SCHOOL DISTRICT OF THE CHATHAMS

Design & Technology
Grade 4
Full Year

Course Overview

The essential intent of the School District of the Chathams' Design & Technology program is to empower students to think critically and creatively to develop innovative solutions to problems present in our modern world. Our Design & Technology program is a nationally award winning and comprehensive program that enables our students to engage in authentic problem solving, collaboration, innovation, and critical thinking, while developing creativity and perseverance. Students gain proficiency in the application of relevant grade 4 mathematics, science, technology, and engineering concepts while engaging in the development of solutions to problems through hands-on, collaborative, project-based learning utilizing the Engineering Design and Design Thinking Processes.

New Jersey Student Learning Standards
The New Jersey Student Learning Standards (NJSLS) can be located at www.nj.gov/education/cccs/2020/.

Engineering Design
8.2.5.ED.1: Explain the functions of a system and its subsystems.
8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
8.2.5.ED.4: Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints).
8.2.5.ED.5: Describe how specifications and limitations impact the engineering design process.
8.2.5.ED.6: Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process.

Interaction of Technology & Humans
8.2.5.ITH.1: Explain how societal needs and wants influence the development and function of a product and a system.
8.2.5.ITH.3: Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use.
8.2.5.ITH.4: Describe a technology/tool that has made the way people live easier or has led to a new business or career.

Nature of Technology
8.2.5.NT.1: Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem.
8.2.5.NT.2: Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies.

Effects of Technology on the Natural World

8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources.

8.2.5.ETW.4: Explain the impact that resources, such as energy and materials used to develop technology, have on the environment.

8.2.5.ETW.5: Identify the impact of a specific technology on the environment and determine what can be done to increase positive effects and to reduce any negative effects, such as climate change.

Ethics and Culture

8.2.5.EC.1: Analyze how technology has contributed to or reduced inequities in local and global communities and determine its short- and long-term effects.

Technology Standards

9.4.5.TL.3: Format a document using a word processing application to enhance text, change page formatting, and include appropriate images, graphics, or symbols.

9.4.5.TL.5: Collaborate digitally to produce an artifact.

9.4.5.IML.2: Create a visual representation to organize information about a problem or issue.

9.4.5.IML.3: Represent the same data in multiple visual formats in order to tell a story about the data.

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Creativity & Innovation

9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions.

9.4.5.CI.2: Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue.

9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity.

9.4.5.CI.4: Research the development process of a product and identify the role of failure as a part of the creative process.

Critical Thinking & Problem-Solving

9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process.

9.4.5.CT.2: Identify a problem and list the types of individuals and resources that can aid in solving the problem (e.g., school, community agencies, governmental, online).

9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.

9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems (e.g., personal, academic, community, global).

Career Ready Practices

CRP2. Apply appropriate academic and technical skills

CRP4. Communicate clearly and effectively and with reason

CRP5. Consider the environmental, social and economic impacts of decisions

CRP6. Demonstrate creativity and innovation.

CRP7. Employ valid and reliable research strategies

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them

CRP11. Use technology to enhance productivity

CRP12. Work productively in teams while using cultural global competence

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Interdisciplinary Connections

Comprehensive Health & Physical Education
- 2.1.5.EH.1: Discuss the impact of one's feelings and thoughts that lead to healthy and unhealthy behaviors.
- 2.1.5.EH.2: Explain how to cope with difficult learning situations.
- 2.1.5.EH.3: Identify different feelings and emotions that people may experience and how they might express these emotions.
- 2.1.5.EH.4: Identify behaviors that help to deal with difficult situations that can occur in school.
- 2.1.5.SSH.3: Demonstrate ways to promote dignity and respect for all people.
- 2.1.5.CHSS.3: Describe strategies that are useful for individuals who are feeling sadness, anger, anxiety, or stress.
- 2.2.5.MSC.1: Demonstrate body management skills and control when moving in relation to others, objects, and boundaries in personal and general space.
- 2.2.5.MSC.6: Execute appropriate behaviors and etiquette while participating and viewing as an observer.
- 2.2.5.PF.2: Accept and respect others of all skill levels and abilities during participation.
- 2.3.5.PS.4: Develop strategies to safely communicate through digital media with respect.
- 2.3.5.PS.5: Communicate personal boundaries and demonstrate ways to respect other people's personal boundaries.

Science
- 3-5-ETS1-1 - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3 - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- 4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- 4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
- 4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes and climate change have on humans.

Social Studies
- 6.1.5.CivicsPI.1: Describe ways in which people benefit from and are challenged by working together.
- 6.1.5.CivicsPD.3: Explain how and why it is important that people from diverse cultures collaborate to find solutions to community, state, national, and global challenges.
- 6.1.5.CivicsPR.1: Compare procedures for making decisions in a variety of settings.
- 6.1.5.CivicsPR.3: Evaluate school and community rules, laws and/or policies and determine if they meet their intended purpose.
- 6.1.5.CivicsCM.3: Identify the types of behaviors that promote collaboration and problem solving with others who have different perspectives.
- 6.1.5.GeoPP.2: Describe how landforms, climate and weather, and availability of resources have impacted where and how people live and work in different regions of New Jersey and the United States.
- 6.1.5.EconET.1: Identify positive and negative incentives that influence the decisions people make.
- 6.1.5.EconET.2: Use quantitative data to engage in cost benefit analyses of decisions that impact the individual and/or community.

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- 6.1.5.EconGE.2: Explain how creativity and innovation resulted in scientific achievement and inventions in many cultures during different historical periods.
- 6.1.5.EconGE.4: Compare and contrast how the availability of resources affects people across the world differently.
- 6.3.5.CivicsPD.3: Propose a solution to a local issue after considering evidence and the perspectives of different groups, including community members and local officials.
- 6.3.5.GeoHE.1: Plan and participate in an advocacy project to inform others about the impact of climate change at the local or state level and propose possible solutions.
- 6.3.5.GeoGI.1: Use technology to collaborate with others who have different perspectives to examine global issues, including climate change and propose possible solutions.

Visual and Performing Arts
- 2.5.5.CR1a: Brainstorm and curate ideas to innovatively problem solve during artmaking and design projects.
- 2.5.5.CR3b: Demonstrate craftsmanship through the safe and respectful use of materials, tools and equipment

English Language Arts
- NJSLSA.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
- NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence
- RI.4.4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.
- RI.4.5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text
- RI.4.7. Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
- 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.
- NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
- W.4.4. Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.
- W.4.6. With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting.
- W.4.7. Conduct short research projects that build knowledge through investigation of different aspects of a topic.
- W.4.8. Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
- NJSLSA.SL1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
- NJSLSA.SL2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

- NJSLSA.SL5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

<u>Mathematics</u>
- 4.MD A. Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit
- 4.MD B. Represent and interpret data.
- 4.MD C. Geometric measurement: understand concepts of angle and measure angles.
- 4.G A. Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

Units of Study

Unit 1: Zip Line Design *(~10 days)*
- How do gravity and friction affect design?
- Why is it useful or important to determine how fast an object is moving towards the ground?
- How can you manipulate the speed of an object to ensure the safety and enjoyability of the object/passengers?

Unit 2: Solar Energy *(~10 days)*
- What is solar energy and how can it be harnessed?
- What makes energy "renewable?"
- What are the benefits and detriments to solar energy?
- What are various design considerations an engineer must consider when designing with solar energy?
- On a local and global scale, what effects could solar power have on the environment?

Unit 3: Wind Energy *(~10 days)*
- What is wind energy and how can it be harnessed?
- What makes energy "renewable?"
- What are the benefits and detriments to wind energy?
- What are various design considerations an engineer must consider when designing with solar energy?
- On a local and global scale, what effects could wind power have on the environment?

Unit 4: Computer Aided Design (CAD) *(~10 days)*
- How is computer technology used to create designs and to effectively communicate ideas?
- How can CAD be used in engineering design and problem solving?
- How can I communicate my design ideas clearly and efficiently?
- How does an object go from an idea to a 3-dimensional, physical object?
- How has (or can) CAD impact the field of engineering and design?

Unit 5: Circuitry *(Extension Unit)*
- How does electricity work and how can we harness it to complete some of our day-to-day tasks?
- What are electrons, conductors, and insulators and how do they interact to create a working circuit and way to power some of our household items?

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Learning Objectives/Discipline Standards of Practice

Learning Objectives:
- Individually or collaboratively create two and three-dimensional models employing the elements and principles of the subject material
- Distinguish pros and cons of different sketches and models.
- Recognize and use various media and materials to represent different models or possible solutions.
- Employ appropriate vocabulary for such categories as solar energy, wind energy, and computer modeling.
- Students will be able to use basic Solar Energy vocabulary while discussing models.
- Students will be able to use basic Wind Energy vocabulary while discussing models.
- Students will be able to use basic 3D printing vocabulary while creating and discussing models.
- Design and describe an object that solves a selected problem.
- Apply the engineering design process to solve a problem.
- Analyze results to figure out how materials and forces affect the design of a zip line transportation/carrying system.
- Analyze results to figure out how materials and weather conditions affect the design of a solar home.
- Analyze results to figure out how materials and weather conditions affect the design of a sail/wind propelled car.
- Reflect on ways to improve an idea or design.
- Engage in scientific reasoning to predict and understand findings.
- Utilize Computer Aided Design (CAD) software to design a customized item that can be fabricated using the 3D printer.
- Explain how CAD and 3D printing can be used in real-world scenarios.
- Explain how conductors and insulators work with regards to circuitry.
- Investigate with various materials to determine which are conductors and which are insulators and determine how each will affect their circuit design..
- Engage in scientific reasoning to predict and understand findings.
- Reflect on ways to improve the idea
- Apply knowledge of electrons, conductors, insulators and circuits use the Makey Makey board to play different computer games.

Discipline Standards of Practice:
- Computing Systems
  - People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.
- Networks and the Internet
  - Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world.
- Impacts of Computing
  - Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their

behaviors and cultural and social interactions, and, in turn, computing influences new cultural practices.
- Data & Analysis
  - Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.
- Algorithms & Programming
  - An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.
- Engineering Design
  - People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.
- Interaction of Technology and Humans
  - Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.
- Nature of Technology
  - Human population, patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.
- Effects of Technology on the Natural World
  - Many of engineering and technology's impacts on society and the environment are widely regarded as desirable. However, other impacts are regarded as less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.
- Ethics & Culture
  - Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.

Instructional Resources and Materials
Whole class resources have been identified with an asterisk.

Resources
- ITEEA's Engineering byDesign™ Program
- Engineering is Elementary (Museum of Science, Boston)
- STEM folders and notebooks *

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- Lesson Resources: *
  - Solar Energy Defenders
  - Google SketchUp or TinkerCAD
  - Solar Energy Review Video
  - Solar Energy: 1st Slide is Questionnaire Review

Materials
- Building/Modeling Materials: *
  - Stopwatch
  - Ruler
  - Yarn
  - Scissors
  - Hole Puncher
  - Wind Energy Science Kit
  - 3D Printer
  - Filament
  - Makey Makey Boards
  - Ping Pong Ball
  - Plastic Straws
  - Cups
  - Cardboard Tubes
  - Construction Paper
  - Pipe Cleaners
  - Solar Panel
  - Glue Stick
  - Masking Tape
  - Popsicle Sticks
  - Aluminum Foil
  - Rubber Bands
  - Paper Clips
  - Graph Paper
  - Water Bottles
  - Little Suns
  - Toilet Paper Tubes
  - Paper Plates
  - Axles

Assessment Strategies
Assessment is designed to measure a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes (formative assessment) and for evaluative purposes (summative assessment).

The following is a general list of the many forms assessment may take in learning.
- Projects
- Unit Assessments

Course Specific Assessments Include:

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- Formative:
  - EDP Self-Guided Checklists
  - Engineering Notebook Review/Student Work Samples
    - Components of Engineering Notebook & Planning:
      - Question/Problem
      - Predictions
      - Materials
      - Procedures
      - Observations
      - Ideas
      - Data
      - Drawings
      - Conclusions

  - Peer Feedback: TAG (Tell, Ask, Give) Sticky Notes
  - Peer Feedback Form
  - Self-Reflection: 2 Stars & 1 Wish
  - Design Challenge Self-Assessment
  - Critique Guide
  - Reflective Exit Tickets/Slips

Summative:
- Zip Line Design Challenge
  - Students will build carriers that can safely transport a ping pong ball from a height down to the ground.
- Solar Energy
  - Students will design and build models of homes that run on Solar Energy.
- Wind Energy
  - Students will design Sail Cars that capitalize on the benefits of Wind Energy.
- Computer Aided Design (CAD) & 3D Printing
  - Students will create and design a 3D model of a key chain to be printed and taken home.
- Circuitry
  - Students will understand the flow of electricity and how circuits work.