Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

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Robots and Mobility

Lesson Plan for Grades: 6th – 8th
Length of Lesson: 2 hr 45 min

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Date created: [06/30/16]

Subject area/course: Mathematics, Robotics

Materials:

- Stopwatch or timer in cell phone
- Colored markers and pencils
- Oven mitts
- Masking tape
- Popsicle sticks

TEKS/SEs:

§111.26, §111.27, §111.28

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate

Lesson objective(s):

- Students will be able to understand information in a graph
- Students will be able to graph information in a graph and identify the x and y axis

Differentiation strategies to meet diverse learner needs:

- The teacher should ask students whether they prefer to read or watch videos to learn about concepts; then have students learn in their preferred learning style. However, the teacher may assign students certain methods to improve their skills. For example, if a student prefers reading, teachers may have them watch a video and take notes to improve their listening skills.
- ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration.

ENGAGEMENT (15 minutes)

- Teachers ask the question "What does a robot look like?" Have students use the attached handout to create an illustration of what they imagine robots look like and how they are used in real-life situations.
  - Teacher should walk around the room asking open ended questions about the student drawings.
  - Teacher should listen to students to find out what they already know.
- Teacher leads a discussion of the different robots the students drew.
  - Highlight drawings where dangerous or unusual situations are shown and stress the importance of how robots do work where it's too dangerous for humans (rescue operations, exploration) or because humans are not capable of those abilities (heavy lifting, etc.)
- Teacher introduces the project for this lesson: to explore how robots move and how close can they imitate

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movements humans do every day (in this case tying shoelaces). Students will create a graph of how long it takes to tie their shoelaces when they have certain robotic characteristics.

EXPLORATION (1 hour)

- Teacher asks whole class to list the major characteristics of robots (brain, sensors, body, power, muscle system).
- Students will be divided into 5 – 10 groups and each group given one of the major parts for robots listed above. Each team will have 30 minutes to research how this component works in a robot, what it may look like, and the limitations in the real-world. See student handout for resources.
  - Teachers should walk around asking questions about component they are researching.
  - Teachers should ask open ended questions to encourage critical thinking in finding real-life examples of robots and how each of the different components works in that robot.
- Each team will have 3 minutes to briefly present how this major component works in a robot and one thing they found in their research.

EXPLANATION (45 minutes)

- Teacher highlights that in the future we will want to use robots to help us in different situations where it is dangerous for humans (fire, outer space) or when humans cannot do an activity (like the elderly or disabled persons).
- Students will be divided into teams and do the "Move Like a Robot" activity. Each team will time how long it takes to tie their shoelaces under normal conditions and then with different mobility impairments.
  - Teachers should ask open ended questions to encourage critical thinking "Which of the impairments is more difficult to handle?", "Is there a different way to tie shoelaces that may be easier for robots to do?", "What are the differences between tying your shoelaces with the oven mitts vs. tying them when you can't bend your fingers?", "Why would we want to use robots to tie our shoelaces?")

ELABORATION (45 minutes)

- Teams have 20 minutes to create a graph (bar or line graph) using the information discovered during the "Move Like a Robot" activity.
- Team graphs will be displayed in a gallery walk. Each team will evaluate 2 other team posters using the rubric provided.

EVALUATION (throughout)

- Teacher ask questions that provide insight into student progress.
- Teacher distribute questions so that all students are accountable and have the opportunity to share.
- Teacher observe students as they create products and look for evidence of understanding.

SOURCES AND RESOURCES

- **Dr. Luis Senti's *Hot Science – Cool Talks* # 99 "Humanoids of Our Future"**, www.hotsciencecooltalks.org
- ***How Robots Work***, science.howstuffworks.com/robot.htm
- ***Robots***, www.explainthatstuff.com/robots.html
- ***Robotics Facts***, idahoptv.org/sciencetrek/topics/robots/facts.cfm

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STUDENT PAGE(S): Engagement Activity (15 minutes)

Create an illustration of what a robot looks like and how it would be used in real-life situations.

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STUDENT PAGE(S): Exploration Activity (1 hour)

You will be assigned one of the FIVE major robot components (brain, muscles, sensors, muscle system or power). In the area below, research in the internet how does this component work, an example of how this component is used in real-life and what are some of its limitations.

***Component**: _____*

What is it or what does it do?
Give an example of how this component is used in real-life examples?
What are some limitations of this component in real-life examples?

Your team will share with the rest of the class a description of your component and one thing you found in real-life examples.

Below are some resources to get you started:

- ***How Robots Work***, science.howstuffworks.com/robot.htm
- ***Robots***, www.explainthatstuff.com/robots.html
- ***Robotics Facts***, idahoptv.org/sciencetrek/topics/robots/facts.cfm

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EXPLANATION ACTIVITY: "Move Like a Robot" (45 minutes)

Purpose: The purpose of this activity is to understand how simple human movements can be difficult for robots to duplicate. Students will gather data on how long it takes them to tie their shoelaces under "normal" circumstances as well as under certain "mobility" impairments. Groups will create graphs based on the information collected.

Materials:

- Stopwatch or timer on their cell phones
- Oven mitts (2 per team)
- Popsicle sticks (8 per team)
- 1-2 feet of masking tape (per team)

Safety Information: N/A

Procedure:

- Revisit the engagement and exploration activities. Refer to drawings or group presentations that focused on robots doing jobs that are too dangerous for humans (rescue operations, etc.) or because humans are not strong enough to accomplish this goal (moving heavy objects, etc.).
- Class will be divided into teams of 3-6 students. Try and make sure that there are several students with shoes that have shoelaces evenly distributed in the groups. If a student is not wearing shoes that tie, they can tie someone else's shoes as part of the testing.
- Teams will have 35 minutes to try to tie their shoes:
    - Using oven mitts,
    - Without bending their fingers (tape the popsicle sticks to the index finger and thumb for both hands),
    - Using regular hand movements (no impairment).

- Teams should record the time it takes for each scenario. Multiple team mates can try one of the three different scenarios for tying the shoelaces.
- As teams do the explanation activity, teachers should:
    - Encourage students to explain if there are some impairments that are harder to overcome than others
    - Highlight important ideas that students provide
    - Ask questions that help students be specific in their explanations ("Is there a different way to tie shoelaces that may be easier for robots to do?", "What are the differences between tying your shoelaces with the oven mitts vs. tying them when you can't bend your fingers?", "Why would we want to use robots to tie our shoelaces?")
- To wrap up activity, consider showing portions of the ***Hot Science – Cool Talks #98 "Humanoids for Our Future"*** with Dr. Luis Sentis. You may consider showing the ending (video of *Valkyrie robot* designed for NASA) or when Dr. Sentis talks about walking patterns and simulations.

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STUDENT PAGE(S): Elaboration Activity (45 minutes)

Your team has 20 minutes to create a graph charting the results of how long it took to tie your shoelaces for each of the different scenarios you tried (with impairments and no impairments). Your graph should contain the following:

- Data from each of the different scenarios (gloves, popsicle sticks, no impairment)
- X-axis label
- Y-axis label (time set in appropriate intervals)
- Title
- Graph can be a bar graph or line graph

Once graphs are created, your team will evaluate other posters in a gallery walk. You will evaluate 2 other posters using the rubric below. Provide some comments and questions to each of the teams you evaluate:

Team: _____

1	2	3	4
Graph is unlabeled, unclear or irrelevant. Missing labels in the x- and y-axis. Intervals for y-axis are not distributed correctly.	**Most parts present and correct. Graph labels or title may be missing. Intervals for y-axis are not distributed correctly.**	**All parts present and correct. Graph clearly shows the differences between impaired and non-impaired scenarios.**	**Graph is clearly labeled. No misspelled words or phrases. Answers the essential question.**

Comments: Questions:

Team: _____

1	2	3	4
Graph is unlabeled, unclear or irrelevant. Missing labels in the x- and y-axis. Intervals for y-axis are not distributed correctly.	**Most parts present and correct. Graph labels or title may be missing. Intervals for y-axis are not distributed correctly.**	**All parts present and correct. Graph clearly shows the differences between impaired and non-impaired scenarios.**	**Graph is clearly labeled. No misspelled words or phrases. Answers the essential question.**

Comments: Questions: