Unit 1: Engineering and Technology

Content Area: **Science**
Course(s): **Sample Course**
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Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Science Grade 4

Unit 1: Engineering and Technology

Belleville Board of Education

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Unit Overview

Unit one provides detailed information about engineering and technology. The content within the unit focuses on exploring how engineers define problems and solutions. The unit explains the importance of prototypes. Models are used to examine how prototypes are tested and improved.

(Reference HMH Science Dimensions, Unit 1)

Enduring Understanding

- Technology is how humans change the natural world to meet a want or a need.
- Engineering is the process of designing new or improved technology.
- Engineers are the people who do engineering.
- Before designing a solution, it is important to learn more about the problem.
- Researching and planning can assist in designing a solution for a problem.
- Prototypes are simple models which allow you to test ideas.
- Prototypes must be thoroughly tested to be sure they're safe and working correctly.
- Engineering solutions need to be tested and improved many times before they meet criteria and satisfy constraints of safety, time, money, or materials.
- Collaboration and communication can lead to improving prototypes.

Essential Questions

- **What is a design problem?**
- **How can you identify constraints and criteria for a design solution?**
- **How do engineers define problems?**
- **How do engineers design solutions?**
- **How do engineers test and improve prototypes?**
- **How can collaboration and communication lead to improving prototypes?**

Exit Skills

By the end of Grade 4, Science Unit 1, the student should be able to:

- Ask questions and define problems
- Construct explanations and design solutions
- Define and delimit engineering problems
- Develop possible solutions
- Optimize the design solution
- Analyze the influence of science, engineering, and technology on society and the natural world

New Jersey Student Learning Standards (NJSLS-S)

SCI.3-5.3-5-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.
SCI.3-5.3-5-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.
SCI.3-5.3-5-ETS1-1.1.1	Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
SCI.3-5.3-5-ETS1-1.ETS1.A.1	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution 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.
SCI.3-5.3-5-ETS1-2.ETS1.B.1	Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
SCI.3-5.3-5-ETS1-3.ETS1.C.1	Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Interdisciplinary Connections

Connections to Math:

- **MP.2:** Reason abstractly and quantitatively.
- **MP.4:** Model with mathematics.
- **MP.5:** Use appropriate tools strategically.

Connections to English Language Arts:

- View "linked" standards below

LA.W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
LA.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.
LA.W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.

Learning Objectives

In Unit 1, students will demonstrate the ability to:

HMH Science Dimensions, Unit 1 - Lesson 1:

- **Explore** engineering problems
- **Develop** solutions based on criteria and constraints
- **Investigate** problems and solutions to gain a deeper understanding of engineering and technology's impact on society

HMH Science Dimensions, Unit 1 - Lesson 2:

- **Determine** how engineers develop solutions to problems
- **Integrate** solutions and technology into society and the environment
- **Design** explanations and solutions to problems using a process which includes constraints and criteria

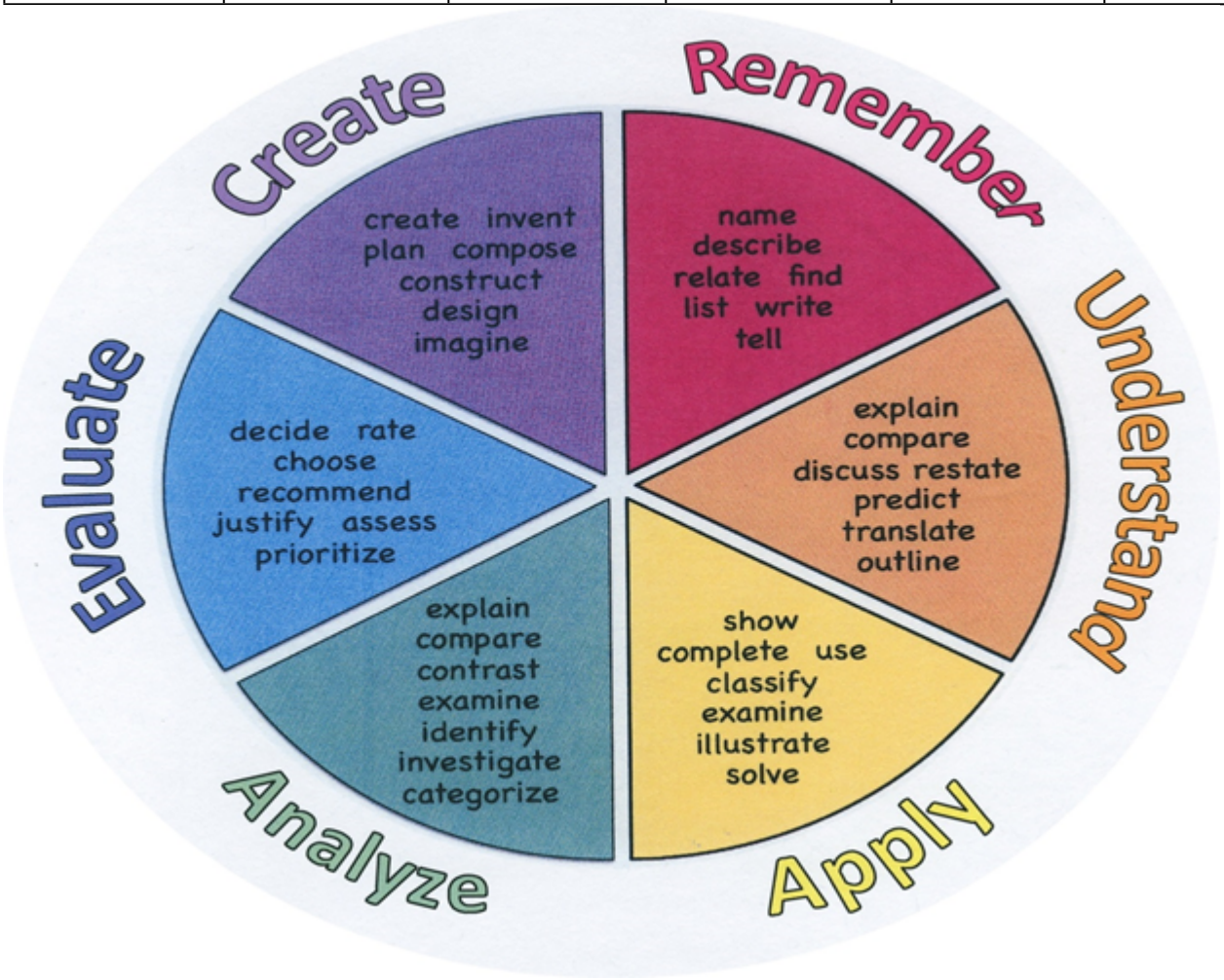
HMH Science Dimensions, Unit 1 - Lesson 3:

- **Plan, design, and test** possible solutions for a prototype to determine which design best solves a problem with the given criteria and constraints
- **Develop** changes to a design with failures in order to improve it
- **Asses** the effectiveness of communication in order to share observations, gain insight, and optimize future solutions and designs.

Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy. These are useful in writing learning objectives, assignment objectives and exam questions.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize
Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive
Outline	Represent	Calculate	Diagram	Support	Devise
Point	Restate	Change	Discriminate	Test	Generate
Quote	Rewrite	Classify	Illustrate		Integrate
Recall	Select	Complete	Outline		Prescribe
Recognize	Show	Compute	Point out		Propose
Repeat	Summarize	Discover	Separate		Reconstruct
Reproduce	Tell	Divide			Revise
	Translate	Examine			Rewrite
	Associate	Graph			Transform
	Compute	Interpolate			
	Convert	Manipulate			
	Discuss	Modify			
	Estimate	Operate			
	Extrapolate	Subtract			

	Generalize Predict				



Suggested Activities & Best Practices

HMH Science Dimensions, Unit 1 - Lesson 1:

- **Engage:** "Can You Solve It?" lesson
- **Explore/Explain:** "What Do You See?" and "Real-World Limits" lessons and hands-on activity (Exploration 1 & 2)
- **Elaborate:** "Discover More" extension activity
- **Evaluate:** "Lesson Check" and "Lesson Roundup" assessments (formative/summative)

HMH Science Dimensions, Unit 1 - Lesson 2:

- **Engage:** "Can You Solve It?" lesson
- **Explore/Explain:** "Research Matters," "Past Hearing Helpers," and " Passing the Test" lessons and hands-on activity (Exploration 1, 2, & 3)

- **Elaborate:** "Discover More" extension activity
- **Evaluate:** "Lesson Check" and "Lesson Roundup" assessments (formative/summative)

HMH Science Dimensions, Unit 1 - Lesson 3:

- **Engage:** "Can You Solve It?" lesson and hands-on activity
- **Explore/Explain:** "Things Fail and Improve" and "Getting Better," lessons and hands-on activity (Exploration 1, 2, & 3)
- **Elaborate:** "Discover More" extension activity
- **Evaluate:** "Lesson Check" and "Lesson Roundup" assessments (formative/summative)

HMH Science Dimensions, Unit 1 - Performance Task (Design a Portable Chair):

- **State Goal**
- **Research**
- **Brainstorm**
- **Plan**
- **Visualize**
- **Evaluate and Redesign**
- **Communicate**

HMH Science Dimensions, Unit 1 - Unit Project (Extend a Sense):

- **Research and Plan**
- **Analyze Results**
- **Claims, Evidence, and Reasoning**

Evidence of Student Learning - Checking for Understanding (CFU)

- Admit Tickets
- Anticipation Guide
- Compare & Contrast
- Define
- Describe
- Evaluate
- Evaluation rubrics

- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- KWL Chart
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Study Guide
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Unit tests

Primary Resources & Materials

Houghton Mifflin Harcourt- HMH Science Dimensions, 2018

Ancillary Resources

Science Weekly, Scholastic News, NewsELA, YouTube/TeacherTube, National Geographics Kids, Science Channel

Technology Infusion

SMARTboard, PowerPoint, Prezi, Social Media, relevant YouTube/TeacherTube videos, HMH Science Dimensions Digital Component, Laptops, WebQuests, Kahoot, Quia

Alignment to 21st Century Skills & Technology

Key SUBJECTS AND 21st CENTURY THEMES

Mastery of key subjects and 21st century themes is essential for all students in the 21st century.

Key subjects include:

- English, reading or language arts
- Mathematics
- Science

21st Century Skills/Interdisciplinary Themes

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

- Environmental Literacy
- Global Awareness
- Health Literacy

Differentiation

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Repeat directions
- Use manipulatives
- Center-based instruction
- Study guides
- Teacher reads assessments allowed

- Scheduled breaks
- Rephrase written directions
- Additional time
- Preview vocabulary
- Preview content & concepts
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games
- Independent research and projects
- Learning contracts
- Leveled rubrics
- Multiple intelligence options
- Multiple texts
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Varied supplemental materials

Intervention Strategies

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning

- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Special Education Learning

- printed copy of board work/notes provided
- additional time for skill mastery
- behavior management plan
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments

- student working with an assigned partner
- Use open book, study guides, test prototypes

English Language Learning (ELL)

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using true/false, matching, or fill in the blank tests in lieu of essay tests

Sample Lesson

Using the template below, please develop a **Sample Lesson** for the first unit only.

Unit Name:

NJSLS:

Interdisciplinary Connection:

Statement of Objective:

Anticipatory Set/Do Now:

Learning Activity:

Student Assessment/CFU's:

Materials:

21st Century Themes and Skills:

Differentiation/Modifications:

Integration of Technology: