



Spokane Public Schools Institute of Science & Technology Biological Solutions

Course: Institute of Science and Technology: Biological Solutions		Total Framework Hours up to: 180
CIP Code: 260102	<input type="checkbox"/> Exploratory <input checked="" type="checkbox"/> Preparatory	Date Last Modified: 10/9/2015
Career Cluster: Health Science		Cluster Pathway: Biotechnology Research and Development

Course Description:

This College in the High School Course allows students to master the concepts, skills and attitudes necessary for success in STEM related degrees, laboratory settings and work places. While it primarily has juniors involved, some sophomores and seniors participate in the full year immersion into authentic research. The research tracts vary from human health related issues to conservation genetics and other topics. The year in Biological Solutions is divided into two semester-long research immersions chosen and directed by the instructor. The rich and rigorous laboratory work is supported by multiple and authentic technical readings, both within the research area and peripherally. Student-scientists persistently investigate relevant real world questions using current molecular bioscience technologies and laboratory work.

Unit 1

Standard/Unit 1:

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:

- Maintain a lab notebook (record and manage data, maintain legible, indelible, clear, and concise notes)
- Evaluate functional groups found in a variety of organic molecules for interactive potential
- Extract, purify, quantify and manipulate DNA from multiple sources
- Illustrate the process by which gene sequences are copied to produce proteins.
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

IST I: Work in teams and individually to extract, purify, and quantify DNA
Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results

Student conduct equipment data research

Students become proficient at time management and calendar management

Students become proficient at goal setting; long term and short terms goals

Students lead, organize and participate in community service

21st Century Skills

Communication and Collaboration:

Collaborate with Others (Examples Below)

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.

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

Reason Effectively

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

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

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

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)

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

Flexibility and Adaptability

Be Flexible

- 7.B.1 Incorporate feedback effectively
- 7.B.2 Deal positively with praise, setbacks and criticism
- 7.B.3 Understand, negotiate and balance diverse views and beliefs to reach workable solutions, particularly in multi-cultural environments

Productivity and Accountability

Produce Results

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

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

Utilize time and manage workload efficiently

Social and Cross-Cultural

Interact Effectively with Others

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

Conduct themselves in a respectable, professional manner

Work Effectively in 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

Leverage social and cultural differences to create new ideas and increase both innovation and quality of work

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

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

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Extract, purify, and quantify protein for downstream application (Elk, Deer, Wheat, Bison, Minnows, Humans, Bees and Bacteria)
- Apply molecular tools and protocols to analyze and define DNA and protein composition (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots)
- Analyze and evaluate DNA sequence

Foundational NCHSE Standards

**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
- Apply speaking and active listening skills

**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.

- Practice personal traits and attitudes desirable in a member of the healthcare team
- Practice professional standards as they apply to hygiene, dress, language, confidentiality and behavior

**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.

- Practice 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

	<ul style="list-style-type: none"> • 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. <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
<p>Standard 11: Information Technology Application</p>	<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"> • Apply the use of data collection tools (such as input screens, document templates) • Apply documentation use of 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. • Evaluate the validity of web-based resources.

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

**Standard 2:
Academic Foundations**

Biotechnology R& D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology

- 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
- Biochemistry – Compare the underlying reasons why some molecules are hydrophilic and some are hydrophobic

**Standard 3:
Introduction to
Biotechnology
Knowledge Areas and
Techniques**

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

- 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**

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).

- Development – Diagram the process involved in making one biotech product in an industrial setting
- 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

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.
Educational Technology	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.
Math	S ID 1: Represent data with plots on the real number line (dot plots, number lines, histograms, and box plots)
Reading	9-10.RI.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. 9-10.RST.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
Science	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. 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.

Standard/Unit 2:

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:

- Perform RFLP, CAPs, and allele-specific PCR
- Analyze the role of a variety of mutations that lead to genetic disease and also adaptations
- Identify and apply all appropriate laboratory safety protocols
- Use technology to identify and evaluate protocol ‘fixes’ to optimize reactions or efficiency

Leadership Alignment:

IST II: Collaborate with classmates and research mentors to optimize molecular bio-science protocols to better acquire and evaluate allele frequencies

Students lead and participate in group projects
Students become proficient at speaking in class in front of peers and public speaking
Students develop and implement self and peer evaluation tools
Students continuously problem solve to optimize laboratory results
Student conduct equipment data research
Students become proficient at time management and calendar management
Students become proficient at goal setting; long term and short terms goals
Students lead, organize and participate in community service

21st Century Skills

Communication and Collaboration:

Communicate Clearly (Examples Below)

- 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).

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

Reason Effectively

- 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

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

Communication and Collaboration

Collaborate with Others

- 3.B.4 Demonstrate ability to work effectively and respectfully with diverse teams
- 3.B.5 Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal
- 3.B.6 Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

Communicate Clearly

- 3.A.6 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- 3.A.7 Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions
- 3.A.8 Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)
- 3.A.9 Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact
- 3.A.10 Communicate effectively in diverse environments (including multi-lingual)

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

Flexibility and Adaptability

Be Flexible

- 7.B.4 Incorporate feedback effectively
- 7.B.5 Deal positively with praise, setbacks and criticism
- 7.B.6 Understand, negotiate and balance diverse views and beliefs to reach workable solutions, particularly in multi-cultural environments

Productivity and Accountability

Produce Results

- 10.B.2 Demonstrate additional attributes associated with producing high quality products including the abilities to:
 - 10.B.1.i Work positively and ethically
 - 10.B.1.j Manage time and projects effectively
 - 10.B.1.k Multi-task
 - 10.B.1.l Participate actively, as well as be reliable and punctual

- 10.B.1.m Present oneself professionally and with proper etiquette
- 10.B.1.n Collaborate and cooperate effectively with teams
- 10.B.1.o Respect and appreciate team diversity
- 10.B.1.p Be accountable for results

Initiative and Self-Direction

Manage Goals and Time

- 8.A.3 Set goals with tangible and intangible success criteria
 - 8.A.4 Balance tactical (short-term) and strategic (long-term) goals
- Utilize time and manage workload efficiently

Social and Cross-Cultural

Interact Effectively with Others

- 9.A.2 Know when it is appropriate to listen and when to speak
- Conduct themselves in a respectable, professional manner

Work Effectively in Diverse Teams

- 9.B.3 Respect cultural differences and work effectively with people from a range of social and cultural backgrounds
 - 9.B.4 Respond open-mindedly to different ideas and values
- Leverage social and cultural differences to create new ideas and increase both innovation and quality of work

Leadership and Responsibility

Guide and Lead Others

- 11.A.4 Use interpersonal and problem-solving skills to influence and guide others toward a goal
 - 11.A.5 Leverage strengths of others to accomplish a common goal
 - 11.A.6 Inspire others to reach their very best via example and selflessness
- 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

Standards and Competencies

Competencies	Total Learning Hours for Unit: 10
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- Apply molecular bio-science tools to analyze and evaluate allele frequencies (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots)
- Optimize molecular bio-science protocols to better acquire, acquire and evaluate allele frequencies

Foundational NCHSE Standards

Standard 1 Academic Foundation	<p>1. <i>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"> • Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease
Standard 4 Employability Skills	<p>4. <i>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"> • 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
Standard 7 Safety Practices	<p>7. <i>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 • Apply principles of basic emergency response in natural disasters and other emergencies

<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 • Practice 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"> • 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 • 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>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
<p><i>Aligned Washington State Standards</i></p>	
<p>Educational Technology</p>	<p>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>MP.2 Reason abstractly and quantitatively</p>
<p>Science</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. 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-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. 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.</p>
<p>Writing</p>	<p>WHST9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p>

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)

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.

Unit 3

Standard/Unit 3: 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:

- Evaluate the central Dogma of Molecular Bioscience and its relationship to biomedical/biotechnology applications and discuss limitations
- Apply and evaluate recombinant technology to transform bacteria using sterile technique and a recombinant plasmid
- Apply drug development technologies for protein extraction and purification
- Identify and apply all appropriate laboratory safety protocols
- Design / implement exploratory protocols

Leadership Alignment:

IST III: Participate in the design and implementation of experimental protocols
Share findings in symposium presentations
Collect field data for individual and team analysis

Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results
Student conduct equipment data research
Students become proficient at time management and calendar management
Students become proficient at goal setting; long term and short terms goals
Students lead, organize and participate in community service

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

Reason Effectively

- 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

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

Communication and Collaboration

Collaborate with Others

- 3.B.7 Demonstrate ability to work effectively and respectfully with diverse teams
- 3.B.8 Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal
- 3.B.9 Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

Communicate Clearly

- 3.A.11 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- 3.A.12 Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions
- 3.A.13 Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)
- 3.A.14 Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact
- 3.A.15 Communicate effectively in diverse environments (including multi-lingual)

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

Flexibility and Adaptability

Be Flexible

- 7.B.7 Incorporate feedback effectively
- 7.B.8 Deal positively with praise, setbacks and criticism
- 7.B.9 Understand, negotiate and balance diverse views and beliefs to reach workable solutions, particularly in multi-cultural environments

Productivity and Accountability

Produce Results

- 10.B.3 Demonstrate additional attributes associated with producing high quality products including the abilities to:
 - 10.B.1.q Work positively and ethically
 - 10.B.1.r Manage time and projects effectively
 - 10.B.1.s Multi-task
 - 10.B.1.t Participate actively, as well as be reliable and punctual
 - 10.B.1.u Present oneself professionally and with proper etiquette
 - 10.B.1.v Collaborate and cooperate effectively with teams
 - 10.B.1.w Respect and appreciate team diversity
 - 10.B.1.x Be accountable for results

Initiative and Self-Direction

Manage Goals and Time

- 8.A.5 Set goals with tangible and intangible success criteria
 - 8.A.6 Balance tactical (short-term) and strategic (long-term) goals
- Utilize time and manage workload efficiently

Social and Cross-Cultural

Interact Effectively with Others

9.A.3 Know when it is appropriate to listen and when to speak
Conduct themselves in a respectable, professional manner

Work Effectively in Diverse Teams

9.B.5 Respect cultural differences and work effectively with people from a range of social and cultural backgrounds
9.B.6 Respond open-mindedly to different ideas and values
Leverage social and cultural differences to create new ideas and increase both innovation and quality of work

Leadership and Responsibility

Guide and Lead Others

11.A.7 Use interpersonal and problem-solving skills to influence and guide others toward a goal
11.A.8 Leverage strengths of others to accomplish a common goal
11.A.9 Inspire others to reach their very best via example and selflessness
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

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Explore the mechanisms beyond the DNA code that determine outcomes that are different for individuals (Epigenetics)
- Evaluate the various modes of gene expression through editing

Foundational NCHSE Standards

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

<p>Standard 2 Communication</p>	<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"> • Apply speaking and active listening skills • Use medical abbreviations to communicate information • Prepare examples of technical, informative, and creative writing
<p>Standard 11 Information Technology Application</p>	<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"> • Apply methods and types of data collection in healthcare • 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.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
<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"> • Biochemistry – Categorize all amino acids into essential and non-essential • Cell Biology – Select cellular barriers to be overcome for a biotechnology product to work inside a cell • Microbiology – Compare and contrast the use of plasmids in bacterial transformation and the process of plasmid DNA isolation
<p>Standard 3: Introduction to Biotechnology Knowledge Areas and</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>

Techniques	<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> <ul style="list-style-type: none"> Development – Diagram the process involved in making one biotech product in an industrial setting 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>	
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>
Writing	<p>WHST9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>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.</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>

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.

Unit 4

Standards/Unit 4: 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 the DNA, Genes, and chromosomes
- Synthesize a chromosome map using recombination frequencies
- Identify and apply all appropriate laboratory safety protocols
- Apply bioinformatics tools to evaluate data
- Apply bioinformatics tools to prepare data
- Apply bioinformatics tools for presentations
- Debate the pros and cons of technological advances in molecular biosciences

Leadership Alignment:

IST IV: Use molecular tools to screen populations for genetic mutations (In class)
Prepare to publish findings for affected populations (Out of class)
Analyze a current societal issue as it relates to the communication of potential research

Students lead and participate in group projects
Students become proficient at speaking in class in front of peers and public speaking
Students develop and implement self and peer evaluation tools
Students continuously problem solve to optimize laboratory results
Student conduct equipment data research
Students become proficient at time management and calendar management
Students become proficient at goal setting; long term and short terms goals
Students lead, organize and participate in community service

21st Century Skills

Information, Communications and Technology (ICT) Literacy

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.

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.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.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.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

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Use molecular tools to screen populations for genetic mutations (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots)
- Evaluate the frequency of genetic mutations in a population
- Infer the cause and effect of genetic mutations on the success of a population (deer, bison, bees, minnows, humans)

Foundational NCHSE Standards

**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.

	<ul style="list-style-type: none"> • Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease • Apply mathematical computation related to healthcare procedures (metric and household, conversions and measurements) • Analyze diagrams, charts, graphs, and tables to interpret healthcare results
<p>Standard 2 Communication</p>	<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"> • 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 • Critique elements of written and electronic communication (spelling, grammar, and formatting) • Prepare examples of technical, informative, and creative writing
<p>Standard 7 Safety Practices</p>	<p>7. <i>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
<p>Standard 11 Information Technology Application</p>	<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"> • 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.

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 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 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 – 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
<i>Aligned Washington State Standards</i>	
Educational Technology	<p>2.2.1 Develop skills to use technology effectively.</p> <p>2.2.2 Use a variety of hardware to support learning.</p>

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 5:

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 ASP5)

Performance Assessments:

- Application of Hardy-Weinberg and Chi-square to lab generated, using PCR and gel electrophoresis, Transposable elements allele and genotype frequencies.
- Identify and apply all appropriate laboratory safety protocols
- Application of peer-reviewed journal knowledge to scope and sequence of research project
- Use multidisciplinary tools to draw inferences from self-generated laboratory data

Leadership Alignment: Leadership activity embedded in curriculum and instruction. (Examples: CTSO project or activity, locally developed leadership project or activity, embedded 21st Century interdisciplinary theme activity such as global awareness, financial, economic, business & entrepreneurial literacy, civic literacy, health & safety, environmental literacy)

IST V: Assess field data / samples for reliability, correlational validity
Follow established protocols in statistical analysis

Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results

Students conduct equipment data research

Students become proficient at time management and calendar management

Students become proficient at goal setting; long term and short terms goals

Students lead, organize and participate in community service

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:

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.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.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.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: 10**

- Correlate phenotypic traits (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots)
- Use molecular tools to correlate phenotypic traits (PCR, Restriction Digest, Gel electrophoresis, Bradford's, ELISA, DNA Sequencing, Western Blots)
- Apply mathematical and statistical analysis to analyze and evaluate gene frequency trends and synthesize understanding of a populations genetic health

Foundational NCHSE Standards**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.

- Apply mathematical computation related to healthcare procedures (metric and household, conversions and measurements)
- Analyze diagrams, charts, graphs, and tables to interpret healthcare results

2. Communication: Healthcare professionals will know the various methods of giving and receiving information. They

<p>Standard 2 Communication</p>	<p><i>will communicate effectively, both orally and in writing.</i></p> <ul style="list-style-type: none"> • Apply speaking and active listening skills • Use roots, prefixes, and suffixes to communicate information • Use medical abbreviations to communicate information • Prepare examples of technical, informative, and creative writing
<p>Standard 7 Safety Practices</p>	<p>7. <i>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 • 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. <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
<p>Standard 11 Information Technology Application</p>	<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"> • 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.

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

**Standard 2:
Academic Foundations**

Biotechnology R& D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology

- Mathematical Concepts- Explain scientific notation

**Standard 3:
Introduction to
Biotechnology
Knowledge Areas and
Techniques**

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

- 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 4:
Laboratory Protocols
and Procedures**

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.

- 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

Aligned Washington State Standards

Math	MP.2 Reason abstractly and quantitatively. (HS-LS4-1),(HS-LS4-2) MP.4 Model with mathematics. (HS-LS4-2)
Reading	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. 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.
Science	9-11 LS3A Biological evolution is due to: (1) genetic variability of offspring due to mutations and genetic recombination, (2) the potential for a species to increase its numbers, (3) a finite supply of resources, and (4) natural selection by the environment for those offspring better able to survive and produce offspring. 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. 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. HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. 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 A: Evidence of Common Ancestry and Diversity Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1) B: Natural Selection Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2),(HS-LS4-3) The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-

	<p>LS4-3) C: Adaptation Evolution is a consequence of the interaction of four factors: (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>
Social Studies	3.1.1 Analyze information from geographic tools, including computer-based mapping systems, to draw conclusions on an issue or event. (12)
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.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>
Unit 6	
Standard/Unit 6:	
<p>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)</p>	
Performance Assessments:	
<ul style="list-style-type: none"> • Utilize ELISA analysis to analyze organism response to perturbation • Analyze yeast perturbations using Bradford Assay • Identify and apply all appropriate laboratory safety protocols • Develop and justify scientific journal entries • Seek and respond to challenges of outcomes / inferences • Seek and employ differences of perspective regarding response to data • Utilize laboratory notebook to create an optimized method and materials • Prepare the methods and materials for potential publication in professional journal 	

Leadership Alignment:

Students lead and participate in group projects
Students become proficient at speaking in class in front of peers and public speaking
Students develop and implement self and peer evaluation tools
Students continuously problem solve to optimize laboratory results
Student conduct equipment data research
Students become proficient at time management and calendar management
Students become proficient at goal setting; long term and short terms goals
Students lead, organize and participate in community service

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.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.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.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: 10

- Draw inferences and clarifying hypothesis of complex system pathways influence on allelic frequencies
- Justify a claim that a variety of phenotypic responses to a single environmental factor can result from different genotypes within the population.
- Use theories and models to make scientific claims and/or predictions about the effects of variation within populations on survival and fitness.

Foundational NCHSE Standards

<p>Standard 1 Academic Foundations</p>	<p>1. <i>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">• Research emerging diseases and disorders• Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease• Apply mathematical computation related to healthcare procedures (metric and household, conversions and measurements)• Analyze diagrams, charts, graphs, and tables to interpret healthcare results
<p>Standard 2 Communication</p>	<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">• Apply speaking and active listening skills• Use roots, prefixes, and suffixes to communicate information• Use medical abbreviations to communicate information• Prepare examples of technical, informative, and creative writing
<p>Standard 4 Employability Skills</p>	<p>4. <i>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">• 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
<p>Standard 8 Teamwork</p>	<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

	<ul style="list-style-type: none"> • 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"> • 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) • 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 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"> • Microbiology – Compare and contrast bacterial, fungal, and animal cells and how these similarities and differences affect biotechnology product development and production decisions
<p>Standard 3:</p>	<p>Biotechnology R&D professionals will be introduced to the following recombinant DNA and genetic engineering,</p>

<p>Introduction to Biotechnology Knowledge Areas and Techniques</p>	<p>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 • 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>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
<p><i>Aligned Washington State Standards</i></p>	
<p>Educational Technology</p>	<p>2.2.1 Develop and use technology effectively</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>

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
Science	HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. 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.
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)

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:

- Analyze the genomic response to perturbations using molecular tools in a variety of model organisms including prokaryotic and eukaryotic cell lines
- Identify and apply all appropriate laboratory safety protocols Test and modify protocols through application of continuous improvement
- Encourage input and collect thinking that reflects broad perspectives for continuous improvement projects
- Evaluate DNA sequence generated by the class and prepare acceptable data for publication in National Center for Biotechnological Information database

Leadership Alignment:

Students lead and participate in group projects
 Students become proficient at speaking in class in front of peers and public speaking
 Students develop and implement self and peer evaluation tools
 Students continuously problem solve to optimize laboratory results
 Student conduct equipment data research
 Students become proficient at time management and calendar management
 Students become proficient at goal setting; long term and short terms goals
 Students lead, organize and participate in community service

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.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.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.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: 10

- Design a plan to answer scientific questions regarding how organisms have changed over time using information from morphology, biochemistry and geology
- Design experiments with the knowledge that complex systems dramatically influence the interaction of an organism’s genome, phenotype and environment
- Critically evaluate experimental design to minimize variables that could erode confidence in the conclusion

Foundational NCHSE Standards

**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.

- Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease
- Apply mathematical computation related to healthcare procedures (metric and household, conversions and measurements)
- Analyze diagrams, charts, graphs, and tables to interpret healthcare results

<p>Standard 2 Communication</p>	<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"> • 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. <i>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"> • 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
<p>Standard 7 Safety Practices</p>	<p>7. <i>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
<p>Standard 8 Teamwork</p>	<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

	<ul style="list-style-type: none"> • 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"> • 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. • Use basic word processing, spreadsheet, and database applications.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
<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 • Protocols – Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team
<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</p>

	<p>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
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Aligned Washington State Standards

Reading	<p>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</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)</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-LS3-1)</p>
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Science	<p>HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis</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-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>
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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:**
- Design experiments using peer-reviewed journal materials and methods
 - Apply flow chart protocols
 - Using “Lean” strategies, design models to improve laboratory flow and efficiencies
 - Identify and apply all appropriate laboratory safety protocols
 - Seek information from team members to optimize and improve data collection and protocols
 - Apply LEAN strategies to improve work flow.

- As a class, debate various LEAN suggestions.
- Modify and adapt LEAN plans, implement and evaluate those plans

Leadership Alignment:

Students lead and participate in group projects
Students become proficient at speaking in class in front of peers and public speaking
Students develop and implement self and peer evaluation tools
Students continuously problem solve to optimize laboratory results
Student conduct equipment data research
Students become proficient at time management and calendar management
Students become proficient at goal setting; long term and short terms goals
Students lead, organize and participate in community service

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.15 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.16 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy**Access and Evaluate Information**

4.A.15 Access information efficiently (time) and effectively (sources)

4.A.16 Evaluate information critically and competently

Use and Manage Information

4.B.22 Use information accurately and creatively for the issue or problem at hand

4.B.23 Manage the flow of information from a wide variety of sources

4.B.24 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.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: 15

- Understand that the experimental design must contain the appropriate statistical tools used to verify the data
- Understand the importance of maintaining the integrity of the process from sampling to data analysis
- 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.

Foundational NCHSE Standards

**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.***
- Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease
 - 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**

- 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 medical abbreviations to communicate information
 - Prepare examples of technical, informative, and creative writing

**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

	<ul style="list-style-type: none"> • 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"> • 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) • 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.
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
<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"> • 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 • Mathematical Concepts- Explain scientific notation
<p>Standard 4:</p>	<p>Biotechnology R& D professionals will understand the principles of solution preparation such as molarity, pH, and dilution;</p>

<p>Laboratory Protocols and Procedures</p>	<p>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
<p><i>Aligned Washington State Standards</i></p>	
<p>Science / Technology / Communications / Reading / Writing</p>	<p>(HS-PS2-6): Obtain, Evaluate, and Communicate Information:</p> <p>Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and 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 (including orally, graphically, textually, and mathematically).</p> <p>(HS-LS1-3): Scientific Investigations Use a Variety of Methods Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.</p> <p>HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a</p>

	<p>population.</p> <p>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.</p>
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Math	HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population
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Unit 9

Standard/Unit: Standard/Unit:

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

- Performance Assessments:**
- Investigate new technologies and methodologies
 - Evaluate multiple data sets for similarities and differences and identify reasons for the similarities and differences.
 - Evaluate data using mathematical tools including graphing and statistical analysis
 - Identify and apply all appropriate laboratory safety protocols
 - Leverage the diversity of research the team and collaborative partners to analyze, evaluate, and synthesize alternative explanations and decide which best fits the data and evidence
 - Research and present emerging technologies in the molecular bioscience world
 - Create a 'dream' laboratory based on emerging technologies

Leadership Alignment:

Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results

Student conduct equipment data research

Students become proficient at time management and calendar management

Students become proficient at goal setting; long term and short terms goals

Students lead, organize and participate in community service

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

Reason Effectively

- 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

Solve Problems

- 2.D.17 Solve different kinds of non-familiar problems in both conventional and innovative ways
- 2.D.18 Identify and ask significant questions that clarify various points of view and lead to better solutions

Communication and Collaboration

Collaborate with Others

- 3.B.10 Demonstrate ability to work effectively and respectfully with diverse teams
- 3.B.11 Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal
- 3.B.12 Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

Communicate Clearly

- 3.A.16 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- 3.A.17 Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions
- 3.A.18 Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)
- 3.A.19 Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact
- 3.A.20 Communicate effectively in diverse environments (including multi-lingual)

Information Literacy

Access and Evaluate Information

- 4.A.17 Access information efficiently (time) and effectively (sources)
- 4.A.18 Evaluate information critically and competently

Use and Manage Information

- 4.B.25 Use information accurately and creatively for the issue or problem at hand
- 4.B.26 Manage the flow of information from a wide variety of sources
- 4.B.27 Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Flexibility and Adaptability

Be Flexible

- 7.B.10 Incorporate feedback effectively
- 7.B.11 Deal positively with praise, setbacks and criticism
- 7.B.12 Understand, negotiate and balance diverse views and beliefs to reach workable solutions, particularly in multi-cultural environments

Productivity and Accountability

Produce Results

- 10.B.4 Demonstrate additional attributes associated with producing high quality products including the abilities to:
 - 10.B.1.y Work positively and ethically
 - 10.B.1.z Manage time and projects effectively
 - 10.B.1.aa Multi-task
 - 10.B.1.bb Participate actively, as well as be reliable and punctual
 - 10.B.1.cc Present oneself professionally and with proper etiquette
 - 10.B.1.dd Collaborate and cooperate effectively with teams
 - 10.B.1.ee Respect and appreciate team diversity
 - 10.B.1.ff Be accountable for results

Initiative and Self-Direction

Manage Goals and Time

- 8.A.22 Set goals with tangible and intangible success criteria
 - 8.A.23 Balance tactical (short-term) and strategic (long-term) goals
- Utilize time and manage workload efficiently

Social and Cross-Cultural

Interact Effectively with Others

- 9.A.4 Know when it is appropriate to listen and when to speak
- Conduct themselves in a respectable, professional manner

Work Effectively in Diverse Teams

- 9.B.7 Respect cultural differences and work effectively with people from a range of social and cultural backgrounds
 - 9.B.8 Respond open-mindedly to different ideas and values
- Leverage social and cultural differences to create new ideas and increase both innovation and quality of work

Leadership and Responsibility

Guide and Lead Others

11.A.10 Use interpersonal and problem-solving skills to influence and guide others toward a goal

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

11.A.12 Inspire others to reach their very best via example and selflessness

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

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- 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.
- Analyze that the conclusions are supported by a preponderance of evidence from the investigation and consistent with established scientific knowledge/practice

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

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Communication**

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- Identify barriers to communication
- Report subjective and objective information
- Interpret the elements of communication using a basic sender-receiver-feedback model

	<ul style="list-style-type: none"> • Apply speaking and active listening skills • Use roots, prefixes, and suffixes to communicate information • Use medical abbreviations to communicate information
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<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
<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 • Protocols – Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team

<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
<p><i>Aligned Washington State Standards</i></p>	
<p>Math</p>	<p>HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context 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 HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling 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) HSS-ID.A.1 Represent data with plots on the real number line. (HS-LS2-6) 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) HSS-IC.B.6 Evaluate reports based on data. (HS-LS2-6)</p>
<p>Reading</p>	<p>RST.9-10.8 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 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</p>
<p>Writing</p>	<p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes</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:

- Apply null hypothesis and statistics to data sets to assess experimental design and efficacy
- Identify and apply all appropriate laboratory safety protocols
- Develop theories & models
- Conduct deep data assembly and analysis
- Application of group thinking on appropriate statistical analysis
- Seek statistical assistance from mentors at Universities
- Meet and discuss statistical applications with University faculty

Leadership Alignment:

Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results

Student conduct equipment data research

Students become proficient at time management and calendar management

Students become proficient at goal setting; long term and short terms goals

Students lead, organize and participate in community service

21st Century Skills

Creativity and Innovation:

Think Creatively

1.A.6 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.26 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.27 Analyze and evaluate major alternative points of view

2.C.28 Synthesize and make connections between information and arguments

2.C.29 Interpret information and draw conclusions based on the best analysis

2.C.30 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.19 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.20 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy**Access and Evaluate Information**

4.A.19 Access information efficiently (time) and effectively (sources)

4.A.20 Evaluate information critically and competently

Use and Manage Information

4.B.28 Use information accurately and creatively for the issue or problem at hand

4.B.29 Manage the flow of information from a wide variety of sources

4.B.30 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.24 Set goals with tangible and intangible success criteria

8.A.25 Balance tactical (short-term) and strategic (long-term) goals

8.A.26 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: 5

- Evaluating the data to accept or reject one or more hypotheses based on a model or theory of a causal relationship.
- Represent novel ideas and critical thinking to analyze and continual evaluation of the hypothesis
- Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Foundational NCHSE Standards

**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.**
 - Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease
 - 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**

- 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

	<ul style="list-style-type: none"> • Prepare examples of technical, informative, and creative writing
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) • 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>	
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 – 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
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>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p>
Reading	RST11-12 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.
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, 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</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-LS1-3)

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:

- Optimize protocols based on data and implement altered protocols to generate new data sets
- Identify and apply all appropriate laboratory safety protocols

Leadership Alignment:

IST XI: Seek and accept challenges where the answer is unknown and success is not assured

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

Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results

Students conduct equipment data research

Students become proficient at time management and calendar management

Students become proficient at goal setting; long term and short terms goals

Students lead, organize and participate in community service

21st Century Skills

Creativity and Innovation:

Think Creatively

1.A.7 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.31 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.32 Analyze and evaluate major alternative points of view

2.C.33 Synthesize and make connections between information and arguments

2.C.34 Interpret information and draw conclusions based on the best analysis

2.C.35 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.21 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.22 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy**Access and Evaluate Information**

4.A.21 Access information efficiently (time) and effectively (sources)

4.A.22 Evaluate information critically and competently

Use and Manage Information

4.B.31 Use information accurately and creatively for the issue or problem at hand

4.B.32 Manage the flow of information from a wide variety of sources

4.B.33 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.27 Set goals with tangible and intangible success criteria

8.A.28 Balance tactical (short-term) and strategic (long-term) goals

8.A.29 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

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Embrace successful failures as a means of applying lessons learned to optimize protocols to better understand experimental design and issues (Grit factor)
- Assess results and refine procedures for continuous improvement

Foundational NCHSE Standards

**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.

- 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**

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 medical abbreviations to communicate information
- Prepare examples of technical, informative, and creative writing

<p>Standard 7 Safety Practices</p>	<p>7. <i>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 • 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. <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
<p>Standard 11 Information Technology Application</p>	<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"> • 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. • Evaluate the validity of web-based resources..

Aligned Washington State Standards

Science

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.

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena:

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

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 novel protocols, after assessing criteria and constraints, to explore new questions arising from current experiments
- Identify and apply all appropriate laboratory safety protocols
- Utilize laboratory constraints to design scope and sequence for full year investigation
- Goal setting; long term and short term

Leadership Alignment:

IST XII: Design complex field laboratory investigations in context of past and developing knowledge and awareness of laboratory constraints

Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results
Student conduct equipment data research
Students become proficient at time management and calendar management
Students become proficient at goal setting; long term and short terms goals
Students lead, organize and participate in community service

21st Century Skills

Creativity and Innovation:

Think Creatively

1.A.8 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.36 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.37 Analyze and evaluate major alternative points of view

2.C.38 Synthesize and make connections between information and arguments

2.C.39 Interpret information and draw conclusions based on the best analysis

2.C.40 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.23 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.24 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

4.A.23 Access information efficiently (time) and effectively (sources)

4.A.24 Evaluate information critically and competently

Use and Manage Information

- 4.B.34 Use information accurately and creatively for the issue or problem at hand
- 4.B.35 Manage the flow of information from a wide variety of sources
- 4.B.36 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.30 Set goals with tangible and intangible success criteria
- 8.A.31 Balance tactical (short-term) and strategic (long-term) goals
- 8.A.32 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: 15**

- Synthesize the knowledge gained from research papers, past experimental procedures and results, collaborative discussions into appropriate strategies to refine and inform next step
- Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits.
- Plan and conduct an investigation.

