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ITEEA *STEL* LESSON PLAN

Lesson Title: KSB 1. Lesson 1: Development of Systems

STEL: Standards for Technological and Engineering Literacy: The Role of Technology and Engineering in STEM Education
KSB: Knowledge and Skill Builder

Author: EbD™

STEL Context(s): The Built Environment

Name of Course: *Technological Systems*

Intended for In-School or At-Home: In-School

Grade Level: 6-8

Big Idea: Technological Systems are designed and engineered following specific criteria. Systems vary in type and must be maintained in order to properly function.

Enduring Understandings:

- Systems are a major component of every part of life.
- Systems can be an open or closed looped.
- Systems need proper maintenance in order to function.
- Systems can be both natural and man-made.

Purpose of Lesson: This lesson enables students to learn that technological systems are built from multiple components to meet specific criteria. Systems are "open" or "closed" and include input, processes, output, and feedback. The relationship between components in a system determines the function of the system

Instructional Time: 4 Hours, plus 1 hour of enrichment

STANDARDS/BENCHMARKS

Standards for Technological and Engineering Literacy (STEL)	
STEL-1L.	Explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations.

Cognitive	Affective	Psychomotor
Understand		

STEL-2N.	Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.

Cognitive	Affective	Psychomotor
Apply		

STEL-2O.	Create an open-loop system that has no feedback path and requires human intervention.

Cognitive	Affective	Psychomotor
Create		Imitating

STEL-2R.	Compare how different technologies involve different sets of processes.

Cognitive	Affective	Psychomotor
Analyze		

STEL-2S.	Defend decisions related to a design problem.

Cognitive	Affective	Psychomotor
	Valuing	

STEL-3F.	Apply a product, system or process developed for one setting to another setting.

Cognitive	Affective	Psychomotor
Apply		Practicing

<table>
<tr><td>STEL-3G.</td><td>Explain how knowledge gained from other content areas affects the development of technological products and systems.<table><tr><th>Cognitive</th><th>Affective</th><th>Psychomotor</th></tr><tr><td>Understand</td><td></td><td></td></tr></table></td></tr>
<tr><td>STEL-7U.</td><td>Evaluate the strengths and weaknesses of different design solutions.<table><tr><th>Cognitive</th><th>Affective</th><th>Psychomotor</th></tr><tr><td>Evaluate</td><td>Responding</td><td></td></tr></table></td></tr>
<tr><td>STEL-7V.</td><td>Improve essential skills necessary to successfully design.<table><tr><th>Cognitive</th><th>Affective</th><th>Psychomotor</th></tr><tr><td>Evaluate</td><td></td><td>Practicing</td></tr></table></td></tr>
<tr><td colspan="2">Next Generation Science Standards (NGSS) Benchmarks</td></tr>
<tr><td>MS-LS2-5</td><td>Evaluate competing design solutions for maintaining biodiversity and ecosystem services.</td></tr>
<tr><td>MS-ETS1-1.</td><td>Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.</td></tr>
<tr><td colspan="2">Common Core Mathematics Standards (CCSS Math) Benchmarks</td></tr>
<tr><td>7.G.1</td><td>Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.</td></tr>
<tr><td colspan="2">Common Core English Language Arts Standards (CCSS-ELA) Benchmarks</td></tr>
<tr><td>CCSS.ELA-Literacy.W.7.9</td><td>Draw evidence from literary or informational texts to support analysis, reflection, and research.</td></tr>
</table>

CCSS.ELA-Literacy.W.8.1	Write arguments to support claims with clear reasons and relevant evidence
CCSS.ELA-Literacy.W.8.6	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas efficiently as well as to interact and collaborate with others.

Applicable *STEL* Practices: Systems Thinking, Critical Thinking, Collaboration, Communication

Learning Objectives:

In Lesson One, students will:

- Define and identify a system as "open" or "closed."
- Identify requirements placed on a system.
- Interpret the components of the systems model: input, processes, output, and feedback.
- Gain understanding through research and explain in writing the relationship between components in a technological system.
- Design and engineer a working prototype in their engineering design teams.
- Use appropriate measurement, angles, area, surface area, and volume of system components to design and engineer a system's components.
- Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task.
- Work safely and accurately with a variety of tools, machines, and materials.
- Actively participate in group discussions, ideation exercises, and debates.

6E MODEL LEARNING HIGHLIGHTS

ENGAGE: (experience, question, stimulate)
The teacher will introduce the concept of systems using the KSB One, Lesson One Slides. Students will document the slides using the KSB One, Lesson One *Words to Know* (File 1.1.1) document. During the lesson, the teacher will give examples and allow students to give examples of each word.

EXPLORE: (predict, experiment, observe, discover, record, retest, discuss)
Students are introduced to the concept of systems through the investigation and discussion of what components make up a system and describing systems in their daily lives.

- The class will discuss the steps needed to complete these tasks, and the teacher will introduce systems terminology, including input, output, process, feedback, and open and closed systems.

- Students write down the steps that they consider important in completing the selected task from the list in their *Engineering Design Journals*.
- Students may also note other potential steps that are part of the process such as charging or plugging in the phone, and these are discussed as requirements or constraints on the system in their *Engineering Design Journals*.
- In their *Engineering Design Journals*, students are asked to create a chart or diagram of the system that was previously described.

EXPLAIN: (develop, progress, grow)
Students are divided into Engineering Design Teams by the teacher. Each group is given a specific system to identify, research, and present to the class. Systems may be natural, such as photosynthesis, or man-made, such as a bicycle. Students will use the KSB One, Lesson One *Explaining the System* (File.1.1.2) document as well as *Engineering Design Journals* to stay on track.

Teacher's Note: Have a list of ideas you would find appropriate for students to choose from. Systems should be simple but allow for students to gain understanding of the system.

eNGINEER: (apply, conceptualize, informed design, modeling, create)
Working in Engineering Design Teams, students will design and engineer a system to accomplish a specific goal or process. Using KSB One, Lesson One *Engineering a System* (File.1.1.3), students will document their progress in their Engineering Design Journals.

- Using the system goal selected by the team in the Explanation activity, students develop a system to complete that task, using appropriate measurement, angles, area, surface area, and volume of system components.
- Documentation of the design process including system sketches, processes, and a diagram or demonstration are included in the *Engineering Design Journal*.
- Documentation of system components, the role that they play within the system, and the system type are included in the presentation and *Engineering Design Journal*.
- The prototype should be a working prototype.
- Teams will present the system with a diagram or demonstration of the system to the class.

Teacher's Note: Choosing a specified task such as popping a balloon, blowing out a candle, or squeezing a tube of toothpaste with help the progress of the project.

ENRICH: (interact, question, hypothesize, experiments, record observations, draw conclusions)
Students will switch systems with another team to complete the enrichment task. Students will peer review each other's systems using the KSB One, Lesson One *Peer Review* (File.1.1.5) document.

Teacher's Note and NASA Extension: The following activities can replace the eNGINEER portion of the assignment.

- On the Moon—NASA and Design Squad: https://www.nasa.gov/pdf/308966main_On_the_Moon.pdf
- NASA BEST: https://www.nasa.gov/audience/for educators/best/activities.html

EVALUATE: (analysis, synthesis, re-visit)
- Students' knowledge, skills, and attitudes will be assessed using selected response items and rubrics for class participation, assignments, brief constructed responses, and presentations. The rubrics will be presented in advance of the activities to familiarize students with the

expectations and performance criteria. They will also be reviewed during the activities to guide students in the completion of assignments. The teacher may wish to develop a collection of annotated exemplars of student work based on the rubrics. The exemplars will serve as benchmarks for future assessments and may be used to familiarize students with the criteria for assessment.

- The teacher should carefully monitor the expert and base groups to ensure that all students are participating equally and to the best of their abilities.
- The teacher should make sure that the groups stay on task throughout this lesson since it is the foundation of the remaining activities in the unit.
- If students are unable to comprehend the material on the resource handouts and websites, remind them that they don't need to memorize every detail, just get the general understanding of the content.
- Use included respective rubrics to evaluate students' work individually and in teams.

Teacher Preparation: The laboratory should provide a flexible and resource-rich learning environment that includes areas for lectures and demonstrations, small group meetings, and research activities. The teacher will adapt the learning environment based on the requirements of the KSB or lesson. For this lesson, areas for lecture and demonstration, design, small group meetings, and fabrication activities should be readied.

TEACHER RESOURCES

Audiovisual Materials:

- How Products are Made Videos
- NASA Earth Systems Video

Print Materials:

- ITEEA *Standards for Technological and Engineering Literacy*: https://www.iteea.org/File.aspx?id=177416&v=90d1fc43
- Benyon, D., Turner, P., and Turner, S. (2005). Designing Interactive Systems: People, Activities, Contexts, Technologies. Boston, MA: Addison Wesley.
- Morgan, J., & Liker, J. (2006). The Toyota product development system: Integrating people, process and technology. New York, NY: Productivity Press.
- Thomas, C. (2009). Introduction to process technology. Independence, KY: Thomson Delmar Learning.

Required Tools/Materials/Equipment:

- Computer with internet access
- Presentation projector
- Engineering Design Journals or blank paper for sketching
- 12" ruler for each student
- Drafting pencils for each student
- Optional: flowchart templates
- Bamboo skewers
- Twine
- Gift wrap tape

- Plastic wheels
- Cardboard
- Assorted sandpaper

Lab/Classroom Safety and Conduct:

- Students should use all tools and equipment safely while maintaining appropriate levels of activity for themselves and others.
- Students should demonstrate respect and courtesy for the ideas expressed by others in the class.
- Students should show respect and appreciation for the efforts of others in the class.

Student Resources:

- KSB One Lesson One—Check for Understanding (File.1.1.5)
- KSB One Lesson One—Check for Understanding Answer Key (File.1.1.6)
- KSB One Lesson One—Engineering the System (File.1.1.3)
- KSB One Lesson One—Explaining the System (File.1.1.2)
- KSB One Lesson One—Peer Review (File.1.1.4)
- KSB One Lesson One—Words to Know (File.1.1.1)

Assessments: The teacher will use rubrics and observation throughout the lesson to gauge student learning:

- Connecting Technology Rubric
- Check for Understanding
- Engineering Design Journals

Supporting Files:

Include attachments as both Word and PDF files.
Include a Design Brief