SANTA ROSA CITY SCHOOLS
Excellence is our Common Ground

# Santa Rosa City Schools Course Proposal: Life Science in Agriculture

Proposal Submitted By: Teaching and Learning

Needs Statement: Discuss how this course fits into your Site and/or the District's goals. Attach minutes of meetings where this course was approved at site or district leadership meetings.

This is a course revision and title change to the Sustainable Biology/Ag Biology courses currently offered at Elsie Allen and Santa Rosa High School. The course is being revised to align with the Next Generation Science Standards (NGSS).

Graduation Requirements: Specify which requirement is met.(High School only)

This course will meet the d-level Life Science requirement for graduation.

UC a-g Requirements: Specify which requirement is met. (High School only)

This course will be submitted to the UC for "d" Lab Science.

Explain the rationale for course addition or modification. How does this fit in with district/site goals. Is this course is replacing a current course, which course is it replacing and why? Will this course require new sections? Be explicit.

This course is being revised to fully align with the Next Generation Science Standards (NGSS). This will allow all students grades 9-12 access to NGSS High School Performance Expectations (PEs) in Life Science. In addition, this revised Life Science course will comprehensively integrate NGSS cross-cutting concepts (CCs) and the NGSS science and engineering practices (SEPs). The NGSS Life Science PEs, CCs, and SEPs are thoughtfully aligned to the Common Core State Standards for Literacy in Science and Technical Subjects and the Common Core State Standards in Mathematics. (Next Generation Science Standards Appendix L and M)

Explain the measurable learning outcomes

In Life Science in Agriculture, students will develop proficient understanding and explain more in-depth phenomena of the four disciplinary core ideas in life sciences - *From Molecules to Organisms: Structures and Processes, Ecosystems: Interactions, Energy and Dynamics, Heredity: Inheritance and*

*Variation of Traits, and Biological Evolution: Unity and Diversity.* Throughout the course, students will also explore current issues and applications of agriscience.

Students will also deepen their understanding and application of NGSS cross-cutting concepts which link the different domains of science throughout their K-12 science education. These include patterns, cause and effect, scale/proportion/quantity, systems and system models, energy and matter, structure and function, and stability and change. These cross-cutting concepts will provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically based view of the world.

Students will continue growing proficiency in their use of the NGSS science and engineering practices which include 1) Asking Questions and Defining Problems, 2) Developing and Using Models, 3) Planning and Carrying Out Investigations, 4) Analyzing and Interpreting Data, 5) Using Mathematics and Computational Thinking, 6) Constructing Explanations and Designing Solutions and 7) Engaging in Argument from Evidence. These practices are behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. Strengthening the science and engineering practices of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life as well as better prepare them for professional level careers in agriculture and natural resources management through classroom laboratory and supervised agricultural experience projects (SAE).

Finally, students will work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the Future Farmers of America (FFA) career technical student organization. Throughout the course, students will be graded on participation in intracurricular FFA activities as well as the development and maintenance of an ongoing Supervised Agricultural Experience (SAE) program discussed above.

## Course Description (To be used in the course catalog)

Life Science in Agriculture is the second course of a three-year Next Generation Science Standards (NGSS) aligned course pathway designed for students with an interest in agriculture. Using agriculture as the learning vehicle, Life Science in Agriculture will build upon and deepen students' K-8 knowledge and skills with NGSS life science disciplinary core ideas, cross-cutting concepts and science and engineering practices. Throughout the course, students will engage in local and regional agriculture applications to better understand life science content. This course meets 'd' lab science credits for UC/CSU entrance.

## Detailed Course Design

(Course design should include the objectives, activities, assessments, and standards to be addressed in this course.)

This course is aligned to the NGSS Life Science Course Content and CTE *M*odel Curriculum Standards for the Agriscience Pathway in the Agriculture and Natural Resources industry sector.

### UNIT 1: STRUCTURE AND FUNCTION

*Unit 1 Overview:* In Unit 1, students will explore the driving question: "How do the structures of organisms enable life's functions?" Students will investigate explanations for the structure and function of cells as the basic units of life, the hierarchical system of organisms (cells, tissues, organs, systems), and the role of specialized cells, tissues, organs and body systems for maintenance and growth. *Life science topics covered in this unit may include:* cell theory, organelles, diffusion, osmosis, homeostasis, mitosis and differentiation, nutrients in food, macromolecules, and body systems.

UNIT 1 NGSS ALIGNMENT:

**HS-LS1-6 :** Construct and revise an explanation based on evidence for how carbon, hydrogen and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

**HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms

***HS-LS1-4**: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms

***HS-LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

* May introduce this topic in this unit and revisit in other units.

### UNIT 2: MATTER AND ENERGY FLOW IN ORGANISMS

*Unit 2 Overview:* Students will explore the driving questions: "How do organisms obtain and use energy they need to live and grow?" Students construct explanations for the role of energy in the cycling of matter in organisms as well to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration and develop models to communicate these explanations. Life science topics covered in this unit include: photosynthesis, cellular respiration, hydrocarbons to macromolecules, the conservation of matter and energy, and begin to explore the carbon cycle. May include circulatory and respiratory systems.

UNIT 2 NGSS ALIGNMENT:

**HS-LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

**HS-LS1-7:** 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 the net transfer of energy.

**HS-LS2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

**UNIT 3: CYCLES OF MATTER AND ENERGY FLOW IN ECOSYSTEMS**

*Unit 3 Overview:* Students will explore the driving question: "How do organisms interact with the living and nonliving environment to obtain matter and energy?" Through inquiry, students can generate mathematical comparisons, conduct investigations, use models, and apply scientific reasoning to link evidence to explanations about interactions and changes within ecosystems. Life science topics covered in this unit include: carbon cycle, energy pyramid, the roles of photosynthesis and cellular respiration in food chains and webs, anthropogenic changes induced by human activity in an ecosystem (i.e. global climate change), and environmental problems and solutions.

UNIT 3 NGSS ALIGNMENT:

**HS-LS2-3.** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

**HS-LS2-4.** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

**HS-LS2-5.** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

**UNIT 4: INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS**

*Unit 4 Overview:* In Unit 4, students will explore the driving question: "How do living and nonliving components in an ecosystem influence one another, creating a system of stability and change?" Students investigate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. Through inquiry, students can generate mathematical comparisons, conduct investigations, use models, and apply scientific reasoning to link evidence to explanations about interactions and changes within ecosystems. Life science topics covered in this unit include: carrying capacity and limiting factors (living and nonliving) in an ecosystem, biodiversity via speciation and extinction, succession, resilience and climax community, and keystone species. Functioning (group behavior), anthropogenic changes induced by human activity in an ecosystem (i.e. global climate change), and environmental problems and solutions. Student activities and labs for this unit may include: predator-prey activity, how biotic and abiotic factors affect living organisms in an ecosystem, and the effects of human activity on an ecosystem (i.e. pollution, climate change).

UNIT 4 NGSS ALIGNMENT:

HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect the carrying capacity of ecosystems at different scales

HS-LS2-2 Use mathematical representation to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems using different scales

HS-LS2-6 Evaluate 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

HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity

HS-LS4-6 Create or revise a simulation to mitigate adverse impacts of human activity on biodiversity

HS-LS2-8 Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce

**UNIT 5: EXPRESSION OF TRAITS**

*UNIT 5 OVERVIEW:* Students will explore the driving questions: "Why is protein synthesis important to the expression of individual characteristics?" Students can explain the structural nature of DNA and the cellular mechanisms for how genes encode proteins, and how proteins determine an organism's traits. They develop conceptual understanding of the role of DNA in the unity and diversity of life on Earth and describe the environmental and genetic causes of gene mutation and changes in gene expression. In addition, ethical issues related to the nature of science can be explored. Life science topics covered in this unit include: The structure and function of DNA, the cellular mechanisms of protein synthesis, causes of mutations and their consequences, and modern DNA technology.

UNIT 5 NGSS ALIGNMENT:

**HS-LSI-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of protein, which carry out the essential functions of life

**HS-LS3-1**: Ask questions to clarify relationships about the role of DNA & chromosomes in coding
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***

***Bolded items are focused on in this unit for LS3-2**

**UNIT 6: INHERITANCE AND VARIATION OF TRAITS**

*Unit 6 Overview:* Students will explore the driving question: "How are the characteristics from one generation transferred to the next generation? How can individuals of the same species and even siblings have different characteristics?" Students demonstrate their understanding of the relationship of DNA and chromosomes in the process of cellular division that pass traits from one generation to the next. They use models to explain the importance of variation within

populations for the survival and evolution of species and can explain the mechanisms of genetic inheritance and predict the result of a variety of chromosomal mutations and recombinations. In addition, ethical issues related to the nature of science can be explored. Life science topics covered in this unit include: The structure and function of DNA, genes and chromosomes, chromosomal mutations and their consequences, meiosis, introductory genetics including dominant and recessive traits, Punnett squares, probability, inheritance patterns.

