Chino Valley Unified School District
High School Course Description

A. CONTACTS	
1. School/District Information:	School/District: Chino Valley Unified School District Street Address: 5130 Riverside Dr., Chino, CA 91710 Phone: (909) 628-1201 Website: www.chino.k12.ca.us
2. Course Contact:	District Contact: Office of Secondary Curriculum and Instruction Position/Title: Director of Secondary Curriculum and Instruction Site: District Office Phone: (909)628-1201 X1630
B. COVER PAGE - COURSE ID	
1. Course Title:	Artificial Intelligence in Medicine Honors
2. Transcript Title/Abbreviation:	AI Med H
3. Transcript Course Code/Number:	5E82
4. Seeking Honors Distinction:	Yes
5. Subject Area/Category:	Meets UC/CSU "d" science requirement
6. Grade Level(s):	9-12
7. Unit Value:	5 units per semester/10 credits total
8. Course Previously Approved by UC:	No
9. Classified as a Career Technical Education Course:	No
10. Modeled after an UC-approved course:	No
11. Repeatable for Credit:	No
12. Date of Board Approval:	April 21, 2022

13. Brief Course Description:

This course introduces students to the history, contemporary, and future of the field of medicine through the lens of artificial intelligence. Students explore the philosophies of medical practices around the world to understand the mechanisms and actions taken to aid the body in maintaining homeostasis. Students use vital signs as clues to understand a lack of equilibrium, while exploring the multiple modalities used to prevent, diagnose, and treat disorders in body systems. Students conduct research, investigate, and develop design solutions to better understand the future and applications of artificial intelligence in medicine.

14. Prerequisites:	Integrated Mathematics I

15. Context for Course:

Aligned with the California NGSS state standard, this course introduces students to the history, contemporary, and future of the field of medicine through the lens of artificial intelligence. Students explore the philosophies of medical practices around the world to understand the mechanisms and actions taken to aid the body in maintaining homeostasis. Students use vital signs as clues to understand a lack of equilibrium, while exploring the multiple modalities used to prevent, diagnose, and treat disorders in body systems. Students will conduct research, investigate, and develop design solutions to better understand the future and applications of artificial intelligence in medicine.

16. History of Course Development:

The use of Artificial Intelligence applications is a rapidly growing and cutting-edge discipline in today's medical field. The goal of this course is to introduce students to the field of applied medicine, through the lens of artificial Intelligence, while developing the skills and knowledge to allow our students to become innovators and highly competitive leaders in the field. Students learn the various philosophies of medicine practiced around the world in hopes of aiding the body to achieve homeostasis. Students use vital signs as clues to understand a lack of equilibrium and the multiple modalities used for prevention, diagnosis, and treatment of disorders. Students investigate the future of artificial intelligence in

medicine--both virtually and physically. Students conduct hands-on research and design solutions to better understand the applications of artificial intelligence in medicine.	
17. Textbooks:	TBD
18. Supplemental Instructional Materials:	BIOLOGY by Prentice Hall, Kenneth R. Miller, Joseph S. Levine, Pearson Education 2006 Websites: "Body Control Center" by PBS & WGBH Educational Foundation https://ca.pbslearningmedia.org/resource/tdc02.sci.life.reg.bodycontrol/body-control-center/ "10 Clever DIY Medical Devices" by Brian Buntz, Medical Device and Diagnostic Industry https://www.mddionline.com/design-engineering/10-clever-diy-medical-devices "Implementation of a Hospital management system using ArrayList in Java" by Ravi Bandakkanavar, Krazytech https://krazytech.com/programs/a-java-application-to-implement-hospital-management-system

C. COURSE CONTENT

1. Course Purpose:

The purpose of this course is to introduce students to the history, contemporary, and future of the medical field. Students learn the various philosophies of medicine practiced around the world in hopes of aiding the body to achieve homeostasis. Students use vital signs as clues to understand a lack of equilibrium and the multiple modalities used for prevention, diagnosis, and treatment of disorders. Students investigate the future of artificial intelligence in medicine--both virtually and physically. Students will conduct hands-on research and design solutions to better understand the applications of artificial intelligence in medicine.

