STEAM Shop 1
COURSE OUTLINE - UC

DESCRIPTION:

STEAM = Science & Technology interpreted through Engineering & the Arts, all based in Mathematical elements.

This course will introduce students to the product design process, a series of steps used by designers, engineers, manufacturers, and inventors to address opportunities, meet needs, or develop solutions to problems. Students will apply the product design process to various projects across all industry sectors. Students will work on projects that involve designing, building, and testing products, repeating steps and making product improvements along the way. Students will follow the design process to strengthen their understanding of open-ended design, and emphasize creativity and problem solving. Activities will challenge and support the critical thinking, communication, collaboration, and creativity skills required of the 21st Century learner. Activities in this course include work-based learning that connects students to industry and the local community.

INFORMATION:

PRE-REQUISITE:	None
LENGTH:	One Year
SECTOR:	Manufacturing and Product Development
PATHWAY:	Product Innovation and Design
ARTICULATED:	Yes
UC A-G APPROVAL:	Yes: College-Preparatory Elective (G) – Interdisciplinary Requirement

O*NET SOC CODES:

17-2112.00	Industrial Engineers
17-2199.04	Manufacturing Engineers
17-3026.00	Industrial Engineering Technicians
17-3019.06	Manufacturing Engineering Technologists

Orientation

    A.   Introduce the course and facilities.
    B.   Discuss the syllabus and major objectives.
    C.   Explain applicable classroom management procedures, the ROP Student Rules of Conduct, and any operational guidelines.
    D.   Review instructor/student expectations.
    E.   Explain enrollment and attendance requirements and procedures.
    F.   Review grading and student evaluation procedures.
    G.   Discuss the community classroom aspect of the program if applicable.
    H.   Discuss the "next steps" related to additional education, training, and employment.
    I.   Review classroom safety, emergency and disaster procedures.

1. Communication Skills

    A.   Demonstrate positive verbal communication skills using appropriate vocabulary, demeanor, and vocal tone in the classroom and/or worksite.
    B.   Read and interpret written information and directions.
    C.   Practice various forms of written communication appropriate to the occupation.
    D.   Practice positive body language skills.
    E.   Practice professional verbal skills for resolving a conflict.
    F.   Demonstrate active listening skills including techniques for checking for understanding, and for obtaining clarification of directions.

2. Interpersonal Skills

    A.   Demonstrate positive teamwork skills by contributing to a group effort.
    B.   Practice the importance of diversity awareness and sensitivity in the workplace.
    C.   Define sexual harassment in the workplace and identify the employee's role and responsibility.
    D.   Practice participation skills.
    E.   Identify different personality types and strategies for working effectively with each type.
    F.   Practice business and social etiquette skills appropriate to the occupation.
    G.   Discuss the role of business and personal ethics in the decision-making process.
    H.   Evaluate various job-related scenarios and justify decisions based on ethics.
    I.   Demonstrate flexibility and adaptability in working with others.
    J.   Demonstrate the use of time management skills.

3. Employability Skills

A. Demonstrate appropriate attendance and punctuality practices for the classroom and worksite if applicable.
B. Prepare a resume, cover letter, and job application forms.
C. Demonstrate interviewing techniques using appropriate tone and body language.
D. Demonstrate appropriate dress and grooming standards in seeking employment and for the workplace.
E. Identify strategies for employment retention.
F. Analyze the impact of social networking on employability.
G. Identify the need for continuing education, professional development, and professional growth in chosen field.
H. Identify appropriate procedures for leaving a job.
I. Identify sources of job information, including electronic sources.
J. Review company policies and current trends in employee compatibility screening, drug screening, and background checks.

4. Leadership

A. Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.
B. Work with peers to promote divergent and creative perspectives.
C. Demonstrate how to organize and structure work, individually and in teams, for effective performance and the attainment of goals.
D. Explain multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace.
E. Employ ethical behaviors and actions that positively influence others.
F. Use a variety of means to positively impact the direction and actions of a team or organization.
G. Analyze the short-term and long-term effects a leader's actions and attitudes can have on productivity, morale, and organizational culture.

5. Personal and Occupational Safety

A. Demonstrate procedures to be followed in the case of emergencies.
B. Discuss ways to report a potential safety hazard to a supervisor.
C. Identify and discuss cyber ethics, cyber safety, and cyber security.
D. Apply personal safety practices to and from the job.
E. Describe the procedure for reporting a work-related hazard or injury.
F. Recognize the effects of substance abuse in the workplace.

6. Researching and Defining the Problem

A. Explain and identify the scientific method.
B. Gather and organize relevant information to identify and define an area of opportunity, need, or problem that can be resolved through design.
C. Identify what a product/service/system is meant to do.
D. Identify who a product/service/system is meant to serve.
E. Identify why it is important to address an opportunity, meet a need, or solve a problem.
F. Identify the short- and long-term effects of missing an opportunity, not addressing a need, or not solving a problem.
G. Identify the cause of the opportunity, need or problem.
H. Identify the required characteristics of the product/service/system.
I. Analyze the barriers that might prevent the product/service/system from meeting the designer's goal.