Foundational NCHSE Standards**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.

	<ul style="list-style-type: none"> • Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease • Apply mathematical computation related to healthcare procedures (metric and household, conversions and measurements) • Analyze diagrams, charts, graphs, and tables to interpret healthcare results
<p>Standard 2 Communication</p>	<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"> • 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 • Prepare examples of technical, informative, and creative writing
<p>Standard 8 Teamwork</p>	<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
<p>NCHSE Biotechnology and Research Development Standards: National Consortium for Health Science Education</p>	
<p>Standard 3: Introduction to Biotechnology</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>

<p>Knowledge Areas and Techniques</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 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>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
<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>2.2.1 Develop and use technology effectively</p>
<p>Reading</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-ETS1-1),(HS-ETS1-3) RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when</p>

	<p>possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3) 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>
<p>Science</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>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. Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5)</p> <p>Influence of Engineering, Technology, and Science on Society and the Natural World :</p> <ul style="list-style-type: none"> • Modern civilization depends on major technological systems • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks

Unit 13	
<p>Standard/Unit:</p> <p>IST XIII: Choosing the best solution involves comparing alternatives with respect to criteria and constraints, then building and testing a model or other representation of the final design. (APPC)</p>	
<p>Performance Assessments:</p> <ul style="list-style-type: none"> • Evaluate lab investigation results and refine steps to create alternative treatments and/or protocols • Identify and apply all appropriate laboratory safety protocols 	

Leadership Alignment:

IST XIII: Critically evaluate a variety of protocol options for similarities and differences

- Assess current practices for improvement opportunities
- Prepare for continuous improvement projects and solution implementations

Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results

Students conduct equipment data research

Students become proficient at time management and calendar management

Students become proficient at goal setting; long term and short term goals

Students lead, organize and participate in community service

21st Century Skills

Creativity and Innovation:

Think Creatively

1.A.9 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.41 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.42 Analyze and evaluate major alternative points of view

2.C.43 Synthesize and make connections between information and arguments

2.C.44 Interpret information and draw conclusions based on the best analysis

2.C.45 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.25 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.26 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy

Access and Evaluate Information

4.A.25 Access information efficiently (time) and effectively (sources)

4.A.26 Evaluate information critically and competently

Use and Manage Information

4.B.37 Use information accurately and creatively for the issue or problem at hand

4.B.38 Manage the flow of information from a wide variety of sources

4.B.39 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.33 Set goals with tangible and intangible success criteria

8.A.34 Balance tactical (short-term) and strategic (long-term) goals

8.A.35 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.33 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise

8.C.34 Demonstrate initiative to advance skill levels towards a professional level

8.C.35 Demonstrate commitment to learning as a lifelong process

8.C.36 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies

Total Learning Hours for Unit: 5

- Evaluate multiple optimization steps in order to refine a final experimental design
- Evaluate the value of procedures in an investigation
- Design and assess test for reliability and validity

Foundational NCHSE Standards

**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.

- Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease
- 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**

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
- Critique elements of written and electronic communication (spelling, grammar, and formatting)

**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
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Standard 11 Information Technology Application	<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"> • Identify methods and types of data collection in healthcare • Use health record data collection tools (such as input screens, document templates) • 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) • Demonstrate use of file organization and information storage. • Use basic word processing, spreadsheet, and database applications.
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**NCHSE Biotechnology and Research Development Standards:
National Consortium for Health Science Education**

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 – Describe how molarity relates to solution preparation
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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</p>
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(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 – Define cGMP and why it is important in biotech production

Aligned Washington State Standards

Communications

Presentation of Knowledge and Ideas:
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.
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.

Educational Technology

2.2.1 Develop and use technology effectively

Math

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-4),(HS-ESS3-5)
MP.4 Model with mathematics. (HS-ESS2-3),(HS-ESS2-6)
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-4)

Science

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-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

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.

Developing and Using Models:
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).

Planning and Carrying Out Investigations:
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide

	<p>evidence for and test conceptual, mathematical, physical, and empirical models.</p> <p>Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-ESS2-5)</p> <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. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, 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>
Writing	<p>WTS 9-10 Text Types and Purposes:</p> <p>WTS 9-10 Research to Build and Present Knowledge:</p> <p>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>8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.</p>

Unit 14	
<p>Standard/Unit:</p> <p>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)</p>	
<p>Performance Assessments:</p> <ul style="list-style-type: none"> • Read and analyze research papers and assess where the next steps are and if there are proposed limitations to the experimental results 	

- Identify and evaluate the limits to methods and materials applied to authentic research questions.
- Discuss what questions remain or have been created due to existing tradeoffs
- Identify and apply all appropriate laboratory safety protocols
- Research external laboratory processes and collaborate with industry about other processes

Leadership Alignment:

IST XIV: Identify, mitigate, understand constraints on models and use this knowledge to mitigate limits of protocols and data

Students lead and participate in group projects

Students become proficient at speaking in class in front of peers and public speaking

Students develop and implement self and peer evaluation tools

Students continuously problem solve to optimize laboratory results

Students conduct equipment data research

Students become proficient at time management and calendar management

Students become proficient at goal setting; long term and short term goals

Students lead, organize and participate in community service

21st Century Skills**Creativity and Innovation:****Think Creatively**

1.A.10 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.46 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.47 Analyze and evaluate major alternative points of view

