G&T Grade 4 Unit 1: Design and Invention

Content Area: **Gifted & Talented**
Course(s):
Time Period: **MP1**
Length: **45 days**
Status: **Published**

NJSLS

SCI.4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
SCI.4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.
SCI.4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
CS.3-5.8.1.5.CS.1	Model how computing devices connect to other components to form a system.
CS.3-5.8.1.5.CS.3	Identify potential solutions for simple hardware and software problems using common troubleshooting strategies.
CS.3-5.8.1.5.DA.5	Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
CS.3-5.8.2.5.ED.1	Explain the functions of a system and its subsystems.
CS.3-5.8.2.5.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.
CS.3-5.8.2.5.ED.3	Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
CS.3-5.8.2.5.ED.4	Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints).
CS.3-5.8.2.5.ED.5	Describe how specifications and limitations impact the engineering design process.
CS.3-5.8.2.5.ED.6	Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process.
CS.3-5.8.2.5.NT.1	Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem.
CS.3-5.8.2.5.NT.2	Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies.
CS.3-5.8.2.5.NT.3	Redesign an existing product for a different purpose in a collaborative team.
CS.3-5.8.2.5.ITH.1	Explain how societal needs and wants influence the development and function of a product and a system.
CS.3-5.8.2.5.ITH.2	Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have.
CS.3-5.8.2.5.ITH.3	Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use.
CS.3-5.8.2.5.ITH.4	Describe a technology/tool that has made the way people live easier or has led to a new business or career.

Rationale and Transfer Goals

Students will use electronic parts kits and manuals to complete challenges (putting together bits to understand

how they work) Students will then learn about the design process and how/why new things get invented. In collaborative teams, students will use the bits and other assorted items in order to create a “new” invention while documenting the entire process using a multimedia template.

Enduring Understandings

Learning via experimentation and the “design process” is something that can be documented in order to reassess and improve methods and outcomes.

The design process can take a short amount of time, or a long time.

In both cases, the process involves generating ideas, creation, testing and revision.

Most scientists and designers work in collaborative teams and this is essential to gathering a wealth of ideas and diverse points of view for testing and improvement.

An invention may not be an end unto itself; the importance is in learning and continuously documenting the design process.

Often, several design solutions exist, each better in some way than the others.

Engineers create and modify technologies to meet people’s needs and wants.

Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

Energy can be transferred in various ways and between objects.

Engineers improve existing technologies or develop new ones.

Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light.

Stored energy can be harnessed into a desired form for practical use.

Possible solutions to a problem are limited by available materials and resources (constraints).

The success of a solution's design is determined by considering the desired features of a solution (criteria).

Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

Technical manuals convey ideas and directions through both text/words and graphics/images

Writing for an audience needs to be clear, coherent, and appropriate to task, purpose, and audience with reference to style, development and language used.

Writing for presentation involves near daily revision and editing for long term projects.

Writing can be collaborative; technology makes this easier than with pen and paper.

Speaking with, and collaborating with other students makes topics more interesting and adds depth and varied points of view when analyzing information.

Essential Questions

What is a technical document? How is a technical document written? Why does it include both text and graphics?

How can electrical "bits" be combined? Which of these needs to come first in a series and why? How can I rearrange the series for a different outcome?

What are the steps of the design process and why are they important? What happens if the steps are out of order, or removed?

How can I test and improve a creation or invention?

If there is something I need to know for my design process, how can I find the answer? How do I analyze the

information for accuracy and relevancy to my project?

Why are constant review and improvement necessary in a design?

Why is documentation important and how can technology help me do that?

Why is it important to collaborate and how can I make sure another's ideas are heard as well as my own?

What are good collaborative practices when working with others?

Content - What will students know?

- Technical manuals are created using both text and graphics and often use step-by-step layouts to convey information.
- Design and Engineering follows a process.
- The meanings, and order of these steps:
    - Ask
    - Research
    - Develop Solution
    - Plan
      Prototype
    - Test
    - Improve
- Multimedia can be used to document a long term process that involves ideas, creation, testing and revision.
- Multimedia can be used to present documentation to an audience.
- When writing and creating for an audience, Information presented needs to be clear, coherent, and appropriate to task, purpose, and audience with reference to style, development and language used.
- When working with others, there are social skills necessary for to convey ideas and viewpoints.

Skills - What will students be able to do?

- Read and comprehend a technical manual in order to complete design challenges and relate to everyday objects and everyday life.
- Use a template to document all challenges and steps in a multimedia presentation with text and images.
- Perform the steps of the "design cycle" in order to research and create something new out of electronic kits parts and everyday objects (tape, glue, cardboard, etc.).
- Use a template to document all steps of the design process/research project in a multimedia presentation with text and images.

Activities - How will we teach the content and skills?

- Introduction to Design Cycle and Process of Invention
- Introduction to the electronics kits and parts
- Introduction to the Student Guide
- "Challenge" completion following student guide
- Review of Design Cycle
- Students create new product/invention using electronic bits and other "everyday" items
- Concurrent with projects:
    - Slide template introduction for documentation of challenge and invention process
    - Review of blank slide creation, use of camera to take pictures, general aesthetics of a slide show, proper grammar, spelling and punctuation

Evidence/Assessments - How will we know what students have learned?

- Daily observation of students' work
- Monitoring of slide templates
- Tests/Quizzes
- Participation in collaborative conversations in groups

- Checking on project progress via inspection of item and slide documentation
- Evaluation of final project

Key Resources

Electronic parts kits and manuals

Chromebooks or other computing device

Google apps: Drive, Slides, Docs, Camera

Assorted items such as cardboard, measuring items, molding clay, tape, glue

21st Century Life and Careers

WRK.9.2.5.CAP.4	Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.

Career Readiness, Life Literacies, & Key Skills

TECH.9.4.5.CT.1	Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2).
TECH.9.4.5.CT.3	Describe how digital tools and technology may be used to solve problems.
TECH.9.4.5.IML.2	Create a visual representation to organize information about a problem or issue (e.g., 4.MD.B.4, 8.1.5.DA.3).

Interdisciplinary Connections/Companion Standards

LA.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.
LA.W.4.4	Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

LA.W.4.5	With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.
LA.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.
LA.W.4.10	Write routinely over extended time frames (time for research, reflection, metacognition/self-correction and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
LA.SL.4.4	Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.
LA.SL.4.5	Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.
LA.SL.4.6	Differentiate between contexts that call for formal English (e.g., presenting ideas) and situations where informal discourse is appropriate (e.g., small-group discussion); use formal English when appropriate to task and situation.