



Learning that works for Washington

Spokane Public Schools Institute of Science & Technology Biomedical Technology

Course: Institute for Science and Technology --Biomedical Technology		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 CTE course is an authentic immersion into molecular and modern bioscience with an intentional, relevant, and rigorous health science theme. Biomedical Technology utilizes a blend of nationally recognized STEM curriculum, such as The Institute for Systems Biology curriculum, coupled with site-developed curriculum that provides a rigorous immersion of high level molecular bioscience laboratory work, concepts and work place expectations. Students use current, authentic and real world protocols and equipment to explore, analyze, evaluate and synthesize understanding of human health issues. This is not science that has been done for decades; this is science for the emerging new millennium.

Unit 1

Standard/Unit:

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

Performance Assessments:

- Extract DNA from field items that peers bring into the lab and perform SYBR check

Leadership Alignment:

Students gain proficiency with professional level laboratory skills and continually add new skills to a resume.

Students use self and peer evaluation tools (rubrics)

Students evaluate lab equipment

Students visit professional work places and dress appropriately

Students present their research to audiences and gain proficiency with public speaking

Students are continuously problem solving as they conduct laboratory experiments

21st Century Skills

Creativity and Innovation:

Think Creatively

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

Critical Thinking and Problem Solving:

Reason Effectively

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

Make Judgments and Decisions

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

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

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

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

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

Use Systems Thinking

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

Solve Problems

2.D.1 Solve different kinds of non-familiar problems in both conventional and innovative ways

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

Information Literacy**Access and Evaluate Information**

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

Use and Manage Information

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

Initiative and Self-Direction**Manage Goals and Time**

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

Work Independently

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

Be Self-Directed Learners

- 8.C.1 Go beyond basic mastery of skills and/or curriculum to explore and expand one’s own learning and opportunities to gain expertise
- 8.C.2 Demonstrate initiative to advance skill levels towards a professional level
- 8.C.3 Demonstrate commitment to learning as a lifelong process
- 8.C.4 Reflect critically on past experiences in order to inform future progress

Standards and Competencies**Competencies****Total Learning Hours for Unit: 20**

- Describe the relationship between DNA, genes and chromosomes
- Extract and quantify DNA from a variety of tissues (Elk, Deer, Wheat, Bison, Minnows, Humans, Bees, and Bacteria)
- Students use basic micropipetting skills to complete laboratory experiments
- Students use professional extraction tools (Instagene, Qiagen) and procedures for extracting DNA for downstream applications

Aligned Washington State Standards**Communications**

9-10.SL.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

Educational Technology	2.2.2 Use a variety of hardware to support learning. 2.2.1 Develop skills to use technology effectively.
Math	S-ID 2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
Reading	9-10.RST.3. 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. 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-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-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. [

Unit 2

Standard/Unit:

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

Performance Assessments:

- Analyze human traits and calculate allele frequencies
- Create pedigree chart based on genotypes and phenotypes of a population

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Initiative and Self-Direction**Manage Goals and Time**

- 8.A.4 Set goals with tangible and intangible success criteria
- 8.A.5 Balance tactical (short-term) and strategic (long-term) goals
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Standards and Competencies**Competencies****Total Learning Hours for Unit: 20**

- Solve single trait Mendelian equations 100% of the time
- Analyze allele frequencies (The proportion of a gene in a population.)
- Utilizing gene frequencies, map gene locations on Chromosomes
- Create histograms representing polygenic trait frequencies
- Apply Polymerase Chain Reaction to gather data from a population
- Analyze data using statistical analysis
- Evaluate results and derive meaning from them

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	<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> <p>HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.</p>

Unit 3

Standard/Unit:

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

Performance Assessments:

- Decode authentic DNA sequence such as Beta-hemoglobin from DNA to RNA to protein
- Use bio-informatics to identify introns and exons
- Apply bio-informatics software from the National Center for Biotechnology Information to study DNA and proteins

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Standards and Competencies

Competencies	Total Learning Hours for Unit: 15
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- Diagram the process of transcription and translation
- Identify several editing mechanisms within cells
- Understand differences in DNA expression creates different cells, leading to differences in tissues and organs
- Recognize that phenotypic differences may be due to influences that are outside the genome yet are inheritable

Aligned Washington State Standards

Educational Technology	2.2.1 Develop skills to use technology effectively. 2.2.2 Use a variety of hardware to support learning.
Math	MP.2 Reason abstractly and quantitatively
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-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.
Writing	WHST9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. WHST. 9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5) 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

Standard/Unit:

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

(LS1 1)

Performance Assessments:

- Compare and contrast mitosis and meiosis
- Map influence of mutations and protein confirmation
- Use restriction fragment length polymorphism analysis to expose polymorphisms and analyze a population of sharks and red-band trout

