CAREER & TECHNICAL EDUCATION

HIGH SCHOOL INTRODUCTION TO ENGINEERING DESIGN

ACADEMIC & PROFESSIONAL SKILLS STANDARDS

CATALINA FOOTHILLS SCHOOL DISTRICT
Approved by the Governing Board
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STANDARDS FOR ENGINEERING

INTRODUCTION TO ENGINEERING DESIGN

Grades: 9-12

Engineering Design introduces aspects of problem solving, logic and relationships. This course emphasizes problem-solving skills using a design development process. Models of product solutions are created, analyzed and communicated using solid modeling computer design software. Topics explored include various technology systems, manufacturing processes, and how technological advances affect society. Students are introduced to the scope, rigor, and discipline of engineering and encouraged to integrate math and science technologies into engineering problem solving processes.

STEM INQUIRY: DESIGN PROCESS

- ENGR1.1.1 Frames testable questions showing evidence of observations and connections to prior knowledge.
- ENGR1.1.2 Develops a testable question appropriate to the technological domain being investigated.
- ENGR1.1.3 Determines collaborative efforts needed for question.
- ENGR1.1.4 Determines design team benefits and constraints.

STEM INQUIRY: FORMULATING PROPOSED SOLUTIONS

- ENGR1.2.1 Develops a testable hypothesis based upon evidence of scientific/technological/mathematical principles, probability and/or modeling.
- ENGR1.2.2 Clearly distinguishes relationships between variables (for example: cause & effect or correlation) within a testable hypothesis.
- ENGR1.2.3 Describes steps in the design process and explains actions that occur in each phase of problem solution.

STEM INQUIRY: DESIGNING INVESTIGATIONS

- ENGR1.3.1 Specifies the parameters of calculation/measurement.
- ENGR1.3.2 Describes suitable controls for the investigation.
- ENGR1.3.3 Designs procedures that appropriately address the problem.

STEM INQUIRY: PROBLEM DISCOVERY

- ENGR1.4.1 Creates safe and ethical procedures.
- ENGR1.4.2 Uses units of measurement with appropriate degree of accuracy.
- ENGR1.4.3 Creates procedures and applies the steps of the design process that appropriately and adequately address the proposed solution (for example: adequate sample size, multiple trials).
- ENGR1.4.4 Creates a suitable method for recording data (for example: data charts, lab notebooks).

STEM INQUIRY: ANALYSIS

- ENGR1.5.1 Interprets data to describe relationships between variables (for example: positive, negative, no relationship).
- ENGR1.5.2 Incorporates mathematical analysis, where appropriate.
- ENGR1.5.3 Critiques the investigation for possible sources of error.
- ENGR1.5.4 Initializes process for debugging.

STEM INQUIRY: SYNTHESIS

- ENGR1.6.1 Makes evidence-based predictions (for example: extrapolations and interpolations).
- ENGR1.6.2 Evaluates whether the data support the hypothesis/proposed solution.
- ENGR1.6.3 Verifies selection of process for problem-solving.

STEM INQUIRY: COMMUNICATION

- ENGR1.7.1 Uses suitable media to inform an audience about an investigation and its process (for example: presentation aids of engineering designs).

HISTORY OF DESIGN AND THE DESIGN PROCESS

- ENGR1.8.1 Explores the evolution of technology (for example: chronological development and rate of change over time in relation to consumer products and improved functionality) and its impact on the field of engineering.
- ENGR1.8.2 Describes how the history of art and artistic periods and styles have influenced the field of engineering, products, and architectural design (for example: the impact of artistic expression as it relates to consumer products).

CONCEPT MODELING

- ENGR1.9.1 Selects appropriate techniques to portray design solutions (for example: pictorial style, annotated sketches, views, color, form, symbols, shading) for two-dimensional and three dimensional drawings and models.
- ENGR1.9.2 Selects and uses appropriate tools to design and construct shapes in selected coordinate systems (for example: absolute, relative, polar).
- ENGR1.9.3 Applies geometric and dimensional constraints to generate a 3-D model.
- ENGR1.9.4 Generates models using CAD software.

ASSEMBLY MODELING

- ENGR1.10.1 Demonstrates assembly modeling skills to solve design problems (for example: applies base component effectively, creates and places components, applies assembly and drive constraints).
- ENGR1.10.2 Applies adaptive design concepts.
- ENGR1.10.3 Evaluates accuracy of mass properties and tolerance calculations.

- ENGR1.10.4 Demonstrates use of appropriate dimensioning practices and techniques (for example: section, auxiliary, and assembly models; annotate drawings; generate general and proprietary specifications).

PRODUCTION

- ENGR1.11.1 Categorizes manufacturing specifications and constraints needed to produce a product.
- ENGR1.11.2 Evaluates and applies correct machine processes (for example: process routing).

MARKETING

- ENGR1.12.1 Performs product cost analysis.
- ENGR1.12.2 Analyzes requirements for packaging a given product.

PROFESSIONAL SKILLS: PROFESSIONALISM & ORGANIZATIONAL CULTURE

- ENGR1.13.1 Demonstrate professionalism in the workplace (being on time, proper dress, courteousness).
    - Follow protocol(s) related to behavior, appearance, and other expectations.
    - Explain the importance of "dress for success."
- ENGR1.13.2 Represent the school [or organization] in a positive manner, demonstrating the school's [or organization's] mission and core values.
    - Communicate the mission and core values of the school [or organization].
    - Perform work with a positive attitude.
- ENGR1.13.3 Demonstrate respect for personal and professional boundaries (distinguish between personal and work-related matters).
    - Distinguish between personal and work-related matters.
- ENGR1.13.4 Interact respectfully with others (cross-cultural, intergenerational, individuals with disabilities); act with integrity.
    - Address challenges with sensitivity.
- ENGR1.13.5 Produce high quality work that reflect professional pride and contributes to organizational success.
    - Create work products in a timely manner that are high quality and positively represent the organization.
- ENGR1.13.6 Take initiative to develop skills and improve work performance.
    - Identify and apply strategies to improve my performance.

PROFESSIONAL SKILLS: COMPLEX COMMUNICATION (TRADITIONAL AND DIGITAL)

- ENGR1.14.1 Communicate effectively in preparation for a diverse work environment (required: style, format, and medium appropriate to audience/culture/generation, purpose and context; accuracy; use of appropriate technical/industry language; to resolve conflicts; address intergenerational differences/challenges; persuade others).
    - Use appropriate verbal and nonverbal modes of communication.
    - Address communications in a style that is appropriate to the audience and situation.
    - Respond in a timely manner to communications.

- ENGR1.14.2 Use documentation (for example: itineraries and schedules) to plan and meet client needs.
- ENGR1.14.3 Use appropriate technologies and social media to enhance or clarify communication.
    - Use professional etiquette and follow applicable laws and regulations for web-, email-, and social media-based communications.
    - Verify the accuracy of information and authority of sources.
- ENGR1.14.4 Use a variety of interpersonal skills, including tone of voice and appropriate physical gestures (for example: eye contact, facing the speaker, active listening) during conversations and discussions to build positive rapport with others.
    - Demonstrate appropriate active listening skills.
- ENGR1.14.5 Pose and respond to questions, building upon others' ideas in order to enhance the discussion; clarify, verify, or challenge ideas and conclusions with diplomacy.
    - Ask questions to obtain accurate information.

PROFESSIONAL SKILLS: SELF-INITIATIVE AND SELF-DIRECTION

- ENGR1.15.1 Apply the skills and mindset of self-direction/self-regulation to accomplish a task or project.
    - Establish priorities and set challenging, achievable goals.
    - Create a plan with specific timelines for completion to achieve the goals.
    - Take initiative to select strategies, resources and/or learning opportunities to accomplish the task(s) in the plan.
    - Identify the success criteria/metrics to determine the effectiveness of the outcome for each goal.
    - monitor progress/productivity and self-correct during the learning process.
- ENGR1.15.2 Select and use appropriate technologies to increase productivity.
    - Use appropriate technology tools and resources to create and deliver a product.
- ENGR1.15.3 Exercise initiative and leadership (for example: recognize and engage individual strengths, plan for unanticipated changes, pursue solutions/improvements).
    - Reflect upon learning (strengths and weaknesses) and use feedback to modify work or improve performance.
    - Persist when faced with obstacles or challenges.

PROFESSIONAL SKILLS: CRITICAL THINKING AND INNOVATION

- ENGR1.16.1 Identify problems and use strategies and resources to innovate and/or devise plausible solutions.
    - Use relevant criteria to eliminate ineffective solutions or approaches and select those that are plausible; put selected alternatives through trials to determine their helpfulness or benefit.
- ENGR1.16.2 Take action or make decisions supported by evidence and reasoning.
    - Evaluate sources of evidence, the accuracy and relevance of information, and the strengths of arguments.
    - Demonstrate ethical reasoning and judgment by clearly sharing multiple perspectives on why the proposed course of action is ethically the best decision.
    - Identify factors that affect one's objectivity or rationality (for example: prejudices, disposition, etc.).
    - Use inquiry and reflection to take action.
    - Explain why a proposed course of action is ethically the best decision.

- ENGR1.16.3 Transfer knowledge/skills from one situation/context to another.
    - Apply knowledge and skills in new contexts.

PROFESSIONAL SKILLS: COLLABORATION

- ENGR1.16.4 Take responsibility for any role on a team and accurately describe and perform the duties of each role, including leadership.
    - Assess project needs and work with a team in a positive manner to create a final project.
    - Build team relationships.
- ENGR1.16.5 Integrate diverse ideas, opinions, and perspectives of the team and negotiate to reach workable solutions.
    - Contribute personal strengths to a project.
    - Respect the contributions of others.
    - Utilize technologies that promote collaboration and productivity, as appropriate or needed.
- ENGR1.16.6 Prioritize and monitor individual and team progress toward goals, making sufficient corrections and adjustments when needed.
    - Proactively solicit feedback; accept and show appreciation for constructive feedback.
    - Act upon feedback to achieve team goals.
    - Develop a plan for improving individual participation and group productivity.
- ENGR1.16.7 Submit high-quality products that meet specifications for assigned tasks.
    - Critique and reflect on individual and collaborative strengths and weaknesses.