MOORESTOWN TOWNSHIP PUBLIC SCHOOLS
MOORESTOWN, NEW JERSEY

William Allen Middle School
Arts & Technology: Technology Education

STEM 7

Grade – 7

Date : Jul 8, 2022
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Course Description and Fundamental Concepts

The Middle School's STEM Technology Education courses are a strong component of the school's Exploratory Arts program. Students meet every other day for a semester and explore STEM concepts via an experience oriented and project based curriculum. In STEM 7, students work with various tools and technology to develop their designs from ideation to creation. Students are challenged to think critically, design, and solve problems while utilizing various methods of material processing. The STEM classes also serve as a precursor for the Technology program at the high school.

- Topics include:
    - Engineering and Design Process
    - Electricity and electronics
    - Problem solving
    - Computer Aided Drafting and Design
    - Mechanical advantage
    - Safety and tool usage

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New Jersey Student Learning Standards (NJSLS)

ITEEA Standards for Technological and Engineering Literacy /
NJSLS - Computer Science and Design Thinking

ITEEA Standards for Technological and Engineering Literacy		
Unit Addressed	**Standard #**	**Standard Description**
1,3,4,5,6	**1**	**Nature and Characteristics of Technology and Engineering**
1,2,3,4,5,6	**2**	**Core concepts of Technology and Engineering**
1,3,4,5,6	**3**	**Integration of knowledge, technology, and Practices**
3,4,5,6	**4**	**Impacts of technology**
3,4,5,6	**5**	**Influence of Society on Technology and Engineering Education**
1,6	**6**	**History of Technology**
1,3,4,5,&6	**7**	**Design in technology and engineering education**
2,3,4,5,&6	**8**	**Applying, maintaining, and assessing technological products and systems**
NJSLS - Computer Science and Design Thinking		
Unit Addressed	**Standard #**	**Standard Description**
	8.1.8.CS.1	*Recommend improvements to computing devices in order to improve the ways users interact with the devices.*
6	**8.1.8.CS.2**	*Design a system that combines hardware and software components to process data.*
6	**8.1.8.CS.3**	*Justify design decisions and explain potential system trade-offs.*
6	**8.1.8.CS.4**	*Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.*
	8.1.8.NI.1	*Model how information is broken down into smaller pieces, transmitted as addressed packets through multiple devices over networks and the Internet, and reassembled at the destination.*
	8.1.8.NI.2	*Model the role of protocols in transmitting data across networks and the Internet and how they enable secure and errorless communication.*

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	8.1.8.NI.3	*Explain how network security depends on a combination of hardware, software, and practices that control access to data and systems.*
	8.1.8.NI.4	*Explain how new security measures have been created in response to key malware events.*
	8.1.8.IC.1	*Compare the trade-offs associated with computing technologies that affect individual's everyday activities and career options.*
	8.1.8.IC.2	*Describe issues of bias and accessibility in the design of existing technologies.*
	8.1.8.DA.1	*Organize and transform data collected using computational tools to make it usable for a specific purpose.*
	8.1.8.DA.2	*Explain the difference between how the computer stores data as bits and how the data is displayed.*
	8.1.8.DA.3	*Identify the appropriate tool to access data based on its file format.*
	8.1.8.DA.4	*Transform data to remove errors and improve the accuracy of the data for analysis.*
	8.1.8.DA.5	*Test, analyze, and refine computational models.*
	8.1.8.DA.6	*Analyze climate change computational models and propose refinements.*
	8.1.8.AP.1	*Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode.*
	8.1.8.AP.2	*Create clearly named variables that represent different data types and perform operations on their values*
	8.1.8.AP.3	*Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.*
	8.1.8.AP.4	*Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.*
6	**8.1.8.AP.5**	*Create procedures with parameters to organize code and make it easier to reuse.*
	8.1.8.AP.6	*Refine a solution that meets users' needs by incorporating feedback from team members and users.*
	8.1.8.AP.7	*Design programs, incorporating existing code, media, and libraries, and give attribution.*
	8.1.8.AP.8	*Systematically test and refine programs using a range of test cases and users*
	8.1.8.AP.9	*Document programs in order to make them easier to follow, test, and debug.*

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	8.2.8.ED.1	*Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.*
	8.2.8.ED.2	*Identify the steps in the design process that could be used to solve a problem.*
3,4,5,&6	**8.2.8.ED.3**	*Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).*
	8.2.8.ED.4	*Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.*
1,3,4,5,&6	**8.2.8.ED.5**	*Explain the need for optimization in a design process*
1,4,5,&6	**8.2.8.ED.6**	*Analyze how trade-offs can impact the design of a product.*
1,4,5,&6	**8.2.8.ED.7**	*Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).*
1	**8.2.8.ITH.1**	*Explain how the development and use of technology influences economic, political, social, and cultural issues.*
1	**8.2.8.ITH.2**	*Compare how technologies have influenced society over time*
	8.2.8.ITH.3	*Evaluate the impact of sustainability on the development of a designed product or system.*
	8.2.8.ITH.4	*Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.*
	8.2.8.ITH.5	*Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.*
6	**8.2.8.NT.1**	*Examine a malfunctioning tool, product, or system and propose solutions to the problem.*
	8.2.8.NT.2	*Analyze an existing technological product that has been repurposed for a different function.*
	8.2.8.NT.3	*Examine a system, consider how each part relates to other parts, and redesign it for another purpose.*
	8.2.8.NT.4	*Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product.*
	8.2.8.ETW.1	*Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs.*

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	8.2.8.ETW.2	*Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).*
	8.2.8.ETW.3	*Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.*
	8.2.8.ETW.4	*Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.*
	8.2.8.EC.1	*Explain ethical issues that may arise from the use of new technologies.*
	8.2.8.EC.2	*Examine the effects of ethical and unethical practices in product design and development.*

English Companion Standards

List grade-level appropriate companion standards for History, Social Studies, Science and Technical Subjects (CTE/Arts) 6-12. English Companion Standards are required in these subject/content areas.

Unit Addressed	Standard #	Standard Description
4, 5, 6	**RST.6-8.1**	*Cite specific textual evidence to support analysis of science and technical texts.*
2, 4, 5, 6	**RST.6-8.2**	*Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.*
1, 3, 4,5,6	**RST.6-8.3**	*Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.*
1, 2, 3, 4, 5, 6	**RST.6-8.4**	*Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.*
4, 6	**RST.6-8.5**	*Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.*
4	**RST.6-8.7**	*Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).*
4, 5, 6	**RST.6-8.9**	*Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.*
4, 5, 6	**RST.6-8.10**	*By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.*

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Career Awareness, Exploration, Preparation, and Training (Standard 9.2)
List appropriate units below for which standards will be addressed

By Grade 8		
Unit Addressed	**Core Idea**	**Standard / Description**
1,3, 4, 5, 6	An individual's strengths, lifestyle goals, choices, and interests affect employment and income	***9.2.8.CAP.1****: Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.* ***9.2.8.CAP.2****: Develop a plan that includes information about career areas of interest.* ***9.2.8.CAP.3****: Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.* ***9.2.8.CAP.4****: Explain how an individual's online behavior (e.g., social networking, photo exchanges, video postings) may impact opportunities for employment or advancement.*
	Developing and implementing an action plan is an essential step for achieving one's personal and professional goals.	***9.2.8.CAP.5****: Develop a personal plan with the assistance of an adult mentor that includes information about career areas of interest, goals and an educational plan.*
	Early planning can provide more options to pay for postsecondary training and employment.	***9.2.8.CAP.6****: Compare the costs of postsecondary education with the potential increase in income from a career of choice.* ***9.2.8.CAP.7****: Devise a strategy to minimize costs of postsecondary education.* ***9.2.8.CAP.8****: Compare education and training requirements, income potential, and primary duties of at least two jobs of interest.* ***9.2.8.CAP.9****: Analyze how a variety of activities related to career preparation (e.g., volunteering, apprenticeships, structured learning experiences, dual enrollment, job search, scholarships) impacts postsecondary options.*
	There are a variety of resources available to help navigate the career planning process.	***9.2.8.CAP.10****: Evaluate how careers have evolved regionally, nationally, and globally.*

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		9.2.8.CAP.11*: Analyze potential career opportunities by considering different types of resources, including occupation databases, and state and national labor market statistics.* ***9.2.8.CAP.12****: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential.*
	Employee benefits can influence your employment choices.	***9.2.8.CAP.13****: Compare employee benefits when evaluating employment interests and explain the possible impact on personal finances.* ***9.2.8.CAP.14****: Evaluate sources of income and alternative resources to accurately compare employment options.*
	Communication skills and responsible behavior in addition to education, experience, certifications, and skills are all factors that affect employment and income	***9.2.8.CAP.15****: Present how the demand for certain skills, the job market, and credentials can determine an individual's earning power.* ***9.2.8.CAP.16****: Research different ways workers/ employees improve their earning power through education and the acquisition of new knowledge and skills.* ***9.2.8.CAP.17****: Prepare a sample resume and cover letter as part of an application process.* ***9.2.8.CAP.18****: Explain how personal behavior, appearance, attitudes, and other choices may impact the job application process.* ***9.2.8.CAP.19****: Relate academic achievement, as represented by high school diplomas, college degrees, and industry credentials, to employability and to potential level*
	There are resources to help an individual create a business plan to start or expand a business.	***9.2.8.CAP.20****: Identify the items to consider when estimating the cost of funding a business.*

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Life Literacies and Key Skills (Standard 9.4)
List appropriate units below for which standards will be addressed

By Grade 8		
Unit Addressed	**Core Idea**	**Standard / Description**
3, 4, 5, 6	**Creativity and Innovation**: Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.	***9.4.8.CI.1****: Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).* ***9.4.8.CI.2****: Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).* ***9.4.8.CI.3****: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).* ***9.4.8.CI.4****: Explore the role of creativity and innovation in career pathways and industries*
3, 4, 5, 6	**Critical Thinking and Problem-solving:** Multiple solutions often exist to solve a problem.	***9.4.8.CT.1****: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).* ***9.4.8.CT.2****: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).*
3, 4, 5, 6	**Critical Thinking and Problem-solving:** An essential aspect of problem solving is being able to self-reflect on why possible solutions for solving problems were or were not successful.	***9.4.8.CT.3:*** *Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.*
	Digital Citizenship: Detailed examples exist to illustrate crediting others when incorporating their digital artifacts in one's own work.	***9.4.8.DC.1****: Analyze the resource citations in online materials for proper use.* ***9.4.8.DC.2****: Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8).*

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	Digital Citizenship: There are tradeoffs between allowing information to be public and keeping information private and secure.	***9.4.8.DC.3****: Describe tradeoffs between allowing information to be public (e.g., within online games) versus keeping information private and secure.*
	Digital Citizenship: Digital footprints are publicly accessible, even if only shared with a select group. Appropriate measures such as proper interactions can protect online reputations.	***9.4.8.DC.4****: Explain how information shared digitally is public and can be searched, copied, and potentially seen by public audiences.* ***9.4.8.DC.5****: Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.* ***9.4.8.DC.6****: Analyze online information to distinguish whether it is helpful or harmful to reputation.*
6	**Digital Citizenship:** Digital communities are used by individuals to share information, organize, and engage around issues and topics of interest.	***9.4.8.DC.7****: Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.*
	Digital Citizenship: Digital technology and data can be leveraged by communities to address effects of climate change.	***9.4.8.DC.8****: Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).*
	Global and Cultural Awareness: Awareness of and appreciation for cultural differences is critical to avoid barriers to productive and positive interaction.	***9.4.8.GCA.1:*** *Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).* ***9.4.8.GCA.2:*** *Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.*
	Information and Media Literacy: Increases in the quantity of information available through electronic means have heightened the need to check sources for possible distortion, exaggeration, or misrepresentation.	***9.4.8.IML.1****: Critically curate multiple resources to assess the credibility of sources when searching for information.* ***9.4.8.IML.2****: Identify specific examples of distortion, exaggeration, or misrepresentation of information.*

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	Information and Media Literacy: Digital tools make it possible to analyze and interpret data, including text, images, and sound. These tools allow for broad concepts and data to be more effectively communicated.	***9.4.8.IML.3****: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping (e.g., 6.SP.B.4, 7.SP.B.8b).* ***9.4.8.IML.4****: Ask insightful questions to organize different types of data and create meaningful visualizations.* ***9.4.8.IML.5****: Analyze and interpret local or public data sets to summarize and effectively communicate the data.*
	Information and Media Literacy: The mode of information can convey a message to consumers or an audience.	***9.4.8.IML.6:*** *Identify subtle and overt messages based on the method of communication.*
	Information and Media Literacy: Sources of information are evaluated for accuracy and relevance when considering the use of information.	***9.4.8.IML.7****: Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).* ***9.4.8.IML.8****: Apply deliberate and thoughtful search strategies to access high-quality information on climate change (e.g., 1.1.8.C1b).*
	Information and Media Literacy: There are ethical and unethical uses of information and media.	***9.4.8.IML.9:*** *Distinguish between ethical and unethical uses of information and media (e.g., 1.5.8.CR3b, 8.2.8.EC.2).* ***9.4.8.IML.10:*** *Examine the consequences of the uses of media (e.g., RI.8.7).* ***9.4.8.IML.11:*** *Predict the personal and community impact of online and social media activities*
3, 4, 5, 6	**Information and Media Literacy:** There is a need to produce and publish media that has information supported with quality evidence and is intended for authentic audiences.	***9.4.8.IML.12:*** *Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.* ***9.4.8.IML.13:*** *Identify the impact of the creator on the content, production, and delivery of information (e.g., 8.2.8.ED.1)****.*** ***9.4.8.IML.14:*** *Analyze the role of media in delivering cultural, political, and other societal messages.* ***9.4.8.IML.15:*** *Explain ways that individuals may experience the same media message differently.*

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1, 3, 4, 5, 6	**Technology Literacy:** Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.	***9.4.8.TL.1****: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.* ***9.4.8.TL.2****: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).* ***9.4.8.TL.3****: Select appropriate tools to organize and present information digitally.* ***9.4.8.TL.4****: Synthesize and publish information about a local or global issue or event (e.g., MSLS4-5, 6.1.8.CivicsPI.3).*
1, 3, 4, 5, 6	**Technology Literacy:** Digital tools allow for remote collaboration and rapid sharing of ideas unrestricted by geographic location or time.	***9.4.8.TL.5****: Compare the process and effectiveness of synchronous collaboration and asynchronous collaboration.* ***9.4.8.TL.6****: Collaborate to develop and publish work that provides perspectives on a real-world problem.*

Interdisciplinary Connections (2020 NJSLS)
List any other content standards addressed as well as appropriate units. All arts integration connections may be listed within this chart.

Visual & Performing Arts Integration (Standard 1)
List appropriate units below for which standards (1.1 through 1.5) may be addressed

Unit Addressed	Artistic Process	Anchor Standard
3, 4, 5, 6	**Creating**	*Anchor Standard 1: Generating and conceptualizing ideas.* *Anchor Standard 2: Organizing and developing ideas.* *Anchor Standard 3: Refining and completing products.*
3, 4, 5, 6	**Connecting**	*Anchor Standard 10: Synthesizing and relating knowledge and personal experiences to create products.* *Anchor Standard 11: Relating artistic ideas and works within societal, cultural, and historical contexts to deepen understanding.*
1, 3, 4, 5, 6	**Performing/ Presenting/ Producing**	*Anchor Standard 4: Selecting, analyzing, and interpreting work.* *Anchor Standard 5: Developing and refining techniques and models or steps needed to create products.* *Anchor Standard 6: Conveying meaning through art.*

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4, 5, 6	**Responding**	*Anchor Standard 7: Perceiving and analyzing products.* *Anchor Standard 8: Applying criteria to evaluate products.* *Anchor Standard 9: Interpreting intent and meaning.*

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Pacing Guide (All Dates are approximate based on the school calendar)

Unit/ Topic	Month (w/Approx number of Teaching Days)
(1) Introduction Unit : Design Process and Docum Documentation review. (spiraling unit) (2) Safety Review : General safety, hand tool safety, machine safety review (spiraling unit)	September/ February (~10 days)
(3) Computer Aided Design (CAD)	October/ March (~10 days)
(4) Structural/Civil Engineering	November/ April (~8 days)
(5) Simple Machines and tool usage	December/ May (~7days)
(6) Robotics	January/ June (~10 days)

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Units

Unit Name: Introduction Unit (1) : Design Process and Documentation review

Learning Goals: What do I want my students to learn?

Standards

NJSLS Computer Science & Design Thinking
ITEEA Technological & Engineering Literacy
NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- What is the formal process for designing solutions or new products? How often can engineers go through the process? How can individuals, companies, and society use the design process? Find a problem, come up with ideas to solve the problem, collaborate about potential effectiveness of the proposed solutions, pick the best one, make that solution, test it, and evaluate how well it solved the problem. Then repeat this process again to continue to remove the initial problem and improve the solution.
- Why document your work and ideas? What is the best way to document them? Documenting work allows for the examination of work and the repeatability of experimental design which has similarities to other content areas but has importance in the engineering world.
- Established design principles are used to evaluate existing design, to collect data, and to guide the design process. The principles include: flexibility, balance, function, and proportion.
- Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
- A prototype is a working model that is used to test a design concept by making actual observations and necessary adjustments.
- An engineer must not only design a product that works—s/he must consider many other factors, such as safety, environmental concerns, ethical considerations, and risks and benefits.

Learning Objectives

Students will be able to…

- The student will demonstrate systems thinking through the completion of a small introduction activity which will be made evident through the development portions of the project documentation.
- The student will develop creativity in design thinking and application through the development and implementation of multiple design techniques and ideas throughout the unit which will be made evident through the development portions of the project documentation.
- The student will build skills in the area of the design process and documentation through the completion of a small introduction activity
- The student will demonstrate critical thinking through the development of unique and original design based ideas which will be further implemented to meet a set of design requirements that are presented to the student and further analyzed by them. :
- Students will engage in written documentation of their work including design development and testing of student developed work.
- Explain how the world around them guides technological development and engineering design.
- Assess how similarities and differences among scientific, mathematics, engineering, and technological knowledge and skills contributed to the design of a product or system.
- Conduct research to inform intentional inventions and innovations that address specific needs and wants.
- Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.

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- Determine the best approach by evaluating the purpose of the design.
- Document trade-offs in the technology and engineering design process to produce the optimal design.
- Optimize a design by addressing desired qualities within criteria and constraints.
- Illustrate principles,elements and factors of design.
- Implement the best possible solution to a design.
- Apply a broad range of design skills to their design process.

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Unit Name: Safety Review (2) : General safety, hand tool safety, machine safety review

Learning Goals: What do I want my students to learn?

Standards

NJSLS Computer Science & Design Thinking
ITEEA Technological & Engineering Literacy
NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- What are safe practices when working in a lab or workshop?
- What safety equipment should you use? Do you use the same safety equipment for all tools?
- Safety is a fundamental responsibility of everyone in the technology laboratory at all times. Just because you might not be using a tool does not mean you do not need to be vigilant. To work safely, one must be constantly acting in accordance with safety procedures.
- All safety procedures must be followed at all times and safety assessments must be passed with 100% accuracy.
- A prototype is a working model that is used to test a design concept by making actual observations and necessary adjustments.
- An engineer must not only design a product that works—s/he must consider many other factors, such as safety, environmental concerns, ethical considerations, and risks and benefits.

Learning Objectives

Students will be able to…

- The student will demonstrate proper machine and tool usage at all times.
- The student will build skills in the area of tools and machine safety procedures through the completion of tutorial and safety assessments.

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Unit 3: Communicating and Brainstorming with Computer Aided Design (CAD)

Learning Goals: What do I want my students to learn?

Standards

NJSLS Computer Science & Design Thinking
ITEEA Technological & Engineering Literacy
NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- There are a variety of computer aided design programs available. 3D modeling, like 2D paper drawings, help engineers communicate ideas, but 3D models can convey significantly more information and detail.
- Established design principles are used to evaluate existing design, to collect data, and to guide the design process. The principles include: flexibility, balance, function, and proportion.
- Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

Learning Objectives

Students will be able to…

- The student will demonstrate systems thinking through the development of a 3D modeling activity which will be made evident through the development portions of the project documentation.
- The student will develop creativity in design thinking and application through the development and implementation of multiple design techniques and ideas throughout the unit which will be made evident through the development portions of the project documentation.
- The student will build skills in the area of Computer Aided Design, dimensioning, ideation, and presentation skills through the development of a digital model that could be used to make a physical prototype.
- The student will demonstrate critical thinking through the development of unique and original design based ideas which will be further implemented to meet a set of design requirements that are presented to the student and further analyzed by them.

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Unit 4: Structural Engineering (static load)

Learning Goals: What do I want my students to learn?

