



Santa Rosa City Schools Course Proposal

Robotics 1

Proposal Submitted By: Stephanie Thomas, Margie BradyLong and Amy Wiese

- 1) 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.

CTE Robotics 1 directly supports the SRCS Vision and Mission by providing an equitable, hands-on STEM learning environment where students develop purpose, critical thinking, collaboration, inclusivity, adaptability, and creativity. Through engineering design, programming, problem-solving, and teamwork, students' individual strengths and cultural assets are celebrated, preparing them to contribute meaningfully to a diverse, rapidly changing world.

This course was discussed and approved at a site leadership meeting on December 3, 2025.

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

A–G Elective (pending UC approval) and CTE

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

College-Preparatory Elective (G) - pending UC approval

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

This course would be a brand new course to the district. It would not replace any other courses. This would be the first of two courses in the CTE Robotics CTE program, under the Engineering and Architecture CTE Industry Sector. This addition aligns with district and site goals of expanding high-quality Career Technical Education (CTE) Programs that prepare students for both college and careers. MCHS

already has an active after-school Robotics Club. By developing a Robotics CTE Program, MCHS will provide access to high-demand career fields while enriching students' academic and technical opportunities.

5) Explain the measurable learning outcomes

Key Student Projects & Assessments

- Engineering notebook portfolio documenting design iterations and test data
- CAD assembly of a robot using OnShape
- Mechanical power transmission and torque design lab
- Electrical wiring, circuit building, and programming lab
- Sensor-based autonomous programming challenge
- Final integrated robotics competition project and presentation

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

Robotics 1 is an introductory engineering and technology course that develops students' foundational skills in mechanical systems, electronics, programming, and computer-aided design. Using VEX IQ and VEX EDR V5 robotics systems, Robot Mesh Studio/VEX Coding Studio, and OnShape CAD, students engage in hands-on, project-based learning that mirrors real-world engineering workflows.

The course emphasizes the engineering design process, problem-solving, iterative prototyping, systems integration, and technical communication. Through collaborative projects, robotics challenges, and competitive tasks, students build practical skills in mechanical design, electrical systems, programming, and automation while developing critical thinking, teamwork, and project management skills. Robotics 1 prepares students for advanced courses and careers in engineering, robotics, and manufacturing.

7) Detailed Course Design

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

Course Overview

Robotics 1 is a full-year, introductory engineering and robotics course that integrates physics, mathematics, mechanical engineering, electrical engineering, and computer science. Students learn to design, build, program, and test robots using VEX IQ and VEX EDR V5 robotic systems, Robot Mesh Studio (Blockly, Python, C++), and OnShape CAD software. Through hands-on engineering challenges, students develop skills in problem-solving, mechanical design, circuit construction,

programming logic, and systems integration.

Students complete engineering notebooks, written assessments, CAD modeling projects, multi-day programming assignments, and competitive robotics challenges. The course meets UC “G” criteria by engaging students in interdisciplinary, college-preparatory scientific reasoning, engineering literacy, and analytical thinking. It meets CTE standards through industry-aligned design, fabrication, testing, and documentation practices.

Course Goals and Learning Objectives

Students will:

- Apply the **engineering design process** to define problems, develop solutions, prototype, test, and iterate.
- Demonstrate foundational understanding of **energy, work, power, torque, electricity, and motion**.
- Build mechanical and electrical systems using **gears, levers, pulleys, linkages, motors, circuits, and sensors**.
- Develop proficiency in **CAD modeling** with OnShape and maintain professional **engineering notebooks**.
- Write and debug programs in **Blockly, Python, or C++** for both teleoperated and autonomous robot control.
- Explain and implement **feedback systems**, including sensors and closed-loop control.
- Integrate mechanical, electrical, and computational systems to create functional robots.
- Communicate technical reasoning through written reports, diagrams, presentations, and digital portfolios.

CTE Anchor Standards Addressed:

- **A1.0 Academics:** Apply math, physics, and engineering principles to solve complex technical problems.
- **A2.0 Communication:** Maintain professional engineering documentation and present design findings.
- **A4.0 Technology:** Safely use robotics hardware, CAD, and programming platforms.
- **A5.0 Problem Solving:** Troubleshoot mechanical, electrical, and programming systems.
- **A6.0 Health & Safety:** Follow engineering lab safety and tool-use protocols.
- **A7.0 Responsibility & Flexibility:** Collaborate effectively on team-based projects.
- **A11.0 Demonstration & Application:** Produce functional robotic systems demonstrating integrated engineering solutions.

CTE Engineering and Technology Pathway Standards:

- Apply the full engineering design cycle from conceptual sketches to CAD modeling and prototype testing.
 - Use measurement tools, hand tools, and digital design platforms safely and effectively.
 - Analyze mechanical systems for torque, speed, load, and efficiency.
 - Build, wire, and troubleshoot electrical systems and microcontroller-based robotics.
 - Program autonomous and driver-controlled robotic systems integrating sensors and actuators.
 - Integrate mechanical, electrical, and software systems to create fully functional robots.
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Course Outline: Unit-by-Unit

Unit 1: Energetics and Simple Mechanics

Students explore core physical science concepts—including energy, work, force, electricity, and motion—and apply them to basic robotic systems. Through activities with VEX IQ kits, students build simple circuits and construct two introductory robots that complete movement and control challenges. Topics include simple machines, gears and torque, structural strength, electrical basics, and circuit design. Quizzes, hands-on labs, and written assignments reinforce conceptual understanding.

Major Topics:

- Energy, work, force, motion
- Simple machines (inclined planes, levers, pulleys, gears, torque)
- Structural strength and load distribution
- Electricity fundamentals: electrons, fields, batteries, generators
- Circuit assembly, resistors

Laboratory Activities:

- Build two VEX IQ robots
- Create and test electrical circuits
- Movement and mechanics challenges

Assessments:

- Problem sets on energy & mechanics

- Quizzes on electricity and simple machines
- Engineering notebook documentation

Unit 2: Engineering and Design

This unit introduces the engineering design process, documentation practices, and collaborative engineering workflows. Students use OnShape to create CAD models and engineering notebooks to record their design rationale. They work with the VEX EDR system to build a Clawbot, learn fundamentals of motor control and wiring, and program their robots using VEX V5 tools. Key topics include mechanical design, open- and closed-loop control, sequencing, programming logic, and system configuration.

Major Topics:

- Engineering Design Process
- Team roles and design documentation
- VEX design system fundamentals
- Building the VEX Clawbot
- Wiring and configuration (V5 system)
- Control theory (open-loop, closed-loop, feedback, hysteresis)
- Basic programming concepts
- CAD modeling using OnShape

Laboratory Activities:

- Build and document the VEX Clawbot
- CAD modeling activities and Clawbot design in OnShape

Assessments:

- Multi-day programming assignments
- Notebook evaluations
- Midterm design presentation
- Written quizzes from online VEX curriculum

Unit 3: Robot Mechanics

Students investigate more advanced mechanical systems, focusing on the transfer of power through gears, chains, belts, and motors. Concepts such as torque, speed, mechanical advantage, and power transmission are explored in depth. Students apply engineering principles to design manipulators, arms, and mechanisms capable of performing game or competition tasks. Labs emphasize object manipulation, mechanical modeling, and applying gear ratios to real engineering challenges.

Major Topics:

- Joint mechanics (rotation, bending, sliding)

- Power transmission: gears, belts, chains, couplers
- Speed, power, torque, and DC motor characteristics
- Gear ratio calculations and simulations
- Mechanisms: manipulators, accumulators, arms, scoops
- Strategy and optimization for robotics games

Laboratory Activities:

- Build and test manipulators and power transmission systems
- Modeling articulating components
- Semester 1 mechanical design project

Assessments:

- Quizzes on mechanics and power transmission
- Object manipulator design project
- Engineering notebook entries
- Semester 1 Final Project

Unit 4: Programming and Circuits

Building on earlier electrical topics, students study capacitance, induction, magnetism, semiconductor behavior, and integrated circuits. They connect these concepts to programmable robotics systems, learning how electronics interface with code. Students practice programming in Blockly, Python, and/or C++, ultimately writing and implementing functional robot programs. Projects include building simple electronic devices (e.g., speakers), wiring VEX V5 robots, and designing custom control algorithms.

Major Topics:

- Capacitance, AC/DC, diodes, capacitors
- Electromagnets, induction, inductors
- Semiconductor physics, integrated circuits, switches
- Introduction to robotics programming (Blockly/Python/C++)
- Applying code to control circuits and motors

Laboratory Activities:

- Build a speaker using induction principles
- Program VEX V5 robot
- Develop autonomous sequences

Assessments:

- Multi-day programming project
- Quizzes on electronics and programming
- Engineering notebook documentation

Unit 5: Control and Intelligent Behavior

In the final portion of the course, students explore advanced robot autonomy, decision-making, and integrated system behavior. Topics include telerobotics, communication systems, programming languages, systems integration, behavioral control architectures, pattern recognition, mapping, and introductory machine learning concepts for robotics. Students complete and refine their competition robot and participate in a final robot challenge or tournament. The course culminates with a written final exam and a digital design presentation of their engineering work.

Major Topics:

- Communication systems (telerobotics, semi-autonomous)
- Comparison of programming languages for robotics
- Systems integration of mechanical/electrical/software subsystems
- Intelligent behavior: reflexive, layered, serial, pattern recognition
- Advanced control: mapping, decision-making, learning algorithms
- Parametric CAD modeling

Laboratory Activities:

- Build the competition robot
- Program autonomous navigation
- Design custom CAD parts (battery clip, wheel, etc.)
- Final robotics challenge/competition

Assessments:

- Final robot competition
- Final exam
- Digital portfolio & presentation
- Engineering notebook evaluation

Instructional Methods and Strategies

- Project-Based Learning (PBL)
- Direct instruction for foundational physics, programming, and electronics
- Hands-on robot construction and circuit labs
- Collaborative engineering team structures
- CAD instruction with iterative design feedback
- Coding workshops and debugging sessions
- Mechanical and electrical prototyping
- Robotics competitions and performance-based challenges

Assessment Methods and Tools

- Engineering notebook (weekly scoring rubric)

- Written exams and quizzes on physics, mechanics, circuits, and programming
- Lab reports and design justifications
- Multi-class programming assignments
- CAD modeling analysis and part creation
- Midterm design presentation
- Final project & robot challenge
- Comprehensive written final exam
- Digital presentation/portfolio

8. Is this course modeled after an approved A-G Course on the UC Portal?

Yes : District and course: CTE Robotics 1, Templeton High School

No

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

Projected Costs	Start-up	Ongoing
Personnel (Requires a teacher and volunteer mentors)	CTE Credentialed Teacher	CTE Credentialed Teacher
Instructional Material Supplies per student (textbooks, software, etc.)	VEX V5 Classroom Starter Bundle And various robotics build supplies \$5000	\$5000
Services (training, equipment maintenance, contracts, etc.)	First Robotics Membership \$6000	\$6000
Capital Outlay (remodeling, technology, etc.)		
Total Projected Costs	\$11,000	\$11,000

9) Instructional Materials- must include estimates for new materials even if none have been selected. Place in the chart above.

Type	Publisher	Title	ISBN	Author	Copyright	# Have/Need

10) Funding Source(s) for Costs and Instructional Materials


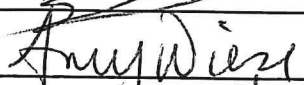


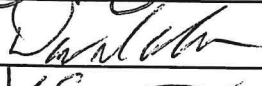

Grants (indicate specific grant and grant timeline)	
Categorical Funds (include related programs)	
Career Technical Education (must be for an approved CTE course)	Perkins, CTE Incentive Grant. Annual
Department Funds	
Other (be specific)	

11) Appendix of Additional Documents

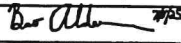
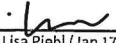
<i>* Required additional documents include meeting minutes where the course was discussed and approved</i>
https://drive.google.com/file/d/1VLm1pnYHh08BWnoui_BnSkMlhymzQFqo/view?usp=sharing

Course Name: Robotics 1

12) District Principal Review and Approvals:

Principal's Signatures	Site	Approved / Not Approved
 1/20/26	EAHS	Approved
 1/20/26	MCHS	Approved
 1/20/26	MHS	Approved
 1/21/26	PHS	Approved
 1/20/26	RHS	Approved
 1/20/26	SRHS	Approved

13) District Department Chair Review and Approvals:

Department Chair Signatures	Site	Approved / Not Approved
<u>Zachary Davis</u> <small>Zachary Davis (Jan 18, 2026 14:51:42 PST)</small>	EAHS	Approved
<u>Stephanie Thomas</u> <small>Stephanie Thomas (Jan 18, 2026 10:53:59 PST)</small>	MCHS	Approved
 <small>Bao Alderson (Jan 16, 2026 12:21:48 PST)</small>	MHS	Approved
<u>Mairreen McCabe</u> <small>Mairreen McCabe (Jan 21, 2026 10:39:55 PST)</small>	PHS	Approved
<u>Colleen Spiers</u> <small>Colleen Spiers (Jan 20, 2026 12:07:34 PST)</small>	RHS	Approved
 <small>Lisa Piehl (Jan 17, 2026 12:26:48 PST)</small>	SRHS	Approved

Course Catalog Information (To be filled by the District Office):

Course Number	TBD
Course Short Title:	Robotics 1
Course Title:	Robotics 1
Number of Credits:	10
Grade Span:	9-12
Graduation Requirement:	Z
Prerequisites:	None
Course Department:	CTE
State Course Code:	7720
A-G Subject:	"G"
CTE Pathway:	Engineering and Architecture - Engineering Technology Pathway
Other Information:	N/A