ROBOTIFICATION

LESSON OVERVIEW

Participants will learn about the importance of robots and design a robot that can perform a given task while learning about the engineering design process. They will also design concept art for their robot designs and work together as a class to choose best robot features and build the bot. The big secret is that a classmate or community member will be the robot, wear the robot suit, and perform programmed commands. The task will only be performed correctly if participants programmed the bot properly. One example is robowling, a game in which the participants programmed a person-bot to bowl (a play bowling set could be used). Each participant received a frame of bowling and received an individual score.

STANDARDS

Next Generation Science Standards (Middle School)

MS-ETS1-1
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.

MS-ETS1-2
Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Next Generation Science Standards (High School)

HS-ETS1-2
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

HS-ETS1-4
Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

OBJECTIVES

- Students will design a robot using the engineering design process.
- Students will create concept art for their robot design.
- Students will work collaboratively on a group design and will construct the robot suit.
- Students will write and state commands to program the bot.

MATERIALS

- Engineering Design Process Handout

- Cardboard or boxes (i.e. shipping boxes, cereal boxes, shoe boxes, discarded boxes)
- String, rope, and/or tubing
- Paper plates and cups
- Tape
- Colorful paper and glue, paint, or spray paint (choose appropriate media for age of participants)
- Other miscellaneous materials
- Task performance materials (i.e. play bowling set)
- Camera

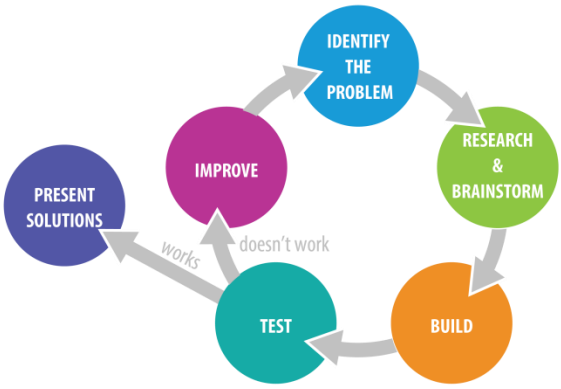
PROCEDURES

1. Facilitate a class discussion on the importance of robots and how they affect the way we live. Below are suggestions for videos related to robots.
    - David Gunkel Part 1: The Machine Question and Robot Ethics
    - Robot Examples
        - Robot ATLAS
        - Alpha Dog
        - Robot Spider
2. Discuss the different types of robots and their uses.
    - Industrial robots (welding, painting, automating vehicles, etc.)
    - Domestic robots (vacuuming, pool cleaning, gutter cleaning, etc.)
    - Medical robots (surgery, lifting, diagnosing, prosthetics, etc.)
    - Service robots (research, technology demonstration, data collection, etc.)
    - Military robots (law enforcement, survival material transportation, search and rescue, etc.)
    - Entertainment robots (toys, alarms, etc.)
    - Space robots (planet exploration, space station operation/mechanics, data collection in space, etc.)
    - Hobby robots (destroyers, robotics kits, etc.)
3. Look at examples of robot concept art at http://conceptrobots.blogspot.com/ and ask some of the following questions.
    - What type of robot do you think this is and what function does it serve?
    - What purposes do the appendages of the robot serve?
    - How does the robot travel?
    - Do humans control any part of the robot and what is its relationship with humans?
4. Describe the engineering design process to the participants, which is described later in this lesson. A video on the process can be found at http://smartspaceniu.com/2014/05/14/i-%E2%99%A5-engineering/
5. Tell the participants that they will design a robot that can perform a task (i.e. robowling). Describe the task and have the participants identify the problem that needs to be solved.
6. Have the participants use the internet to locate existing robotic solutions for the assigned task.
7. Have the participants design concept art for their robots in the form of rough sketches. Beginning at this point in the lesson, take pictures and notes with a phone or other device to use the documentation media in the presentation phase.
8. As a class, choose the best robot features and sketch out the design.
9. Build the bot. The big secret is that a classmate or community member will be the robot, wear the robot suit, and perform programmed commands. The task will only be performed correctly if participants programmed the bot properly. One example is robowling, a game in which the participants programmed a person-bot to bowl (a play bowling set could be used). Each participant received a frame of bowling and received an individual score.
10. Have the participants program the bot.
11. With an established computer or mobile device-based scoring system, enter each participant's score based on his/her programming success.
12. Have the participants present their robotic solution to another class or other group with a multimedia presentation that includes images of proposed solutions, selected criteria for the final design, and constraints and successes that were experienced.

ENGINEERING DESIGN PROCESS OVERVIEW

Identify the Problem
What is the problem, and why is it important?

Research and Brainstorm
Research: What has been done to solve this problem? Who is affected by this problem? What current solutions are available?
Brainstorm: What sort of things can be used to solve this problem? How can current solutions be improved? What materials will you need? Create concept designs.



Build
Decide upon your best design, gather your materials, and build your prototype.

Test
Test your prototype to determine its challenges, problems, and level of effectiveness.

Improve
If the prototype does not work, repeat the process by identifying problems with the prototype design, conducting more research and brainstorming possible improvements, modifying or rebuilding the prototype, and performing additional testing until a solid solution is found.

Present Solutions
Once an effective solution is discovered, present your work to others. Possible forms of presentation include a project board or multimedia presentation at a meeting or conference, documentation made accessible to those who can benefit from the work, and electronic communication of the solution via email, social media, blogs, websites, digital signs, videos, etc.

STUDENT MULTIMEDIA PRODUCT RUBRIC

	Target (3)	Meets (2)	Partially Meets (1)	Does Not Meet (0)
Robotic Conceptual Design	Effectively demonstrates understanding of robotic conceptual design for a specific purpose.	Demonstrates some understanding of robotic conceptual design but some elements do not reinforce the purpose.	Attempts to demonstrate understanding of robotic conceptual design but the design provides limited evidence of this knowledge.	Does not demonstrate understanding of robotic conceptual design.
Use of Materials in Prototyping	Inventively and successfully chooses materials that produce visual interest and serves to support the robot's purpose.	Appropriately chooses materials that serve to support the robot's purpose.	Chooses materials but some work against the purpose of the robot.	Does not choose appropriate materials.
Collaboration	Works well with others and discusses ideas in a fair, respectful, and encouraging way and is considerate of the feelings of others.	Works okay with others and discusses ideas in a fair, respectful way, but may not have been encouraging. Considers the feelings of others.	Works with others, but did not contribute a fair share of work OR was discouraging and did not consider the feelings of everyone.	Did not work well with others and/or discusses ideas in an unfair, disrespectful way.
Robotic Prototype	The prototype works well to accomplish the assigned task.	The prototype works okay to accomplish the assigned task.	The prototype works to partially accomplish the assigned task.	The prototype does not even partially accomplish the assigned task.
Requirements	Meets all of the requirements for the	Meets most of the requirements for the	Meets some of the requirements for the	Does not meet the requirements for the

	project.	project.	project.	project.
Demonstration of knowledge of Curricular Content in Discussions and Activities	Demonstrates an advanced understanding of the curricular content covered in class related to this project.	Demonstrates an adequate understanding of the curricular content covered in class related to this project.	Demonstrates limited understanding of the curricular content covered in class related to this project.	Does not demonstrate an understanding of the curricular content covered in class related to this project.
Total				/18