Teacher's Guide for Odyssey: *Robo-Buddy*

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Focus

Using *Odyssey's* issue *Robo-Buddy* as the organizer for curriculum development, teachers will be able to cover an array of topics including scientific process, problem solving, teamwork, communication skills, mathematics, and creative writing.

Initiating Activity

Start a discussion on robotics by first having students look at the cover of this issue.

- What do they think of when they hear the term "Robo-buddy"?

Have students brainstorm and recall previous knowledge and experiences about robots. Discuss the following questions. On a chart, record students' answers.

1. Think about machines and appliances around your home and school. Are any of them robots? What makes them so?
2. What kinds of robots have you seen in movies or on television? What was your impression of them -- were they helpful, scary, etc.?
3. Have you seen robots in action in a real-life setting? What were they doing?
4. Are you aware of ways robots are used in our world today?

Read aloud the letter from the editor (pg. 2) to spark further interest in the topic. Have students share their responses to the questions posed by the editor. This discussion will be re-visited in the culminating activity.

Developmental Activities

The Real Iron Man (pp. 2-3)

Read this article aloud and complete the following activities as a whole-group experience or design learning stations with task cards where students can work alone or in small groups to explore the following ideas.

1. Writing Prompt:
   After reading the article "The Real Iron Man," have students respond to the writing prompt: "If you had an XOS suit, what kinds of things would you do while wearing it?" Students' responses can be outlandish or practical. Encourage volunteers to share their writing with the class.

2. Understanding Vocabulary: Exoskeleton
   If possible, set up a learning station with real-life examples of exoskeletons. Display photos of cicadas, hermit crabs, various crustaceans, and even suits of armor. Include images of powered exoskeleton suits like XOS (search Google for Images.)

- Have students create a Compare/Contrast Matrix (see below) to compare similarities and differences between exoskeletons in nature and man-made exoskeletons like the XOS suit.

Attributes	Item 1	Item 2	Item 3
Attribute 1			
Attribute 2			
Attribute 3			

- How do you think having an exoskeleton helps or hinders the wearer?

3. Understanding Vocabulary: Hydraulic fluid
   - Review the website "How Stuff Works" to read about "How Hydraulic Machines Work." http://www.howstuffworks.com/hydraulic.htm/printable
   - On the same website, watch the *Discovery Channel* video "Deadliest Catch: Crane Pots Hydraulics." View the simple animations to understand the idea of applied force in hydraulic systems. For older students, study hydraulic multiplication where force is traded for distance. View the animation to understand the concept further.
   - Take the online Hydraulic Machines Quiz http://science.howstuffworks.com/hydraulic-machine-quiz.htm
   - In small groups, have students write responses to the questions below.
     (a) Identify uses of hydraulic machines in your daily life.
     (b) Consider how a job would change or be different without the use of hydraulics?
     (c) How do you think hydraulics aid the operation of the XOS suit? other robotics?
4. Set up a video station where students can view the video of the XOS suit in action (see page 3.)
5. Provide a learning center, or collaborate in a group, to allow students to suggest further non-military applications of the XOS suit. (See "EXTRA CREDIT" page 3.) Gather all the ideas generated and email them to *Odyssey*.

This Product Tested By Robots (pp. 3,5) and Robots to the Rescue (pp. 28-30)
Make a list of dangerous jobs that could be performed by robots to eliminate danger to humans or animals. Throughout the reading of this issue, check off each idea as it is encountered in the magazine. (*examples - fire, bombs, poisons, cave-ins, building collapse, natural disasters*)

Help! Robo-Buddies Through the Ages (pp. 5-49)
Following the thumbnails in the lower right-hand corner throughout the magazine, create a timeline on a wall or bulletin board of each of the events listed. Then have each student research to find one significant robotic development to add to the timeline. Discuss key points along the timeline. Are students surprised to learn about robotic creations being invented as early as 270 B.C.? Are they surprised to discover that Japan's Karakuri automatons were helper robots, or robo-buddies, created as long ago as the 1600s?

Say Hello to Helper Robots (pp. 6-10)
Consider the questions below after reading the article.

1. How is a "real robot" different from motorized machines, toys or animatronics? *(They do work.)*

2. Make a list of at least five of the nine challenges mentioned in this article that robot developers face when designing helper robots. Why are each of these challenges so important to consider?
    - *Robots should be designed so that they do not pose a danger to the user.*
    - *Robots need to be able to adapt to the unpredictability of their environments outside a lab.*
    - *Robots need to be able to obey detailed instructions.*
    - *Robots need to be designed with advanced programming to do multiple jobs.*
    - *Robot designers need to consider the materials used in a robot.*
    - *They need to consider the manageability of its size and weight.*
    - *They need to consider the physical appearance of the robot and its appeal to the user.*
    - *They need to consider the personality of the robot so that it does not seem obnoxious.*
    - *Cost is also a challenge of developers.*

3. Read about Isaac Asimov's "Three Laws of Robotics" written in 1942 and later included in his science fiction novel *I, Robot* in 1950. http://en.wikipedia.org/wiki/Three_Laws_of_Robotics
    1) "A robot may not injure a human being or, through inaction, allow a human being to come to harm.
    2) A robot must obey orders given to it by human beings, except where such orders would conflict with the First Law.
    3) A robot must protect its own existence as long as such protection does not conflict with the First or Second Law."

4. Consider the correlations between the challenges listed above and these laws. What similarities do you see? If you were to create a set of laws for robots to follow, would there be anything that you would add to or change about Asimov's list?

Crawls, Creeps, Swims or Flies: Robots Go Wild! (pp. 11-13)
Use the text or a dictionary to define the following words:

- **biomimetrics** - the science of mimicking animals and the natural world
- **hexapod** - having six feet
- **optic lobe** - part of the brain containing the visual centers
- **LGMD** - lobula giant movement detector- a term for a locust's visual system
- **neurons** - an impulse-conducting cell in the nervous system; a nerve cell
- **neural circuit** - interconnected neurons that influence one another
- **autonomous**- independent; not controlled by outside forces
- **replicate**- to repeat, duplicate or reproduce
- **fjord** - A long, narrow, deep inlet from the sea between steep slopes of a mountainous coast.

Robo-Speak! (pp. 14-19)
Writing Dialogue

Using this article as inspiration, have students select a robot that interests them, either from this article or from the magazine, and write a dialogue. The conversation can be between themselves and the robot or between two different robots. Content can be in the form of questions and answers, as in "Robo-Speak!" or they can create an imaginary conversation based on a fiction scenario. For example, a sample dialogue might start like:

Mike and I walked around the corner heading towards the park. We could see a metallic figure up ahead, and we squinted to see more detail. It had the shape of a person, but, clearly, it was not human. Stranger still, it looked as if it was reaching towards a cat that was sleeping on the park bench.

"What is that thing?" asked Mike.

"Is it a robot?" I said, as we walked closer.

It turned to look at us.

"Hello," it said in a stiff voice that sounded both mechanical and human.
"Uh, hello," said Mike. "What are you doing with that cat?"

After establishing a scenario, students can continue the dialogue and finish the conversation. Another idea for writing dialogue could begin with the student just starting a conversation. For example, "I'm a sensitive robot." A response could be, "Do you ever cry?" Then continue the dialogue.

Get Me My Glasses, Please (pp. 22-23)
Have students read the article and respond to the following questions.

1. List some of the tasks that robots are helping people with today. (*household chores like vacuuming, cleaning floors and cutting grass; bathing*)
2. What are some of the ways that robots may be helping people in the future? (*opening jars, dispensing medicines, clear the dining room table, load and unload the dishwasher.)*
3. What is one of the obstacles that developers must overcome when creating assistive robots? (*cost)*
4. What is one of the main reasons why robot engineers are striving to create assistive robots? (*shortage of nurses, oncoming health care crunch, too many elderly patients)*

Bears of Syria Planum (pp. 24- 27)
After reading the article, have students find answers to the following mathematics questions.

1. In this story, THEO calculates the probability of a successful mission. His calculations change during the course of his rescue of Corporal Anders. Using THEO's calculations for the probability of live retrieval of Corporal Anders, determine the percentage of change between each of THEO's recalculations?
   (94.193% - 85.267% = 8.926%;) (85.267% - 75.001% = 10.266%;)
   (75.001% - 45.203% = 29.798%;) (45.203% - 25.000% = 20.203%.)

2. Which recalculation results in the highest percentage of change? (*75.001%-45.203%=29.798%)*

3. At the end of the story, THEO calculates the live extraction probability of the 238 remaining soldiers. Using the four percentages listed in the story, find the average percent of probability for live retrieval of the remaining soldiers. *(37.983%)*

If desired, continue the study of probability using web resources like the one below.
Probability -- http://www.cimt.plymouth.ac.uk/projects/mepres/book7/bk7i21/bk7_21i2.htm

Robots to the Rescue (pp. 28-30) and Smoke Detectors (pp. 38-41)
After reading "Robots to the Rescue" as a class, in small groups or individually, have students find answers to the following questions:

1. What general purpose do all rescue robots serve? *(to extend the senses of humans)*
2. List four ways in which rescue robots accomplish this goal.
   - *using cameras to extend sight*
   - *using microphones and speakers to extend listening and speaking*
   - *using chemical sensors to smell toxins*
   - *using maneuverable wheels, treads and arms to extend reach*
3. Why are robot competitions like the ones mentioned in these articles important? *(boosts interest in the technology and provides a showcase for better designs and new ideas.)*
4. How did rescue robots help after the destruction of the World Trade Center in 2001?

- *they searched for victims*
- *the found pathways through the rubble*
- *they checked for structural weaknesses*
- *they detected hazardous materials*

5. What were the rescue robots able to do that humans could not? *(explore spaces that were too small and too dangerous for people, and find remains within the wreckage.)*
6. Give an example of how one challenge in the development of rescue robots led to an improvement in their design. (*limited battery size led to "marsupial robot" design.)*

Space Station Jam (pg. 31)
Creative Writing
Using the scenario of this article as a springboard, have students write their own ending to a fiction story.

"You and your crew have solved the mystery of the teleportation device and have been transported to a parallel universe. Here you find the answers to Earth's most urgent problems." Write about your discoveries.

Welcome to the Robo-Builders Lab (pp. 32-34)
Set up a robotics lab in your classroom by designating three stations to building each of the robots listed in this article. Collect supplies needed and provide them at each station.

1. For Robot #1 -- Post a sign that identifies this principle of robotics -- memory and programming.

    - Provide a copy of the article "Tiro, the robot, debuts as a teacher in S. Korean classroom" which is given as a link in the article (pg. 33.)

    - After reading the article, ask students to consider the final sentence of the news story -- "South Korea, like Japan, has set a goal to become the leader in the emerging robotics industry and put robotics in every home by 2020." Does this statement surprise them?

    - What kinds of robots can students imagine in homes by 2020?

2. For Robot #2 -- Post a sign at this station identifying this principle of robotics -- sensing.

    - Read "Chapter 5. Barometer Basics," in NASA's Meteorology guide to learn more about barometers and even understand why your ears pop on an airplane.
      NASA - Meteorology: An Educator's Resource for Inquiry-Based Learning for Grades 5-9
      http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Meteorology_Guide.html

3. For Robot #3 -- Identify this principle of robotics -- propulsion and directional control.

    - Read the history of the Karakuri robots built in Japan in the 1600s. Create an historical timeline of concurrent events taking place around the world during this same time period.
      karakuri.info
      http://www.karakuri.info/origins/index.html

    - Watch the video about the Karakuri Ningyo Tea-Carrying Doll
      Karakuri dolls-Traditional handicrafts of the Edo period
      http://video.google.com/videoplay?docid=-3698181664223784657&q=automata&hl=en

    - Students can build their own automata using templates available for download from several websites. Download some of the free paper automata kits from the website below.
      http://www.flying-pig.co.uk/pages/freedownloads.html

Raise Your Hand! Robots Go to School (pp. 35-37)

1. Writing a News Story
   Ask students to gather newsworthy facts from the article as they read. On a piece of paper, students should collect the who, what, when, where, why and how of this story and then write an informative feature article. Students should develop an effective lead in which the main points of the story are summarized into one or two sentences. Encourage students to find an interesting angle or unexpected approach to writing if they can.

2. Have students try to come up with four or five additional circumstances where having access to a remote robotic helper would be an advantage. Share information about the shopping assistant robot in Japan that can be controlled remotely by a cell phone.
   Remote-control shopping robot ::: Pink Tentacle
   http://www.pinktentacle.com/2008/07/remote-control-shopping-robot/

Culminating Activity

You may like to choose one or more of the following activities to use as a culminating activity to your class' study of "Robo-Buddies."

1. Illustrating the Future of Robo-Buddies:
   Review the editor's questions on page 2. How have students' responses to the questions changed or deepened? From the ideas generated during this discussion, ask each student to create an illustration of how they foresee robots interacting with humans in their daily lives both now and in the future. Create a mural or backdrop to display the illustrations on a large bulletin board and follow-up with a class discussion of students' vision of the future.

2. File Folder Robot Profiles:
   Invite each student to select one of the robots discussed in this issue to research and investigate. Assign students the task of creating a one-page profile or a file-folder profile based on the robot of their choice. Each profile should contain a photo of their robot along with facts about its development. Students can include information such as when the robot was first created, its official name or nickname, lists of jobs it performs, challenges faced by its robot engineers, its country of origin, and any other information they can dig up. Upon completion, the profiles can be displayed on a bulletin board or bound in a book to serve as a reference throughout the year or to be donated to the school library for use by future classes.

Website Resources for Teachers and Students

Robotics Curriculum Clearinghouse -- http://robotics.nasa.gov/rcc/index.php
Robotics Academy --http://www.education.rec.ri.cmu.edu/roboticscurriculum/index_to_robotics.htm
The Tech Museum: Robotics: Sensing, Thinking, Acting -- http://www.thetech.org/robotics/
Teaching With Robots --http://www.botmag.com/articles/01-18-06_Teaching_With_Robots.shtml
Classroom Robotics --http://classroomrobotics.blogspot.com/2007_10_01_archive.html