U15 Y4 S2 iSTEM4 Capstone Research Formal Presentation

Content Area: **CTE**
Course(s): **iSTEM**
Time Period: **February**
Length: **21 Weeks**
Status: **Published**

Unit Overview:

Formal Presentation Preparation

Capstone research projects engage students in personalized learning experiences, allowing students to apply critical thinking skills while investigating a specialized area of interest. Students synthesize their previous teaching and learning to solve real-world problems related to their chosen field of research. Each student has the assistance of a capstone project teacher to guide the student through their project deliverables. Also, each student will select an adult mentor in their field of research as well as two peers to serve as critical alliances throughout the capstone research project. Capstone research projects serve as a culminating application of student learning. Throughout the semester, students draw upon their technical skills to address complex and authentic problems. Students will apply skills toward a real-world problem. Through research, questioning, brainstorming, innovation and invention, persistence, flexibility, and reflection, students will communicate with clarity to an audience of adult professionals in their chosen field of study.

Students keep an Engineer's Notebook which records:

- preliminary research
- empathy and design focus
- identification of "unknowns" for research
- the "end-user" needs
- material & material properties considerations
- designing for aesthetics
- capital & asset considerations
- fabrication planning and processes
- design hypothesis
- data recording and analysis

Students supplement prototypes with verbal presentations that include storyboards and slideshows. Reference texts regarding the design process, patent law, and production provide source materials for lessons and lab activities.

Classroom instruction will emphasize:

- personal safety and lab safety
- career research
- socially responsible and environmentally friendly themes
- sustainability and efficiency
- technical writing, oral communication & graphic communication

Approximate Time-Frame & Pacing:

- Week 01: Contemplating The Field of Research & The Design Problem
- Weeks 02-03: Invention v Innovation. Building a Resource Library
- Week 04: Narrowing Problem Focus. Assemble a Design Team. Begin ENB Entries.
- Week 05: Consider Unknowns. Develop Multiple Solutions.
- Weeks 06-07: Materials & Materials Properties.
- Week 08: Project Ideation. Design Hypothesis. Fabrication Planning.
- Weeks 9-13: Prototype Fabrication
- Weeks 14-15: Methods of Testing. Prototype Performance & Data Analysis.

- Week 16: Drawing Conclusions. Making Recommendations.
- Weeks 17-19: Technical Writing. Abstracts & Lab Reports. Creating a Story Board
- Week 19: Prototype Demonstrations & Presentations of Findings.
- Weeks 20-21: Design Modifications.

Key Phases and Performance Expectations:

- Phase I - Proposal: Pre-Proposal: Topic Brainstorming/Selection, Pre-Proposal Core Question, Minor Literature Review, Service Learning Component
- Phase II - Research & Investigation: Bi-Weekly Reflective Journal Entries and Research
- Phase III – Project Creation: Bi-Weekly Reflective Journal Entries and Product, System, or Event Development/Creation
- Phase IV – Culminating Defense and Presentation: Defense to Panel of Experts, Community Showcase, and Final Portfolio Reflection

Enduring Understandings:

- Appreciate how the design process impacts both invention and innovation.
- Conduct on-going self-assessments and research in the face of evolving educational and workplace environments.
- Identify central tenents of design problems through research prior to the pursuit of solutions.
- The effects of manufacturing/production transportation technology on ecosystems, people, and our planet.
- The positive and negative effects technology can impart on a community, region, and society as a whole.
- Why mechanical, structural, power, and transportation systems are designed to work the way they do.

Essential Questions & Skills:

- How are the three forms of communication used to deliver an effective presentation?
- What are the stages in a product's life cycle?
- What are the stages/steps of a complete design cycle?
- What factors should be considered when engineering a product?
- What is sustainable manufacturing? How is lean manufacturing different from traditional manufacturing?
- Why is a bill of materials and important part of the manufacturing process?

Standards/Indicators/Student Learning Objectives (SLOs):

PATHWAY: ENGINEERING & TECHNOLOGY CAREER PATHWAY (ST-ET)

9.3.ST-ET.1 Use STEM concepts and processes to solve problems involving design and production. **SWBAT:** Apply techniques of investigation, research, brainstorming, pragmatic design selection, production planning, testing, and analysis as required by design project development.

9.3.ST-ET.2 Display and communicate STEM information. **SWBAT:** Define sustainable production and differentiate between styles or forms of production. Differentiate between material types and their properties. Articulate why a bill of materials and an important in manufacturing. Articulate the difference between lean and traditional manufacturing. Identify the stages of the Design Process and describe its benefits. Articulate how different modes of communication can effectively communicate an idea. Provide an electronic presentation with physical artifacts, articulating the processes involved in developing an assistive technology prototype.

9.3.ST-ET.3 Apply processes and concepts for the use of technological tools in STEM. **SWBAT:** Produce an assistive technology prototype from conception through production.

9.3.ST-ET.4 Apply the elements of the design process. **SWBAT:** Incorporate the design cycle/process in the interpretation and execution of developing team design solutions.

9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems. **SWBAT:** Catalog parts, generate a bill of materials, chart manufacturing processes, make efficient use of capital and resources.

9.3.ST-ET.6 Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems ethically and legally. **SWBAT:** Recognize the role product development plays in the daily lives of people in the world. Examine the positive and negative effects that production can exact on society, culture, and the health of the planet.

STEM.9-12.1	Engineering & Technology
STEM.9-12.9.4.12.O.(1).1	Apply the concepts, processes, guiding principles, and standards of school mathematics to solve science, technology, engineering, and mathematics problems.
STEM.9-12.9.4.12.O.(1).2	Apply and use algebraic, geometric, and trigonometric relationships, characteristics, and properties to solve problems.
STEM.9-12.9.4.12.O.(1).3	Demonstrate the ability to select, apply, and convert systems of measurement to solve problems.
STEM.9-12.9.4.12.O.(1).4	Demonstrate the ability to use Newton's laws of motion to analyze static and dynamic systems with and without the presence of external forces.
STEM.9-12.9.4.12.O.(1).5	Explain relevant physical properties of materials used in engineering and technology.
STEM.9-12.9.4.12.O.(1).6	Explain relationships among specific scientific theories, principles, and laws that apply to technology and engineering.
STEM.9-12.9.4.12.O.(1).7	Use mathematics, science, and technology concepts and processes to solve problems in projects involving design and/or production (e.g., medical, agricultural, biotechnological, energy and power, information and communication, transportation, manufacturing, and construction).
STEM.9-12.9.4.12.O.(1).8	Select and use a range of communications technologies, including word processing, spreadsheet, database, presentation, email, and Internet applications, to locate and display information.
STEM.9-12.9.4.12.O.(1).9	Employ concepts and processes for the application of technology to engineering.
STEM.9-12.9.4.12.O.(1).10	Model technical competence by developing processes and concepts for using different technologies.
STEM.9-12.9.4.12.O.(1).11	Demonstrate understanding of processes and concepts that are key to understanding the design process.
STEM.9-12.9.4.12.O.(1).12	Model technical competence by developing and applying processes and concepts in the design process.

Lesson Titles:

- Design Considertations - Choosing a Design Focus
- Design Hypothesis & Production Planning
- Design Teams & Multiple Solutions
- Maintaining an Engineers Notebook & Artifact Documentation
- Medods of Testing & Data Collection
- Preparing Storyboards
- Presentations & Interviews
- Reporting: Analysis, Conclusions & Recommendations
- The Complete Design Process
- Tools & Fabrication
- Unknows & Researh: Materials & Material Properties

Career Readiness, Life Literacies, & Key Skills

TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Inter-Disciplinary Connections:

LA.RI.9-10.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.) and make relevant connections, to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
MA.G-CO.D.12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
LA.W.9-10.2	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
SOC.6.1.12.C.3.a	Analyze how technological developments transformed the economy, created international markets, and affected the environment in New Jersey and the nation.
9-12.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.

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Direct: Structured Overviews, Daily over Promethean & Chromebooks.
- Direct: Drill & Practice - Bill of Materials, Production Charting, Data Collection & Recording
- Direct: Lectures & Demonstrations -The Complete Design Process, Materials & Material Properties, Production Planning, Tools & Fabrication
- Experiential: Experimentation - Simulations - Model Building & Fabrication: Considering Performance

Consistency & Efficiency

- Independent: Homework: Generally assigned as supplemental time for activities not completed within the classroom.
- Independent: Learning Activity Packages: See attached unit activity-pacing guide.
- Independent: Maintaining ENB, Develpping Prototypes, Developing Storyboards
- Indirect: Reflective Discussion & Technical Writing: Writing to Inform, Engineer's Notebook Enrtries & Evidence of Product Development, Project Conclusions
- Indirect: Reflective Discussion & Technical Writing: Writing to Inform, Technical Lab Report & Presentation of Project Development

Modifications

ELL Modifications:

- Choice of test format (multiple-choice, essay, true-false)
- Continue practicing vocabulary
- Provide study guides prior to tests
- Read directions to the student
- Read test passages aloud (for comprehension assessment)
- Vary test formats

IEP & 504 Modifications:

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments
- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Use of a graphic organizer
- Use of concrete materials and objects (manipulatives)
- Use of word processor

G&T Modifications:

- Alternate assignments/enrichment assignments
- Enrichment projects
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments
- Tiered centers

At Risk Modifications

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures

- Work in progress check

Alternative Assessments

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Benchmark Assessments

Skills-based assessment

Reading response

Writing prompt

Lab practical

Formative Assessment:

- Closure consists of a time to reflect on the day's activities and to offer clarity as needed.
- Conferences between the instructor and student at various points in the semester.
- Homework exercises as a review for exams and class discussions.
- In-class activities where students informally present their results.
- Observations during in-class activities; of students' non-verbal feedback during lectures.

- Observations of student progress in class, during activities, and through a grade-book review.
- Question and answer sessions, formal, planned and informal, spontaneous.
- Reflections journals that are reviewed periodically during the semester.
- Student feedback collected by periodically answering specific questions about the instruction and their self-evaluation of performance and progress.
- The anticipatory set is posted on classroom blackboard & Promethean board providing an overview of "do now" items and upcoming events.
- The warm-up consists of review preview time with an opportunity for clarity on the previous day's work.

Summative Assessment:

- Marking Period Assessment: Quarterly Presentations
- Periodic On-Going: Engineers Notebooks
- Periodic On-Going: Lab Participation Team Participation
- Projects: Prototype Performance

Resources & Materials:

- Goetsch, Chalk, Nelson. Technical Drafting, NY: Delmar, 1994
- Hansen, Autodesk Inventor 2016 Tutorial, SDC Publications, Kansas, 2016
- Shih, AutoCAD 2016 Tutorial, SDC Publications, Kansas, 20160
- Wright Berkeihiser. Manufacturing & Automation Technology, IL: Goodhart Wilcox 2012

Technology & Technology Standards:

- Autodesk Suite
- Chromebooks, Google Drive Storage & Related Google Apps
- Hand Tools & Power Tools as Dictated by Designs
- MS Office Software as Needed
- SmartBoard Presentations and Peripheral Technology
- Smartphones
- XYZ Printing Software

TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.D	Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.B	Technology and Society: Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.D	Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.