SIEMENS STEM DAY | Science Technology Engineering Math

GRADES 9–12

SIEMENS STEM DAY ACTIVITY

DESIGNING A MARS ROVER

OBJECTIVES

Students will be able to:

- **Explore** steering systems and wheel placement with an orthographic drawing.
- **Develop** a model of a chassis for a Mars rover.

THIS LESSON FOCUSES ON

Engineering Design Cycle

- Designing Solutions

21st Century Skills

- Critical Thinking

OVERVIEW

Students explore the basic components of vehicle design and learn about the conditions affecting Mars rovers. They design an improved Mars rover by defining a problem and proposing a solution in the form of improved design elements.

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

- Images of terrain (printed or electronically displayed)
- **Mars Rover Planning Sheet** Handout—one per student
- Sticky Notes—three per student

HAVE YOU EVER WONDERED . . .

How is a vehicle built to turn, climb, and transport smoothly on difficult terrain like Mars?

MAKE CONNECTIONS!

How does this connect to students?

Three rovers will be headed to Mars in 2020. China, Europe/ Russia, and the United States are all planning on landing rovers to collect samples to gain new insights into Mar's history.[1]

How does this connect to careers?

An **Aerospace Engineer** is employed primarily in manufacturing analysis and design, research and development of the building of aircraft, spacecraft, missiles, and satellites.[2] In this role an employee could be working the next rover as well as asteroid impact devices. Aerospace Engineers would most likely work for the government, but there have been developing private aerospace businesses.

An **Automotive Engineer** is responsible for the development of passenger cars, trucks, buses, motorcycles or off-road vehicles.[3] In this role an employee may design vehicles for all types of terrain. Automotive Engineers would work for major automotive brands as well as small custom designers.

How does this connect to our world?

Engineers create new designs for vehicles products every year from the latest Mars rover to super tires of the future.

Michelin tire Uptis in 2024 will be airless and puncture-proof. Meaning you could drive this tire over the toughest terrain and never have an issue.

Local Motors is 3D printing cars that you can design yourself. They will have a selection of engine types that you can then choose to print the vehicle of your dreams.

[1] C&EN, Astrochemistry, 3 rovers will head to Mars in 2020. Here's what you need to know about their chemical missions, On the internet https://cen.acs.org/physical-chemistry/astrochemistry/3-rovers-head-Mars-2020/97/i29 (August 22, 2019)
[2] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, Aerospace Engineers, on the Internet at https://www.bls.gov/ooh/architecture-and-engineering/aerospace-engineers.htm (visited August 22, 2019).
[3] Educating Engineers, Automotive Engineer, On the internet https://educatingengineers.com/careers/automotive-engineer (visited August 22, 2019)

BLUEPRINT FOR DISCOVERY

1. To engage students in their challenge to create an improved Mars rover, work together to brainstorm a list of chassis components (i.e., "parts that make up a car"). Anticipated responses might include: frame, wheels, tires, axles, suspension, power plant, transmission, brakes, and steering.
2. Provide brief descriptions and purposes of some of the more recognizable and necessary components to any vehicle. Examples include:
    - **Frame:** the main structure of the vehicle that supports everything else
    - **Wheels:** reduce the friction so the vehicle can move
    - **Tires:** provide traction and absorb road shocks
    - **Suspension:** keeps the frame from hitting the ground on different terrain
    - **Transmission:** sends that power to the wheels
3. Display images (printed or electronic) of the types of terrain that their rover might encounter (i.e., mountains, gorges, large rocks, etc.). Facilitate a discussion about which vehicle components play a role in various environmental considerations.
4. Distribute the **Mars Rover Planning Sheet** Handout and instruct students to write down notes that are relevant to their project as they watch the following video: https://youtu.be/nQ365jzwk5w (i.e., weight, design elements, environmental considerations, etc.).
5. Ask students to brainstorm a problem they notice about current rover design that could be solved with a new design and record it on their sheet along with their suggested design element. Examples might include:
    - Concern about durability of materials might inform their choice in metals
    - Keeping the rover right side up might inform their chassis design
    - Inability to move over certain terrains might inform the number of wheels they have or tire design
6. Challenge students to draw and label their new Mars Rover. Walk around the room while students work to provide assistance or answer questions. Encourage students to consider frame design, number of wheels, where their power base will be located, etc.
7. Display designs around the room and allow students an opportunity to participate in a gallery walk. Provide three sticky notes to each student on which they can provide feedback on their peers' designs.

TAKE ACTION!

- Students can use recycled materials and/or motor elements to create a prototype of their design and test on various terrain samples. Students can adjust their design and prototype based on results.

NATIONAL STANDARDS

Science	Next Generation Science Standards HS-PS2-3. Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
Technology Education	International Technology and Engineering Educators Association Standard 9: Students will develop an understanding of Design. This includes knowing about engineering design. Standard 10: Students will develop an understanding of Design. This includes knowing about the role of troubleshooting, research and development, invention and innovation, and experimentation in problem-solving.

MARS ROVER PLANNING SHEET

Video Notes:

My Design will attempt to solve this problem:

By including this design element:

Improved Mars Rover Design: