Elementary GATE - Grade 4

Unit Title: Fourth Grade Unit One (Introduction to Engineering and the Engineering Design Process)

Stage 1: Desired Results

Standards & Indicators:

National Standards in Gifted and Talented Education

- **1.1** - Self-Understanding. Students with gifts and talents recognize their interests, strengths, and needs in cognitive, creative, social, emotional, and psychological areas.
- **2.1** - Identification. All students in Pre-K through grade 12 with gifts and talents have equal access to the identification process and proportionally represent each campus.
- **2.5** - Learning Progress. Students self assess their learning progress.
- **3.2** - Talent Development. Students with gifts and talents demonstrate growth in social and emotional and psychosocial skills necessary for achievement in their domain(s) of talent and/or areas of interest.
- **3.3** - Responsiveness to Diversity. Students with gifts and talents develop knowledge and skills for living in and contributing to a diverse and global society.
- **3.4** - Instructional Strategies. Students with gifts and talents demonstrate their potential or level of achievement in their domain(s) of talent and/or areas of interest.
- **3.5** - Instructional Strategies. Students with gifts and talents become independent investigators
- **4.1** - Personal Competence. Students with gifts and talents demonstrate growth in personal competence and dispositions for exceptional academic and creative productivity. These include self-awareness, self-advocacy, self-efficacy, confidence, motivation, resilience, independence, curiosity, and risk taking.
- **4.2** - Social Competence. Students with gifts and talents develop social competence manifested in positive peer relationships and social interactions.6.1. Talent Development. Students identify and fully develop their talents and gifts as a result of interacting with educators who possess content pedagogical knowledge and meet national teacher preparation standards in gifted education and the Standards for Professional Learning.

Computer Science and Design Thinking

Standard	Performance Expectations	Core Ideas
8.2.5.ED.1	Explain the functions of a system and its subsystems	Engineering design is a systematic and creative process of communicating and collaborating to meet a design challenge. Often, several design solutions exist, each better in some way than the others
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.ITH.2	Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have	A new tool may have favorable or unfavorable results as well as both positive and negative effects on society. Technology spurs new businesses and careers.
8.2.5.NT.1	Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem	Technology innovation and improvement may be influenced by a variety of factors. Engineers create and modify technologies to meet people's needs and wants; scientists ask

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		questions about the natural world.
Career Readiness, Life Literacies and Key Skills		
Standard	**Performance Expectations**	**Core Ideas**
9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.	An individual's passions, aptitude and skills can affect his/her employment and earning potential.
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.	
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.	Curiosity and a willingness to try new ideas (intellectual risk-taking) contributes to the development of creativity and innovation skills.

Central Idea/Enduring Understanding:
- The engineering design process emphasizes open-ended problem solving and encourages students to learn from failure.

Essential/Guiding Question:
- How does the engineering design process help solve real world problems?

Content:
- Technology Scavenger Hunt
- Quake Safe
- Freshwater Filter
- RoboHand

Skills (Objectives):
- Identify objects that are classified as technology
- Design and build a house to withstand an earthquake
- Construct a water filter to clean polluted water
- Build a robotic arm

Interdisciplinary Connections:

NJSLS - 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.

NJSLS - Math
- MP.2 Reason abstractly and quantitatively. (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)
- MP.4 Model with mathematics. (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)
- MP.5 Use appropriate tools strategically. (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)

NJSLS - ELA
- W.AW.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
- W.WR.4.5 Conduct short research projects that use multiple reference sources (print and non-print) and build knowledge through investigation of different aspects of a topic.
- W.SE.4.6 Gather relevant information from multiple print and digital sources; take notes, prioritize and categorize information; provide a list of sources.

Stage 2: Assessment Evidence

Performance Task(s):
- Correctly identify objects classified as technology and explain why

Other Evidence:
- Group discussion of technology

● Construct a model building that can withstand a shake table for 20 shakes ● Design and build a water filtration system that will remove particles from dirty water ● Design and assemble a robotic arm that can grasp a ball	● Students reflect on their original plan and how it differed from their final plan. ● Students show the ability to improve on their design further.

