Unit 1: Engineering and Technology (Engineering Design)

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Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Science: Grade 5

Unit 1: Engineering and Technology

Belleville Board of Education

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Unit Overview

In Unit 1 students will:

- **discover how science and math are used in engineering.**
- **investigate a design process**
- **explore how technology decisons affect society**

Enduring Understanding

Enduring understandings:

- define a simple design problem reflecting a need or a want that includes specific criteria for success and constraints on materials, time, or cost.
- generate and compare multiple possible solutions to a problem based on how well each is likely the meet the criteria and constraints of the problem.
- 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.

Essential Questions

Essential Questions:

- **How are science and math used in engineering?**
- **What is the design process?**
- **How does technology affect society?**

Exit Skills

By the end of Grade 5, Science Unit 1, students should be able to:

- describe how science and math are used in engineering
- use the engineering design process to find a good solution to a problem
- understand how and why technology changes over time

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

SEP - Asking Questions and Defining Problems

SEP - Obtaining, Evaluating, and Communicating Information

SEP - Developing and Using Models

SEP - Planning and Carrying Out Investigations

SEP - Constructing Explanations and Designing Solutions

DCI - Human Impacts on Earth Systems

DCI - Defining and Delimiting Engineering Problems

DCI - Developing Possible Solutions

DCI - Optimizing the Design Solution

CCC - Systems and System Models

CCC - Influence on Engineering, Technology, and Science on Society and the Natural World

NextGen Science Standards

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.
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-ETS1-1.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-ETS1-2.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-ETS1-3.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.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.
5-PS1-1.2	Developing and Using Models
5-PS1-1.2.1	Develop a model to describe phenomena.

Interdisciplinary Connections

Do the Math! - pp. 20, 50

MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.5.OA.B.3	Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.
MA.5.G.A.2	Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.
LA.W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different perspectives of a topic.
LA.W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Learning Objectives

Unit 1 Project

Lesson 1: Explain the prupose of engineering and technology and give examples of how engineering and math are used in science

Lesson 2: Define problems seens in photographs and maps, using the engineering design process to find goo solutions to the problems

Lesson 3: Explain how society affects the evolution and development of technology, describe positive and negatives and planned and unintended consequences of technology and explain tradeoffs.

Suggested Activities & Best Practices

Unit project: Dropping off, Picking up

For this task, small groups of students will work together to design a school entranceway that improve access to the school during congested time periods. They will ask questions and identify a problem to solve related to

the school enterance, and then engineer a possible solution to the problem. Students may have limited knowledge of the laws and safety regulations that must be considered when children are entering and leaving school. Provide background, instruction and assistance as needed.

Assessment Evidence - Checking for Understanding (CFU)

- Admit Tickets
- Anticipation Guide
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- 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
- Multimedia Reports
- 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
- Unit tests (Summative)
- Web-Based Assessments
- 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

- On Level: How Do Engineers Solve Problems?
- Extra Support: How Do Engineers Solve Problems?
- Enrichment: Harnessing the Wind

Ancillary Resources

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

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

Technology Infusion

HMH Science Dimensions digital platform

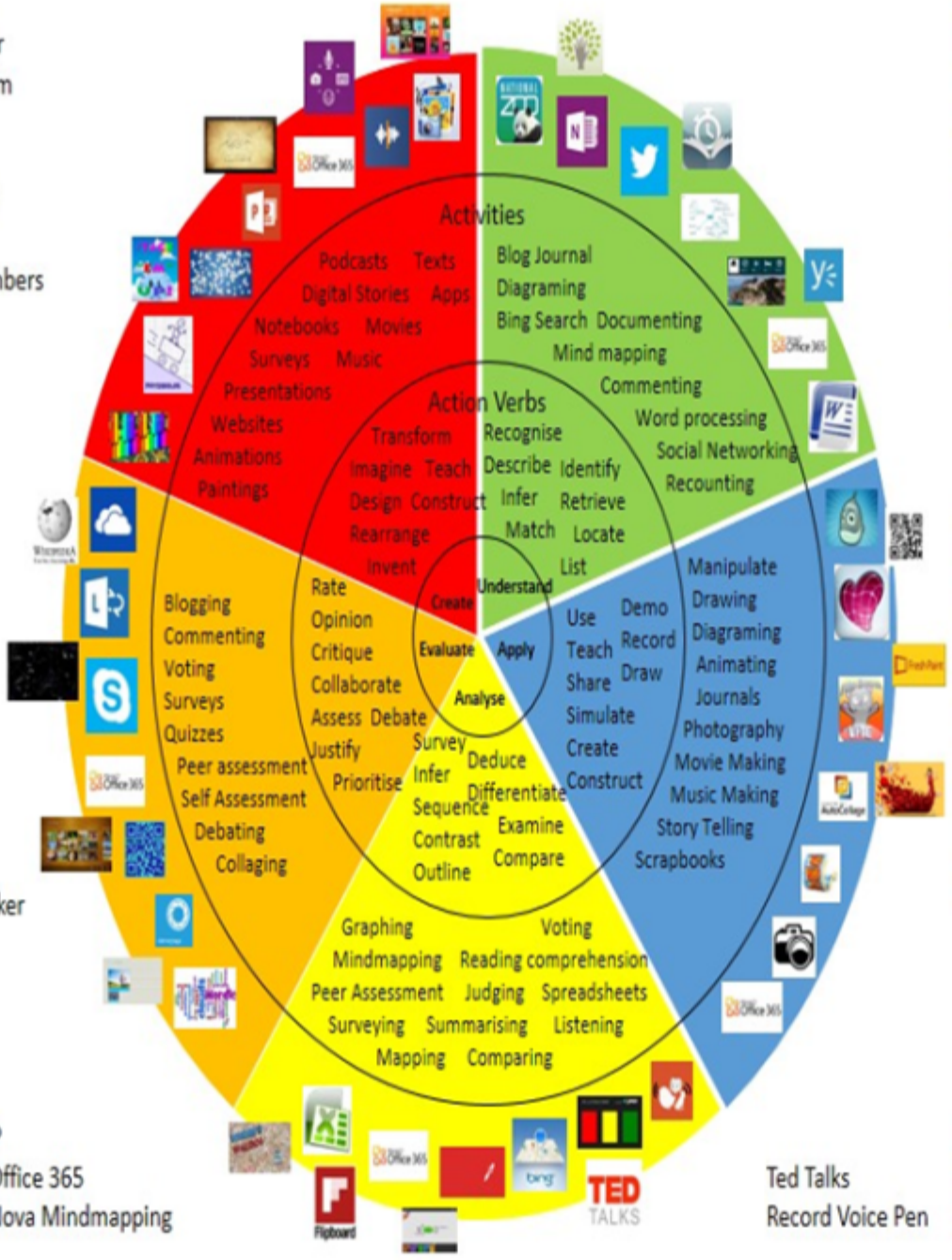
Chromebook

Google classroom

Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker



Where's Waldo?
MS Excel Office 365
Flipboard Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

Alignment to 21st Century Skills & Technology

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Technology;

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

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)

- 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)

- 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

- 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)

- 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

NJSLS: ESS3.C; 3-5 ETS1.A

Interdisciplinary Connection: Math and Language Arts

Statement of Objective: explain the purpose of engineering and technology, and give examples of how engineering and math are used in science.

Anticipatory Set/Do Now: "Can you solve it?" - can you explain it video

Learning Activity: Students will read pages 6-10 and apply what they have read to the "in touch with technology" activity. Students will then use straws to test straw beams.

Student Assessment/CFU's: Hand's-on Worksheet

Materials: HMH Science dimensions text and kit

21st Century Themes and Skills: technology

Differentiation/Modifications: leveled readers

Integration of Technology: SmartBoard, video