Unit 1: Engineering and Technology (Engineering Design)

Content Area: **Science**
Course(s): **Science Gr K**
Time Period: **October**
Length: **23 Days**
Status: **Published**

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Science: Kindergarten

Unit 1: Engineering and Technology

Belleville Board of Education

102 Passaic Avenue

Belleville, NJ 07109

Prepared by: Ms. Jaclyn Corino

Dr. Richard Tomko, Ph.D., M.J., Superintendent of Schools

Ms. LucyAnn Demikoff, Director of Curriculum and Instruction K-12

Ms. Nicole Shanklin, Director of Elementary Education

Mr. George Droste, Director of Secondary Education

Board Approved: September 23, 2019

Unit Overview

In this unit, children will...

- define a simple problem that can be solved by developing a new or improved tool
- ask questions, make observations, and gather information helpful in thinking about a problem
- make a model based on evidence to represent a tool that solves a problem
- compare and test design solutions to a problem
- use sketches and models to communicate a solution to a problem

Enduring Understanding

- A problem is something that needs to be fixed or made better.
- A problem may have many solutions.
- A solution is something that helps fix a problem.
- An engineer uses math and science to help solve problems.
- Technology is what engineers make and use to solve problems.
- Engineering is the process of designing new or improved technology.
- A design process is a set of five steps that engineers follow to solve problems.
- Step 1: Define a problem.
- Step 2: Plan and build.
- Step 3: Test and improve.
- Step 4: Redesign.
- Step 5: Communicate

Essential Questions

Lesson 1:

- What does an engineer do?

Lesson 2:

- How can we use a design process?

Unit Project:

- Have you ever mixed up a pile of coins?
- What can you make to help sort the coins?
- What are some ways to sort coins?
- What evidence can be collected to show that a coin sorter works as planned?
- How is the design of a coin sorter related to what you intend it to do?

Exit Skills

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

- tell how an engineer defines problems and comes up with solutions
- use a design process to define and solve a problem

New Jersey Student Learning Standards (NJSLS-S) & NGSS

SEP - Asking Questions and Defining Problems (L1, L2)

SEP - Developing and Using Models (L2)

SEP - Analyzing and Intepreting Data (L2)

DCI - Defining and Delimiting Engineering Problems (L1, L2)

DCI - Developing Possible Solutions (L2)

DCI - Optimizing the Design Solution (L2)

CCC - Interdependence of Science, Engineering, and Technology (L1)

CCC - Influence of Engineering, Technology, and Science on Society and the Natural World (L1)

CCC - Structure and Function (L2)

NextGen Science Standards

K-2-ETS1-1	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
K-2-ETS1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
K-2-ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
K-PS2-2.ETS1.A.1	A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.

Interdisciplinary Connections

Do the Math! pp. 13, 21

MA.K.MD.A.2	Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference.
MA.K.G.A.2	Correctly name shapes regardless of their orientations or overall size.
LA.W.K.6	With guidance and support from adults, explore a variety of digital tools to produce and publish writing, including in collaboration with peers.
LA.W.K.8	With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
LA.SL.K.5	Add drawings or other visual displays to descriptions as desired to provide additional detail.

Learning Objectives

Lesson 1:

- SWDAT identify engineers as workers who find solutions to problems.

Hands-On Activity 1: SWDAT determine the problem and design a solution, by asking questions.

Lesson 2:

- SWDAT analyze a situation to solve a problem.

Hands-On Activity 2: SWDAT develop, test, modify, and compare tools that solve a problem.

You Solve It:

- SWDAT create the fastest race car possible using the design elements of a race car.
- SWDAT test the design to determine if it works as intended.

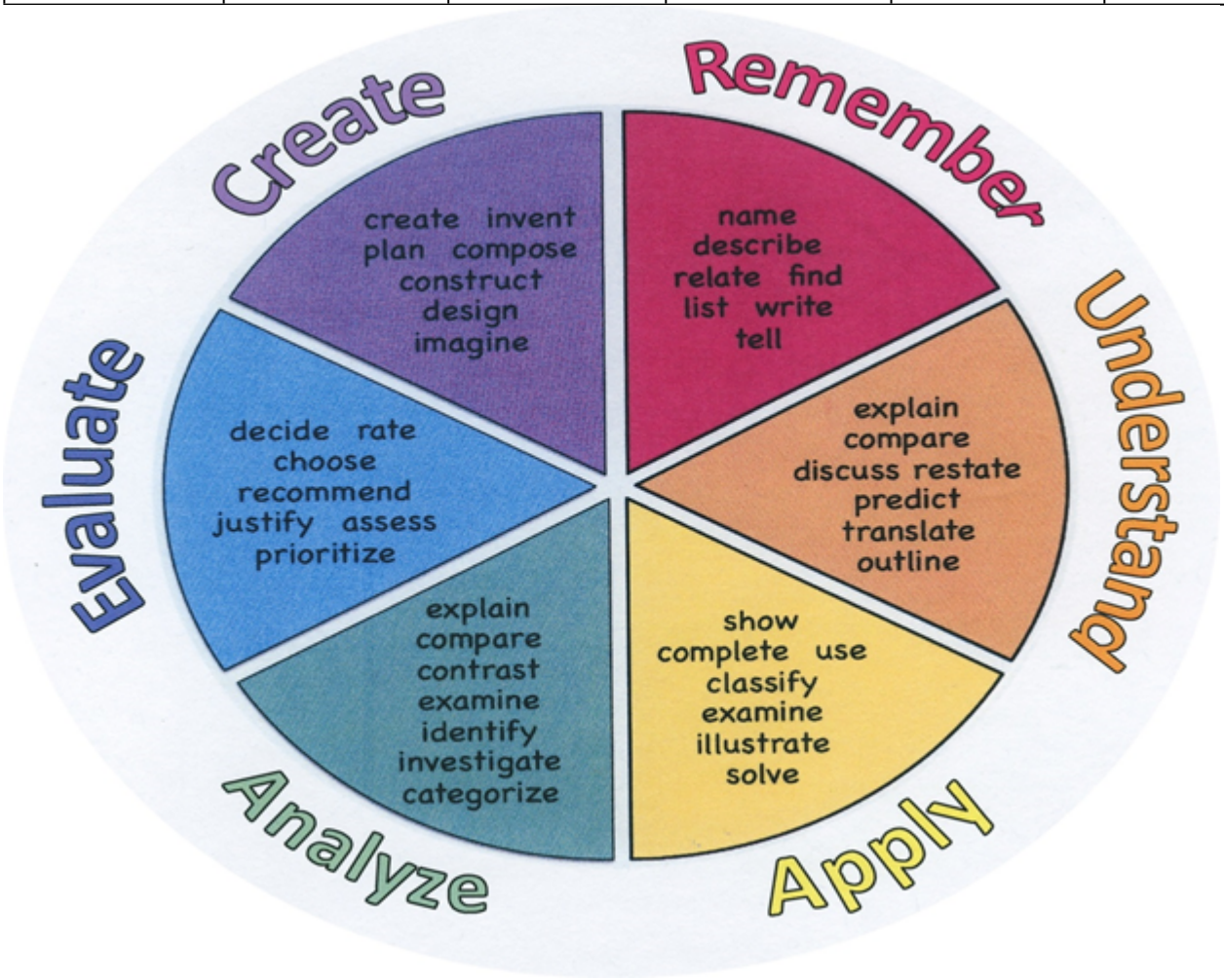
Unit Project:

- SWDAT develop a new or improved coin sorter.
- SWDAT test the design to determine if it works as intended.

Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

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 Extrapolate Generalize Predict	Operate Subtract			



Suggested Activities & Best Practices

Vocabulary Game - Draw the Word!

Hands-On Activites - Problem and Solution; A Design Process

You Solve It Virtual Lab - Off to the Races!

Unit Project - Design a Coin Sorter

Performance Tast - Build an Airplane

Take it Further - People in Scienc and Engineering: Dr. Ayanna Howard

Assessments

- Pre-Assessment
- Formative: interactive workbook, apply what you know, lesson check/self check
- Summative: assessment guide, lesson quizes, unit test
- Online Assessment

Assessment Evidence - Checking for Understanding (CFU)

- Admit Tickets
- Anticipation Guide
- Compare & Contrast
- Create a Multimedia Poster
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- HMH End-of-Year Test (Benchmark)
- HMH Mid-Year Test (Benchmark)
- HMH Performance-based Assessment (Alternative)
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Newspaper Headline

- Outline
- Question Stems
- Quickwrite
- Quizzes (Formative)
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep (Formative)
- Unit tests (Summative)
- Web-Based Assessments (Formative)
- Written Reports

Primary Resources & Materials

HMH Science Dimensions: Teacher Edition, Student workbooks, online resources

HMH Equipment & Safety Kits

HMH Science Dimensions S&E Leveled Readers (Unit 1)

- On Level: How Can We Solve Problems?
- Extra Support: How Can We Solve Problems?
- Enrichment: Make a Better Bird Feeder

Ancillary Resources

https://ngss-assessment.portal.concord.org/

Technology Infusion

HMH Science Dimensions "Explore online" sections embedded throughout online teacher/student edition to extend student learning

HMH Science Dimensions "Can you explain/solve it?" videos embedded throughout online teacher/student

edition

Computer-based assessments

Alignment to 21st Century Skills & Technology

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

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

Leveled Readers (On Level, Extra Support, Enrichment)

Reinforce Vocabulary - Help students connect vocabulary to real world examples

RTI/Extra Support - Provide additional opportunites for hands-on discovery

ELL - Provide hands-on examples of important concepts (ELL support resources include a glossary in English and Level Readers in Spanish and English)

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions

- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share

- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

- Provide modifications dictated by the IEP/504 Plan
- Modify assessment format
- Check work frequently for understanding

- 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
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- 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)

- Provide study guides
- Allow students to correct errors (looking for understanding)
- Allowing productions (projects, models, timelines, demonstrations, charts, etc.) to demonstrate student's learning

- 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 computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

- Tutoring by peers
- Using videos, illustrations, pictures, and drawings to explain or clarify
- Decreasing the amount of work represented or required

- 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

Talented and Gifted Learning (T&G)

- Advanced problem-solving
- Higher order, critical and creative thinking skills, and discovery
- Utilize project based learning for a greater depth of knowledge

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

Unit Name: Engineering and Technology

NGSS: Engineering Design: K-2-ETS1-1; ETS1-2

Interdisciplinary Connection: Math K.G.A.2

Statement of Objective: SWDAT compare designs in terms of how their shape and stability address the problem of a desk covered with different things.

Anticipatory Set/Do Now: Begin with a discussion about the design process. Explain that the following steps in the design process may help solve the problem. Ask students to describe the problem. (the desk is very crowded)

Learning Activity: Ask: Suppose there were one more thing to put on the desk. What would be the problem? (there is no space for everything) Plan and build a model. Follow the steps of the design process to create a solution to the problem. Use the online handbook for tips on how to follow the design process in order to come up with the best solution to the problem. Students will also complete the "Do the Math!" activity and the apply what you know portion of their evidence notebook. When the students reach step 3 (test and improve), they will test their designs and then make any necessary improvements.

Student Assessment/CFU's: "Do the Math" activity; "Apply What You Know" in Evidence Notebook; teacher observation

Materials: SMART TV/SMARTBoard, HMH Science Dimensions workbook, evidence notebook and online resources

21st Century Themes and Skills: Collaboration, Communication

Differentiation/Modifications: use online handbook, visuals, small group assistance

Integration of Technology: explore the design process online using HMH Science Dimensions Resources, online handbook