SIEMENS STEM DAY | Science Technology Engineering Math

GRADES 9–12

SIEMENS STEM DAY ACTIVITY

MEDICAL PROFESSIONALS + ROBOTS = COLLABORATIVE HEALTHCARE

OBJECTIVES

Students will be able to:

- **Evaluate** the rewards and risks associated with various robotic healthcare technologies
- **Explain** how predictive analytics are beneficial for medical diagnostic teams as a means of assistance rather than replacement
- **Develop** their own thoughts and opinions associated with the advancement of healthcare robotics

THIS LESSON FOCUSES ON

Engineering Design Cycle

- Designing Solutions
- Communicating Results

21st Century Skills

- Collaboration
- Critical Thinking

OVERVIEW

Students will work together to evaluate the effects of collaborative efforts between doctors and robotic technology that is providing advancements in healthcare. Students will analyze a variety of scenarios to identify the implications (rewards and risks) of robotics usage in the future of healthcare, including but not limited to cost savings, improved patient care, and waste reduction regarding time and resources.

STEM incorporates Science, Technology, Engineering, and Mathematics to focus on real-world issues and problems guided by the engineering design process. This type of instruction supports students in developing critical thinking, collaboration, reasoning, and creative skills needed to be competitive in the 21st century workforce.

Each Siemens STEM Day classroom activity highlights one or more components of the engineering design cycle and an essential 21st century skill.

MATERIALS

- **Scenario Cards**—one per pair
- **Scenario Cards with Potential Answers**—one for instructor
- **Would You Rather? Activity Prompts**—one for instructor

HAVE YOU EVER WONDERED . . .

Can healthcare jobs and doctors be replaced by computers?

MAKE CONNECTIONS!

How does this connect to students?

Today's students have been raised with technology and see robots integrated into everyday life. To bring even greater awareness of the power of robots, students will consider that robots are used in many facets of healthcare today. It is important for students to start thinking about the societal and ethical implications of the use of robotics in the field of healthcare.

How does this connect to careers?

A **health information technology specialist** is responsible for managing the electronic and technical aspects of patient health information. This role may involve "collaborating with other healthcare teams to drive improved outcomes, lowered costs, and new developments in patient care."[1]

A **project manager for healthcare IT** is responsible for ensuring that projects are strategically completed within the scope, financial budget, and allotted time and achieve the desired result. This role requires adaptability because every project is unique and brings its own challenges to achieving success. An IT healthcare project manager may find themselves collaborating with a variety of subject matter experts.

How does this connect to our world?

The relationship between patients and healthcare providers is critical for establishing high-quality medical care. Robots are increasingly reducing time spent on certain tasks and therefore allotting more time for healthcare professionals to provide greater patient interaction.

Predictive analytics are becoming more widespread in the healthcare profession. For example, "Creating risk scores based on lab testing, biometric data, claims data, patient-generated health data, and the social determinants of health can give healthcare providers insight into which individuals might benefit from enhanced services or wellness activities."[2] By proactively identifying individuals who could potentially be at greater health risk, these technological innovations are allowing people to ultimately live longer, healthier lives.

[1] https://himt.wisconsin.edu/about-himt/what-health-it-professionals-do/
[2] https://healthitanalytics.com/news/10-high-value-use-cases-for-predictive-analytics-in-healthcare

BLUEPRINT FOR DISCOVERY

1. To engage students in what they will be learning, facilitate an introductory conversation about their thoughts on whether society is currently operating under the premise of humans vs. machines or a collaboration between humans and machines. Encourage students to share their initial reactions. Emphasize that there is no right or wrong response; rather, it's a matter of personal perspective and experiences.
2. Explain to students that they are going to learn about a variety of robots used within the medical profession today. Before further explanation, you may consider asking the students if they know how robots are used in the medical field.
3. Instruct students to work with a partner to first read all the Scenario Cards.
4. Tell students that based on the information on each of the cards and their own ideas, they are going to brainstorm some of the rewards and risks associated with each robotic device. Encourage the students to discuss their thoughts with their partner and then record their ideas on each of the cards.
5. After sufficient time has been provided, ask for student volunteers to begin the discussion of the rewards and risks associated with each of the robots. An answer key with potential ideas has been provided for you; however, please realize that these are not the only acceptable responses.
    - *Note:* Students should discover that there are both advantages and disadvantages associated with the integration of robotic technology into our society. Some students may start to question ethical and/or moral considerations.
6. To continue exploring the students' perspectives on the presence of robots in the medical field, use the Would You Rather? Activity Prompts for the next activity. Instruct students to gather in the center of the room and explain that one side of the room will be used to represent the first idea mentioned and the opposite side of the room will represent the second idea.
7. Read and repeat each statement to give students time to consider their own perspective on the given choices and then move to the side of the room that corresponds with their choice. Once students have made their choices, encourage them to share their reasoning behind their choice.
    - *Note:* Students may find it helpful if you reinforce that these are not right or wrong choices. Everyone is entitled to their own opinion and reasoning.
8. Conclude the lesson by asking students to take a few minutes to identify their own thoughts on "collaborative healthcare." There is no need for students to share their thoughts at this time; rather, they will apply their thoughts in this concluding activity.
9. Read the following quote to the students: "It also seems increasingly clear that AI systems will not replace human clinicians on a large scale, but rather will augment their efforts to care for patients. Over time, human clinicians may move toward tasks and job designs that draw on uniquely human skills like empathy, persuasion and big-picture integration. Perhaps the only healthcare providers who will lose their jobs over time may be those who refuse to work alongside artificial intelligence."[3] Then facilitate a discussion regarding what students think about this statement.

[3] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/

TAKE ACTION!

- Students can research and learn more about the ethical/moral implications of collaborative healthcare. There are many articles and videos available on the internet. Students may consider creating an awareness campaign to educate their community about this topic.

NATIONAL STANDARDS

Standards for Technology Literacy	Standard 13: Students will develop Abilities for a Technological World. This includes becoming able to assess the impact of products and systems. Standard 14: Students will develop an understanding of The Designed World. This includes selecting and using medical technologies.
Next Generation Science Standards	HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

SCENARIO CARDS

Scenario 1	**da Vinci Surgical System**
Robert finds out that he needs surgery. Dr. Wittson, Robert's surgeon, explains to him that she will be using the da Vinci Surgical System to perform the operation. This minimally invasive option allows surgeons to remotely perform both open surgery and laparoscopy. The multi-armed robot gives surgeons more precise control over a range of procedures and reduces the potential for surgical error. "Using magnified 3D high-definition vision and controls that strap to a surgeon's wrists and hands, the da Vinci System makes tiny, exact incisions that human hands might not otherwise be able to make."[4] Research has proven that patients experience faster healing with the da Vinci than with traditional surgical methods.	Carefully consider this scenario and try to identify the rewards and risks of this robotic system for the future of healthcare. Rewards: Risks:

Scenario 2	**PARO Therapeutic Robot**
Although she is only six years old, Kaitlyn has an extensive medical history and has historically struggled post-surgery. This time, her team of doctors is going to use the PARO Therapeutic Robot to assist Kaitlyn with her recovery. This furry baby harbor seal is an interactive robot designed to provide the benefits of animal therapy. Research has shown that PARO can also assist elderly patients and people of all ages suffering from depression or mental illness. "The fuzzy PARO can respond to its name, enjoys being stroked, and, over time, develops a customized, pleasing personality tailored by its memory of previous interactions. PARO also naps, blinks, wiggles its flippers and makes funny little noises, especially for its owner."[4] PARO is also known for its calming effect that reduces stress for recovering patients. This reduction in stress often leads to a quicker recovery.	Carefully consider this scenario and try to identify the rewards and risks associated with this robot for the future of healthcare. Rewards: Risks:

[4] https://online-engineering.case.edu/blog/medical-robots-making-a-difference

Scenario 3	**The Xenex Germ-Zapping Robot**
As a nurse, part of Jose's job is to disinfect hospital rooms between patient use. Although humans try their best to rid the rooms of bacteria, unfortunately the Center for Disease Control has reported that hospital-acquired infections (HAIs) are a widespread problem in healthcare. "HAIs often occur because hospitals can't always clean rooms with 100 percent sterility between patients, whether due to time constraints or the simple invisibility of germs."[1] Therefore, Xenex, an automated and portable robot, is used to combat this problem as it can disinfect an entire hospital room in a matter of minutes. Xenex uses pulsated, high energy UV-rays to kill a range of infectious bacteria. This robot was designed to reduce HAIs, so it kills the microorganisms that cause them.	Carefully consider this scenario and try to identify the rewards and risks of this robotic system for the future of healthcare. Rewards: Risks:

Scenario 4	**DataRobot**
Using machine learning, this AI (Artificial Intelligence) platform ingests massive amounts of medical data and then assists healthcare professionals with making medical predictions and decisions. DataRobot helps by promoting wellness, preventing diseases and illnesses, and assisting with early intervention. The main goal is to promote value-based care, which in turn provides patients with higher quality healthcare. In addition to the medical benefits, DataRobot is also used to address strategic decisions related to finances and operations. In the book *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again*, Dr. Eric Topol explains, "The greatest opportunity offered by AI is not reducing errors or workloads, or even curing cancer: it is the opportunity to restore the precious and time-honored connection and trust—the human touch—between patients and doctors."[5]	Carefully consider this scenario and try to identify the rewards and risks associated with this robot for the future of healthcare. Rewards: Risks:

[5] https://www.datarobot.com/webinar/breaking-through-the-barriers-ai-adoption-and-the-healthcare-industry/watch/

Scenario 5	**The Tug**
Holly's job as a nurse is made easier each day with the help of The Tug by Aethon. This autonomous mobile robot (AMR) can perform a multitude of tasks, from delivering goods and materials to streamlining hospital housekeeping operations. A fleet of these innovative, strong, and reliable robots uses an IT system to run algorithms that control their every move. The command center allows the robots to wirelessly interact with doors, elevators, alarms, and secure areas in the hospital. If Holly needs to transport blood or other fluids to the lab, she can count on The Tug to assist her, which frees her up for greater patient interaction.[6] The robots are monitored in real time, and support specialists are on call to detect and search for solutions to any problems The Tug may be experiencing.	Carefully consider this scenario and try to identify the rewards and risks associated with this robot for the future of healthcare. Rewards: Risks:

Scenario 6	**Zebra's Imaging Analytics Engine**
Assisting with CT and X-ray scans, "Zebra uses a proprietary database of millions of imaging scans, along with machine and deep learning tools, to create software that analyzes data in real time with human level accuracy—providing radiologists the assistance they need to manage ever growing workloads, without sacrificing quality."[7] Dr. Hershman relies on Zebra's imaging expertise to receive a second opinion (so to speak) to confirm or refute his initial medical diagnosis. Unlike humans, Zebra has the ability to access past scans and automate the visual aspects of medicine as it detects and diagnoses medical conditions. However, Dr. Hershman knows that Zebra does not replace his ability to perform a proper medical examination and diagnosis. Rather, it enhances his ability to provide the best possible medical care to his patients.	Carefully consider this scenario and try to identify the rewards and risks associated with this robot for the future of healthcare. Rewards: Risks:

[6] https://aethon.com/why-mobile-robots-from-aethon/
[7] https://www.zebra-med.com/solutions

SCENARIO CARDS WITH POTENTIAL ANSWERS

Scenario 1	**da Vinci Surgical System**
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Scenario 2	**PARO Therapeutic Robot**
Although she is only six years old, Kaitlyn has an extensive medical history and has historically struggled post-surgery. This time, her team of doctors is going to use the PARO Therapeutic Robot to assist Kaitlyn with her recovery. This furry baby harbor seal is an interactive robot designed to provide the benefits of animal therapy. Research has shown that PARO can also assist elderly patients and people of all ages suffering from depression or mental illness. "The fuzzy PARO can respond to its name, enjoys being stroked, and, over time, develops a customized, pleasing personality tailored by its memory of previous interactions. PARO also naps, blinks, wiggles its flippers and makes funny little noises, especially for its owner."[1] PARO is also known for its calming effect that reduces stress for recovering patients. This reduction in stress often leads to a quicker recovery.	Carefully consider this scenario and try to identify the rewards and risks associated with this robot for the future of healthcare. Rewards: • Benefits of animal therapy • Promotes a positive mood • Lessens patient stress • Reduces recovery time • Helps people of all ages Risks: • Cleanliness over time • Potential stigma or embarrassment • Cost and added workload for caregivers[8]

