DENVER MUSEUM OF NATURE & SCIENCE

ROBOTICS

courtesy NASA/ JPL

Museum Classroom Programs

Pre- and Postvisit Activities

Grades 4–8

LL-050

We're Glad You're Coming!

Thank you for selecting this Museum Classroom Programs class at the Denver Museum of Nature & Science for your field trip. In order to make the most of your visit, we recommend the following:

- Include your students and chaperones in the planning process.
- Discuss and distribute an agenda that explains what the students can expect to do and see during their field trip. In the agenda, include time for students to visit the gift shop, take breaks, and eat lunch.
- These classes are most effective when students have adult guidance. Please invite parents and other adults to help the students get the most out of the Museum class. The adults will enjoy the experience of exploring the stations with the students, and the class will be more productive for the students.
- Bring cameras! Photographs are a great way for kids to document their visit.

IMPORTANT: Use the enclosed pre- and postvisit activities to extend and enhance your scheduled program(s) at the Denver Museum of Nature & Science.

Included in this packet you will find pre- and postvisit activities especially designed to extend and deepen the educational value of your Museum class. Research shows that students who engage in related activities before and after a field trip obtain and retain more knowledge and understanding from their visit than unprepared peers retain. Therefore, we strongly recommend that you use the enclosed activities before and after your visit.

"Robotics" Class Overview

Students learn and review the importance and function of robots in a society dependent upon technology. Students identify specific uses of robots in space exploration and travel, such as extravehicular repairs and data collection on distant planets. They spend the majority of their time working in small groups to design, build, and test a robot. Once completed, they present their robot to the class.

While You Are in the Museum

- Visit the *Space Odyssey* exhibition
- Attend a Planetarium show

Please review the enclosed materials prior to your visit. If you have questions, please call 303-322-7009 or visit www.dmns.org.

courtesy NASA/ JPL

Preparation
- Estimated Preparation Time: 20 minutes
- Estimated Activity Time: 1–2 class periods

Materials for Teachers
- Overhead transparencies (or other recording materials)
- Overhead markers
- Examples of common machines (listed in Background Content section)
- Dictionary (optional)

Materials for Students
- One Venn diagram (see Figure 1)
- Pencils (one per student)

CDE Standards
- Science: 4.4d,5b,5c
- Reading and Writing: 2
- Visual Arts: 1,2,3

Learning Goals
Students will
- Discuss the similarities and differences between humans and robots
- Develop a definition of a robot
- Use the definition of a robot to categorize various machines
- Identify tasks better suited to robots than to humans

What Students Do in This Activity
Students compare and contrast the capabilities of humans and robots. They complete a Venn diagram listing the similarities and differences between the two. They use their understanding of humans and robots to define "robot," to list tasks better suited to robots than to humans, and to identify common machines that have the properties of a robot.

Advance Preparation
1. Read and review lesson plan. Background Content is located at the end of this packet.
2. Bring several examples of machines with robotic properties to class (see list in Background Content section).
3. Arrange the room for a discussion.
4. Prepare materials for recording student contributions to the discussion.

Classroom Activity
Introducing the Activity
1. Explain to students that in preparation for their visit to the Museum and the class "Robotics," they will discuss what they know about robots.
2. Remind students that this is a brainstorming session and that all ideas are welcome.


courtesy NASA/ JPL

Facilitating the Activity

1. The goal of the class is for students to generate and compare the attributes of humans and robots; to define, as clearly as possible, the conditions that make a machine a robot; to apply their definition to several examples; and to identify tasks better suited to robots than to humans.
2. There are several methods for facilitating this discussion. You may introduce examples of machines that contain some or all of the qualities of a robot (see Background Content) at the start of the discussion or use the machines at the end of the discussion to assess the students' understanding.
3. A useful graphic organizer for comparing and contrasting two items is the Venn diagram (figure 1 below).

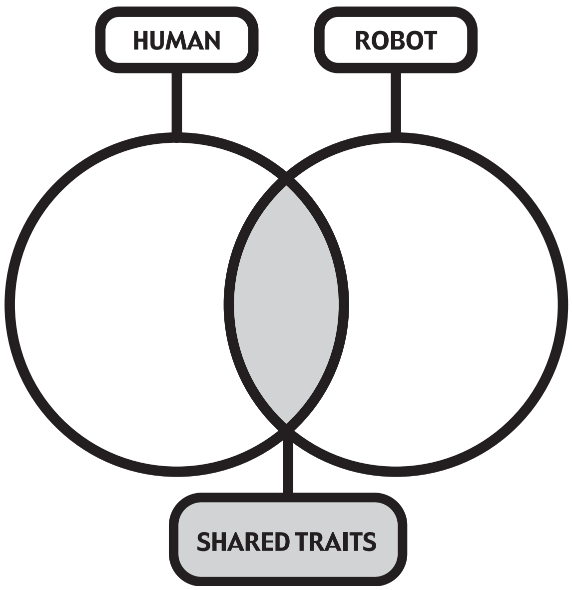

figure 1: Venn diagram

4. Ask students to generate a list of the qualities of humans and of robots. Try to have students focus on qualities that may be attributed to both, such as movement, thought processes, and so on.
5. As students share their ideas, ask them if the idea falls into the "Human Only," "Similarities," or "Robots Only" category.
6. Record student ideas as long as the discussion is fruitful. Before completing the list, ask students if anything is missing.
7. Some students may want to debate the appropriate category of classification. You may encourage debate at this time or explain that the class will review the contents of each category after all ideas have been generated.
8. Following the discussion, provide students with a blank copy of a Venn diagram.
9. Ask students to copy the information created by the class onto their Venn diagram.

Teacher Tip
For advanced students and those familiar with Venn diagrams, allow students to generate their own list of human and robotic attributes, deciding what to list and where to list it. To stimulate discussion, pair or group students as they create a Venn diagram. If you choose this approach, be sure to reconvene the whole class to allow teams to share their work.


courtesy NASA/ JPL

10. Next, ask the class to develop a definition of "robot" upon which all may agree.
11. Write the definition in a prominent location in the classroom.

Teacher Tip
After the class defines "robot," you may want to share the following definition with them, from the Merriam-Webster Online Dictionary:

Main Entry: ro·bot
Pronunciation: 'rO-"bät, -b&t
Function: noun
Etymology: Czech, from robota compulsory labor; akin to Old High German arabeit
trouble, Latin orbus orphaned Date: 1923
1 a: a machine that looks like a human being and performs various complex acts (as walking or talking) of a human being; also: a similar but fictional machine whose lack of capacity for human emotions is often emphasized b: an efficient insensitive person who functions automatically
2: a device that automatically performs complicated often repetitive tasks
3: a mechanism guided by automatic controls

12. Assess student ability to apply the definition. Hold up an example of a machine that may or may not be a robot. Ask the class to consider whether or not the object is a robot based on the definition they developed. Using the criteria set by the class, classify several more simple machines as either robots or not. Pay close attention to the reasoning students use to categorize the objects and make sure that their ideas are consistent.

Summarizing and Reflecting
During this exercise, students will have discussed the features that make a machine a robot, defined "robot" in their own terms, and categorized several examples of machines using their definition of robot.

Ask students to apply what they have learned about robots during this lesson by generating a list of tasks better suited to robots than to humans. You may pose the following question:

"Now that you are familiar with robots, can you think of any situations when a robot should perform work rather than a person?"

Answers to this question will vary depending upon the age and experience of the students. Robots are employed in place of humans for jobs that require repetition that leads to boredom and fatigue. They are used when the job poses risks of injury for humans, such as handling toxic or very hot materials. Robots perform work in environments where humans cannot easily survive. They repair the exterior of spaceships, travel to distant planets, and dive deep into the oceans.


courtesy NASA/ JPL

Assessment Options

This activity provides opportunities for assessing students in all or some of the following areas:

- Identifying the characteristics of living organisms
- Comparing and contrasting
- Communicating complex ideas
- Organizing information and ideas

Extensions

This activity leads to several excellent and engaging extensions. List below are a few recommendations:

- Ask students to describe the importance or necessity of robots for space exploration. Have them consider the arguments for and against sending robots and humans.
- Write a story about how your life would be or would change if you had a robot companion.
- Describe how your life might change if you had a robot to do your work.
- Make a model of a robot using common objects and explain to the class the tasks it would perform if it truly functioned.
- Using images cut from magazines, find some examples of machines that are robotic in nature and make a collage.
- Describe how you think life might change for humans if robots did a lot of our work. What are some of the positive and negative changes?

Background Content

> *A robot is the ultimate of all computer-controlled machines. Its movements can be directed with immense precision, enabling it to repeat actions exactly and to relieve humans of monotonous or hazardous tasks.*— David Macaulay, *The Way Things Work*.
> Boston: Houghton Mifflin Co., 1988.

The Czechoslovakian playwright Karel Çapek introduced the term "robot" in his 1921 play, "R.U.R. (Rossum's Universal Robots)." Çapek envisioned robots to be biologically engineered humans capable only of slave labor. In Czech, *robota* means "slave labor." Since then, our idea of a robot has changed to include a wide variety of machines that generally fulfill the role of performing repetitive or dangerous work not suited for humans.

The first generation of robots, introduced in the 1950s, was programmed to perform routine tasks primarily for use in the automobile industry. While this type of robot can be reprogrammed, they cannot change their work without human intervention. The next wave of development occurred in the 1970s and created machines with the ability to receive information and change their work patterns according to preprogrammed information. Recent advances in robotics have created machines that have the ability to make simple decisions. Such machines have "artificial intelligence," which allows them to choose a course of action based on information received through sensors. Future advances in the study of robotics may one day lead to biologically controlled microscopic robots capable of navigating inside a living organism.

The use of robots parallels their development. First-generation machines carry out repetitive tasks that require precision that is lost when humans become bored or fatigued. A common job for such machines is painting or welding on an exact location on a product delivered along an assembly line. Second-generation robots have the ability to identify variations to their environment, such as poorly aligned or manufactured parts. Equipped with sensors, these robots choose from a set of previously determined actions. More advanced robots in the same situation might choose to realign or discard the part based on the information received from sensors.

courtesy NASA/ JPL

Robots handle a wide variety of tasks that put humans at great risk. Robots perform their work in conditions where humans cannot survive. They work where temperatures and pressures are too high or low for human existence and where the conditions create the likelihood of injury or death. The exploration of space and resulting knowledge of our solar system would not be as extensive without the use of robots. Machines such as Sojourner, the rover that landed on Mars, transmit information from Mars to Earth in less than seven minutes. We know the depths of the oceans through the images and samples retrieved by autonomous submarines such a JASON. Remotely controlled machines monitor dangerous zones, such as nuclear power and waste containment plants. Other robots, such as NASA's Hazbot, handle risky materials such as bombs and chemical waste.

The potential use for robots is only limited by our imaginations. Today, we find robots assisting in hospital procedures, fire fighting, sewer maintenance, and war. In the future, as technology improves, microscopic nanobots may lead to biological and chemical uses only imagined today. Already, companies such as IBM have used these tiny robots to manipulate individual atoms.

ITEM	ROBOT	NOT A ROBOT	BOTH
Wall Clock			
Alarm Clock			
VCR (programmable)			
Binoculars			
Answering Machine			
Elevator			
Telephone			

Resources

Books

Lovine, John. *Robots, Androids, and Animatrons*. McGraw-Hill, 1998.

Web sites

http://robotics.nasa.gov/index.html
http://www.uwec.edu/Academic/Curric/jerzdg/RUR/
http://www.frc.ri.cmu.edu/robotics-faq/