SANTA ROSA CITY SCHOOLS
Excellence is our Common Ground

Santa Rosa City Schools Course Proposal

Proposal Submitted By (School):

Teaching and Learning

Course Title & Course ID (Only if it is a revision or title change to a current course):

Advanced Placement Environmental Science

In the needs statement below indicate if the course is a:	Answer Below:
Addition, Revision, Deletion, Pilot, or Title Change? (Pick one)	Addition
What year will the course be initially offered?	2020-2021
What prerequisite, if any, are there for this course and how does the course fit into continuous improvement at your school site?	No prerequisite. Course offered at 11th and 12th grades for students choosing a laboratory science class. Students will have a greater range of options to enable progress through our graduate profile.

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.

MCHS is expanding students' access to AP courses and expanding the menu of courses we offer, giving students choices of which laboratory science course best fits their needs, interests, and future plans. The course was approved at the 11-6-19 Advisory Committee Meeting.

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

Science

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

D-Science

Explain the rationale for course addition or modification

Students planning to go into the sciences will have access to science that connects to environmental concerns regarding the natural world and humanity's role in it.

Explain the measurable learning outcomes

AP ENVIRONMENTAL SCIENCE - Science Practices as outlined in College Board Course/Exam Description

Concept Explanation - Explain environmental concepts, processes, and models presented in written format.
1.A Describe environmental concepts and processes.
1.B Explain environmental concepts and processes.

Visual Representations - Analyze visual representations of environmental concepts and processes.
2.A Describe characteristics of an environmental concept, process, or model represented visually.
2.B Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: In theoretical contexts - In applied contexts
2.C Explain how environmental concepts and processes represented visually relate to broader environmental issues.

Text Analysis - Analyze sources of information about environmental issues
3.A Identify the author's claim.
3.B Describe the author's perspective and assumptions.
3.C Describe the author's reasoning (use of evidence to support a claim).
3.D Evaluate the credibility of a source (not assessed): Recognize bias - Scientific accuracy
3.E Evaluate the validity of conclusions of a source or research study (not assessed).

Scientific Experiments - Analyze research studies that test environmental principles
4.A Identify a testable hypothesis or scientific question for an investigation.
4.B Identify a research method, design, and/or measure used.
4.C Describe an aspect of a research method, design, and/or measure used.
4.D Make observations or collect data from laboratory setups (not assessed).
4.E Explain modifications to an experimental procedure that will alter results.

Data Analysis - Analyze and interpret quantitative data represented in tables, charts, and graphs
5.A Describe patterns or trends in data.

5.B Describe relationships among variables in data represented.
5.C Explain patterns and trends in data to draw conclusions.
5.D Interpret experimental data and results in relation to a given hypothesis.
5.E Explain what the data implies or illustrates about environmental issues.

Mathematical Routines - Apply quantitative methods to address environmental concepts
6.A Determine an approach or method aligned with the problem to be solved.
6.B Apply appropriate mathematical relationships to solve a problem, with work shown (e.g., dimensional analysis).
6.C Calculate an accurate numeric answer with appropriate units.

Environmental Solutions - Propose and justify solutions to environmental problems
7.A Describe environmental problems.
7.B Describe potential responses or approaches to environmental problems.
7.C Describe disadvantages, advantages, or unintended consequences for potential solutions.
7.D Use data and evidence to support a potential solution.
7.E Make a claim that proposes a solution to an environmental problem in an applied context.
7.F Justify a proposed solution, by explaining potential advantages.

Course Description (To be used in the course catalog)

AP Environmental is a one-year course. Unlike most other college-introductory courses, environmental science is offered from a wide variety of sciences including geology, biology, environmental studies, environmental science, chemistry, and geography. The AP Environmental course has been developed to be a rigorous, science course that stresses scientific principles and analysis. The course provides students with the scientific principles required to understand the interrelationships of the natural world and draws upon various scientific disciplines. In both breadth and level of detail, the content of the course reflects what is found in many college introductory courses.

The goal of this course is to provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, to examine alternative solutions for resolving and/or preventing them, and to develop and focus their own political perspective.

Detailed Course Design

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

Unit 1: Ecosystems

The first unit sets the foundation for the course by examining the Earth as a system with

interdependent components, processes, and relationships. Students will examine the distribution of resources in ecosystems and its influences on species interactions. There is a global distribution of terrestrial and aquatic biomes—regional ecosystems—that each have specific environmental features based on their shared climate. This distribution is dynamic, and it has changed due to global climate change. Each ecosystem relies on biogeochemical cycles for survival. These cycles facilitate the acquisition and transfer of energy into usable forms, and they can be altered by human activities. In subsequent units, students will apply their understanding of ecosystems to the living world and examine the importance of biodiversity.

Students will be able to...

- describe environmental processes and relationships with visual representations and models, particularly those of biogeochemical cycles, food chains, food webs, and trophic diagrams.
- use visual representations to describe the individual steps of the hydrologic, carbon, nitrogen, and phosphorus cycles and then explain how each chemical is either stored or transferred throughout its cycle.
- predict the effects of a change in one or more parts of a given cycle, including impacts to humans and the ecosystem at large.
- develop a foundational understanding of biomes and describe how relationships between organisms are affected by environmental conditions.
- develop the quantitative skills to calculate the decrease of energy as it passes through ecosystems and then explain the transfer of energy through ecosystems.
- apply environmental concepts and processes in real-world situations.
- identify and describe the biogeochemical cycles and then predict the effects of a change within a cycle.
- write step-by-step descriptions of the cycles, including characteristics and attributes.

Sample LAB: Aquarium Nitrogen Cycle
This lab gives students a hands-on approach to the nitrogen cycle. The students observe the daily changes in different nitrogen compounds in an aquarium that has been newly setup. When an aquarium is initially set up, the levels of three nitrogen compounds (ammonia, nitrite and nitrate) fluctuate as nitrification occurs as part of the nitrogen cycle. These levels will eventually stabilize as bacteria become established in the aquarium.
In this lab, students will...

- observe and record daily changes in the amounts of three nitrogen compounds as they relate to the nitrogen cycle in a newly setup aquarium.
- observe and record daily changes in the pH of a newly setup aquarium.
- understand how bacteria can clean the water by consuming and converting toxic compounds into less toxic forms

Unit 2: Biodiversity

Biodiversity, which includes genetic, species, and habitat diversity, is critically important to ecosystems. Biodiversity in ecosystems is a key component to sustaining life within the living world. Natural and human disruptions have short- and long-term impacts on ecosystems. Ecological succession can occur in terrestrial and aquatic ecosystems in both developed and developing areas. Organisms within ecosystems must adapt to the changes created by these disruptions. In subsequent units, students will examine in greater detail how populations change over time.

Students will be able to...

- understand that tables and graphs are important tools of communication used to identify patterns and trends that indicate environmental problems.
- describe the characteristics of data in tables or graphs and identify patterns or trends.
- describe and explain the environmental concepts and processes of biodiversity.
- understand the differences between similar concepts and clearly articulate those differences in their written and verbal explanations (ie: differences among species, genetic, and habitat diversity; between keystone and indicator species; and between ecosystem services and ecological services).
- explain environmental science concepts that are represented using tables, charts, and graphs.
- explain patterns and trends related to data.
- give several examples of ecosystems and ecological services.
- explain environmental concepts in context, rather than memorizing textbook definitions without a full understanding of the context.
- indicate the direction of change to a species as a result of disruptions to the ecosystem based on data.
- describe whether or not a species can adapt to an environmental change.

Sample LAB: Using Detritus to Determine Arthropod Biodiversity in Relation to Ecosystem Type

By studying the biodiversity of arthropods located on the school campus, students will be able to recognize the relationship between organism type and number to specific habitat.

In this lab, students will be able to...

- Employ a proper field collection technique, use appropriate sampling methods, and utilize
- field guides effectively.
- Use measurement devices for evaluating climatic conditions.
- Preserve organisms and use proper microscopic technique for observation.
- Use quantitative methods for measuring arthropod populations and calculate biodiversity
- using an accepted statistical formula.
- Compile data and present findings, with interpretations, in a formal lab report,research paper, and/or electronic presentation.

Unit 3: Populations

Populations within ecosystems change over time in response to a variety of factors. This unit examines the relationship between the type of species and the changes in a habitat over time. Specialist species are advantaged by habitats that remain constant, while generalist species tend to be advantaged by habitats that are changing. Different reproductive patterns, including those exhibited by K- and r-selected species, also impact changes to population. Population growth is limited by environmental factors, especially by the availability of resources and space. In subsequent units, students will explore how increases in populations affect earth systems and resources, land and water use, and energy resources.

Students will be able to...

- interpret experimental data in order to explain environmental changes that occur over time by comparing trends and patterns.

- predict patterns and trends based on information provided in graphs and tables.
- analyze population growth, age structure diagrams, and survivorship curves
- show their work, including the numbered steps they used to obtain an answer, with appropriate units.
- calculate population growth and the apply of the rule of 70.
- practice selecting the appropriate calculation that is required in the analysis of a data set.
- explain trends in population data for organisms.
- explain population density and population growth.
- interpret population growth curves.
- connect data represented by tables, charts, and graphs to real-life examples of population changes.

Sample LAB: Duckweed Population Study
Students can witness a population explosion right before their eyes as they nurture and experiment with living duckweed plants. Students start with a small number of plants and watch them reproduce vegetatively into a large matted colony, too numerous to count. Students can design their own experiments to determine factors that can affect the rate of the population explosion.
In this lab, students will be able to...

- Care for duckweed fronds over a 10-12 week period
- Observe population growth of a species overtime
- Quantify carrying capacity for a growing population
- Graph and interpret population data

Unit 4: Earth Systems and Resources

This unit explores earth systems and its resources that support life. Geological changes that occur to earth systems at convergent and divergent boundaries can result in the creation of mountains, island arcs, earthquakes, volcanoes, and seafloor spreading. Soils are a resource, formed when parent material is weathered, transported, and deposited. The atmosphere is another resource, composed of certain percentages of major gases. Climate is influenced by the sun's energy, Earth's geography, and the movement of air and water. In subsequent units, students will examine how humans use natural resources and the impact on the environment.

Students will be able to...

- analyze and interpret qualitative models and representations of environmental issues.
- describe global maps and maps of plate boundaries to explaining the global changes that occur at plate boundaries.
- develop an understanding of the relationship between the geography of the earth and climate (ie: by describing the impact of El Niño on marine food chains, and other specific examples).
- identify and describe environmental processes displayed visually.
- practice explaining the meaning of a diagram or infographic, ultimately building to the ability to explain the consequences of a change in an environmental process (i.e., "What would happen if ...") in later units.
- explain representations of convergent, divergent, and transform boundaries present on a global map.
- examine global maps to identify the distribution of global plate boundaries.
- practice analyzing characteristics of soil.
- identify how climate factors influence the rate of soil formation and be able to

indicate if that factor speeds up or slows down the rate of formation.
- connect visual representations with explanations of the Earth's atmosphere/ geography, climate, global wind patterns, solar radiation, and the Earth's seasons

Sample LAB: Physical & Chemical Properties of Soil
Healthy soil provides structure and nutrients for plant growth and is a vital component of the hydrologic (water) cycle. Explore how the physical and chemical properties of soil impact soil quality with this two-part investigation.
In this lab, students will be able to...
- determine soil texture—the relative amounts of sand, silt and clay—by measuring the amount of each that settles out of a soil "solution" after definite time intervals.
- analyze the chemical properties of soil by measuring the pH and testing for the presence of essential macronutrients, nitrate and phosphate ions.
- understand why soil is an essential natural resource

Unit 5: Land and Water Use

This unit explores human activities that disrupt ecosystems both positively and negatively and the methods employed to reduce impact. It examines human use of natural resources through many means, including mining and clearcutting, and the impacts on the environment. Agricultural practices in particular can cause environmental disruption. For example, one of the largest uses of freshwater is for irrigation. Every irrigation method employed for agriculture has its own benefits and drawbacks. In subsequent units, students will examine different types of energy resources, the consumption of these resources, and the impact on the environment.

Students will be able to...
- identify environmental problems (e.g., pollution, depletion of the ozone layer, global climate change).
- think critically about the problem, and when evaluating a given solution, articulating its benefits and drawbacks.
- describe and propose viable solutions for environmental problems is critical for this unit.
- describing the development process for legislation enacted to mitigate environmental problems and the effects of the legislation on the various stakeholders.
- evaluate a proposed solution to an environmental problem and/ or the legislation that addresses it and then describe benefits and drawbacks to the solution.
- describe and explain concepts related to the tragedy of the commons, clearcutting, agricultural practices, and mining.
- practice proposing solutions to environmental problems and describing the benefits or disadvantages of those solutions.
- analyze text-based resources about environmental issues and the impact of human activities on the environment by providing explanations that both describe the data and connect the data to an environmental issue.

Sample LAB: Exploring Groundwater Activity-Stations
Students will explore important concepts related to groundwater by completing three "mini-lab" activities, each focusing on a specific groundwater-related principle.
In this lab, students will be able to...
- students perform a measurement lab activity to determine and calculate the percent porosity and permeability of different soil samples.
- create and test a groundwater simulation model. Model features include confined aquifers, wells and both point and nonpoint pollution sources.

- observe the potential of using metallic iron to clean up contaminated groundwater via an oxidation-reduction reaction.

Unit 6: Energy Resources and Consumption

This unit examines human use of renewable and nonrenewable sources of energy and its impact on the environment. Energy consumption differs throughout the world and the availability of natural energy resources depends on the region's geologic history. Subsequent units will examine the impact of human activity on the atmosphere, land, and water.

Students will be able to...

- identify where natural energy resources occur (e.g., coal, crude oil, ores) on a global map.
- describe other forms of energy and differentiating between nonrenewable and renewable forms of energy.
- identify the claims as well as describing the perspectives and assumptions of the author in a text.
- explain concepts related to renewable and nonrenewable energy sources.
- compare and contrast different sources of fuel and how they are used, with an emphasis on the impacts of usage on the environment.
- apply appropriate mathematical relationships to determine the amount of energy produced or used based on the given information.
- manipulate formulae and use the data provided to solve a problem, especially problems that use dimensional analysis and multiple steps.
- explain environmental problems related to the use of different energy resources and propose solutions.
- propose realistic solutions to environmental problems related to the use of different energy sources.

Sample LAB: Wind Energy

Students will study the principles behind using wind energy to produce mechanical power. They will determine the power generated by self-constructed windmills to relate to power and efficiency.

In this lab, students will be able to...

- construct a windmill with two interchangeable fans of three and four blades, respectively.
- measure the time required for the torque of the windmill shaft to lift a weight a given distance.
- determine the power produced from the two different blade designs and calculate which is more efficient.

Unit 7: Atmospheric Pollution

LAB: Greenhouse Effect and Global Warming Student Laboratory Kit

Unit 8: Aquatic and Terrestrial Pollution

LAB: Environmental Pollution—Air and Water Pollution Test kit

Unit 9: Global Change

LAB: Thermal Expansion of Water

LAB: Greenhouse Effect and Global Warming Student Laboratory Kit

Budget

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.)	Start Up Materials per section: Flinn 14-kit bundle: $739 Flinn Duckweed: $13 Carolina N-cycle Lab: $264.50 Flinn Dissolved Oxygen Kit: $56.55 Flinn Water Pollution Test Kit: $446.90 Per Student Costs: Textbook: $120 - $150 per book (Can buy used on Amazon for ~$50	TBD - refills of consumables for kits will be needed year after year.
Services (training, equipment maintenance, contracts, etc.)		
Capital Outlay (remodeling, technology, etc.)		
Total Projected Costs	~$3,000	~$100-$200

Instructional Materials

Type	Publisher	Title	ISBN	Author	Copyright	# Have/Need
Textbook	Ingram; HARDCOVER edition (January 6, 2014)	Living in the Environment (AP Edition) 18th Edition	ISBN-13: 978-1-285-19728-9 ISBN-10: 1-285-19728-3	G. Tyler Miller & Scott E. Spoolman	2014	Have 0/ Need 1 per student

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)	AP Test sales & Parent Association

Appendix of Additional Documents

** Required additional documents include meeting minutes where the course was discussed and approved*
AC Minutes November 6, 2019

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
	SRHS	Approved
	PHS	APPROVED
Doug Benenson	MHS	Approved
	RHS	Approved
Kelly M. Mack	EAHS	Approved
	MCHS	Approved