SIEMENS STEM DAY ACTIVITY

DESIGN A NEWBOT

OBJECTIVES

Students will be able to:

- Engage in the engineering design process to create and design a robot prototype that meets a need or solves a problem.

- Provide constructive feedback and suggestions to help their peers make design improvements.

- Utilize and apply peer input in order to enhance a prototype.

THIS LESSON FOCUSES ON

Engineering Design Cycle

- Defining the Problem

- Designing Solutions

21st Century Skills

- Collaboration

- Communication

- Critical Thinking

OVERVIEW

Students will identify a current need or problem in society and design a prototype, including sensors and components necessary for a new robot (NewBot). Students will engage in the engineering design process and seek input and suggestions from their peers to modify and improve their design concept.

STEM incorporates Science, Technology, Engineering, and Mathematics to focus on real-world issues and problems guided by the engineering design process. This type of instruction supports students in developing critical thinking, collaboration, reasoning, and creative skills to be competitive in the 21st-century workforce.

Each Siemens STEM Day classroom activity highlights one or more components of the engineering design cycle and an essential 21st-century skill.

MATERIALS

- "Stages of the Design Process Poster", to project or display

- Stages of the Design Process Handout, one per person

- Computers with internet access

HAVE YOU EVER WONDERED . . .

If I could invent a robot, what would I design it to do?

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MAKE CONNECTIONS!

How does this connect to students?

Today's students are the valuable problem solvers of tomorrow. To help improve our society, students will identify something they perceive as a problem and design a solution. Students need to be empowered as **visionaries** to help make our world a better place for all.

How does this connect to careers?

A robotics engineer is responsible for creating robots and robotic systems that make tasks easier, safer, and/or more efficient. This role may involve working on mechanics, electronics, computer systems, and even the application of human psychology. Becoming a robotics engineer requires curiosity and persistence as well as analytical thinking.

A robotics programmer is responsible for using programming code to bring robots to life. A robotics programmer may find themselves working closely with engineers, as this role not only involves the development of computer software, but also includes assisting engineers in designing, assembling, testing, and repairing robots.

How does this connect to our world?

Artificial intelligence is an advancing field that involves collecting large amounts of data, fast processing, and the application of intelligence algorithms to allow software to learn from patterns and features of the data. Learning about AI is not only helpful when designing a robot, but it also helps humans to better understand the advancing and changing society in which they live.

BLUEPRINT FOR DISCOVERY

1. To engage students, ask them to collectively list as many different types of robots as possible. Then ask them to categorize these robots according to their purpose. Students often most easily identify exploration and consumer robots such as the Mars rovers or the Roomba iRobot vacuum. Explain to the students that there are actually six main types of robots:
   - Industrial
   - exploration
   - consumer
   - medical
   - aerospace
   - aquatic

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2. Instruct the students to turn to a partner and as a pair, brainstorm current problems or needs of society. After this is completed, ask them to discuss with their partner possible solutions to these problems and needs.

3. Explain that the students are going to use the engineering design process to design a NewBot to solve one of the problems they identified. Instructors can find more information and concept ideas at: https://www.researchgate.net/publication/340025406_PROJECT_IDEAS_FOR_MECHANICAL_ENGINEERING_STUDENTS

4. Show the students the "Stages of the Design Process" poster. Pass out a copy of the "Design a NewBot" handout, one to each student. Determine the group's familiarity with the design process, and use this to gauge to amount of time needed to review the different stages.

5. Explain that the students will work with their partner to design a new robot. Instruct the students to complete the "Stages of the Design Process" handout to document their thinking as they work. Remind students to label their designs to promote clarity and understanding of their ideas. Encourage students to include sensors and other robotic components necessary for proper operation of the robot.

6. To enhance each group's design, students will present their idea to the class to gather input and suggestions from their peers. Encourage the students to be honest, yet constructive with their questions and ideas in order to provide valuable feedback. This can be done orally or on paper depending upon time and the nature of the group of students. Please note: To do this orally, it is best if there is an open, honest, and welcoming classroom environment in which making mistakes is encouraged and valued.

7. After receiving peer input, provide students with additional time to make revisions to their design. Once the final revisions have been completed, ask each student to complete the "Peer Feedback Evaluation Form". If time remains, you may choose to discuss this as a class.

TAKE ACTION!

- Students can use CAD software such as Siemens Solid Edge, TinkerCAD, MeshLab, or Onshape to digitally design their robots.

- Provide students with a variety of building supplies and allow students to construct physical models of their robot designs.

- Students can enter engineering design challenges such as eCybermission, ExploraVision, and many more. Support students in researching these opportunities.

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NATIONAL STANDARDS

Standards for Technology Literacy	Standard 2: Students will develop an understanding of the Nature of Technology. This includes acquiring knowledge of the core concepts of technology. Standard 8: Students will develop an understanding of Design. This includes knowing about the attributes of design. Standard 11: Students will develop Abilities for a Technological World. This includes becoming able to apply the design process.
Next Generation Science Standards	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. SEP 2: Developing and Using Models

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STAGES OF THE DESIGN PROCESS POSTER

DESIGN THINKING PROCESS

PROBLEM DEFINITION
What do you want to solve?

EMPATHY BUILDING
For whom do you want to solve which problem?

IDEATION
Which ideas could solve the problem?

PROTOTYPING
What exactly is the solution?

TESTING
What does the user think about your solution?

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PROBLEM DEFINITION
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**DESIGN
THINKING
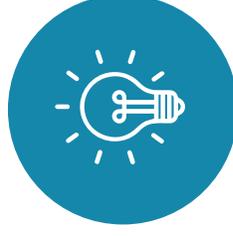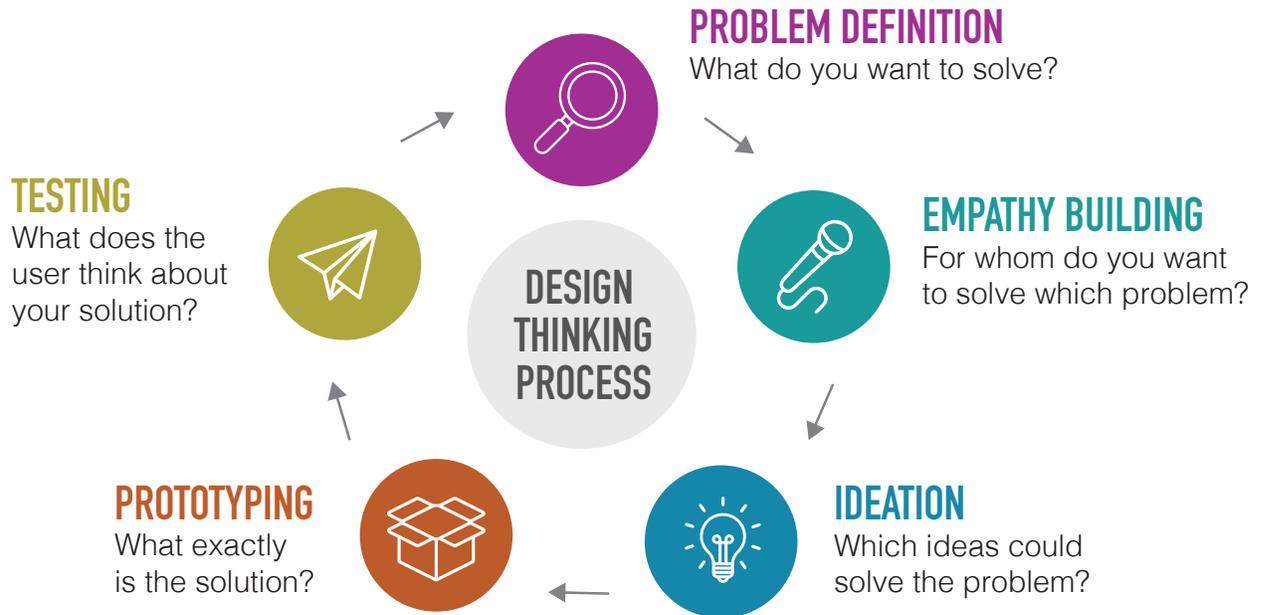PROCESS**

TESTING
What does the
user think about
your solution?

PROTOTYPING
What exactly
is the solution?

IDEATION
Which ideas could
solve the problem?

Stage	Document Your Ideas
Problem Definition	
Empathy Building	
Ideation	

Stage	Document Your Ideas
Prototype 1	
Empathy Building	
Ideation	

PEER FEEDBACK EVALUATION FORM

1.   What piece of feedback was most helpful to you? Explain why it was helpful.

2.   What feedback surprised you the most? Explain why.

3.   Based upon the feedback you received, what changes did you make to your robot design? Explain why you made each change.

4.   If you could repeat this experience, what would you do differently, and why?