2. Course Outline:

Philosophy of Medicine (2.5 weeks)

- Students ask questions to clarify relationships about the role philosophical approaches to medicine from various cultures around the world affect patient care
- Students use and apply inductive and deductive reasoning to describe the approaches to medicine
  - Scientific method & engineering design process
- Students describe an array of careers in the medical field including job description, trends for growth, pathway, and average income

Homeostasis and Essentials for Life Functions (3 weeks)

- Students communicate scientific information about the importance of homeostasis in sustaining life
- Students plan and investigate to provide evidence that feedback mechanisms maintain homeostasis (HS-LS1-3)
- Students use a model to illustrate how carbon, hydrogen, oxygen, phosphorous, nitrogen, and sulfur are the building blocks of life
- Students use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy (HS-LS1-7)

Vital Signs and Current Technology in Testing/Diagnosis (3 weeks)

- Students carry out investigations to demonstrate stability and change of vital signs as clues to internal functioning and homeostasis
  - Heart rate, blood pressure, respiration rate, pupils, temperature, blood sugar, etc.
- Students use mathematical modeling to assess patterns over time.
  - Independent & dependent variables
- Students apply their understanding of cellular respiration to construct explanations of the effects of abnormal vital signs and the need for homeostasis

- Students engage in argument to determine best tool for patient diagnosis & treatment based on knowledge of radio waves
    - X-Ray, MRI, Ultrasound, PET, CAT/CT, EKG, ECG, Gamma Rays, etc.

Artificial Intelligence in Medicine (9 weeks)

- Virtual (software)
    - Students use informatics, "deep learning", mathematical algorithms to collect data to form conclusions based on patterns in data
    - Students use mathematical representation to support and revise explanations to determine whether a relation defined by a graph, a set of pairs, or a symbolic expression is a functional and justify the conclusion (1.1.4)
    - Students apply concepts of statistics and probability to add, subtract, multiply, and divide rational expressions and functions. Students solve both computationally and conceptually challenging problems by using these techniques. (1.1.1)
    - Students use mathematical and/pr computational representations to determine the domain of independent variables and the range of the dependent variables defined by a graph, a set of ordered pairs, or a symbolic expression. (1.1.3)
    - Students engage in argumentative discussions from evidence, as to the advantages of electronic health record systems to neural network-based guidance in health treatment decisions
    - Students ask questions to clarify relationships about flowchart-based approach versus database approach to diagnosis
        - Students design and create a functional web-based dichotomous key to diagnose patients (flowchart-based approach).
        - Students design and create a program to identify and classify key features to diagnose patients (database approach).
    - Current Technology: virtual appointments, apple watch, fitness trackers, diabetes monitoring, etc.
- Physical (hardware) (9 weeks)
    - Students develop models to carry out investigations of softbots and how they help with surgical procedures and patient care (i.e., service, medical devices, etc.).
    - Students construct explanations and design solutions to help with prevention, detection, and treatment of disorders
    - Students design and construct a model to create a physical artificial intelligence device that solves a real-world problem
        - I.e., Vex robotics to assist with patient care or medical practices
    - Current Technology: Prosthetics, artificial heart valves, pancreas, brain to control technology (Torsion Diagnostic System), nanotechnology etc.

Data Mining & Genetics (6 weeks)

- Students 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-LS3-1)
- Students 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-LS3-2)
- Students apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population (HS-LS3-3)
- Students discuss advantages of omics in its role in advancing biological understandings of genetics
- Students develop and use a model to illustrate the process of genetic engineering
- Performance Indicator: Students know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant, or recessive) (2.3.1)

- Students know how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes (2.3.3)

Ethics and Considerations (3 weeks)

- Students explore the concept of Uncanny Valley and discuss the role and implications of artificial intelligence and its boundaries
- Students explore how artificial intelligence based on its design can privilege dominant cultures over minority cultures
  - Students problem solve solutions to address the inherent bias in many artificial intelligence machines
- Students explore political and economic impacts of the medical field, specifically in relation with historical laws and the organization of health insurance

3. Key Assignments:

Philosophy of Medicine

- Students create a double bubble map comparing key elements of Eastern vs. Western medical philosophies.
- Students design (but do not carry out) an investigation using the scientific method; writing a flowchart to describe the process and making a claim using a hypothesis and naming the dependent variable and at least three independent variables.
- Students design (but do not carry out) a solution to a problem using the engineering design process; including a labelled blueprint, list of materials, flowchart for construction, and explanation of how it solves a problem.
- Students create a double bubble map comparing the inductive and deductive reasoning process.
- Students create a list of KWL charts regarding medicine and medical practices to be revisited at the end of the year.
- Students present about a career in the medical field.

Homeostasis and Essentials for Life Functions

- Use the Body Center simulation to engage with the concept of homeostasis.
- Write a Claim, Evidence, Reasoning (CER) statement about positive & negative feedback loops.
  - Students identify one positive feedback loop and one negative feedback loop and explain how the process uses information to adjust the system.
- Create a model to demonstrate the interconnectedness and process of transference of energy from photosynthesis and cellular respiration.

Vital Signs and Current Technology in Testing/Diagnosis

- Learn how to take vital signs (Heart rate, blood pressure, respiration rate, pupils, temperature, blood sugar, etc.) on the self, and partners in the class.
  - Collect class data and create graphs to analyze mean, median and mode.
- Construct and argument from evidence (CER) to explain how abnormal vital signs indicate problems occurring internally.
- Create a chart demonstrating when each digital technology would be indicated to help diagnose and explain how the technology works to provide data for analysis.
- Students are provided case studies in which they will identify what the abnormalities may signify and what technology they would use to assist in further tests/diagnosis.

Artificial Intelligence in Medicine

- Students use the flowchart-based approach (using skip logic) to create a working web-based dichotomous key used to help diagnose patients.
- Students use the database approach to create their own way of maintaining digital medical records to help diagnose patients (students can enter their own vital signs over a course of week).
- Students engage in arguments from evidence as to the advantages and disadvantages of each approach via a philosophical debate.

- Students create a double bubble map to compare virtual versus physical artificial intelligence.
- Students create their own physical artificial intelligence device that is operational.
- Students brainstorm problems and provide potential solutions to current needs that artificial intelligence can solve in the medical field.

Data Mining & Genetics

- Students have a choice to either interview and create a pedigree showing phenotypes and genotypes for own family or based on a case study.
- Students use Punnett squares and probability to create a baby, then using the information about the child's genotype to cross that child with another student in class and create a "grandbaby" --use statics and randomization to determine features. (This should include simple dominance, codominance, and incomplete dominant traits)
- Karyotyping lab.
- Students present about the major genes on specific chromosomes that code for physical appearance and major disorders.
- Students explore major historical milestones in the genetic engineering process.
- Students engage in argument from evidence to write a CER related to a solution in genetic engineering to help improve quality of life.

Ethics and Considerations

- Students write a CER regarding the role and implications of artificial intelligence and its boundaries.
- Students solve solutions to address the inherent bias in many artificial intelligence machines and present their solutions.
- Students engage in a philosophical debate regarding privatized and universal healthcare from multiple perspectives.
- Students make an argument for the boundaries/limits covered by insurance ("where does treatment stop?" -- survivability vs thriving)

4. Instructional Methods and/or Strategies:

APB (Activity, Project, and Problem-based) Instructional Design providing students with unique opportunities to work collaboratively, identify problems, apply what they know, persevere through challenges, find unique solutions, and lead their own learning. Including:

- Lab-based learning (skills-based labs as well as student designed and implemented labs)
- Cross Cutting Concepts (Patterns, Similarity & Diversity; Cause & Effect; Scale, Proportion & Quantity; Systems & Systems Models; Energy & Matter; Structure & Function; Stability & Change)
- Science & Engineering Practices (Asking Questions & Defining Problems; Developing & Using Models; Planning & Carrying out Investigations; Analyzing & Interpreting Data; Using Mathematics, Information & Computer Technology & Computational Thinking; Constructing Explanations & Designing Solutions; Engaging in Argument from Evidence; Obtaining, Evaluating & Communication Information)
- Four Corners discussions (Agree, Strongly Agree, Disagree, Strongly Disagree)
- Data interpretation and predictions
- Jig Saw research projects (students or student groups research different aspects of a topic and report their learning back to the whole class, e.g., different types of invasive species or genetic disorders)
- Computer based research projects: individual students or groups research
- Evidence based data interpretation (Claim, Evidence and Reasoning writing from labs or research projects)
- Student centered and created activities (e.g., Evolution Island where students determine changes over time to organisms (e.g., rats) on islands with different ecosystems)
- Scientific article reading, annotation and/or class report/presentation
- Using CER (claims, evidence, and reasoning) graphic organizer
- Project Based Learning
- Argument Driven Instruction

- "5 E" Lessons (Engage, Explore, Explain, Elaborate & Evaluate)
- Phenomena

5. Assessment Including Methods and/or Tools:

The evaluation of student progress and evaluation will be based on the following criteria outlined in Board Policy:

- Assessments: 60-75% of the final grade
- Assignments and class discussions: 25-40% of the final grade

Units with Standards Correlations

Unit 1: Philosophy of Medicine

Philosophy of Medicine

- Students ask questions to clarify relationships about the role of philosophical approaches to medicine from various cultures around the world and the effect of patient care
- Students use and apply inductive and deductive reasoning to describe the approaches to medicine
- 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-ETS1-2)
- Scientific method & engineering design process
- Students describe an array of careers in the medical field including job description, trends for growth, pathway, and average income

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
• Asking questions & defining problems • Developing & using models • Analyzing & interpreting data	Philosophical approaches to medicine: Cultures have different approaches to medicine; some are inductive reasoning while others are deductively driven; some are holistic while others are localized. **ETS1.A: Defining and Delimiting Engineering Problems** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1) • Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1) **ETS1.B: Developing Possible Solutions** • When evaluating solutions, it is important to consider a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3) • Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways	• Patterns • Systems & System Models • Cause & Effect • Structure & Function **Connections to Nature of Science** • Science is a Human Endeavor ○ Technological advances have influenced the progress of science and science has influenced advances in technology (HS-LS3-3) ○ Science and engineering are influenced by

	of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4) **ETS1.C: Optimizing the Design Solution** • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)	society and society is influenced by science and engineering (HS-LS3-3)

Common Core State Standards Connections

ELA/Literacy:
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) 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 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)
SL.11-12.5 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

Mathematics:
MP.2 Reason abstractly and quantitatively (HS-ETS1-1), (HS-ETS1-3), (HS-ETS1-4)
MP.4 Model with mathematics (HS-ETS1-1), (HS-ETS1-2), (HS-ETS1-3), (HS-ETS1-4)

Key Assignments

1. Students create a double bubble map comparing key elements of Eastern vs. Western medical philosophies.
2. Students design (but not carry out) an investigation using the scientific method; writing a flowchart to describe the process and making a claim using a hypothesis and naming the dependent variable and at least three independent variables.
3. Students design (but not carry out) a solution to a problem using the engineering design process; including a labelled blueprint, list of materials, flowchart for construction, and explanation of how it solves a problem.
4. Students create a double bubble map comparing the inductive and deductive reasoning process.
5. Students create a list of KWL charts regarding medicine and medical practices to be revisited at the end of the year.
6. Students present about a career in the medical field

Unit 2: Homeostasis and Essentials for Life Functions

Homeostasis and Essentials for Life Functions

- Students communicate scientific information about the importance of homeostasis in sustaining life
- Students develop and construct and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms (HS-LS1-2)
- Students plan and investigate to provide evidence feedback in how mechanisms maintain homeostasis (HS-LS1-

- Students use a model to illustrate how carbon, hydrogen, oxygen, phosphorous, nitrogen, and sulfur are the building blocks of life (HS-LS1-6)
- Students use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy (HS-LS1-7)
- Students use a model to illustrate how photosynthesis transforms light energy into chemical energy (HS-LS1-5)

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
• Develop and Use Models • Planning and Carrying Out Investigations • Constructing Explanations and Designing Solutions	**LS1.A: Structure and Function** • Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2) • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3) **LS1.C: Organization for Matter and Energy Flow in Organisms** • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5) • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6) • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6), (HS-LS1-7) • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken, and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)	• Systems & System Models • Energy & Matter • Structure & Function • Stability & Change

Common Core State Standards Connections

ELA/Literacy:
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-LS1-6)
WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes (HS-LS1-6)
WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is the most significant for a specific purpose and audience (HS-LS1-6)
WHST.9-12.7 Conduct short as well as more sustained research project 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.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively, assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into a text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation (HS-LS1-3)
WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research (HS-LS1-6)
SL.11-12.5 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 (HS-LS1-2), (HS-LS1-5), (HS-LS1-6)

Key Assignments

1. Use the Body Center simulation to engage with the concept of homeostasis
2. Write a Claim, Evidence, Reasoning (CER) statement about positive & negative feedback loops
   - Students will identify one positive feedback loop and one negative feedback loop and explain how the process uses information to adjust the system
3. Create a model to demonstrate the interconnectedness and process of transference of energy from photosynthesis and cellular respiration

Unit 3: Vital Signs and Current Technology in Testing/Diagnosis

Vital Signs and Current Technology in Testing/Diagnosis

- Students carry out investigations to demonstrate stability and change of vital signs as clues to internal functioning and homeostasis i.e., Heart rate, blood pressure, respiration rate, pupils, temperature, blood sugar, etc.
- Students apply their understanding of cellular respirations to construct explanations of the effects of abnormal vital signs and the need for homeostasis (feedback loops)
- Students engage in argument to determine best tool for patient diagnosis & treatment based on knowledge of radio waves (HS-PS4-5) i.e., X-Ray, MRI, Ultrasound, PET, CAT/CT, EKG, ECG, Gamma Rays, etc.
- Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of the waves traveling in various media (HS-PS4-1)

Chino Valley Unified School District
High School Course Description

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts

• Using Mathematics and Computational Thinking
• Asking questions & Defining Problems
• Analyzing & Interpreting Data
• Engaging in Argument from Evidence
	LS1.A: Structure and Function
	• Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
	• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
	• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)
	
	LS1.C: Organization for Matter and Energy Flow in Organisms
	• The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
	• The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)
	• As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6), (HS-LS1-7)
	• As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken, and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)
	PS4.A: Wave Properties
	• The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.
		• Cause & Effect
		• Patterns
		• System & System Models
		• Energy & Matter
		• Structure & Function
		• Stability & Change
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		Connections to Engineering, Technology and Applications of Science
		• Interdependence of Science, Engineering and Technology
		  ○ Science and engineering complement each other in the cycle known as research and development (R&D), (HS-PS4-5)
		• Influence of Engineering, Technology, and Science on Society and the Natural World
		  ○ Modern civilization depends on major technological systems (HS-PS4-2), (HS-PS4-5)
		  ○ Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks (HS-PS4-2)

	PS3.D: Energy in Chemical Processes • Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. *(secondary)* **PS4.A: Wave Properties** • Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. **PS4.B: Electromagnetic Radiation** • Photoelectric materials emit electrons when they absorb light of a high-enough frequency. **PS4.C: Information Technologies and Instrumentation** Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.	

Common Core State Standards Connections

ELA/Literacy:
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) to address a question or solve a problem (HS-PS4-1)

Mathematics:
MP.2 Reason abstractly and quantitatively (HS-PS4-1)
MP.4 Model with mathematics (HS-PS4-1)
HSA-SSE.A.1 Interpret expressions that present a quantity in terms of its context (HS-PS4-1)
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression (HS-PS4-1)
HSA-CED.A.4 Rearrange formulas to highlights quantity of interest, using the same reasoning as in solving equations (HS-PS4-1)

Key Assignments
1. Learn how to take vital signs (Heart rate, blood pressure, respiration rate, pupils, temperature, blood sugar, etc.) on the self, and partners in the class. • Collect class data and create graphs to analyze mean, median and mode 2. Construct and argument from evidence (CER) to explain how abnormal vital signs indicate problems occurring internally 3. Create a chart demonstrating when each digital technology would be indicated to help diagnose and how the technology works to provide data for analysis 4. Students provided with case studies in which they will identify what the abnormalities may signify and what technology they would use to assist in further tests/diagnosis