Stage 3: Learning Plan

Learning Opportunities/Strategies:	And Resources:
Lesson 1 ● Students find items around the room that fit the definition of technology and explain what problem it solves and how it has been improved over time.	**Lesson 1** ● Student pages of “What am I?”
Lesson 2 ● Students will work in groups to research and present one of the following STEM careers: Architect, Structural Engineer, Seismologist, or Civil Engineer	**Lesson 2** ● Graphic organizer ● Engineering Design Process Journal ● STEM career task card ● Lakeshore Real STEM Challenge Kit
Lesson 3 ● Students must design and make a building frame that is at least 12” high, fits on the shake table and stands straight after 20 shakes.	**Lesson 3** ● Lakeshore Real STEM Challenge Kit ● Engineering Design Process Journal ● Materials to make a building
Lesson 4 ● Students will construct and test their building frame and redesign as needed.	**Lesson 4** ● Lakeshore Real STEM Challenge Kit ● Engineering Design Process Journal ● Materials to make a building
Lesson 5 ● Students will design the appearance of their building to fit into a modern or traditional city without changing the structure and submit a proposal to an architectural company.	**Lesson 5** ● Lakeshore Real STEM Challenge Kit ● Engineering Design Process Journal ● Materials to make a building
Lesson 6 ● Students will work in groups to research and conduct interviews of students acting as one of the following STEM careers: Water Resource Supervisor, Groundwater Geologist, Environmental Health and Safety Specialist, or Sanitation and Waste Engineer.	**Lesson 6** ● Graphic organizer ● Engineering Design Process Journal ● STEM career task card ● Lakeshore Real STEM Challenge Kit
Lesson 7 ● Students will design and build a water filtration system that will remove particles from dirty water.	**Lesson 7** ● Engineering Design Process Journal ● STEM career task card ● Lakeshore Real STEM Challenge Kit ● Materials to construct water filter

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Lesson 8 ● Students will construct and test their water filtration system and redesign as needed. **Lesson 9** ● Students will work in groups to research and place a help wanted for one of the following STEM careers: Programmer, Electrician, Roboticist or Mechanical Engineer **Lesson 10** ● Students will design and construct a robotic arm that can grasp three types of balls from a distance of 12 inches. **Lesson 11** ● Students will construct and test their robotic arm and redesign as necessary. arm **Lesson 12** ● Students will make a digital or print ad for their robotic arm to present to a hospital.	**Lesson 8** ● Engineering Design Process Journal ● Lakeshore Real STEM Challenge Kit ● Materials to construct water filtration system **Lesson 9** ● Engineering Design Process Journal ● Lakeshore Real STEM Challenge Kit **Lesson 10** ● Engineering Design Process Journal ● Lakeshore Real STEM Challenge Kit ● Materials to build with **Lesson 11** ● Engineering Design Process Journal ● Lakeshore Real STEM Challenge Kit ● Materials to build with **Lesson 12** ● Engineering Design Process Journal

Differentiation *Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to struggling and/or Special Needs Section for differentiation.

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Students will be provided with more challenging work based on their individual needs.	Students will be provided with more challenging work based on their individual needs.	Student and teacher will make plan to improve in certain areas as needed	Students will be allotted extra time as needed to finish projects Students will have the opportunity to work solo if needed.

Unit Title: Fourth Grade Unit 2 (Rube Goldberg and Chain Reaction Machines)

Stage 1: Desired Results

Standards & Indicators:

National Standards in Gifted and Talented Education

- **1.1** - Self-Understanding. Students with gifts and talents recognize their interests, strengths, and needs in cognitive, creative, social, emotional, and psychological areas.
- **2.1** - Identification. All students in Pre-K through grade 12 with gifts and talents have equal access to the identification process and proportionally represent each campus.
- **2.5** - Learning Progress. Students self assess their learning progress.
- **3.2** - Talent Development. Students with gifts and talents demonstrate growth in social and emotional and psychosocial skills necessary for achievement in their domain(s) of talent and/or areas of interest.
- **3.3** - Responsiveness to Diversity. Students with gifts and talents develop knowledge and skills for living in and contributing to a diverse and global society.
- **3.4** - Instructional Strategies. Students with gifts and talents demonstrate their potential or level of achievement in their domain(s) of talent and/or areas of interest.
- **3.5** - Instructional Strategies. Students with gifts and talents become independent investigators

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- **4.1** - Personal Competence. Students with gifts and talents demonstrate growth in personal competence and dispositions for exceptional academic and creative productivity. These include self-awareness, self-advocacy, self-efficacy, confidence, motivation, resilience, independence, curiosity, and risk taking.
- **4.2** - Social Competence. Students with gifts and talents develop social competence manifested in positive peer relationships and social interactions.6.1. Talent Development. Students identify and fully develop their talents and gifts as a result of interacting with educators who possess content pedagogical knowledge and meet national teacher preparation standards in gifted education and the Standards for Professional Learning.

Computer Science and Design Thinking		
Standard	**Performance Expectations**	**Core Ideas**
8.2.5.ED.1	Explain the functions of a system and its subsystems	Engineering design is a systematic and creative process of communicating and collaborating to meet a design challenge. Often, several design solutions exist, each better in some way than the others
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).	Engineering design requirements include desired features and limitations that need to be considered
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	
8.2.5.ITH.2	Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have	A new tool may have favorable or unfavorable results as well as both positive and negative effects on society. Technology spurs new businesses and careers.
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.NT.1	Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem	Technology innovation and improvement may be influenced by a variety of factors. Engineers create and modify technologies to meet people's needs and wants; scientists ask questions about the natural world.
8.2.5.NT.2	Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies	

Career Readiness, Life Literacies and Key Skills		
Standard	**Performance Expectations**	**Core Ideas**
9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.	An individual's passions, aptitude and skills can affect his/her employment and earning potential.
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,	

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	medicine, education) and examples of these requirements.	

Central Idea/Enduring Understanding:

- The engineering design process is involved in the creation and production of many items in our everyday lives that include entertainment.

Essential/Guiding Question:

- How do chain reaction machines help make life easier?

Content:

- Types Simple Machines
- Mouse Trap
- Rube Goldberg
- Chain Reaction Machines
- Comic Strips

Skills (Objectives):

- Identify and explain the six different types of simple machines
- Explain how one reaction causes another
- Explore how Rube Goldberg influenced Science
- Understand how Rube Goldberg used chain reaction machines for entertainment
- Use comic plan strips to plan out Rube Goldberg machines

Interdisciplinary Connections:

NJSLS - 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.
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- 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.

NJSLS - Math

- MP.2 Reason abstractly and quantitatively. (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)
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NJSLS - ELA

- W.AW.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
- W.WR.4.5 Conduct short research projects that use multiple reference sources (print and non-print) and build knowledge through investigation of different aspects of a topic.
- W.SE.4.6 Gather relevant information from multiple print and digital sources; take notes, prioritize and categorize information; provide a list of sources.

Stage 2: Assessment Evidence

Performance Task(s):

- Students will use their knowledge of simple machines to plan a Rube Goldberg machine of their own consisting of 5 different chain reactions.
- Students will construct a Rube Goldberg machine
- Students will design a comic strip of a Rube Goldberg machine to make an everyday task easier.

Other Evidence:

- Group discussion of improved backpacks.
- Students reflect on their original plan and how it differed from their final plan.
- Students show the ability to improve on their design further.

Stage 3: Learning Plan

Learning Opportunities/Strategies:

Lesson 1

Resources:

Lesson 1

- Hyper Doc link
- Ok GO! Music Video

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● Navigate a Hyper Doc and explore the 6 types of simple machines. Watch a music video highlighting a large chain reaction machine.	
Lesson 2 ● Practice assembling and using a chain reaction machine with the game Mouse Trap. Identify different types of simple machines in the game.	**Lesson 2** ● Mouse Trap Game
Lesson 3 ● Research who Rube Goldberg was and discuss the important inventions he created with other students.	**Lesson 3** ● Article on Rube Goldberg
Lesson 4 ● Read “Rube Goldberg’s Simple Humdrum School Day” and discuss how Rube designed machines to make everyday tasks easier and harder.	**Lesson 4** ● Book, “Rube Goldberg’s Simple Humdrum School Day” ● Paper
Lesson 5 ● Students work in groups to plan and create a comic strip of a Rube Goldberg Machine.	**Lesson 5** ● Book, “Rube Goldberg’s Simple Humdrum School Day” ● Paper
Lesson 6 ● Outline objectives for students to begin planning an actual Rube Goldberg machine that will use simple and compound machines to turn a light switch off.	**Lesson 6** ● Engineering Design Poster ● Engineering Design Process Journal ● Book, “Rube Goldberg’s Simple Humdrum School Day”
Lesson 7 ● Students will begin to build the first chain reaction step of their Rube Goldberg machine.	**Lesson 7** ● Engineering Design Poster ● Engineering Design Process Journal ● Materials for Rube Goldberg Machine
Lesson 8 ● Students will begin to build the 2nd chain reaction step of their Rube Goldberg machine and test it with step 1 to check for success.	**Lesson 8** ● Engineering Design Poster ● Engineering Design Process Journal ● Materials for Rube Goldberg Machine
Lesson 9 ● Students will begin to build the 3rd and chain reaction step of their Rube Goldberg machine and test it with step 1 and 2 to check for success.	**Lesson 9** ● Engineering Design Poster ● Engineering Design Process Journal ● Materials for Rube Goldberg Machine
Lesson 10 ● Students will design and build the 4th and final steps of their Rube Goldberg machine to turn off a light and test for success.	**Lesson 10** ● Engineering Design Poster ● Engineering Design Process Journal ● Materials for Rube Goldberg Machine
Lesson 11	**Lesson 11** ● Engineering Design Poster ● Engineering Design Process Journal

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● Students will review types of kinetic and potential energy and demonstrate both types using their finished Rube Goldberg machine. **Lesson 12** ● Each group will present their finished Rube Goldberg machines to 3rd grade GATE students to be judged in a contest.	 **Lesson 12** ● Finished Rube Goldberg Machines

Differentiation *Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to the Struggling and/or Special Needs Section for differentiation.

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Students will be provided with more challenging work based on their individual needs.	Students will be provided with more challenging work based on their individual needs.	Student and teacher will make plan to improve in certain areas as needed	Students will be allotted extra time as needed to finish projects Students will have the opportunity to work solo if needed.

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Pacing Guide

Course Name	Resource	Standards
UNIT 1 Introduction to Engineering and the Engineering Design Process 12 days 2 days per the 6 day cycle 12 weeks	A. Lakeshore Real STEM Challenge Kit, Quakeshake B. Lakeshore Real STEM Challenge Kit, Freshwater Filter C. Lakeshore Real STEM Challenge Kit, Robohand	**National Standards in Gifted and Talented Education** 1.1, 2.1, 2.5, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 6.1 **NJSLS - Science** 3-5-ETS1-1, 2, 3 **NJSLS- Math** (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3). (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3) (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)(3-5-ETS1-1), (3-5-ETS1-2) **NJSLS- Language Arts** W.5.7, W.5.8
UNIT 2 Rube Goldberg & Chain Reaction Machines 12 days 2 days per the 6 day cycle 12 weeks	A. Book, “Rube Goldberg’s Simple Humdrum School Day”	**National Standards in Gifted and Talented Education** 1.1, 2.1, 2.5, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 6.1 **NJSLS - Science** 3-5-ETS1-1, 2, 3 **NJSLS- Math** (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3). (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3) (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)(3-5-ETS1-1), (3-5-ETS1-2) **NJSLS- Language Arts** W.5.7, W.5.8