7. Developing Design Concepts and Selecting Solutions

A. Apply ideation techniques when collaborating with team members to explore and produce multiple design concepts.
B. Identify tools used to assist in the decision-making process (e.g., Pugh Matrix, PMI, Pros and Cons).
C. Debate the merit of each concept to refine ideas.
D. Edit concepts by identifying key ideas that address an opportunity, meet a need, or solve a problem.
E. Assess the impact (short and long-term) of possible design solutions on multiple stakeholders.
F. Identify materials, mechanisms, technologies, and other requirements the concepts may require.
G. Synthesize information and experiment with non-traditional and innovative design solutions.
H. Analyze and assess the strengths and weaknesses in the design, function, ergonomics, features, and benefits.
I. Recognize the safety issues related to the reliability, functionality, and use of proposed concepts.
J. Identify possible resolutions for improvement.

8. Constructing a prototype

A. Build a looks-like, works-like prototype using the appropriate techniques or technologies.
B. Assess the outcome of the prototype.
C. Analyze any issues that need redesigning or refining.
D. Resolve and/or redesign issues with a prototype.
E. Design multiple iterations, if applicable.

9. Testing and Evaluating Solution(s)

A. Create performance criteria and a quality standard to measure and evaluate the prototype.
B. Test the features of the prototype against the performance criteria.
C. Evaluate the results of the prototype testing to determine if it meets the requirements and objectives.
D. Identify any redesigning or additional corrections required to improve the overall quality, look, and performance of the prototype.
E. Determine if multiple iterations are required.

10. Communicating Results

A. Create a presentation of the design solution that effectively communicates its success or failure to select audiences.
B. Develop and utilize technical vocabulary to describe and explain design processes.
C. Produce electronic media to promote/market the design solution.
D. Provide analysis in all relevant mediums (i.e. cost, schedule, materials).

11. Portfolio

A. Create a professional digital portfolio reflecting employability skills in the relevant industry to include an "About Me" page.
B. Collect original works and documents that demonstrate technical skills and knowledge in the industry.
C. Demonstrate knowledge of competencies by accompanying each selected document or work with a journal entry or summary.
D. Write a brief resume and cover letter to be included in portfolio.
E. Develop interviewing techniques using portfolio materials.
F. Display portfolio materials for critique by a professional panel (industry partners and classmates).
G. Gather feedback and update portfolio.

Key Assignments

Assignment	Competencies	Career Ready Practices	Anchor Standards	Pathway Standards	CCSS
1. Students will participate in mock interviews that represent current industry practices (e.g., skills demonstrations, resumes, applications, portfolios, personal websites, etc.).	1A, B, D 3B, C, D, I, J	2 3	2 3		LS 11-12.6 SLS 11-12.2
2. In teams, students will research the impact of waste on the planet, identifying those items that can be recycled and/or repurposed. Using a specific resource (plastics, glass, wood, metal, fabric, etc.), students will brainstorm different uses for commonly disposed of items, research existing concepts similar to theirs, and determine the concept they plan to implement as a team. Students will design and build a prototype, testing it appropriately to ensure it meets the desired design goal(s). Students will assess the success and failures of the prototype, making necessary alterations to improve design and function. Students will present their concept, articulating the impact their concept could have on landfills, the benefits their concept would have on the community, and the money making potential the concept might have. Examples of projects might include: Create usable art with empty plastic beverage bottles. http://www.designrulz.com/product-design/2012/11/45-ideas-of-how-to-recycle-plastic-bottles/ Making fashion out of fused plastic shopping bags. http://etsylabs.blogspot.com/2007/05/long-overdue-fusing-plastic-bag.html http://tinkering.exploratorium.edu/plastic-fusing Unmaking technology http://www.edutopia.org/blog/dissecting-un-makerspace-recycled-learning	1A, B, E, F 2A, B, D, I, J 4C 5A, B 6A-F 7C-G 8A-D 9A-D 10A, B	5 9 10 12	2 5 9 10	D2.0 D3.0 D6.0 D7.0 D10.0	HS-ESS3-4 HS-ETS1-2 S-IC 6 WHSST 11-12.7

Assignment	Competencies	Career Ready Practices	Anchor Standards	Pathway Standards	CCSS
3. In design teams, students will design and create an educational game appropriate to a specific population. Students will choose and then identify the cognitive needs of the population and their physical limitations. Students will develop and create their game, testing their products' ability to meet their cognitive goals. Students will present their teams' results electronically, detailing the research, design process, testing, and results of their concept.	1A, E, F 2A, B, D, I, J 4C 6A-F 7C-I 8A 9A-D 10A-C	2 5 9 10 12	2 5 7 9 10	D2.0 D3.0 D7.0 D10.0	S-IC 6 WHSST 11-12.7
4. In teams, students will research various electronic processes to design and build various projects. Students will design and build prototypes, testing to ensure their concept meets their desired design goal(s). Students will assess the success and failures of their prototypes, making necessary alterations to improve design and function. Students will present their concept, articulating the impact their concept could have on specific populations, and the community at large. Examples of projects might include: Circuit Boards – http://tinkering.exploratorium.edu/sites/default/files/Instructions/circuit_boards.pdf Scribbling Machines – do one basic and then teams elevate their designs http://tinkering.exploratorium.edu/sites/default/files/Instructions/scribbling_machines.pdf Toy Take Apart - http://tinkering.exploratorium.edu/sites/default/files/Instructions/toy_take_apart_0.pdf Paper Circuits – Create cards for children in hospitals or another	1A, B, E, F 2A, B, D, F, I, J 4C 6A-F 7A-C, E-I 8A-D 9A-D 10A-C	1 2 5 9 10	2 4 5 7 9	D2.0 D3.0 D6.0 D7.0 D10.0	HS-PS3-5 S-IC 6 WHSST 11-12.7

Assignment	Competencies	Career Ready Practices	Anchor Standards	Pathway Standards	CCSS
group in need. http://tinkering.exploratorium.edu/sites/default/files/Instructions/paper_circuits.pdf					
5. In teams, students will research the kinetic properties of everyday items, putting them into motion to accomplish a variety of tasks. Students will design and build prototypes, testing to ensure their concept meets their desired design goal(s). Students will assess the success and failures of their prototypes, making necessary alterations to improve design and function. Students will present and demonstrate their concept, articulating how the Law of Physics is demonstrated in each of the tasks. Examples of projects might include: Marble Machines - http://tinkering.exploratorium.edu/sites/default/files/Instructions/marble_machines.pdf Moving Sculptures - http://tinkering.exploratorium.edu/sites/default/files/Instructions/cardboard_automata.pdf Building a water clock - http://www.sciencebuddies.org/science-fair-projects/project_ideas/ApMech_p047.shtml#background http://sciencenetlinks.com/lessons/building-a-water-clock/ Rube Goldberg Machines - http://coolmaterial.com/roundup/rube-goldberg-machines/	1A, B, E, F 2A, D, I, J 4C 6A, B, E, F 7A-C, E-I 8A-D 9A-D 10A-C	2 5 9 10 11	2 4 5 9	D2.0 D3.0 D6.0 D7.0 D10.0	HS-PS3-3 S-IC 6 WHSST 11-12.7

Standards Assessed in this Program

Career Ready Practices

1. **Apply appropriate technical skills and academic knowledge.**
2. **Communicate clearly, effectively, and with reason.**
3. **Develop an education and career plan aligned to personal goals.**
4. **Apply technology to enhance productivity.**
5. **Utilize critical thinking to make sense of problems and persevere in solving them.**
6. **Practice personal health and understand financial well-being.**
7. **Act as a responsible citizen in the workplace and the community.**
8. **Model integrity, ethical leadership, and effective management.**
9. **Work productively in teams while integrating cultural/global competence.**
10. **Demonstrate creativity and innovation.**
11. **Employ valid and reliable research strategies.**
12. **Understand the environmental, social, and economic impacts of decisions.**

Anchor Standards

2.0 Communications
- Acquire and use accurately sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

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.

4.0 Technology
- Use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the sector workplace environment.

5.0 Problem Solving and Critical Thinking
- Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

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 sector workplace environment.

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 sector workplace environment and community settings.

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.

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.

10.0 Technical Knowledge and Skills
- Apply essential technical knowledge and skills common to all pathways in the sector following procedures when carrying out experiments or performing technical tasks.

Pathway Standards

Manufacturing and Product Development – Product Innovation and Design Pathway

D2.0 Understand and apply research methodologies as a means to identify a need, problem, or opportunity for a new product, product line, system design, or service.

D3.0 Understand and apply various ideation techniques to develop ideas and concepts.

D6.0 Produce a prototype of a product.

D7.0 Evaluate the prototype to determine if it meets the requirements and objectives.

D10.0 Produce a presentation of the product, product line, system design, or service.

Common Core State Standards

ENGLISH LANGUAGE ARTS

Language Standards
LS 11-12.6: Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the (career and college) readiness level, demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Speaking and Listening Standards
SLS 11-12.2: Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions, and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

Writing Standards

WHSST 11-12.7: Conduct short as well as more sustained research projects to answer a question (including self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

MATHEMATICS

S-IC Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
  6. Evaluate reports based on data.

SCIENCE

HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to interaction.