

**Newport-Mesa Unified School District**  
**Office of Secondary Curriculum and Instruction**  
**Middle School Course of Study**

<b>Course Title</b>	<i>Design and Modeling Re-Write</i>	<b>Course Code</b>	<i>KT008</i>
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Transcript Title:	Design&Modeling		Grades Levels:	7-8	Board Adoption Date:	
Content Area:	Engineering		GPA Scale:	4.0	Date Course Submitted:	3/27/18
Credential Required:	CTE	Graduation Subject Areas:		ELECTIVE		
UC/CSU "A-G" Area Approvals:				School Site/person that wrote and submitted the course:	TeWinkle/Candice Woods	
Recommend Skills:	Reading, Writing, Speaking, Mathematics					
Next course(s):	Automation and Robotics, Medical Detectives, Flight and Space					

## Design and Modeling

**DATE:** March 2018

**INDUSTRY SECTOR:** Engineering and Architecture

**PATHWAY:** Engineering Design

**CBEDS TITLE:** Introduction to Engineering and Architecture (999)

**CBEDS Code:** 7700

**HOURS:**

Total	Classroom	Laboratory/CC/CVE
90 Hours	25 hours	65 hours

JOB TITLE	ONET CODES	JOB TITLE	ONET CODES
N/A	N/A		

**COURSE DESCRIPTION:** Design and Modeling (DM) provides students opportunities to apply the design process to creatively solve problems. Students are introduced to the unit problem in the first activity and are asked to make connections to the problem throughout the lessons in the unit. Students learn and utilize methods for communicating design ideas through sketches, solid models, and mathematical models. Students will understand how models can be simulated to represent an authentic situation and generate data for further analysis and observations. Students work in teams to identify design requirements, research the topic, and engage stakeholders. Teams design a toy or game for a child with cerebral palsy, fabricate and test it, and make necessary modifications to optimize the design solution.

**PREREQUISITES:** N/A

High School Name:	Site Prerequisite:
N/A	

**A – G APPROVAL:** ☐ Yes ☒ No ☐ Desired

**ARTICULATION:** N/A

High School Name:	College Name:	College Course Title:
N/A	N/A	

LEVEL: ☒ Introductory ☐ Concentrator ☐ Capstone

CERTIFICATION: N/A

High School Name:	Embedded/Leads to:	Description:
N/A		

**METHOD OF STUDENT EVALUATION:**

- ✓ Pre and Post test
- ✓ Student Projects
- ✓ Written work
- ✓ Observation record of student performance
- ✓ Completion of assignments and worksheets

**METHOD OF INSTRUCTION:**

- ✓ Lecture
- ✓ Group and individual applied projects
- ✓ Demonstration
- ✓ Field Trips
- ✓ Guest Speaker

**RECOMMENDED TEXTS:**

PLTW Course Curriculum

**MODEL CTE PATHWAY:**

Exploratory PLTW Course for Engineering

**CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS**

California Department of Education CTE Standards website: <http://www.cde.ca.gov/ci/ct/sf/ctemcstandards.asp>

**Advanced Manufacturing and Engineering  
KNOWLEDGE AND PERFORMANCE ANCHOR STANDARDS**

## **1.0 Academics**

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Engineering and Architecture academic alignment matrix for identification of standards.

## **2.0 Communications**

Acquire and accurately use Engineering and Architecture sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats. (Direct alignment with LS 9-10, 11-12.6)

2.1 Recognize the elements of communication using a sender–receiver model.

2.2 Identify barriers to accurate and appropriate communication.

2.3 Interpret verbal and nonverbal communications and respond appropriately.

2.4 Demonstrate elements of written and electronic communication, such as accurate spelling, grammar, and format.

2.5 Communicate information and ideas effectively to multiple audiences using a variety of media and formats.

2.6 Advocate and practice safe, legal, and responsible use of digital media information and communications technologies.

## **3.0 Career Planning and Management**

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans. (Direct alignment with SLS 11-12.2)

3.1 Identify personal interests, aptitudes, information, and skills necessary for informed career decision making.

3.2 Evaluate personal character traits, such as trust, respect, and responsibility, and understand the impact they can have on career success.

3.3 Explore how information and communication technologies are used in career planning and decision making.

3.4 Research the scope of career opportunities available and the requirements for education, training, certification, and licensure.

3.5 Integrate changing employment trends, societal needs, and economic conditions into career planning.

3.6 Recognize the role and function of professional organizations, industry associations, and organized labor in a productive society.

3.7 Recognize the importance of small business in the California and global economies.

3.8 Understand how digital media are used by potential employers and postsecondary agencies to evaluate candidates.

3.9 Develop a career plan that reflects career interests, pathways, and postsecondary options.

## **4.0 Technology**

Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Engineering and Architecture sector workplace environment. (Direct alignment with WS 11-12.6)

4.1 Use electronic reference materials to gather information and produce products and services.

4.2 Employ Web-based communications responsibly and effectively to explore complex systems and issues.

4.3 Use information and communication technologies to synthesize, summarize, compare, and contrast information from multiple sources.

4.4 Discern the quality and value of information collected using digital technologies, and recognize bias and intent of the associated sources.

4.5 Research past, present, and projected technological advances as they impact a particular pathway.

4.6 Assess the value of various information and communication technologies to interact with constituent populations as part of a search of the current literature or in relation to the information task.

## **5.0 Problem Solving and Critical Thinking**

Conduct short, as well as more sustained, research projects to create alternative solutions to answer a question or

solve a problem unique to the Engineering and Architecture sector using critical and creative thinking; logical reasoning, analysis, inquiry, and problem-solving techniques. (Direct alignment with WS 11-12.7)

5.1 Identify and ask significant questions that clarify various points of view to solve problems.

5.2 Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate.

5.3 Use systems thinking to analyze how various components interact with each other to produce outcomes in a complex work environment.

5.4 Interpret information and draw conclusions, based on the best analysis, to make informed decisions.

## **6.0 Health and Safety**

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Engineering and Architecture sector workplace environment. (Direct alignment with RSTS 9-10, 11-12.4)

6.1 Locate, and adhere to, Material Safety Data Sheet (MSDS) instructions.

6.2 Interpret policies, procedures, and regulations for the workplace environment, including employer and employee responsibilities.

6.3 Use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.

6.4 Practice personal safety when lifting, bending, or moving equipment and supplies.

6.5 Demonstrate how to prevent and respond to work-related accidents or injuries; this includes demonstrating an understanding of ergonomics.

6.6 Maintain a safe and healthful working environment.

6.7 Be informed of laws/acts pertaining to the Occupational Safety and Health Administration (OSHA).

## **7.0 Responsibility and Flexibility**

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Engineering and Architecture sector workplace environment and community settings. (Direct alignment with SLS 9-10, 11-12.1)

7.1 Recognize how financial management impacts the economy, workforce, and community.

7.2 Explain the importance of accountability and responsibility in fulfilling personal, community, and workplace roles.

7.3 Understand the need to adapt to changing and varied roles and responsibilities.

7.4 Practice time management and efficiency to fulfill responsibilities.

7.5 Apply high-quality techniques to product or presentation design and development.

7.6 Demonstrate knowledge and practice of responsible financial management.

7.7 Demonstrate the qualities and behaviors that constitute a positive and professional work demeanor, including appropriate attire for the profession.

7.8 Explore issues of global significance and document the impact on the Engineering and Architecture sector.

## **8.0 Ethics and Legal Responsibilities**

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms. (Direct alignment with SLS 11-12.1d)

8.1 Access, analyze, and implement quality assurance standards of practice.

8.2 Identify local, district, state, and federal regulatory agencies, entities, laws, and regulations related to the Engineering and Architecture industry sector.

8.3 Demonstrate ethical and legal practices consistent with Engineering and Architecture sector workplace standards.

8.4 Explain the importance of personal integrity, confidentiality, and ethical behavior in the workplace.

8.5 Analyze organizational culture and practices within the workplace environment.

8.6 Adhere to copyright and intellectual property laws and regulations, and use and appropriately cite proprietary information.

8.7 Conform to rules and regulations regarding sharing of confidential information, as determined by Engineering and Architecture sector laws and practices.

### **9.0 Leadership and Teamwork**

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 SkillsUSA career technical student organization. (Direct alignment with SLS 11-12.1b)

9.1 Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.

9.2 Identify the characteristics of successful teams, including leadership, cooperation, collaboration, and effective decision-making skills, as applied in groups, teams, and career technical student organization activities.

9.3 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.

9.4 Explain how professional associations and organizations and associated leadership development and competitive career development activities enhance academic preparation, promote career choices, and contribute to employment opportunities.