Unit 4: Artificial Intelligence in Medicine
Artificial Intelligence in Medicine • Virtual ○ Students use informatics, "deep learning", mathematical algorithms to collect data to form conclusions based on patterns in data ○ Students use mathematical representation to support and revise explanations to determine whether a relation defined by a graph, a set of pairs, or a symbolic expression is functional and justifies the conclusion (1.1.4) ○ Students apply concepts of statistics and probability to add, subtract, multiply, and divide rational expressions and functions. Students solve both computationally and conceptually challenging problems by using these techniques. (1.1.1) ○ Students use mathematical and/pr computational representations to determine the domain of independent variables and the range of the dependent variables defined by a graph, a set of ordered pairs, or a symbolic expression. (1.1.3) ○ Students engage in argument from evidence as to the advantages of electronic health record systems to neural network-based guidance in health in treatment decisions ○ Students ask questions to clarify relationships about flowchart-based approach versus database approach to diagnosis ○ Students design and create a functional web-based dichotomous key to diagnose patients (flowchart-based approach). • Physical ○ Students develop models to carry out investigations of softbots and how they help with surgical procedures and patient care (i.e., service, medical devices, etc.) ○ Students construct explanations and design solutions to help with prevention, detection, and treatment of disorders ○ Students design and construct a model to create a physical artificial intelligence device that solves a real-world problem

Chino Valley Unified School District
High School Course Description

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
• Asking Questions & Designing Problems • Using Mathematics & Computational Thinking • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	**PS3.D: Energy in Chemical Processes** • Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. *(secondary to HS-PS4-5)* **PS4.A: Wave Properties** • The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1) • Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2), (HS-PS4-5) • [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3) **PS4.B: Electromagnetic Radiation** • Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3) • When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4) • Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5) **PS4.C: Information Technologies and Instrumentation** • Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)	• Cause & Effect • Systems & System Models • Stability & Change ---------- **Connections to Engineering, Technology and Applications of Science** • Interdependence of Science, Engineering and Technology ○ Science and engineering complement each other in the cycle known as research and development (R&D), (HS-PS4-5) • Influence of Engineering, Technology, and Science on Society and the Natural World ○ Modern civilization depends on major technological systems (HS-PS4-2), (HS-PS4-5) ○ Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks (HS-PS4-2)

Chino Valley Unified School District
High School Course Description

Common Core State Standards Connections

ELA/Literacy:

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 (HS-PS4-2), (HSPS4-3), (HSPS4-4)

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account HS-PS4-2), (HSPS4-3), (HSPS4-4)

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (E.g., Quantitative data, video, multimedia) to address a question or solve a problem HS-PS4-1), (HSPS4-4)

RST.11-12.8 Evaluate the hypothesis, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information HS-PS4-2), (HSPS4-3), (HSPS4-4)

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes (HS-PS4-5)

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

Mathematics:

MP.2 Reason abstractly and quantitatively (HS-PS4-1), (HS-PS4-3)

MP.4 Model with mathematics (HS-PS4-1)

HSA-SSE.A.1 Interpret expressions that present a quantity in terms of its context (HS-PS4-1), (HS-PS4-3)

HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression (HS-PS4-1), (HS-PS4-3)

HSA-CED.A.4 Rearrange formulas to highlights quantity of interest, using the same reasoning as in solving equations (HS-PS4-1), (HS-PS4-3)

Key Assignments

1. Students use the flowchart-based approach (using skip logic) to create a working web-based dichotomous key used to help diagnose patients
2. Students use the database approach to create their own way of maintaining digital medical records to help diagnose patients (students can enter their own vital signs over a course of week)
3. Students engage in argument from evidence as to the advantages and disadvantages of each approach via a philosophical debate
4. Students create a double bubble map to compare virtual versus physical artificial intelligence
5. Students create their own physical artificial intelligence device that is operational
6. Students brainstorm problems and provide potential solutions to current needs that artificial intelligence can solve in the medical field

