Unit 03: How is the problem going to be solved?

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **FY**
Status: **Published**

Standards Alignment

New Jersey Student Learning Standards

PFL.9.1.12.B	Money Management
PFL.9.1.12.B.6	Design and utilize a simulated budget to monitor progress of financial plans.
SOC.6.1.12.9	Contemporary United States (1970-Today)
SOC.6.1.12.C.16	Economics, Innovation, and Technology
SOC.6.1.12.C.16.a	Evaluate the economic, political, and social impact of new and emerging technologies on individuals and nations.

Integration of Career Readiness, Life Literacies and Key Skills

12.9.3.ST	Science, technology, engineering & mathematics
12.9.3.ST.1	Apply engineering skills in a project that requires project management, process control and quality assurance.
12.9.3.ST.4	Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.
12.9.3.ST.5	Demonstrate an understanding of the breadth of career opportunities and means to those opportunities in each of the Science, Technology, Engineering & Mathematics Career Pathways.
12.9.3.ST-ET	Engineering & Technology Career Pathway
12.9.3.ST-ET.2	Display and communicate STEM information.
12.9.3.ST-ET.4	Apply the elements of the design process.
12.9.3.ST-ET.5	Apply the knowledge learned in STEM to solve problems.
12.9.3.ST-ET.6	Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.
12.9.3.ST-SM	Science & Mathematics Career Pathway
12.9.3.ST-SM.2	Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
12.9.3.ST-SM.3	Analyze the impact that science and mathematics has on society.
12.9.3.ST-SM.4	Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP3	Attend to personal health and financial well-being.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Technology / Integration of Computer Science and Design Thinking

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.A	The Nature of Technology: Creativity and Innovation: Technology systems impact every aspect of the world in which we live.
TECH.8.2.12.A.1	Propose an innovation to meet future demands supported by an analysis of the potential full costs, benefits, trade-offs and risks, related to the use of the innovation.
TECH.8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
TECH.8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
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.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
TECH.8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants.
TECH.8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
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.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

Interdisciplinary Connections: NJSLS for ELA, Social Studies, Science and/or Math Section

LA.K-12.NJSLSA.W	Writing
	Production and Distribution of Writing
LA.K-12.NJSLSA.W4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.K-12.NJSLSA.W5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
LA.K-12.NJSLSA.W6	Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
	Research to Build and Present Knowledge
LA.K-12.NJSLSA.W7	Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.
LA.W.11-12.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
LA.W.11-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, trying a new approach, or consulting a style manual (such as MLA or APA Style), focusing on addressing what is most significant for a specific purpose and audience.
LA.W.11-12.6	Use technology, including the Internet, to produce, share, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
LA.W.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a 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.

Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media LiteracyNew Section

see Crosswalks

21st Century Life and Careers

Stage I: Desired Results

Transfer/Overview/Rationale

Transfer / Overview / Rationale

Unit Rationale

The purpose of this unit…

This unit will allow students to go through a very imperative step that all engineers must got through. Throughout this unit students will be furthering their design proposals by constructing research, developing design constraints, and brainstorming solution ideas.

Meaning

Essential Questions

Essential Questions

- **What are specifications and constraints, and how do they affect the design process and design brief?**
- **What are the benefits of a well-written design brief and how are they used in industry to guide the design process?**
- **What is intellectual property?**
- **How and where can I research and investigate every possible aspect of my problem?**

Enduring Understanding/Indicators of Understanding

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- **Constraints/Limitations dictate boundaries to which the solution must adhere.**
- **Technical writing is objective, clear and concise, using specific vocabulary and structure to describe physical characteristics, properties, or sequential operations related to technical products and systems.**
- **Intellectual property is a term that refers to an work or invention that is a result of creativity. Providing the creator with a set of exclusive rights that are covered under the law.**
- **Research can come from people (interviews), human factor data, or reliable sources.**

Acquisition (Student Learning Objectives)

Knowledge

Knowledge

Students will know…

- **How to research using credible sources.**
- **How to set up constraints and specifications for design project.**
- **How a proper design brief is written.**
- **How to break up the project into different systems/subsystems.**
- **Various brainstorming techniques.**
- **Intellectual property**
  - **Copyrights**
  - **Patents**
  - **Trademarks**
- **Differences between qualitative and quantitative research.**

Skills

Skills

Student will be skilled at …

- **Maintain an individual Engineering Notebook (Website) to document design process and provide reflections.**
- **Create a blog post displaying any research found.**
- **Develop a Gantt chart mapping out the project timeline.**
- **Research the benefits of using a Gantt throughout the design process.**
- **Generate constraints and specifications for the Design brief.**
- **Construct a well written Design Brief/Proposal.**
- **Create a proposed budget sheet mapping out the costs of the project.**
- **Conduct research from credible sources.**
- **Develop a method to use for research related to the design problem and solution topics.**
- **Evaluate and summarize the research and data collection found.**
- **Describe how the compilation of research meets the specification and limitations of the project.**
- **Apply the design process.**
- **Brainstorm various solution ideas.**

Stage 3: Learning Plan

Resource and Mentor Texts

Resources and Mentor Texts

- **TSA Event:** Engineering Design.
- **Website Platform (google sites, wordpress)**
- **Chromebooks/desktops**
- **http://www.techinsider.io/**
- **https://www.kickstarter.com/**
- **http://makezine.com/**

Formative Assessment Strategies

Formative Assessment Strategies

- **Engineering notebooks/websites.**
- **Notebook/websites checks.**
- **Research.**
- **Design sketches.**
- **Twitter board.**
- **Teacher lead questions and discussion.**
- **Peer feedback.**
- **Scale model.**
- **What did we learn chart.**
- **KWL chart.**
- **Daily Design Logs.**
- **Feedback meetings with teacher.**
- **Self evaluations of progress.**
- **Presentation practice.**
- **Thumbs up/down/sideways.**

Learning Activities/Unit of Study

Learning Activities/Unit of Study

- **Do now- students will come in answer a question, take out, log on to the computers.**
- **Discussion and lecture on brainstorming, constraints and research.**
- **Open lab days- students will be working on different parts of their projects (websites, problem statement, research, resume).**

- **Feedback - students will meet with the teacher to receive feedback on each step of the design process before moving forward.**
- **Presentations of progress and ideas- students will present their ideas and progress to the class and receive feedback from their peers.**
- **Working on researching for design projects.**
- **White Board- as a class students will write different ideas on the board to receive feedback.**

Modifications and/or Accommodations

Suggested Modifications (ELL, Sp. Ed, GIfted, At-risk of Failure)

English Language Learners

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how

much time they have to complete an assignment.

Students with 504 Plans

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Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

Modify/Change Activities: Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just

may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.