2.C.48 Synthesize and make connections between information and arguments

2.C.49 Interpret information and draw conclusions based on the best analysis

2.C.50 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.27 Solve different kinds of non-familiar problems in both conventional and innovative ways

2.D.28 Identify and ask significant questions that clarify various points of view and lead to better solutions

Information Literacy**Access and Evaluate Information**

4.A.27 Access information efficiently (time) and effectively (sources)

4.A.28 Evaluate information critically and competently

Use and Manage Information

4.B.40 Use information accurately and creatively for the issue or problem at hand

4.B.41 Manage the flow of information from a wide variety of sources

4.B.42 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.36 Set goals with tangible and intangible success criteria

8.A.37 Balance tactical (short-term) and strategic (long-term) goals

8.A.38 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.37 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise

8.C.38 Demonstrate initiative to advance skill levels towards a professional level

8.C.39 Demonstrate commitment to learning as a lifelong process

8.C.40 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies

Total Learning Hours for Unit: 40

- Construct an explanation based on evidence
- Construct and revise an explanation based on evidence
- Understand the limitations of current science as it relates to the complex interactions of environmental and societal constraints
- Synthesize opinions based upon “good science” in the context of the constraints of a modern world

Foundational NCHSE Standards

**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.

- Investigate biomedical therapies as they relate to the prevention, pathology, and treatment of disease
- 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

**Standard 8
Teamwork**

7. 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
- 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"> • 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.
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**NCHSE Biotechnology and Research Development Standards:
National Consortium for Health Science Education**

<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
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Aligned Washington State Standards

<p>Math</p>	<p>MP.2 Reason abstractly and quantitatively MP.4 Model with mathematics</p>
<p>Reading</p>	<p>RST3 9-10 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text RST7 9-10 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 (e.g., in an equation) into words RST8 9-10 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 RST9 9-10 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>

Social Studies	SS 5.2.2 Evaluates the breadth of research to determine the need for new or additional investigation when researching an issue or event.
Science	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</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 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>
Writing	<p>WHST 4 9-10 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience</p> <p>WHST 5 9-10 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> <p>WHST 8 9-10 8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.</p>

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:

IRB and Ethics: Participate, encourage, and employ ethical practices in research and presentation of results

Students invite external review of best laboratory practices
Students create an IRB document and have a university IRB board give feedback
Students lead and participate in group projects
Students become proficient at speaking in class in front of peers and public speaking
Students develop and implement self and peer evaluation tools
Students continuously problem solve to optimize laboratory results
Student conduct equipment data research
Students become proficient at time management and calendar management
Students become proficient at goal setting; long term and short terms goals
Students lead, organize and participate in community service

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.

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.

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.

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

	<ol style="list-style-type: none"> 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	<p>IRB III: Students will understand the requirements and importance of Informed Consent when designing and implementing research studies</p> <ol style="list-style-type: none"> 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.
Standard IRB / Ethics 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
Foundational NCHSE Standards	
Standard 2	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>

Communication	<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 • 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	<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</i></p>

<p>Teamwork</p>	<p><i>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
<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"> • 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) • 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 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

<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.
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)

<i>21st Century Skills</i>		
Check those that students will demonstrate in this course:		
<p>LEARNING & INNOVATION</p> <p>Creativity and Innovation</p> <input checked="" type="checkbox"/> Think Creatively <input checked="" type="checkbox"/> Work Creatively with Others <input checked="" type="checkbox"/> Implement Innovations <p>Critical Thinking and Problem Solving</p> <input checked="" type="checkbox"/> Reason Effectively <input checked="" type="checkbox"/> Use Systems Thinking <input checked="" type="checkbox"/> Make Judgments and Decisions <input checked="" type="checkbox"/> Solve Problems <p>Communication and Collaboration</p> <input checked="" type="checkbox"/> Communicate Clearly <input checked="" type="checkbox"/> Collaborate with Others	<p>INFORMATION, MEDIA & TECHNOLOGY SKILLS</p> <p>Information Literacy</p> <input checked="" type="checkbox"/> Access and /evaluate Information <input checked="" type="checkbox"/> Use and Manage Information <p>Media Literacy</p> <input checked="" type="checkbox"/> Analyze Media <input checked="" type="checkbox"/> Create Media Products <p>Information, Communications and Technology (ICT Literacy)</p> <input checked="" type="checkbox"/> Apply Technology Effectively	<p>LIFE & CAREER SKILLS</p> <p>Flexibility and Adaptability</p> <input checked="" type="checkbox"/> Adapt to Change <input checked="" type="checkbox"/> Be Flexible <p>Initiative and Self-Direction</p> <input checked="" type="checkbox"/> Manage Goals and Time <input checked="" type="checkbox"/> Work Independently <input checked="" type="checkbox"/> Be Self-Directed Learners <p>Social and Cross-Cultural</p> <input checked="" type="checkbox"/> Interact Effectively with Others <input checked="" type="checkbox"/> Work Effectively in Diverse Teams <p>Productivity and Accountability</p> <input checked="" type="checkbox"/> Manage Projects <input checked="" type="checkbox"/> Produce Results <p>Leadership and Responsibility</p> <input checked="" type="checkbox"/> Guide and Lead Others <input checked="" type="checkbox"/> Be Responsible to Others