Chino Valley Unified School District
High School Course Description

Unit 5: Data Mining & Genetics

Data Mining & Genetics

- Students 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-LS3-1)
- Students 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-LS3-2)
- Students apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population (HS-LS3-3)
- Students discuss advantages of omics in its role in advancing biological understandings of genetics (HS-LS4-3)
- Students develop and use a model to illustrate the process of genetic engineering
- Students predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant, or recessive) (2.3.1) (HS-LS4-3) (HS-LS4-5)
- Students predict the probable mode of inheritance from a pedigree diagram showing phenotypes (2.3.3)

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
• Asking Questions and Defining Problems • Analyzing and Interpreting Data • Engaging in Argument from Evidence	**LS1.A: Structure and Function** • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. *(secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)* **LS3.A: Inheritance of Traits** • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1) **LS3.B: Variation of Traits** • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2) • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus,	• Cause & Effect • Scale, Proportion, & Quantity --- **Connections to Nature of Science** • Science is a Human Endeavor ○ Technological advances have influenced the progress of science and science has influenced advances in technology (HS-LS3-3) ○ Science and engineering are influenced by society and society is influenced by science and engineering (HS-LS3-3)

	the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2), (HS-LS3-3)	

Common Core State Standards Connections

ELA/Literacy:
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account (HS-LS3-1), (HS-LS3-2)
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible (HS-LS3-2)
WHST.9-12.1 Write arguments focused on discipline specific content (HS-LS3-2)

Mathematics:
MP.2 Reason abstractly and quantitatively (HS-LS3-2), (HS-LS3-3)

Key Assignments

1. Students choose to either interview and create a pedigree showing phenotypes and genotypes for own family or base on a case study
2. Students use Punnett squares and probability to determine characteristics of a baby, then using the information about the child's genotype to cross-reference that child with another student in class and determine the probable characteristics of a "grandbaby" -- use statics and randomization to determine features. (This should include simple dominance, codominance, and incomplete dominant traits)
3. Karyotyping lab
4. Students present about the major genes on specific chromosomes that code for physical appearance and major disorders
5. Students explore major historical milestones in the genetic engineering process
6. Students engage in argument from evidence to write a CER related to a solution in genetic engineering to help improve quality of life

Unit 6: Ethics and Considerations

Ethics and Considerations

- Students explore the concept of Uncanny Valley and discuss the role and implications of artificial intelligence and its boundaries
- Students explore how artificial intelligence based on its design can privilege dominant cultures over minority cultures
- Students problem solve solutions to address the inherent bias in many artificial intelligence machines
- Students explore political and economic impacts of the medical field, specifically in relation with historical laws and the organization of health insurance (HS-LS4-5), (HS-LS4-6)

Chino Valley Unified School District
High School Course Description

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
• Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Constructing explanations and Designing Solutions • Obtaining, Evaluating and Communicating Information	**LS4.D: Biodiversity and Humans** • Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning, and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (HS-LS4-6) *(Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.)* **ETS1.B: Developing Possible Solutions** • When evaluating solutions, it is important to consider a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary to HS-LS4-6)* • Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. *(secondary to HS-LS4-6)*	• Patterns • Cause & Effect --- **Connections to Nature of Science** Scientific Knowledge Assumes an Order and Consistency in Natural Systems • Scientific knowledge assumes that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-LS4-1), (HS-LS4-4)

Common Core State Standards Connections

ELA/Literacy:

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account (HS-LS3-1), (HS-LS3-2)

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible (HS-LS3-2)

WHST.9-12.1 Write arguments focused on discipline specific content (HS-LS3-2)

SL.11-12.5 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

Mathematics:

MP.2 Reason abstractly and quantitatively

Key Assignments
1. Students write a CER regarding the role and implications of artificial intelligence and its boundaries 2. Students solve solutions to address inherent bias in many AI machines and present their solutions 3. Students engage in a philosophical debate on medical care and availability from multiple perspectives 4. Students make an argument for the boundaries/limits covered by insurance (“where does treatment stop?” -- survivability vs thriving)