2023 U11 iSTEM 4 - Student Capstone Projects

Content Area: **CTE**
Course(s): **iSTEM**
Time Period: **September**
Length: **6 - 8 weeks**
Status: **Published**

Unit Overview:

This unit allows students to work on an open-ended engineering research project that coincides with their interests. Students work in teams to design and develop an original solution to a well-defined and justified open-ended problem by applying an engineering design process. Students will perform research to select, define, and justify a problem. After carefully defining the design requirements and creating multiple solution approaches, teams of students select an approach, create, and test their solution prototype. Student teams will present and defend their original solution to a panel of classmates, teachers/administrators, and/or classmates. Projects will vary based upon student interest and will focus more on problem solving. Because of the individuality of the project and the ability to gather materials with vary students will continue work on this project throughout the school year after the first 6 - 8 weeks.

Essential Questions:

- How do I identify problems and make sure my team is involved?
- How do we generate and implement ideas as a team?
- How can the team communicate the status of our project, the tasks needed to be completed, and manage our time for the project?
- What are the best ways to document the results of my research and determine if a problem is worth pursuing?
- What is the best way to evaluate the team's possible solutions?
- How should criteria be picked for evaluating solutions?
- How do I apply my skills and knowledge from other iSTEM courses to effectively design a prototype of my design?
- What methods would be most efficient for building my prototype?
- How do I test my design prototype?
- How can I effectively communicate my ideas, the results of my tests, and organize information from my project to facilitate their use in future projects?

Enduring Understandings:

- The work of engineers impacts issues and problems that our ongoing in our society.
- Relevant principles and practices of STEM are used to inform and justify design choices.
- An open-ended design process involves identifying a justifiable problem and developing an original solution that attempts to solve it.
- Project management is the discipline of planning, organizing, motivating, utilizing resources to achieve specific goals.
- Utilizing precise time management is necessary for on-time completion of large projects
- There are principles and practices related to documenting an engineering design process that allow

teams to work effectively, preserve the work allowing continuation at a later date, and protect the designer's intellectual property.
  - The ability to communicate as a professional is a critical skill in the business world.
  - Testing and Evaluation methods are a critical component to any problem solution.
  - Presentation of a design and project findings are critical to the overall system's success.

Lesson Titles:

- Presentation of Information: All Slides and materials from previous iSTEM courses

- Review of tool safety

- Design Challenge: Capstone Project

- Project Presentations

- Project Packet

- Project Prototype

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

- Direct Instruction: Daily Overviews (Promethean Board, Chromebooks, White Board)
- Direct Instruction: Presentations - Review of presentations of information (google slides)
- Independent / Group Work: Capstone Project
- Indirect Instruction: Reflective Discussion, Evaluation of Data and Technical Writing - ENB Write Ups, Self Evaluations, Presentation of Projects
- Experiential: Project - Design Challenge - Capstone Project
- Cooperative: Partner classwork, short projects, projects and ENB entries

Summative Assessment:

- ENB Brainstorming, Solution Sketching, Grading of Possible Solutions
- ENB Evaluation and Testing Criteria
- ENB Prototype Annotated Sketch
- ENB Task Management
- Project: Design Challenge - Capstone Project Packet
- Project: Design Challenge - Capstone Project Presentation

- Project: Design Challenge - Capstone Project Prototype
- Quiz: ENB Check

Formative Assessment:

- Anticipatory Set - Overview of items for the day, future activities of the unit, and/or review of previous information from the unit
- Classroom / Student Observation - check in on student work during in-class activities / projects
- Closure of Projects - students provide results of their projects, self-evaluate projects for possible improvements that could be made, and evaluate instruction that could be improved
- Closure of Units - students complete a design project that pertains to the unit at hand as well as prior units
- Conferences between the instructor and student at various points in the semester.
- ENB (engineering notebooks) - reviewed periodically during the school year
- In-class activities where students informally present their results.
- Presentation Sample Slides - Students participate in classroom discussion on topic that is being introduced and reviewed
- Q & A session - Student led question and answer session at the start of class for project information as needed
- Question and answer sessions, formal, planned and informal, spontaneous.
- Warm-Up - review information from current topic or previous topics, preview time for current activity, and/or opportunity for clarity on the previous day's work

Benchmark Assessments

Skills-based assessment

Reading response

Writing prompt

Lab practical

Alternative Assessments

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Standards/Indicators/Student Learning Objectives (SLOs):

9-12.HS-ETS1	Engineering Design
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.
9-12.HS-ETS1-1.1	Asking Questions and Defining Problems
9-12.HS-ETS1-1.1.1	Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
9-12.HS-ETS1-4.ETS1.B.1	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
9-12.HS-ETS1-2.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Career Readiness, Life Literacies, & Key Skills:

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.3	Consider the environmental, social and economic impacts of decisions.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.6	Model integrity, ethical leadership and effective management.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

LA.SL.11-12.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
LA.SL.11-12.1.B	Collaborate with peers to promote civil, democratic discussions and decision-making, set clear goals and assessments (e.g., student developed rubrics), and establish individual roles as needed.

LA.SL.11-12.1.C	Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
LA.SL.11-12.2	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.
LA.SL.11-12.4	Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
LA.SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
LA.SL.11-12.6	Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

Technology Materials and Standards

- SmartBoard Presentations
- Chromebooks, Google Drive, Google Applications
- MS Office Software as needed
- Smartphones
- Construction Hand Tools and Safety Equipment

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
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.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.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.

Computer Science and Design Thinking Standards

CS.K-12.2.a	Cultivate working relationships with individuals possessing diverse perspectives, skills, and personalities.
CS.K-12.2.b	Create team norms, expectations, and equitable workloads to increase efficiency and effectiveness.
CS.K-12.2.c	Solicit and incorporate feedback from, and provide constructive feedback to, team members and other stakeholders.

CS.K-12.2.d	Evaluate and select technological tools that can be used to collaborate on a project.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.
CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
CS.K-12.4.b	Evaluate existing technological functionalities and incorporate them into new designs.

Modifications

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

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

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be considered:

- 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

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- 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

Resources & Materials:

- Project Lead the Way, Introduction to Engineering Design Information
- Walker, Exploring Drafting, II: Goodhart-Wilcox, 1996
- Gradwell & Wekch. Technology, Engineering Our World, IL: Goodhart-Wilcox, 2012