9.5 Understand that the modern world is an international community and requires an expanded global view.

9.6 Respect individual and cultural differences and recognize the importance of diversity in the workplace.

9.7 Participate in interactive teamwork to solve real Engineering and Architecture sector issues and problems.

### **10.0 Technical Knowledge and Skills**

Apply essential technical knowledge and skills common to all pathways in the Engineering and Architecture sector, following procedures when carrying out experiments or performing technical tasks. (Direct alignment with WS 11 -12.6)

10.1 Interpret and explain terminology and practices specific to the Engineering and Architecture sector.

10.2 Comply with the rules, regulations, and expectations of all aspects of the Engineering and Architecture sector.

10.3 Construct projects and products specific to the Engineering and Architecture sector requirements and expectations.

10.4 Collaborate with industry experts for specific technical knowledge and skills.

### **11.0 Demonstration and Application**

Demonstrate and apply the knowledge and skills contained in the Engineering and Architecture anchor standards, pathway standards, and performance indicators in classroom, laboratory and workplace settings, and through the SkillsUSA career technical student organization.

11.1 Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices specific to the Engineering and Architecture sector program of study.

11.2 Demonstrate proficiency in a career technical pathway that leads to certification, licensure, and/or continued learning at the postsecondary level.

11.3 Demonstrate entrepreneurship skills and knowledge of self-employment options and innovative ventures.

11.4 Employ entrepreneurial practices and behaviors appropriate to Engineering and Architecture sector opportunities.

11.5 Create a portfolio, or similar collection of work, that offers evidence through assessment and evaluation of skills and knowledge competency as contained in the anchor standards, pathway standards, and performance indicators.



I.	Introduction to Design	CR	LAB/ CC	STANDARDS
	<p><b>Activity 1.1: Foot Othosis Instant Design Challenge</b></p> <ul style="list-style-type: none"> <li>In this activity students will work in a team to solve an instant design challenge. In this challenge they will design, test, and build a model solution for patients with a movement disorder called <b>cerebral palsy</b>. You will put on your designer hats to document and explore the steps you use to solve this problem.</li> </ul> <p><b>Activity 1.2: A Picture Is Worth a Thousand Words</b></p> <ul style="list-style-type: none"> <li>Students will learn different sketching techniques used in engineering. With some sketching practice and an understanding of sketch types, students will improve their ability to quickly and effectively transfer their design ideas to a visual representation to share with team members.</li> </ul> <p><b>Activity 1.3: How Big Was That Fish?</b></p> <ul style="list-style-type: none"> <li>In this activity, students will learn about using different systems of measurement and the importance of accuracy. They'll apply their measuring and dimensioning skills to find the surface area and volume of an object.</li> </ul> <p>-All Systems Go! -Measuring Tools -Practice Measuring -Dimensioning -Area, Surface Area, and Volume</p> <p><b>Activity 1.4: Investigate the Inside</b></p> <ul style="list-style-type: none"> <li>During this project, students will work in a team to carefully dissect a puzzle toy. They will remove the pieces, document how the puzzle is disassembled. Students will then document the parts with sketches and <b>annotations</b>. Finally, they will design a modification for the puzzle toy, determine the <b>optimal</b> team design <b>solution</b>, and present your design concept.</li> </ul>	6 hrs	15 Hrs	<p><b>Academic:</b> <b>English Language:</b> 7.W.3 7.SL.1.b-d 7.SL.4 <b>Reading:</b> AS.R.1 AS.R.4 AS.R.7 AS.W.3 AS.SL.1,2,4,5 AS.L.4,6 <b>Social Studies:</b> 6-8 RH.7 6-8 RST.3,4,7</p> <p><b>Technology:</b> 3.6-8.F 4.6-8.D 6.6-8.E 7.6-8.D 8.6-8.E,F,G 9.6-8.F,G 11.6-8.H,J,K 14.6-8.G 17.6-8.J,K</p> <p><b>Math:</b> 7.NS.3 7.G.2,4,6 8.G.p</p> <p><b>Computer Science:</b> N/A</p> <p><b>CTE Anchor:</b> 2.0 3.0 4.0 5.0 7.0 8.0 9.0 10.0 11.0 <b>CTE Pathway:</b> C2.0 C3.0 C4.0 C5.0 C.10 C.11</p>

II.	Modeling and Statistical Analysis	CR	LAB/ CC	STANDARDS
	<p><b>Activity 2.1: Building Blocks</b></p> <ul style="list-style-type: none"> <li>Implementing the design process, students will learn to use various types of modeling as they work on a puzzle cube project. They will have the opportunity to be creative and to develop their sketching and modeling skills. Students will learn how to read a design brief listing constraints and criteria.</li> <li>Students will learn the tools in Geogebra to represent mathematical models such as area, surface area, and volume.</li> </ul> <p><b>Activity 2.2: Taking Modeling to Another Dimension</b></p> <ul style="list-style-type: none"> <li>In this activity, students will use two-dimensional shapes to create solid models their puzzle cube parts in a CAD application.</li> </ul> <p><b>Activity 2.3: Puzzle Cube Statistical Analysis</b></p> <ul style="list-style-type: none"> <li>Engineers build prototypes to test a design to decide whether it meets the design criteria. Testing a product and looking at the results can help engineers improve the design. Getting feedback from the people who will use the product also helps ensure that the design meets the needs of users and works well.</li> </ul> <p>Student will:</p> <ul style="list-style-type: none"> <li>Create solid models of all of their puzzle cube parts.</li> <li>Prototype their puzzle cubes.</li> <li>Test their puzzle cube design and collect data.</li> <li>Use a spreadsheet to analyze the data to decide whether their design meets the design criteria.</li> <li>Explore options for making their design better.</li> </ul>	8 hrs	20 Hrs	<p><b>Academic:</b> <b>English Language:</b> Reading: AS.R.1 AS.R.4 AS.R.7 AS.W.3 AS.SL.2 AS.SL.4,6</p> <p><b>Technology:</b> 2.6-8.M,R,T 7.6-8.C 8.6-8.E,F,G 9.6-8.G,H 11.6-8.J,K,L 12.6-8.H,J 13.6-8.G,I 17.6-8.J,K</p> <p><b>Social Studies:</b> 6-8 RH.7 6-8 RST.3,4,7</p> <p><b>Math:</b> 7.G.1,2,3,4,6 7.SP.8,8b 8.G.1</p> <p><b>Computer Science:</b> CSTA.3A.CL3 CSTA.3A.CPP12</p> <p><b>CTE Anchor:</b> 2.0 4.0 5.0 8.0 9.0 10.0 11.0</p> <p><b>CTE Pathway:</b> C.1.0 - C.11.0</p>
III.	Design Challenge	CR	LAB/ CC	STANDARDS
	<p><b>Activity 3.1 Let's Stimulate to Elucidate</b></p> <ul style="list-style-type: none"> <li>In this lesson, students will explore two computer models used by scientists and physicians. Since a patient's gait and grasp are two of the most common presentations of cerebral palsy, students will use a modeling and simulation tool to study their musculoskeletal models before they proceed to the unit problem. As they study these models, they'll think about how their observations might enhance their therapeutic toy design.</li> </ul>	7 Hrs	20 hrs	<p><b>Academic:</b> <b>English Language:</b> 7.W.2.a,d 7.W.3 7.W.10 7.SL.1.b-d 7.SL.2,4 AS.R.1 AS.R.4 AS.R.7 AS.W.3,4,6 AS.SL.1,2,4,5 AS.L.4,6</p>



	<p><b>Activity 3.2 Therapeutic Toy Design</b></p> <ul style="list-style-type: none"> <li>Following the design process, students will work with their design team to create a toy to use for therapy with children with cerebral palsy. They will use their understanding of design tools, technology, and teamwork to communicate ideas and collaborate with their design team.</li> <li>Their team must identify a design opportunity for which they will create a toy by completing each step of the design process and document them in their Gateway Notebook. As a team designs their toy, they will describe each task that they perform during each step. Include ideas, sketches, photos, tables, graphs, models, and other artifacts to communicate their design and process.</li> </ul>			<p><b>Technology:</b>  S2.6-8.M  3.6-8.F  4.6-8.D,F  6.6-8.E  8.6-8.E,F,G  9.6-8.F,G,H  11.6-8H-M  12.6-8.H,J  13.6-8.G,I  14.6-8-G,J,K</p> <p><b>Social Studies:</b>  6-8 RH.7  6-8 RST.3,4,7,9</p> <p><b>Math:</b>  7.NS.3  7.G.2,3,6  8.G.1,9</p> <p><b>Computer Science:</b>  CSTA.3A.CL3  CSTA.3A.CPP10,12  CSTA.3A.CT8</p> <p><b>CTE Anchor:</b>  2.0  4.0  5.0  7.0  8.0  10.0  11.0</p> <p><b>CTE Pathway:</b>  C.1.0 – C.11.0</p>
<b>IV.</b>	<b>EMPLOYMENT PORTFOLIO</b>	<b>CR</b>	<b>LAB/ CC</b>	<b>STANDARDS</b>
	<p>Students will prepare an update to their professional portfolio (lab book)</p> <p>A. Portfolio showcases best professional level work</p> <p>B. Portfolio is organized</p> <p>C. Research engineers/careers specific to content</p>	<p>4 hr ONGOING</p>	<p>10 hrs ONGOING</p>	<p><b>Academic:</b>  <b>Reading:</b>  AS.R.1,4,7  AS.W.2,4,7  AS.SL.1,2,4  AS.L.1,2,6</p> <p><b>CTE Anchor:</b>  1.0  2.0  3.0  11.0</p> <p><b>CTE Pathway:</b>  C11.0</p>