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<i>Standards and Competencies</i>	
Competencies	Total Learning Hours for Unit: 10
<ul style="list-style-type: none"> Recognize multiple mechanisms that lead to population diversity (Genetic variation) Understand the mechanisms that lead to genetic mutation and the various types of mutations (additions, deletions, substitutions, translocations) Understand that genetic mutations may lead to change in protein functions that lead to phenotypic changes 	
<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	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:	
<p>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)</p>	
Performance Assessments:	
<ul style="list-style-type: none"> Analyze bitter taste allele frequency using Hardy-Weinberg and chi square analysis Apply cleaved amplified polymorphic sequence procedures to analyze the frequencies of alleles in a population of students and apply the results to understand world populations. 	
Leadership Alignment:	
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Information Literacy

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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	
Standards and Competencies	
Competencies	Total Learning Hours for Unit: 10
<ul style="list-style-type: none"> Understand that multiple environmental mechanisms act on populations to cause adaptive / selective pressure Understand and analyze the role of differential reproduction in the evolution of a population Apply mathematical analysis (Hardy-Weinberg, Chi Square) to analyze and evaluate allele / gene frequencies to determine and understand if the population is evolving 	
Aligned Washington State Standards	
Math	8.3.F Determine probabilities for mutually exclusive, dependent, and independent events for small sample sizes.
Reading	<p>9-10.RST.8 Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.</p> <p>9-10.RST.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.</p>
Science	<p>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.</p> <p>9-11 LS3B Random changes in the genetic makeup of cells and organisms (mutations) can cause changes in their physical characteristics or behaviors. If the genetic mutations occur in eggs or sperm cells, the changes will be inherited by offspring. While many of these changes will be harmful, a small minority may allow the offspring to better survive and reproduce.</p> <p>HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</p> <p>HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</p> <p>HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p>
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>
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Unit 6

Standard/Unit:

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

- Performance Assessments:**
- Induce transformed cells to alter protein production and assess changed phenotype
 - Apply genetic engineering techniques (bacterial transformation) to make bacteria glow

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Initiative and Self-Direction

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Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Understand the interaction of molecular pathways within organisms such as transduction (molecular communication involving stimulatory and inhibitory signals from other cells, other organisms or the environment)
- Understand that signal transduction patterns are under strong selective pressure
- Represent and use appropriate models of cell signaling pathways (Immune response)

Aligned Washington State Standards

**Educational
Technology**

2.2.1 Develop and use technology effectively

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-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
Writing	WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1) 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

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 multiple metabolic pathways and identify positive and negative feedback mechanisms
- Use National Center for Biotechnology Information to analyze the genes on the pGlo plasmid (used to engineer transformed bacteria)

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Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Determine if a systems approach will be helpful in answering a question or solving a problem
- Represent the system with a diagram specifying components, boundaries, flows, and feedbacks
- Describe relevant subsystems and the larger system that contains the system being analyzed

Aligned Washington State Standards

Reading	RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically
Science	HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis
Social Studies	
Writing	<p>WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS2-6)</p> <p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>

Unit 8

Standard/Unit:

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

Performance Assessments:

- Pre-lab simple to complex protocols and modify taking into account laboratory limitations and capabilities
- Modify standard laboratory procedures to suit our purposes

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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

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: 5

- Plan and conduct a scientific investigation, choosing a method or methods appropriate to the question being asked
- Collect, analyze, use and display data using calculators, computers, or other technical devices where appropriate

Aligned Washington State Standards

**Science / Technology /
Communications /
Reading / Writing**

(HS-PS2-6):

Obtain, Evaluate, and Communicate Information:

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.

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).

(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.

Unit 9

Standard/Unit:

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

Performance Assessments:

- Assess and evaluate laboratory-generated data and new data questions
- Write research results using standard academic writing conventions
- Present research results to diverse audiences

Leadership Alignment:

Students gain proficiency with professional level laboratory skills and continually add new skills to a resume.

Students use self and peer evaluation tools (rubrics)

Students evaluate lab equipment

Students visit professional work places and dress appropriately

Students present their research to audiences and gain proficiency with public speaking

Students are continuously problem solving as they conduct laboratory experiments

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

Use Systems Thinking

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

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

Initiative and Self-Direction

Work Independently

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

Be Self-Directed Learners

- 8.C.29 Go beyond basic mastery of skills and/or curriculum to explore and expand one’s own learning and opportunities to gain expertise
- 8.C.30 Demonstrate initiative to advance skill levels towards a professional level
- 8.C.31 Demonstrate commitment to learning as a lifelong process
- 8.C.32 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Draw conclusions supported by evidence from the investigation and consistent with established scientific knowledge/practice
- Analyze alternative explanations and decide which best fits the data and evidence

Aligned Washington State Standards

Math	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)
Reading	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
Science	HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
Writing	WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes

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:

- Read and analyze multiple research reports and synthesize understanding of competing conclusions
- Apply methods taken from authentic research papers

Leadership Alignment:

Students gain proficiency with professional level laboratory skills and continually add new skills to a resume.

