

Developing Solutions for Robots at Work

Companion Lesson to X-STEM All Access Episode "[The Future of Robots is Now!](#)"

Grade/ Grade Band: High School	Topic: Engineering	
Brief Lesson Description: Students develop solutions for dull, dangerous, and dirty jobs using robots based on the needs of a given profession		
Performance Expectation(s): NGSS HS-ETS1-2 : Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering		
Specific Learning Outcomes: Students will know and be able to: -Brainstorm a variety of jobs that are dirty, dull, and dangerous. -Research the benefits and consequences of robots being used to complete tasks that are dirty, dull, and dangerous. -Read and analyze a scenario to determine the needs of a stakeholder -Develop a solution based on the stakeholders' needs		
Narrative / Background Information		
Prior Student Knowledge: Students should have a basic understanding of the following concepts:		
<p>Science & Engineering Practices:</p> <p>Constructing Explanations and Design Solutions</p> <p>Constructing explanations and designing solutions in 9-12 builds on the K-8 experiences and progresses to explanations and designs that are supported by multiple and student generated sources of evidence consistent with scientific ideas, principles and theories.</p> <p>Design a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria and trade off considerations (HS-ETS1-2)</p>	<p>Disciplinary Core Ideas:</p> <p>ETS1.C: Optimizing the Design Solution</p> <p>Criteria may need to be broken down into simpler ones that can be approached systemically and decisions about the priority of certain criteria over others (trade-offs) may be needed (HS-ETS1-2)</p>	<p>Crosscutting Concepts:</p> <p>N/A</p>
Possible Preconceptions/Misconceptions: Students come with many misconceptions related to robotics including:		
<ul style="list-style-type: none"> <input type="checkbox"/> Robots must be humanoid (like C3PO) to be a “real” robot. However, many different types of robots use electronic systems to do a job or a task. <input type="checkbox"/> Robots are something “futuristic” and do not impact our daily lives. However, millions of robots are currently impacting our daily lives. <input type="checkbox"/> Robots will be able to take over all jobs and displace human workers. However, robots are limited in what tasks they can do. Learn more here. 		

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:

1. Begin the lesson by asking students to **brainstorm and define what they think dull, dangerous, and dirty jobs are**. Make a class list on the board.
2. Ask students “**Would these be jobs you want in your future? Why or why not?**” Allow them to discuss with a partner and then share with the class.
3. Explain to students that robots are currently being designed to help with these types of jobs.
4. Show the X-STEM Episode “[The Future of Robots is Now!](#)” with Dr. Suzy Young. As students watch the video, ask them to write a list of different dull, dangerous, and dirty jobs that robotics are doing!
5. After the episode, have students add jobs to their initial list of jobs. Explain that today their goal will be to create robots that might help with these types of jobs.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

1. Divide students into partners. Each partner pair will need a device with YouTube access.
2. Have each set of partners watch one video on the [Playlist “Robotics for Dull, Dangerous or Dirty Jobs”](#) There should be one group per video so that all of the examples are viewed.
3. As they watch the videos, students should collect the following information:
 - a. Jobs robots are doing
 - b. Possible benefits of using this robot
 - c. Possible consequences of using this robot
4. Have each group share their learnings with the class.

EXPLAIN:

1. Facilitate a class discussion on the **benefits of using robotics to automate dull, dangerous, and dirty jobs**. Emphasize how automation can improve efficiency, safety, and human well-being.
2. Discuss any **ethical considerations or potential downsides of replacing human workers with robots in certain industries**.

ELABORATE: Applications and Extensions:

1. Explain to students that their task will be as follows:
“Design and sketch a robotic solution to address the specified job. They should consider factors such as functionality, cost, and safety.”
2. Divide students into partners. Each partner pair will be assigned one of the Robot Design Scenarios here:
https://docs.google.com/document/d/1oLA2Pn5s6XaruX_UeFKdTQSDcaJm3B_w-Qgsy6DCVE4/edit?usp=sharing
3. Have students read and analyze the scenario to determine the stakeholder needs for each problem.
4. Provide students time to develop potential solutions. Then have each group **present their design solutions to the class and explain their reasoning behind their design choices**.

EVALUATE:

Formative Monitoring (Questioning / Discussion):

Questions throughout the lesson in **bold and italics** can be used to check students' understanding throughout the lesson. You can also assess student understanding during their presentations to the class on the Explore and/or Elaborate sections of the lesson.

Summative Assessment (Quiz / Project / Report):

Conclude the lesson by asking students to reflect on what they have learned about the role of robotics in automating dull, dangerous, and dirty jobs.

Assess student understanding through a brief exit ticket or class discussion, asking students to summarize the benefits and challenges of using robotics in these scenarios.

Elaborate Further / Reflect: Enrichment

Students interested in learning more about robotics can participate in activities from [RoboNation](#), [Hour of Code](#), [First Tech Challenge](#), or [VEX Robotics](#).

CAREER CONNECTIONS

The Robotics field is growing in demand as advanced manufacturing continues to expand. With careers ranging from Software Engineering writing code to control robots to Autonomous Vehicle Engineers designing probes for exploration in space, there are a wide variety of opportunities for students to explore.

Have students visit <https://usasciencefestival.org/resources/> to access the Student Career Resources. Once there, they should select the Robotics Industry.

Have students browse the careers within the chosen cluster. Select one career that they would like to learn more about. They should then gather the following information using the [student graphic organizer](#) or in a class notebook:

- Job description and typical responsibilities
- Education and training required
- Skills and qualities needed
- Average Salary
- Work environment and schedule
- Professional Organizations, Educational Programs, and Internship & Apprenticeship Opportunities

Choose a Choice Board Activity and use the information gathered to complete the chosen activity.

<p>Career in Action Find a reliable video or article about someone working in this career. Summarize what you learned and how it aligns with your expectations.</p>	<p>Job Skills Match List at least five skills needed for this career. Identify which of these skills you already have and which ones you need to develop.</p>	<p>Future You Write a letter to your future self explaining why this career interests you and what steps you plan to take to pursue it.</p>
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Provide students an opportunity to share their findings with peers or with you.

SOCIAL-EMOTIONAL LEARNING ACTIVITY

CASEL Competency Addressed: Self Awareness

It can be intimidating for students to enter a challenging and rigorous STEM field such as the engineering and robotics fields showcased in the X-STEM video. Today students will explore how to overcome these challenges.

Procedure:

1. Begin by asking students to share examples of situations where they felt intimidated by a challenge.
2. Discuss as a class the common feelings and reactions that arise when confronted with intimidating challenges.
3. Introduce the objective of the lesson: to learn strategies to deal with intimidating challenges effectively.

Activity 1: Understanding Intimidation

Divide students into small groups.
Distribute [handouts](#) with scenarios of intimidating challenges.
In their groups, students should discuss the scenarios and identify the emotions and thoughts that come to mind when faced with these challenges.
Each group presents their analysis to the class, highlighting the common reactions and feelings experienced.

Activity 2: Strategies for Overcoming Intimidation

Using the whiteboard, brainstorm strategies for overcoming intimidation.
Encourage students to suggest strategies based on personal experiences or observations.
Discuss the effectiveness of each strategy and its applicability to different situations.
Highlight the importance of self-talk, positive affirmations, seeking support, breaking tasks into smaller steps, and practicing self-care.

Conclusion:

Invite volunteers to share their plans or reflections with the class.
Summarize the key strategies discussed and emphasize the importance of resilience and perseverance in facing challenges.
Encourage students to support each other and offer assistance when needed.

INTERDISCIPLINARY CONNECTIONS/IDEAS

Computer Science: Dr. Young discussed the challenge of keeping up with processing speeds. Have students research Moore’s Law and the impact it has had on technology development over the past 50 years.

Mathematics: Help students learn about Data Science using the lessons at [YouCubed](#)

Language Arts: Have students read the short story [“Runaround” by Issac Asimov](#) and have a class discussion about the three rules posed for robotics. Are they sufficient to control our world of AI/Machine Learning/Robotics? Why or why not?

Materials Required for This Lesson/Activity	
Quantity	Description
1 per partner set	Device with YouTube Access
1 per Group	Whiteboard with whiteboard marker



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