Standards

NJSLS Computer Science & Design Thinking
ITEEA Technological & Engineering Literacy
NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- There are a variety of structures throughout the world. Each structure had a reason for its construction, whether it be culturally or religiously important or if it was necessary to access important resources.
- Bridges and buildings come in many different shapes and sizes. The unique combination of design choices of each structure is dependent on the individual(s) assembling it, where it is located in the world (i.e. geographic considerations like fault lines, mountains, waterways, borders, etc.), weather conditions it will withstand (i.e. extended sun, potential natural diasters, etc.), and the use of the structure.
- It is more important to have a plan for how to build the structure to ensure it will accomplish its task for an extended period of time. The plan includes the materials and reason behind the materials chosen (i.e. sustainable, strength, cost, etc.) and the final shape of the structure as well as how each material is used/combined to make the structure.
- Established design principles are used to evaluate existing design, to collect data, and to guide the design process. The principles include: flexibility, balance, function, and proportion.
- Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
- A prototype is a working model that is used to test a design concept by making actual observations and necessary adjustments.
- An engineer must not only design a product that works—s/he must consider many other factors, such as safety, environmental concerns, ethical considerations, and risks and benefits.

Learning Objectives

Students will be able to…

- The student will demonstrate systems thinking through the development of a physical structure which will be made evident through the development portions of the project documentation.
- The student will develop creativity in design thinking and application through the development and implementation of multiple design techniques and ideas throughout the unit which will be made evident through the development portions of the project documentation.
- The student will build skills in the area of structural engineering, dimensioning, ideation, presentation skills, materials processing, assembly techniques, and testing through the development of a physical prototype which will be tested against the design constraints.

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Unit 5: Simple Machines and tool usage

Learning Goals: What do I want my students to learn?

Standards

NJSLS Computer Science & Design Thinking
ITEEA Technological & Engineering Literacy
NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- Simple machines and fundamental mechanical devices along with electrical components make up the majority of the tools and complex machinery we take for granted in the 21st century technological world. The unique combination of these mechanisms is what makes new devices that make things easier, faster, more reliable, and overall better for us.
- Engineers solve problems by breaking down the issue into the simple tasks that need to be accomplished. From there, they can brainstorm mechanisms to use as well as the materials and processes to use to make the product that will solve the previously identified problem. The fewer moving parts, the more "elegant" the solution and most likely the more "robust" it will be (i.e. last longer, handle a wider variety of fringe situations, etc).
- Established design principles are used to evaluate existing design, to collect data, and to guide the design process. The principles include: flexibility, balance, function, and proportion.
- Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
- A prototype is a working model that is used to test a design concept by making actual observations and necessary adjustments.

Learning Objectives

Students will be able to…

- The student will demonstrate systems thinking through the development of a plan and physical prototype which will be made evident through the development portions of the project documentation.
- The student will develop creativity in design thinking and application through the development and implementation of multiple design techniques and ideas throughout the unit which will be made evident through the development portions of the project documentation.
- The student will build skills in the area of Computer Aided Design and/or technical drawing, dimensioning, ideation, presentation skills, materials processing, and assembly techniques through the development of a physical prototype which will be tested for effectiveness.
- The student will demonstrate critical thinking through the development of unique and original design based ideas which will be further implemented to meet a set of design requirements that are presented to the student and further analyzed by them.

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Unit 6: Robotics

Learning Goals: What do I want my students to learn?

Standards

NJSLS Computer Science & Design Thinking
ITEEA Technological & Engineering Literacy
NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- There is an endless list of uses for robots. From household vacuums to car assembly lines, robots make monotonous and dangerous tasks a thing of the past for humans.
- Robots do not design and build themselves - yet - so that's where engineers come in. Engineers need to identify how they can build the structure of the robot to withstand whatever circumstances it will encounter, make it mobile enough to maneuver/accomplish tasks as desired, and be programmed to handle any situation thrown its way.
- Established design principles are used to evaluate existing design, to collect data, and to guide the design process. The principles include: flexibility, balance, function, and proportion.
- Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
- A prototype is a working model that is used to test a design concept by making actual observations and necessary adjustments.
- An engineer must not only design a product that works—s/he must consider many other factors, such as safety, environmental concerns, ethical considerations, and risks and benefits.

Learning Objectives

Students will be able to…

- The student will demonstrate systems thinking through the development of a robotic system which will be made evident through the development portions of the project documentation.
- The student will develop creativity in design thinking and application through the development and implementation of multiple design techniques and ideas throughout the unit which will be made evident through the development portions of the project documentation.
- The student will build skills in the area of robotics, building, dimensioning, ideation, presentation skills, and troubleshooting through the development of a physical prototype which will be tested and improved.
- The student will demonstrate critical thinking through the development of unique and original design based ideas which will be further implemented to meet a set of design requirements that are presented to the student and further analyzed by them.

Please contact the content supervisor for any questions.

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