Students use self and peer evaluation tools (rubrics)

Students evaluate lab equipment

Students visit professional work places and dress appropriately

Students present their research to audiences and gain proficiency with public speaking

Students are continuously problem solving as they conduct laboratory experiments

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.30 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.31 Analyze and evaluate major alternative points of view

2.C.32 Synthesize and make connections between information and arguments

2.C.33 Interpret information and draw conclusions based on the best analysis

2.C.34 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.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.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.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

- Formulate one or more hypotheses based on a model or theory of a causal relationship.
- Demonstrate creativity and critical thinking to formulate and evaluate the hypothesis

Aligned Washington State Standards

Science	Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and/or refine a solution to a complex, real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations
Writing	WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3) WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-ESS2-5)
Reading	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 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.

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 results
- Demonstrate a growth mindset, grit and perseverance by re-doing labs until successful

Leadership Alignment:

Students gain proficiency with professional level laboratory skills and continually add new skills to a resume.

Students use self and peer evaluation tools (rubrics)

Students evaluate lab equipment

Students visit professional work places and dress appropriately

Students present their research to audiences and gain proficiency with public speaking

Students are continuously problem solving as they conduct laboratory experiments

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.35 Effectively analyze and evaluate evidence, arguments, claims and beliefs

2.C.36 Analyze and evaluate major alternative points of view

- 2.C.37 Synthesize and make connections between information and arguments
- 2.C.38 Interpret information and draw conclusions based on the best analysis
- 2.C.39 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.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.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.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

Total Learning Hours for Unit: 5

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:

- Consistently collaborate on multiple levels and multiple laboratory demands
- Apply newly learned lab techniques to new research situations

Leadership Alignment:

Students gain proficiency with professional level laboratory skills and continually add new skills to a resume.
Students use self and peer evaluation tools (rubrics)
Students evaluate lab equipment
Students visit professional work places and dress appropriately
Students present their research to audiences and gain proficiency with public speaking
Students are continuously problem solving as they conduct laboratory experiments

21st Century Skills

Creativity and Innovation:

Think Creatively

1.A.11 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

Use Systems Thinking

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

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

Work Independently

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

Be Self-Directed Learners

8.C.41 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise

8.C.42 Demonstrate initiative to advance skill levels towards a professional level

8.C.43 Demonstrate commitment to learning as a lifelong process

8.C.44 Reflect critically on past experiences in order to inform future progress

Standards and Competencies

Competencies

Total Learning Hours for Unit: 10

- Work collaboratively with other students to generate ideas for solving a problem. Identify criteria and constraints, research the problem, and generate several possible solutions

Aligned Washington State Standards

Educational Technology

2.2.1 Develop and use technology effectively

Reading

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 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.

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.
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)

Analyzing and Interpreting Data :

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)

Unit 13

Standard/Unit:

IST XIII: Choosing the best solution involves comparing alternatives with respect to criteria and constraints, then building and testing a model or other representation of the final design. (APPC)

Performance Assessments:

- Use data sets and analysis to help design protocols

Leadership Alignment:

Students gain proficiency with professional level laboratory skills and continually add new skills to a resume.

Students use self and peer evaluation tools (rubrics)

Students evaluate lab equipment

Students visit professional work places and dress appropriately

Students present their research to audiences and gain proficiency with public speaking

Students are continuously problem solving as they conduct laboratory experiments

Standards and Competencies

Competencies

Total Learning Hours for Unit: 5

- Choose the best solution for a problem, create a model or drawing of the final design, and devise a way to test it. Redesign the solution, if necessary, then present it to peers

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

<p>Math</p>	<p>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)</p>
<p>Science</p>	<p>HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p> <p>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> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p>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).</p> <p>Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4)</p> <p>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 evidence for and test conceptual, mathematical, physical, and empirical models. 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>
<p>Writing</p>	<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>ST 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"> Analyze real-life solutions to health issues and identify side effects and issues with current and emerging therapies
<p>Leadership Alignment:</p>	<p>Students gain proficiency with professional level laboratory skills and continually add new skills to a resume. Students use self and peer evaluation tools (rubrics)</p>

Students evaluate lab equipment
 Students visit professional work places and dress appropriately
 Students present their research to audiences and gain proficiency with public speaking
 Students are continuously problem solving as they conduct laboratory experiments

Standards and Competencies

Competencies	Total Learning Hours for Unit: 45
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- Analyze a societal issue that may be addressed through science and/or technology. Compare alternative solutions by considering trade-offs and unintended consequences

Aligned Washington State Standards

Math	MP.2 Reason abstractly and quantitatively MP.4 Model with mathematics
Reading	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 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. (HS-ETS1-1),(HS-ETS1-3)
Science	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. 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.

21st Century Skills

Check those that students will demonstrate in this course:

LEARNING & INNOVATION

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

Critical Thinking and Problem Solving

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

Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy

- Access and /evaluate Information
- Use and Manage Information

Media Literacy

- Analyze Media
- Create Media Products

Information, Communications and Technology (ICT Literacy)

- Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability

- Adapt to Change
- Be Flexible

Initiative and Self-Direction

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

Social and Cross-Cultural

- Interact Effectively with Others
- Work Effectively in Diverse Teams

Productivity and Accountability

- Manage Projects
- Produce Results

Leadership and Responsibility

- Guide and Lead Others
- Be Responsible to Others