SCHOOL DISTRICT OF THE CHATHAMS
CURRICULUM

CONTENT AREA(S): Design & Technology **GRADE LEVEL(S):** 6th Grade

COURSE: Creative Problem Solving *(formerly iSTEM)* **TIME FRAME:** Quarterly (39-40 days)

I. Course Overview

Using a variety of tools that will foster self-reflection and decision making, each student will be encouraged to take risks, make mistakes and imagine ideas to solve a variety of challenges. This exploration will allow individuals to advance skills, assist others by implementing their own strengths and grow a collaborative learning environment.

II. Units of Study

1.) iSTEM & the Design Process
2.) Engineering Design Application

III. Essential Questions

Unit 1: iSTEM & the Design Process *(~15 days)*

- What is the difference between science and technology, and how are they related?
- If technology and the nature of technological problems are continuously evolving, why is it so important to understand science, technology and engineering design in the present day?
- What processes help designers and engineers develop organized and successful solutions to technological problems?
- Why is the engineering design process modeled as a loop, not linearly?

Unit 2: Engineering Design Applications *(~25 days)*

- What are the various problem solving processes? What are their similarities and differences?
- What do I already know that can help me/my group with developing a solution to the problem at hand?
- What else do I/we need to know in order to develop a solution to the problem at hand?
- Who am I designing for (target audience) and how do I ensure my design meets the wants and needs of the target audience?
- How can I use the materials and time provided, as well as our prior knowledge and new knowledge to solve the problem at hand?
- How do I clearly communicate the attributes of my/our design to others to aid in the manufacturing/production process?
- Of all the possible designs, which one best solves the problem and meets the criteria/constraints?
- What are my personal strengths and weaknesses as it relates to the problem solving process?
- How did I/we do in our process of design? What went well? What could have gone better?
- After testing and reviewing the associated data, how can I/we improve the design to optimize results?

IV. Learning Objectives

NJSLS - Design Technology

- 8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.
- 8.2.8.A.2 Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.
- 8.2.8.C.1 Explain how different teams/groups can contribute to the overall design of a product.
- 8.2.8.C.2 Explain the need for optimization in a design process.
- 8.2.8.C.3 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
- 8.2.8.C.4 Identify the steps in the design process that would be used to solve a designated problem.
- 8.2.8.C.5 Explain the interdependence of a subsystem that operates as part of a system.
- 8.2.8.C.5A Create a technical sketch of a product with materials and measurements labeled.

Technology Integration | NJSLS 8.1

- 8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.
- 8.1.8.F.1 Explore a local issue, by using digital tools to collect and analyze data to identify a solution and make an informed decision.

21st Century Integration | NJSLS 9

- 9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

Career Ready Practices

- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP11. Use technology to enhance productivity

Interdisciplinary Connections

- NGSS | Science
    - MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
    - MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
    - MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
    - MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
- NJSLS | ELA
    - RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts

- WHST.6-8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation
- WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration

- NJSLS | Mathematics
  - MP.2 Reason abstractly and quantitatively
  - 7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

Social Emotional Learning Competencies

- Self-Awareness
  - Recognize one's personal traits, strengths and limitations.
- Social Awareness
  - Recognize and identify the thoughts, feelings and perspectives of others.
  - Demonstrate an awareness of the differences among individuals, groups and others' cultural backgrounds.
- Responsible Decision-Making
  - Develop, implement and model effective problem solving and critical thinking skills.
  - Identify the consequences associated with one's actions in order to make constructive choices.

V. Instructional Materials

Core Materials:

- Engineering by Design (ITEEA)
- Launch: Using Design Thinking to Boost Creativity and Bring Out the Maker in Every Student by John Spencer and A.J. Juliani
- The Innovator's Mindset: Empower Learning, Unleash Talent, and Lead a Culture of Creativity by George Couros
- Teacher computer with Internet access and projector/Smart Board
- Document Camera
- Chromebooks/Computing Devices
- Access to basic hand tools and fabrication equipment.
  - Hot Glue Guns
  - X-Acto Knives
  - Hot Glue Gun & XActo Knife Rules/Procedures
- Building Materials for Design Challenges:
  - Cardboard
  - Felt
  - Rubber Bands
  - Plastic Cups

- Construction Paper
- Foam Core
- Popsicle Sticks
- Masking Tape
- Glue
- Straws
- Markers
- Colored Pencils
- Paper Clips
- Binder Clips
- Foam
- Building Blocks

Supplemental/District Created Materials:

- iSTEM Introduction Presentation
- Unit 1 Presentation
- Engineering Design Process Rubric
- Cup Tower Design Challenge
- Paper Chain Challenge
- Lens Challenge
- Birdhouse Challenge
- Project Introduction Slideshows
  - Coin Sorter
  - Maze
  - Catapults
  - Locker Organizer
  - Wallets

VI. Key Performance and Benchmark Tasks

Assessment Methods:

- Students will complete approximately four (4) guided projects with individual self-reflection and notes to contribute to a group discussion.
- Students will also complete approximately two (2) projects that will allow them to demonstrate knowledge of creative problem solving in an independent manner with the assistance of notes, and student/teacher feedback.
- Students will complete a technical drawing using guidelines to demonstrate mental planning and communication before construction of a product begins.
- When a student completes a project, s/he will complete a critique sheet, reflecting on their work and answer thoughtful questions on their design process.
- A rubric is outlined on the critique sheet, delineating the project parameters and expectations.

Summative:

Unit 1: iSTEM & the Design Process

- Identify and define products and scenarios as the study of science, technology, or engineering.

- Present and reflect upon critical developments in the human-designed world.
- Identify and classify products into the six categories of the designed world.
- Identify and explain the steps of the engineering design process.

Unit 2: Introduction to Skills for Engineering Design

- Apply the steps of the engineering design process to solve problems.
    - Example Problem: You have been collecting change everyday for the past year. The time has come that you want to find out how much money you have collected. Unfortunately, the bank only accepts coins that have been sorted and separated. Your goal will be to create a device that can sort handfuls of coins and separate them by type. You will be given a mix of quarters, nickels, and dimes that you will need to separate.
- Work collaboratively to brainstorm what they will need to know prior to the design and build phases of the design process.
    - Conduct research
    - Note down what they already know
- Engage in interviews and discussions with members of the target audience in order to ensure that all necessary prerequisite information is obtained and included in the design process.
- Develop multiple solutions to a given problem.
- Create an orthographic drawing for the final design.
- Select the best solution, explaining how it will work and how it meets the criteria and constraints.
- Reflect on their personal strengths and weaknesses as it relates to the problem solving process, as well as on their process of design.
- Engage in testing, data analysis, and a redesign of their solution, clearly explaining what improvements were made and why.
- Demonstrate proper safety procedures when using tools to assist in design.

Formative:

- Peer Feedback: TAG (Tell, Ask, Give) Sticky Notes
- Peer Feedback Form
- Self-Reflection: 2 Stars & 1 Wish
- Critique Guide
- Reflective Exit Tickets/Slips
- Throughout each project, students will be asked to self-reflect on their goals and achievements, and modify tasks to meet future goals.
- Students will also provide task oriented feedback to their peers which will allow for improvements to be made and goals to be adjusted.

Alternative:

- Student choice is built into each project, which makes each project unique for each and every student.
- Adjustments to assessment criteria and assessments themselves are described below in Section VII.

VII. Accommodations & Modifications for Special Education, Students at Risk for School Failure, English Language Learners, Gifted & Talented, and 504s

Special Education

- Student choice in projects to allow for appropriate skill levels to be applied.
- Clarify and repetition expectations by providing digital copies, review of expectations at the start of class, highlighting expectations on student hardcopies, provide specific tasks as needed in group work to clarify goals.
- Support of student focus: verbal prompts, visual cues (lights out, etc)
- Positive reinforcement and praise
- Use of word processors and digital image software to replace writing and drawing by hand.
- Pacing and guidance in long term projects.
    - Work chunked out based on tasks, individual check ins.
    - Extended projects are broken down into manageable tasks with frequent check-ins from the teacher.
- Cup Tower Design Challenge
    - Students are heterogeneously grouped.
    - Clarification and additional scaffolding of directions.
    - Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
    - Provide frequent redirection/prompts to refocus attention.
- Paper Chain Challenge
    - Students are heterogeneously grouped.
    - Clarification and additional scaffolding of directions.
    - Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
    - Provide frequent redirection/prompts to refocus attention.
- Lens Challenge
    - Reduce total number of outcomes so student can successfully complete the project in its entirety.
    - Students are heterogeneously grouped.
    - Clarification and additional scaffolding of directions.
    - Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
    - Provide frequent redirection/prompts to refocus attention.
- Birdhouse Challenge
    - Extended time.
    - Students are heterogeneously grouped.
    - Clarification and additional scaffolding of directions.
    - Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
    - Provide frequent redirection/prompts to refocus attention.
    - Reduce amount of writing required in documentation.
- <u>Possible Major Projects</u>
    - <u>Coin Sorter</u>
        - Allow students to research ideas online including videos to gather ideas.

- Chunk out big picture plans into more manageable goals.
  - Students are given specific tasks to complete at the start of class and are to check in when they are completed so that additional tasks can be discussed.
- Students are heterogeneously grouped.
- Clarification and additional scaffolding of directions.
- Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
- Provide frequent redirection/prompts to refocus attention.

- Maze
  - Chunk out big picture plans into more manageable goals.
    - Students are given specific tasks to complete at the start of class and are to check in when they are completed so that additional tasks can be discussed
  - Students can print a maze and build on top of the already drawn lines to complete their goals.
  - Reduce total number of outcomes so student can successfully complete the project in its entirety.
  - Students are heterogeneously grouped.
  - Clarification and additional scaffolding of directions.
  - Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
  - Provide frequent redirection/prompts to refocus attention.
- Catapults
  - Allow students to research ideas online including videos to gather ideas.
  - Assist students with physical skills such as cutting and measuring.
  - Reduce accuracy requirements for catapult.
  - Chunk out big picture plans into more manageable goals.
    - Students are given specific tasks to complete at the start of class and are to check in when they are completed so that additional tasks can be discussed
  - Students are heterogeneously grouped.
  - Clarification and additional scaffolding of directions.
  - Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
  - Provide frequent redirection/prompts to refocus attention.
- Locker Organizer
  - Students can be provided with a list of questions or topics to help them interview their client.
  - Assistance with measuring lockers and the materials for accuracy.
  - As needed, students will be assisted with communication strategies and pre planning conversations with other students.
  - Students are heterogeneously grouped.
  - Clarification and additional scaffolding of directions.
  - Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
  - Provide frequent redirection/prompts to refocus attention.

- Wallets
  - Students can be provided with a list of questions or topics to help them interview their client.
  - As needed, students will be assisted with communication strategies and pre planning conversations with other students.
  - Students can provide design options for their client that they think will be appropriate and get direct feedback throughout the project as needed.
  - Students are heterogeneously grouped.
  - Clarification and additional scaffolding of directions.
  - Ensure students understand directions by providing additional processing time, repeat or rephrase directions.
  - Provide frequent redirection/prompts to refocus attention.

English Language Learners

- Use of Google Translate to assist students with instructions and lessons so they can follow along.
- Adjust goals to allow for language acquisition.
- Visual prompts and demonstrations.
- Teacher modeling of skills.
- Simplified written and verbal instructions. Include written instructions to supplement verbal.
- Preferential seating.

Gifted & Talented

- Access to additional materials to develop ideas and project details.
- Cup Tower Design Challenge
  - Additional challenges provided after students complete initial challenge *(ex. Create another pyramid with mouth of cups up.).*
  - Add in additional specifications or limitations *(ex. Extended time of students being unable to talk or maintain one arm behind their back.).*
- Paper Chain Challenge
  - Limit the type and/or number of materials used.
- Lens Challenge
  - Students will be asked to explain how their design fits the definition of a lens and provide scientific information to support their ideas.
  - Increase expected number of lenses built.
- Birdhouse Challenge
  - Work in a specific scale.
  - Use of higher level reflection questions.
- Coin Sorter
  - Students will be asked to incorporate a moving part into their design.
  - Students will be asked to sort pennies in addition to quarters, nickels, and dimes.

- Maze
    - Students will be expected to add more complex features into their designs; such as ramps, more pathways, etc.
    - Students will be required to create a more cohesive theme with a larger number of themed features throughout their maze.
- Catapults
    - Increase accuracy requirement of the final product.
    - Students will be asked to identify the simple machines in their catapult and describe in scientific terms how their catapult functions.
- Locker Organizer
    - Student accuracy in measurement and fit of the organizer into the locker is more heavily weighted.
    - Students can ask more developed questions as part of the interviewing process.
    - Students will be required to add additional features into their final products.
- Wallets
    - Students can ask more developed questions as part of the interviewing process.
    - Students will be required to add additional features into their final products.

Students at Risk of School Failure

- Student choice in projects to allow for appropriate skill levels to be applied.
- Clarify and repetition of expectations, review of expectations at the start of class, highlighting expectations on student hardcopies, provide specific tasks as needed to clarify goals.
- Support of student focus: verbal prompts, visual cues (lights out, etc.).
- Positive reinforcement.
- Pacing and guidance in long term projects: Work chunked out based on tasks, individual check ins.
- Extended projects are broken down into manageable tasks with frequent check-ins from the teacher.

504s

- Completely dependent on the student's 504 plan.
    - If the student cannot utilize computers or look at screens, research, planning, and computer-based learning experiences can be done on paper.
    - If the students' level of mobility is limited, making it difficult for the students to navigate the classroom, the student will be assigned a buddy to help with acquiring the necessary materials and supplies.
    - If the students' fine or gross motor skills are impacted, s/he will receive assistance from the teacher for the specific artistic skills that require them.

GENERAL NOTES:

- The order in which the units are taught can be adjusted at the teacher's discretion.
- Days are fluid and some activities may extend longer.
- Lessons and units will be adjusted as per students' prior knowledge.