

Unit 1: Engineering Processes

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Department of Curriculum and Instruction



Belleville Public Schools

Curriculum Guide

Unit 1: Engineering Processes

Grade 3

Belleville Board of Education

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Unit Overview

Unit 1: Engineering

In this unit, students will...

- define problems and design solutions to those problems
- test solutions and make improvements to solutions

Vocabulary

- constraint
- criteria
- engineer
- technology

Enduring Understanding

Enduring understandings:

- Engineers design solutions to meet a want or need

- Technology is human-made devices or systems that meet a variety of needs
- Brainstorming, planning, designing, modeling, and prototyping are all parts of the engineering process
- Engineers must do a lot of pre-work before any final product (technology) is ready for use
- The first step in a design process is to find a problem
- Criteria are the desirable features of the solution to an engineering problem
- Constraints are the limits on the resources that can be used to solve a problem
- Researching past solutions will help you understand problems and avoid making mistakes
- Engineers pay close attention to detail, constraints, criteria, and many important aspects
- Engineers work to design and test solutions

Essential Questions

Essential Questions:

- How do we define a problem?
- Where do solutions come from?
- How can we design a solution?
- How do we test and improve a solution?

Exit Skills

By the end of Grade 3, Science Unit 1, the student should be able to:

- Ask questions and define problems
- Construct explanations and design solutions
- Find the limits on problem solving in engineering
- Develop possible solutions
- Optimize the design solution
- Analyze the influence of science, engineering, and technology on society and the natural world

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-ETS1-1	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-ETS1-3	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.
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.
3-5-ETS1-3.3.1	Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
3-5-ETS1-2.6.1	Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
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.
3-5-ETS1-3.ETS1.B.1	Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
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.
3-5-ETS1-2.ETS1.B.2	At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
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:

- **MC.3.MD.A.2** Solve problems involving measurement and estimation
- **MP.2** Reason abstractly and quantitatively
- **MP.4** Model with mathematics
- **MP.5** Use Appropriate Tools
- **3.MD.A.2**
- **3-5.OA** Operations and algebraic thinking

Connections to English Language Arts:

- **W.3.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly
- **W.3.2.B** Develop the topic with facts, definitions, and detail
- **W.3.8** Recall information from experiences
- **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research
- **SL.3.4** Report on a topic
- **RL.3.2** Ask and answer questions
- **RI.3.1** Ask and answer questions to demonstrate understanding of text, referring explicitly to the text as the basis for the answers

- **RI.3.7** Use information gained from illustrations

MA.3.OA.A	Represent and solve problems involving multiplication and division.
MA.K-12.2	Reason abstractly and quantitatively.
LA.RL.3.2	Recount stories, including fables, folktales, and myths from diverse cultures; determine the central message/theme, lesson, or moral and explain how it is revealed through key details in the text.
MA.K-12.4	Model with mathematics.
LA.RI.3.1	Ask and answer questions, and make relevant connections to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
LA.RI.3.7	Use information gained from text features (e.g., illustrations, maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
MA.3.MD.A.2	Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.
LA.W.3.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
LA.W.3.2.B	Develop the topic with facts, definitions, and details.
LA.W.3.8	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
LA.W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
LA.SL.3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

Learning Objectives

Students will demonstrate ability to:

- Define simple design problems reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost
- Integrate prior problem solving experience with the engineering concepts of criteria and constraints
- Explore real world examples of engineering concepts and that needs that they fulfill
- Research and design possible solutions to a problem
- Communicate and compare design solutions with others
- Develop criteria based on likely conditions in which the solution will be used
- Plan and conduct investigations that test solutions
- Identify problems and improvements to increase benefits or decrease risks associated with a device or solutions

Suggested Activities & Best Practices

HMH Science Dimensions, Unit 1 - Lesson 1:

- **Engage:** "Can You Solve It?" lesson
- **Explore/Explain:** "Defining Engineering Problems" and "Exploring the Limits on Problem Solving" 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:** "Water Movers", "How Dry Am I?", "Testing, Testing" 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:** "What Could Possibly Go Wrong?", "Fixing Failures!", "The Best... For Now" 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 (The Benefits of Research):

- **Identify the Problem**
- **Research**
- **Brainstorm**
- **Design**
- **Compare**
- **Evaluate**

HMH Science Dimensions, Unit 1 - Unit Project (Building a Better Backpack):

- **Plan and Design**
- **Analyze Results**
- **Restate Question**
- **Claims, Evidence, and Reasoning**

Evidence of Student Learning - Checking for Understanding (CFU)

- **Fist-to-Five**
- **Exit Tickets**

- Unit Tests/Quizzes
- Unit Projects
- Teacher Observation
- Think, Pair, Share
- Think, Write, Pair, Share

- Admit Tickets
- Anticipation Guide
- Common benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit tests

Primary Resources & Materials

HMH Science Dimensions Grade 3 Teacher Edition, 2018

HMH Science Dimensions Grade 3 Student Workbook, 2018

Ancillary Resources

- Scholastic News
- Science Weekly
- National Geographic Kids
- Bill Nye the Science Guy and appropriate educational videos
- TeacherTube/Youtube

Technology Infusion

- HMH Online Resources
- Brainpop
- SMARTboard
- PowerPoint
- Social Media
- Relevant YouTube/TeacherTube videos
- HMH Science Dimensions Digital Components
- Laptops
- Kahoot
- Quia

Alignment to 21st Century Skills & Technology

CAEP.9.2.4.A.1	Identify reasons why people work, different types of work, and how work can help a person achieve personal and professional goals.
CAEP.9.2.4.A.2	Identify various life roles and civic and work - related activities in the school, home, and community.
CAEP.9.2.4.A.3	Investigate both traditional and nontraditional careers and relate information to personal likes and dislikes.

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

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

Differentiation

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks / Brain breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary, content & concepts
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Games
- Group investigations
- Guided Reading
- Independent research and projects
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Project-based learning
- Problem-based learning
- Stations/centers
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills (RISE)
- Open-ended activities
- Think-Pair-Share
- Think-Write-Pair-Share
- Reading buddies
- 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 work presented 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
- assistive technology
- behavior management plan
- Center-Based Instruction
- 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
- multi-sensory presentation
- 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
- teacher initiated weekly assignment sheet
- 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 clarify
- 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 work presented 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 computer word processing spell check and grammar check features
- 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:

