed consent requirements on different types of studies involving children.
Foundational NCHSE Standards	
Standard 2 Communication	<p>2. <i>Communication: Healthcare professionals will know the various methods of giving and receiving information. They will communicate effectively, both orally and in writing.</i></p> <ul style="list-style-type: none"> • Report subjective and objective information • Apply speaking and active listening skills
Standard 3 Systems	<p>3. <i>Systems: Healthcare professionals will understand how their role fits into their department, their organization and the overall healthcare environment. They will identify how key systems affect services they perform and quality of care.</i></p> <ul style="list-style-type: none"> • Assess the impact of emerging issues such as technology, epidemiology, bioethics, and socioeconomics on healthcare delivery systems Describe the responsibilities of consumers within the healthcare system
Standard 5 Legal Responsibilities	<p>5. <i>Legal Responsibilities: Healthcare professionals will understand the legal responsibilities, limitations, and implications of their actions within the healthcare delivery setting. They will perform their duties according to regulations, policies, laws and legislated rights of clients.</i></p> <ul style="list-style-type: none"> • Analyze legal responsibilities and limitations • Apply procedures for accurate documentation and use of electronic and print health records • Apply standards for the privacy and confidentiality of health information (Health Insurance Portability and Accountability Act HIPAA) • Describe advance directives • Summarize the essential characteristics of a patient's basic rights within a healthcare setting (Patient's Bill of Rights) • Understand informed consent • Differentiate laws governing harassment, labor and scope of practice
Standard 6 Ethics	<p>6. <i>Ethics: Healthcare professionals will understand accepted ethical practices with respect to cultural, social, and ethnic differences within healthcare environment. They will perform quality healthcare delivery.</i></p> <ul style="list-style-type: none"> • Differentiate between ethical and legal issues impacting healthcare • Recognize ethical issues and their implications related to healthcare • Utilize procedures for reporting activities and behaviors that affect the health, safety and welfare of others

	<ul style="list-style-type: none"> • Research religious and cultural values as they impact healthcare and develop plans/guidelines for addressing cultural diversity. • Demonstrate respectful and empathetic treatment of ALL patients/clients (customer service)
Standard 8 Teamwork	<p>8. <i>Teamwork: Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.</i></p> <ul style="list-style-type: none"> • Understand roles and responsibilities of team members • Recognize characteristics of effective teams • Differentiate creative methods for building positive team relationships • Analyze attributes and attitudes of an effective leader • Apply effective techniques for managing team conflict
Standard 11 Information Technology Application	<p>11. <i>Information Technology Application: Healthcare professionals will use information technology applications required within all career specialties. They will demonstrate use as appropriate to healthcare applications.</i></p> <ul style="list-style-type: none"> • Identify methods and types of data collection in healthcare • Use health record data collection tools (such as input screens, document templates) • Create documentation in the health record that reflects timeliness, completeness, and accuracy. • Adhere to information systems policies and procedures as required by national, state, local, and organizational levels. • Describe appropriate methods to correct inaccurate information/errors personally entered into an electronic medical records (EMR) • Evaluate the validity of web-based resources. • Demonstrate use of appropriate e-mail and social media usage.
NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education	
Standard 3: Introduction to Biotechnology Knowledge Areas and Techniques	<p>Biotechnology R&D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (product recombinant DNAC products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics</p> <ul style="list-style-type: none"> • Knowledge Areas – Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities
Standard 4: Laboratory Protocols and Procedures	<p>Biotechnology R& D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculums development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.</p>

	<ul style="list-style-type: none"> • Procedures – Calculate the molarity of a given solution and measure pH of this solution • Protocols – Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team
Standard 5: Product Design and Development	<p>Biotechnology R&D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including: R&D at the lab bench level, both pre-clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).</p> <ul style="list-style-type: none"> • Regulation – Examine the role of a Quality Assurance person in this process • Regulation – Define cGMP and why it is important in biotech production
Standard 6: Bioethics	<p>Biotechnology R & D professionals are not isolated from the social effect of their products in our society. Science, technology and society are intertwined. Biotechnology R & D employees will be conversant with the larger ethical, moral and legal issues related to biotech research, product development and use in society.</p> <ul style="list-style-type: none"> • Societal – Differentiate between morality and ethics and the relationship of each to biotechnology health care product development • Societal- Discuss bioethical issues related to recombinant products • Societal – Contrast personal, professional and organizational ethics • Institutional – Comply with policies and requirements for documentation and record keeping • Institutional – Comply with institutional ethical policies and procedures
<i>Aligned Washington State Standards</i>	
Educational Technology	2.2.1 Develop and use technology effectively
Communications	1.2.1 Communicate and collaborate to learn with others. 1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.
Math	A1.8.D Generalize a solution strategy for a single problem to a class of related problems, and apply a strategy for a class of related problems to solve a specific problem
Writing	WHST.9-12.1 Write arguments focused on discipline-specific content WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1)

21st Century Skills

Check those that students will demonstrate in this course:

LEARNING & INNOVATION

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

Critical Thinking and Problem Solving

- Reason Effectively
- Use Systems Thinking
- Make Judgments and Decisions
- Solve Problems

Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy

- Access and /evaluate Information
- Use and Manage Information

Media Literacy

- Analyze Media
- Create Media Products

Information, Communications and Technology (ICT Literacy)

- Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability

- Adapt to Change
- Be Flexible

Initiative and Self-Direction

- Manage Goals and Time
- Work Independently
- Be Self-Directed Learners

Social and Cross-Cultural

- Interact Effectively with Others
- Work Effectively in Diverse Teams

Productivity and Accountability

- Manage Projects
- Produce Results

Leadership and Responsibility

- Guide and Lead Others
- Be Responsible to Others