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 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:

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Constructing Explanations and Design Solutions Constructing explanations and designing solutions in 9-12 builds on the K-8 experiences and progress to explanations and designs that are supported by multiple and student generated sources of evidence consistent with scientific ideas, principles and theories. 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)	**ETS1.C: Optimizing the Design Solution** 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)	N/A

Possible Preconceptions/Misconceptions:
Students come with many misconceptions related to robotics including:

- ☐ **Robots must be humanoid (like C3PO) in order to be a "real" robot.** However, there are many different types of robots that use electronic systems to do a job or a task.
- ☐ **Robots are something "futuristic" and do not impact our daily lives.** However, there are millions of robots that are currently impacting our daily life.
- ☐ **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 to using this robot
    c. Possible consequences to 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-Qqsy6DCVE4/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.

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 to 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	White board with whiteboard marker

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