UNIT 6 NGSS ALIGNMENT:

**HS-LS1-4**: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms

**HS-LS3-1**: Ask questions to clarify relationships about the role of DNA & chromosomes in coding
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

**HS-LS3-3**: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population

**UNIT 7: EVOLUTION AND BIODIVERSITY**

*Unit 7 Overview:* Students will explore the driving question: "How has life changed over time and what evidence supports our understanding of this?" This unit is anchored by an exploration of the genetic and morphological changes that occur in a population over time and the multiple lines of evidence that support the nature of these changes. Examples of the evolution of populations by natural selection are investigated. Students also provide physical and molecular evidence that establishes the evolution of these populations. This evidence can simultaneously show the common ancestry and emerging diversity of all organisms, especially closely related populations.Students will use models, apply statistics, and analyze data. Life science topics include: similarities and differences among individuals, natural selection via competition and differential survival, adaptation, speciation, and extinction.

**UNIT 7 NGSS ALIGNMENT:**

**HS-LS4-1**
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence

**HS-LS2-8** Evaluate evidence for the role of group behavior an individual species' chances to survive and reproduce

**HS-LS2-7** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity

**HS-LS4-6** Create or revise a simulation to mitigate adverse impacts of human activity on biodiversity

**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 individual in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

**HS-LS4-3** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

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

**HS-LS4-5** Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

### Daily Assignments:

- Phenomenon observation and inquiry
- Storytelling (Scientist Biographies)/People to Ponder/Research a Scientist
- Collaborative group work
- Citizen science inquiry and data collection
- Claim-evidence-reasoning (CER) writing
- Formal lab report writing (with particular focus on data analysis and evidence-based writing
- Close-reading annotations and leveled questioning for science texts
- Direct instruction
- Reflective/strategic note-taking
- Reflective science notebooks
- NGSS Science and Engineering Practices *( 1) Asking Questions and Defining Problems, 2) Developing and Using Models, 3) Planning and Carrying Out Investigations, 4) Analyzing and Interpreting Data, 5) Using Mathematics and Computational Thinking, 6) Constructing Explanations and Designing Solutions and 7) Engaging in Argument from Evidence.)*

## Key Assignments:

Formative and summative assessment will be used throughout involving:

- Quick writes
- Close reading current events
- Science and engineering lab investigations (authentic science and engineering practices opportunities)
- Whiteboard responses
- Pair-share/group share oral and written responses
- Diagrams/graphs/illustrations
- Reading and notetaking annotations and summaries
- FFA Activities

- Quizzes and other larger assessments
- Computer modeling activities and projects
- Research reports and other projects
- Written lab reports, including writing from evidence and/or design solutions
- Evidence-based writing and explanations
- Presentations
- Supervised Agricultural Experience (SAE) projects

Budget- budget figures must be included even if they are an estimate.

| Projected Costs | Start-up | Ongoing |
|---|---|---|
| Personnel (Not to include classroom instructor unless a new section is needed) | | |
| Instructional Material Supplies per student (textbooks, software, etc.) | These costs covered in textbook adoption for science. Estimated costs for textbooks and remaining Chromebook carts is approximately 1.5 million. | |
| Services (training, equipment maintenance, contracts, etc.) | | |
| Capital Outlay (remodeling, technology, etc.) | | |
| **Total Projected Costs** | | |

Instructional Materials- must include estimate for new materials even if none have been selected. Place in chart above. **Instructional materials in pilot process.**

| Type | Publisher | Title | ISBN | Author | Copyright | # Have/Need |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Funding Source(s) for Costs and Instructional Materials

| | |
|---|---|
| Grants (indicate specific grant and grant timeline) | |
| Categorical Funds (include related programs) | |
| Career Technical Education (must be for an approved CTE course) | |
| Department Funds | |
| Other (be specific) | |

