WHAT IS A ROBOT?

AT A GLANCE Students will reveal their personal interactions with robots and compare their interactions and thoughts with how robots are evolving and assist with real-life scenarios.

OBJECTIVES

Students will:

- Create a definition of robot.
- Discover four different categories of robots and how they interact with their surroundings.
- Illustrate a robot's build (form) based upon a specific set of parameters (function).

KEY VOCABULARY

Robot, Programmer, Code

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices:

- Asking questions and defining problems
- Developing and using models
- Analyzing and interpreting data
- Constructing explanations and designing solutions
- Obtaining, evaluating, and communicating information

CROSSCUTTING CONCEPTS:

- Patterns
- Systems and system models
- Structure and function

DISCIPLINARY CORE IDEAS:

- MS-PS4: Waves and their applications in technologies for information transfer
- MS-ETS1: Engineering design

PACE YOURSELF

- 45 minutes

ADVANCE PREPARATION

Print out a classroom set of the Robot Comparison Venn diagram and copies of the Robot Scenarios.

MATERIALS

Per student:

- Paper
- Drawing utensils

WHAT YOU NEED TO KNOW

When you hear the word robot, the first visual that might come to mind is something that looks like the picture to the right. As the robotics industry continues to evolve and grow, this stereotypical image and misconception starts to dissolve. If not this image, then what exactly is a robot? To complete their tasks, **robots** have to sense, plan and act. Robots use different kinds of sensors to collect the information they need. Software processes this information so the robot can plan a response. Then they act to get the job done. The person that instructs or programs a robot is called a **programmer**. Programmers use a specific "language" called code to interact with a variety of robots through a computer or software system.

Robots come in different shapes and sizes depending on the activities the robots are intended to carry out. During the design process, engineers consider functionality when creating the form and build of the robot. In the Robot Revolution exhibit, robotics is divided into four different categories: industrial robots, social robots, telerobotics and mobile robots.

Industrial Robots

Robotic companies, such as FANUC, are the largest makers of industrial robots in the world. Many robots, including the M-1iA Delta Robot, work in assembly lines to increase the production time of a product. As human beings, we use hand-eye coordination in order to complete tasks on an assembly line. Robots are very precise and their vision, powerful motors (actuators) and lightweight arms can work more efficiently than a human. Today it is more likely for a worker to be trained how to program and function a robot to work on an assembly line rather than completing the task themselves.

WHAT IS A ROBOT?

Social Robots

Scientists have been studying human facial expressions for many years. With the dozens of muscles found in our faces we are able to communicate emotional cues such as joy, anger, or shock. Social robots like EMYS have the ability to detect emotional cues from human beings. Social robots can also be used as a comfort mechanism. Paro is a baby seal used for therapeutic purposes and can have a calming effect on a person in a nursing home or hospital. This idea is much like live Animal-Assisted Therapy. Even though emotional cues can be detected, these robots do not feel or experience emotions themselves.

Telerobotics

Some robots can be controlled from great distances, such as from Earth to Mars! The Curiosity rover is a remotely operated robot on Mars driven by a team engineers at NASA's Jet Propulsion Laboratory on Earth. Every morning the rover is sent a specific list of tasks to accomplish—these tasks include taking pictures of the Martian surface or collecting soil samples. Not all remote-controlled robots have to be millions of miles away; the Da Vinci Surgical System is a robot that assists in making major surgeries minimally invasive. Its robotic arms carefully perform the surgery on the body as the surgeon orchestrates every movement, incision and suture from the Da Vinci console. This console produces a three-dimensional, high-resolution image for the surgeon to observe and manipulate while performing the surgery.

Mobile Robots

GOAL! Soccer 'bots are autonomous robots that move around and play a game of soccer. The robots move with the help of artificial intelligence (AI) software and two cameras mounted above that act as eyes to control the game. These eyes sense and compute data, which then flows to a central computer that holds the AI software. The AI software processes and plans out a strategy for the robots. Finally, the AI software sends out commands to the player 'bots, allowing them to act in the game by kicking or blocking the ball. Mobile robots can be fun, but can also have a more serious purposes: RHex has the ability to travel through rocks, sand, and other climates. This robot is used to study areas that humans are not able to reach or that are unsafe to travel. Attaching objects like climate sensors allow RHex to collect data for humans to study later.

WARM UP

1. Ask students to draw a robot, based upon their experiences.

2. Have students take two minutes to do a "think, pair, share and explain" about what they drew and why they drew their robot in that particular manner.

3. Lead students through a group discussion with an outcome of creating a definition of robots. Pose questions such as:

- Have you ever seen a robot before? What did it look like?
- What type of task was the robot trying to accomplish?
- Does a robot move? Or have arms that move?
- Are robots important? Why?
- What is a robot? Robots use different kinds of sensors to collect the information they need. Software processes this information so the robot can plan a response. Then they act to complete the task.

WHAT IS A ROBOT?

ACTIVITY

1. Assemble students in groups of three to four to work together. Pass out one scenario card and all robot cards to each group.

2. Groups should read through each scenario and pick two robots best suited for the scenario.

3. Pair two groups together to present their scenario to each other. What two robots did they choose and why?

4. Pass out the Robot Comparison student worksheet and have students compare and contrast their original robot drawing from the warm up to the robots they chose to help in a real life scenario.

- What is similar about the robots?
- What is different about the robots?
- If you were to go back and create another drawing would you make any changes? Why?

5. Conclude with a group discussion by sharing their answers from the Venn diagrams and discuss the questions below.

CHECK FOR UNDERSTANDING

- How do you know if something is a robot?
- What is the purpose of a robot?
- What should an engineer take into consideration before building a robot?
- Is a dishwasher a robot? Why or why not?
- Is a cellphone a robot? Why or why not?

WHAT'S HAPPENING?

Students are preparing to visit *Robot Revolution* by dissolving prior misconceptions and reevaluating their thought process about robotics. Through group discussion, students will design a definition of a robot incorporating the idea that robots sense, plan and act in order to complete a series of tasks. This process of sensing, planning and acting is what distinguishes something as being a robot. Students recall prior interactions with robotics to realize how robots are built with a purpose—"form fits function"—to help humans in their everyday lives. Additionally, by making choices based upon specific, real-world scenarios, students will determine what robots would be helpful for humans day-to-day. Using a Venn diagram, students will compare and contrast the robot they drew in their warm up with the robot they chose for their real-world scenario.

DIFFERENTIATED INSTRUCTION

Have students select their two robots and research the different jobs they assist with and/or perform. Students can create a small presentation about their robots, explaining the research they discovered to back up their personal conclusions.

EXTENSIONS:

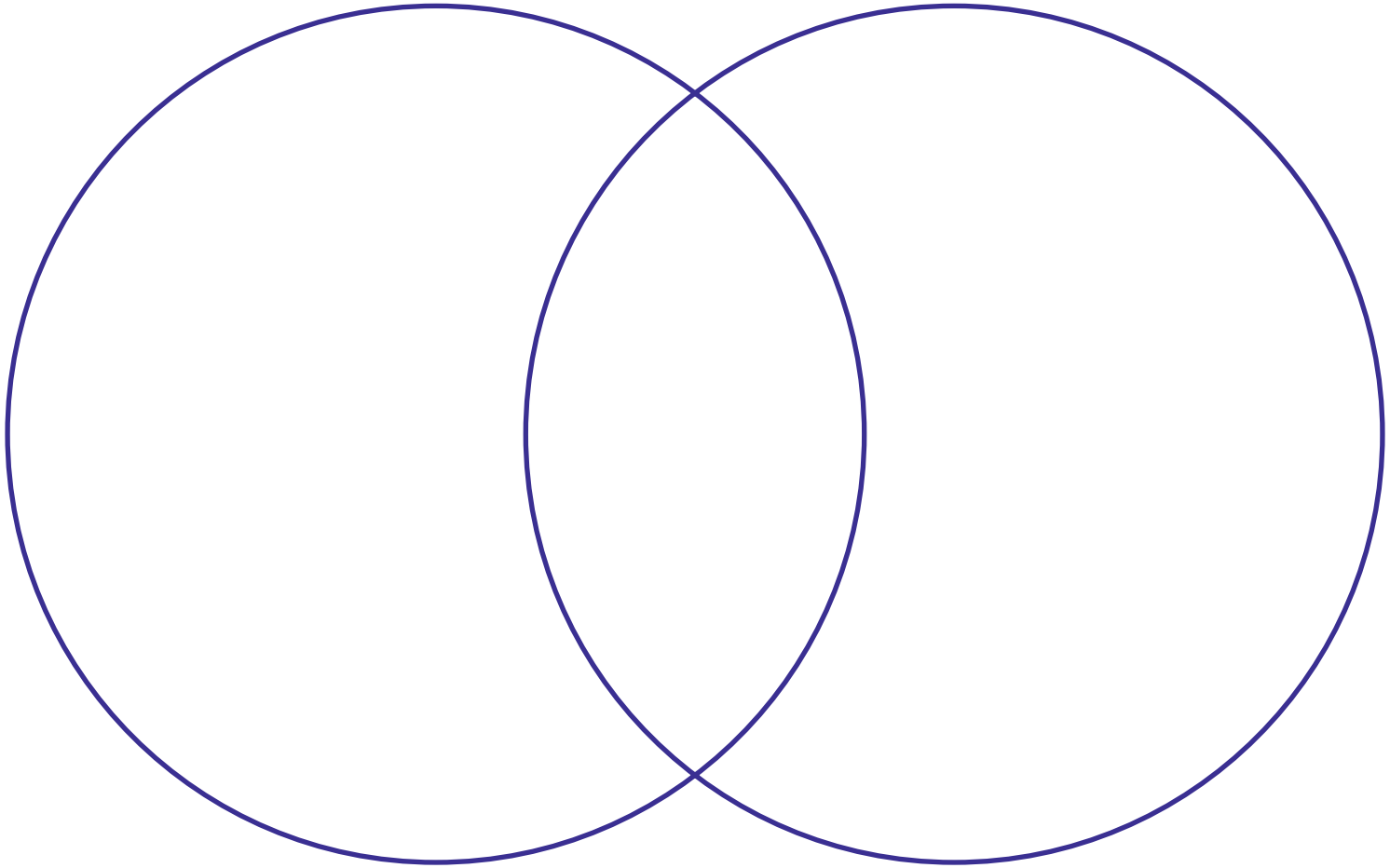
- Have students complete the warm up activity again, and then create a Venn diagram to compare and contrast their two robot drawings.
- Have students complete the warm up again, and then create a 3D-model using classroom materials such as Kleenex boxes, pipe cleaners, construction paper, markers or paper towel tubes.
- Incorporate a read aloud about robots (fiction or non-fiction).

IN THE EXHIBIT:

- PARO
- EMYS
- Baxter
- Da Vinci Surgical System
- Soccer Bots
- Swarm Bots
- RHex
- FANUC M-1iA Delta Robot

ROBOT COMPARISON

NAME: _____ DATE: _____



ROBOT SCENARIO CARDS

SCENARIO 1

The local hospital wants to make children feel more comfortable after they come out of surgery. Unfortunately, they cannot bring live animals like a dog or a cat to help relax the young patients, but they can bring in robots and different types of artificial intelligence. What type of robot would you offer to the hospital?

- How does the robot work?
- How does your robot benefit the young patients in the hospital?
- Why is this robot the best choice compared to the other robot options?

SCENARIO 2

A new electric car company has just been funded and they are starting to put together their facility where the cars will be produced. The company has hired several employees but they are quickly learning that some of the car parts are too heavy for one person to lift. What type of robot would you offer to assist the electric car company?

- How does the robot work?
- How does your robot benefit the young patients in the hospital?
- Why is this robot the best choice compared to the other robot options?

SCENARIO 3

Scientists are interested in researching rock formations at the Grand Canyon. As they are exploring they discover a cave and have come to a point where humans can no longer fit through the opening. They are curious about the depth of the cave, and if there are any living plant life or insects present. What type of robot would you offer to the scientists to enhance their research?

- How does the robot work?
- How does your robot benefit the scientist researching the Grand Canyon?
- Why is this robot the best choice compared to the other robot options?

SCENARIO 4

NASA is interested in learning more about Jupiter's moon Europa. Scientists have discovered that under the icy surface of Europa there is an ocean they would like to research and study. A mission this far into deep space has never been attempted before and NASA is starting to plan for this future event now. What type of robot would you offer NASA to send to the Jupiter's moon Europa?

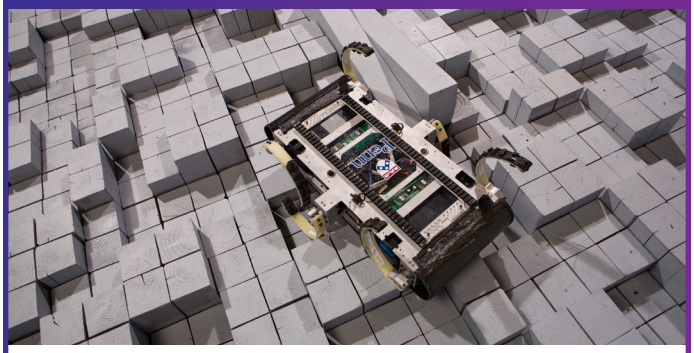
- How does the robot work?
- How does your robot benefit the young patients in the hospital?
- Why is this robot the best choice compared to the other robot options?

SWARM ROBOTS

Inspired by flocks of birds and swarms of insects in nature, swarm robots work together in groups to operate. Each robot performs its own task, but they all follow one leader in the pack.

These robots are currently in the research phase. Potential future uses include search and rescue, mining and even miniaturization for medicine.

RHEX

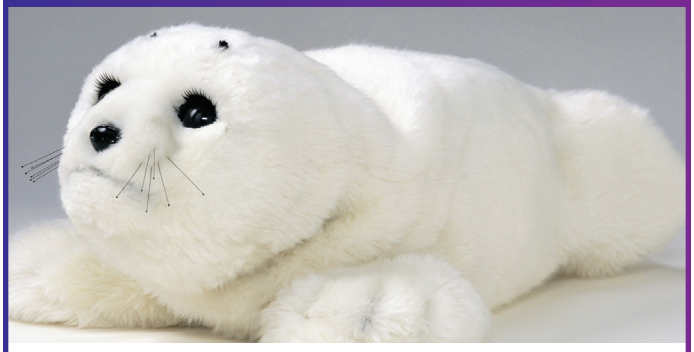


RHex has the ability to travel through rocks, sand and other climates. This robot is used to study areas that humans are not able to reach or that are unsafe for travel. Attaching objects like climate sensors allow RHex to collect data for humans to study later.

FANUC–M-1iA DELTA ROBOT

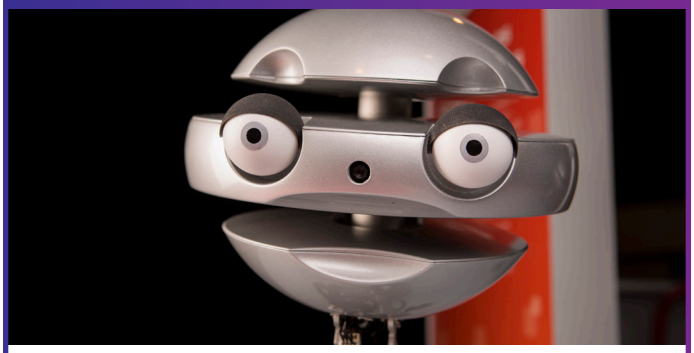
The M-1iA Delta Robot works in assembly lines to increase the production time of a product. Humans use hand-eye coordination to complete tasks on an assembly line. Robots are very precise and their vision, powerful motors (actuators) and lightweight arms can work more efficiently than humans. Today it is more likely for a worker to be trained how to program and function a robot to work on an assembly line rather than completing the task themselves.

PARO



PARO is a therapeutic robotic seal. It is designed to look approachable and to have a calming effect on people who interact with it. PARO works with the help of interactive sensors that allow it to respond when being touched. PARO will respond to petting with reactions such as moving its tail, “purring” and closing its eyes.

EMYS



EMYS stands for “Emotive headY System.” It was designed to research how humans react to robots that show emotions. EMYS can show emotions like happiness, sadness, surprise and anger by moving its three disks and two eyes. EMYS can respond to “seeing” a person’s face and also responds to touch.

BAXTER

Baxter is a robot that has the ability to “learn.” A worker moves Baxter’s arms in a desired motion; Baxter memorizes the motions and repeats them over and over. Baxter is often used in industrial environments and is considered unique because it does not need a software engineer to program it.

DA VINCI SURGICAL SYSTEM

The Da Vinci Surgical System is a robot that assists in making major surgeries minimally invasive. Its robotic arms carefully perform the surgery on the body as the surgeon orchestrates every movement, incision and suture from the Da Vinci console. This console produces a three-dimensional, high-resolution image for the surgeon to observe and manipulate while performing the surgery.