

# SCHOOL DISTRICT OF THE CHATHAMS

## Design & Technology

Grade 5

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 5 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/](http://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.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.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.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.

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

8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved.

### Computing Systems

8.1.5.CS.1: Model how computing devices connect to other components to form a system.

8.1.5.CS.2: Model how computer software and hardware work together as a system to accomplish tasks.

### Data & Analysis

8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.

### Algorithms & Programming

8.1.5.AP.1: Compare and refine multiple algorithms for the same task and determine which is the most appropriate.

8.1.5.AP.2: Create programs that use clearly named variables to store and modify data.

8.1.5.AP.3: Create programs that include sequences, events, loops, and conditionals.

8.1.5.AP.4: Break down problems into smaller, manageable sub-problems to facilitate program development.

8.1.5.AP.6: Develop programs using an iterative process, implement the program design, and test the program to ensure it works as intended

### 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.

### 21st Century Integration | NJSL 9

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.

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.

CRP6. Demonstrate creativity and innovation

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

CRP11. Use technology to enhance productivity.

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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 (e.g., anger, fear, happiness, sadness, hopelessness, anxiety).
- 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.
- 5-PS1-3 Make observations and measurements to identify materials based on their properties.
- 5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down.

### **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.GeoHE.2: Cite examples of how technological advances have changed the environment in New Jersey and the United States (e.g., energy, transportation, communications).
- 6.1.5.EconGE.2: Explain how creativity and innovation resulted in scientific achievement and inventions in many cultures during different historical periods.
- 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.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.5.4. Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.
- RI.5.7. Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- 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.5.4. Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.
- W.5.6. With some guidance and support from adults and peers, 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 two pages in a single sitting.
- W.5.7. Conduct short research projects that use several sources to build knowledge through investigation of different perspectives of a topic.
- W.5.8. Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, 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.

### Mathematics

- 5.OA A. Write and interpret numerical expressions
- 5.OA B. Analyze patterns and relationships.
- 5.MD B. Represent and interpret data.
- 5.G A. Graph points on the coordinate plane to solve real-world and mathematical problems.

## Units of Study

### Unit 1: Designing for Safety (~10 days)

- How does gravity affect our world?
- How do forces neutralize each other?
- How do air resistance and gravity affect the design?
- How can you manipulate the speed of an object to ensure the safety and enjoyability of the object/passengers?

### Unit 2: Bridge & Infrastructure Design (~10 days)

- What forces act on bridges and what adjustments can you make to ensure a safe and strong bridge design?
- How do engineers manipulate forces to ensure bridge designs can hold a specified load/weight?
- What basic shapes are strong and how can they be manipulated to ensure strong structural designs?

### Unit 3: Air Transportation Vehicle Design (~10 days)

- What forces act on air transportation vehicles and what adjustments can you make to ensure a safe design that will travel a specific distance?
- How can we use measurements to find out other missing information?
- How do forces oppose/counteract each other?

### Unit 4: Coding & Humanoid Robotics (~10 days)

- What is computational thinking and what role does it play in our day-to-day lives?
- What does it mean to be autonomous and how can something become autonomous?
- How does a computer program make its way to an object or robot (inputs & outputs)?
- What are some real world uses for coding and robotics?

## 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 safety, vehicle, and bridge design.
- Design and describe an object that solves an identified problem.
- Apply the engineering design process to solve a problem.
- Analyze results to figure out how materials and forces affect the design of a transportation/carrying system.
- Reflect on ways to improve an idea or design.
- Engage in scientific reasoning to predict and understand findings.
- Analyze results to figure out how materials and forces affect the design of an air transportation vehicle.
- Analyze results to figure out how materials and weather conditions affect the design of a bridge/transportation system.
- Reflect on ways to improve an idea or design.

- Engage in scientific reasoning to predict and understand findings.
- Explain real-world applications of computational thinking, coding, and robotics.
- Explain how a computer takes inputs, processes, and commands in order to reach an intended output.
- Use a simple, block-based coding software to create a simple program (using loops, events, and procedures) to control a humanoid robot, keeping proper order/sequence in mind.

### 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 \*
- Lesson Resources: \*
  - Rocket Launch Simulation
  - Egg Drop Video
  - What Makes Bridges So Strong? Video
  - NAO Instructions
  - Stomp Rocket Video 1
  - Stomp Rocket Video 2

#### **Materials**

- Building/Modeling Materials: \*
  - Brown Bags
  - Toothpicks
  - Yarn
  - Paper Clips
  - Plastic Straws
  - Coffee Filters
  - Tape
  - Cotton Balls
  - Pipe Cleaners
  - Rubber Bands
  - Balloons
  - Water Bottles
  - Streamers
  - Construction Paper
  - Wax Paper
  - Foam Core
  - Jumbo Popsicle Sticks

## 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:

- 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:
  - Designing for Safety
    - Students will design and build egg transportation vehicles that can safely transport an egg to the ground without any damage.
  - Bridge Design
    - Students will design and create a bridge focusing on the concepts of span, compression, tension and load.
  - Air Transportation Vehicle Design
    - Students will design and create an air transportation vehicle, such as a rocket, focusing on material selection, as well as the concepts of air resistance, and drag.
  - Coding & Humanoid Robotics
    - Students will engage in block based computer programming, focusing on computational thinking, to program the humanoid robots to move and interact with the outside environment.