## Appendix of Additional Documents

** Required additional documents include meeting minutes where the course was discussed and approved*

**NGSS HS Pathway Collaboration Team**
November 29, 2017
3:45 – 5:00
C & I Conference room

| **Alignment to the District's Local Control Accountability Plan (LCAP)** | |
|---|---|
| **condary LCAP Goal #1:** | *Provide a coherent, rigorous and relevant teaching and learning program to graduate college and career ready students.* |
| **AP Action/Services:** | • Create and implement Next Generation Science Standards based curriculum for all students that include assessments, an online repository for the curriculum and resources<br>• Develop and implement a three-year high school a - g program that meets NGSS standards for all SRCS students |

Norms:

**Members:** Doug Benenson (MHS) Kyla Bradylong (MCHS) Debbi Crapeau ( ) Elaine Dolcini (SRHS) Doug Gibson (EAHS) Linda Kastanis (HSMS) Mark Mantoani (PHS ) Gale Ligotti (MCHS) Connie Rice (SRHS) Katheryne Stoural (HCMS), Kelly Makura (EAHS) Steven Williams (TOSA)

| Topic | Who | Outcome<br>Notes/Agreements/Ownership: |
|---|---|---|
| Welcome<br>• Shared NGSS folder<br>• Review of MHS new course and book | Rani | Doug discussed the course being proposed (IB Environmental Systems) and the rationale for the course. He also shared the textbook for recommendation. All signed off. |

| | | |
|---|---|---|
| What are the agreements we have (or not) regarding<br>• years of science<br>  ○ SRCS will develop and implement a **3-year science program** that meets all NGSS standards for all SRCS students. (Implementation beginning with 2019-2020 9th graders)<br>• timeline<br>• models<br>  ○ We will develop and offer two pathways (six courses):<br>**Model/Pathway One:**<br>• **9th:** The Living Earth<br>• **10th:** Chemistry in the Earth<br>• **11th:** Physics in the Universe<br>**Model/Pathway Two:**<br>• **9th:** Earth Science<br>• **10th:** Biology<br>• **11th:** Physical Science<br>• others | All | After incredibly rich conversation the following was agreed upon:<br>SRCS will develop two foundational sequences on which other pathways can be built to support a **3-year science program** that meets all NGSS standards for all SRCS students. (Implementation beginning with 2019-2020 9th graders)<br>We agreed that the two foundational sequences are the two models to the right and that we will collaboratively create blueprints of these first. These then become the bones to base other courses on. For example: Gale would compare her standards in zoology to the foundational sequences. She would determine what PEs and other NGSS standards she meets. She would then know what to add or not so that students who took her course were meeting the NGSS standards from one of the foundational sequence courses. This allows the department to make a sequence that includes zoology so that students can be exposed to all NGSS standards. |
| What are our next steps:<br>• timeline<br>• communication with administrators, counselors, colleagues, and community<br>• other | All | It was decided that a small group of teachers representing the NGSS team would go to each HS to meet with counselors and site admin to discuss the work of the science teaches and timeline for implementation. Rani will be a part of this group too.<br>• Who will these 2 - 4 teacher be? Please email me. You will be out of classroom for a day probably<br>**Talking points will be a collaborative effort of all by using our team drive to make a ppt**<br>Timeline:<br>2019: 9th grade NGSS or course 1<br>2020: 10th grade NGSS or course 2<br>2021: 11th grade NGSS or course 3 |

| | | |
|---|---|---|
| | | |
| Full Day of PD for all science teachers | | We have three days for science teacher PD in second semester (2 provided by district and 1 written into C&I budget). We need to develop a coherent scope of PD that builds on each day. **The work will also be started in our team drive.** |

**Meeting Schedule:**

| Meeting Schedule | | |
|---|---|---|
| Jan. 23 3:45 - 5:00 | NGSS Pathway Team | C & I conf. room |
| Feb. 27 3:45 - 5 | 6 - 12 DC | C& I conf. room |
| | | |

District Principal Review and Approvals:

| Principal's Signatures | Site | Approved / Not Approved |
|---|---|---|
| | PHS | approved |
| | RHS | approved |
| | SRHS | Approved |
| | MHS | APPROVED |
| | EAHS | APPROVED |
| | MCHS | Approved |

District Department Chair Review and Approvals:

| Department Chair Signatures | Site | Approved / Not Approved |
|---|---|---|
| | MCHS | Approve |
| | SRHS | approve |
| | PHS | APPROVED |
| Doug Benenson | MHS | Approved |
| | RHS | Approved |
| Kelly M. Madsen | EAHS | Approved |