[8] https://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-019-1244-6

Scenario 3	**The Xenex Germ-Zapping Robot**
As a nurse, part of Jose's job is to disinfect hospital rooms between patient use. Although humans try their best to rid the rooms of bacteria, unfortunately the Center for Disease Control has reported that hospital-acquired infections (HAIs) are a widespread problem in healthcare. "HAIs often occur because hospitals can't always clean rooms with 100 percent sterility between patients, whether due to time constraints or the simple invisibility of germs."[1] Therefore, Xenex, an automated and portable robot, is used to combat this problem as it can disinfect an entire hospital room in a matter of minutes. Xenex uses pulsated, high energy UV-rays to kill a range of infectious bacteria. This robot was designed to reduce HAIs, so it kills the microorganisms that cause them.	Carefully consider this scenario and try to identify the rewards and risks of this robotic system for the future of healthcare. Rewards: • Disinfects hospital rooms • Reduces HAIs • Operates in minutes Risks: • Costs associated with additional infections • Benefit lasts until new microorganisms enter the room • Needs to be operated in several locations to fully disinfect all surfaces in the room

Scenario 4	**DataRobot**
Using machine learning, this AI (Artificial Intelligence) platform ingests massive amounts of medical data and then assists healthcare professionals with making medical predictions and decisions. DataRobot helps by promoting wellness, preventing diseases and illnesses, and assisting with early intervention. The main goal is to promote value-based care, which in turn provides patients with higher quality healthcare. In addition to the medical benefits, DataRobot is also used to address strategic decisions related to finances and operations. In the book *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again*, Dr. Eric Topol explains, "The greatest opportunity offered by AI is not reducing errors or workloads, or even curing cancer: it is the opportunity to restore the precious and time-honored connection and trust—the human touch—between patients and doctors."[9]	Carefully consider this scenario and try to identify the rewards and risks associated with this robot for the future of healthcare. Rewards: • Optimizes decisions and problem solving related to medical situations, finances, and operations • Increases data productivity • Reduces operational costs associated with healthcare facilities • Optimizes time Risks: • Potential for data to be hacked or compromised • Patient reluctance • Costs associate with operation and execution

[9] https://www.datarobot.com/webinar/breaking-through-the-barriers-ai-adoption-and-the-healthcare-industry/watch/

Scenario 5	**The Tug**
Holly's job as a nurse is made easier each day with the help of The Tug by Aethon. This autonomous mobile robot (AMR) can perform a multitude of tasks, from delivering goods and materials to streamlining hospital housekeeping operations. A fleet of these innovative, strong, and reliable robots uses an IT system to run algorithms that control their every move. The command center allows the robots to wirelessly interact with doors, elevators, alarms, and secure areas in the hospital. If Holly needs to transport blood or other fluids to the lab, she can count on The Tug to assist her, which frees her up for greater patient interaction.[10] The robots are monitored in real time, and support specialists are on call to detect and search for solutions to any problems The Tug may be experiencing.	Carefully consider this scenario and try to identify the rewards and risks associated with this robot for the future of healthcare. Rewards: • Reduces labor costs • Improves productivity, reliability, and accuracy • Frees up clinical and service staff for better use of skills Risks: • Potential power outage • Occasionally difficult to find their current location

Scenario 6	**Zebra's Imaging Analytics Engine**
Assisting with CT and X-ray scans, "Zebra uses a proprietary database of millions of imaging scans, along with machine and deep learning tools, to create software that analyzes data in real time with human level accuracy—providing radiologists the assistance they need to manage ever growing workloads, without sacrificing quality."[11] Dr. Hershman relies on Zebra's imaging expertise to receive a second opinion (so to speak) to confirm or refute his initial medical diagnosis. Unlike humans, Zebra has the ability to access past scans and automate the visual aspects of medicine as it detects and diagnoses medical conditions. However, Dr. Hershman knows that Zebra does not replace his ability to perform a proper medical examination and diagnosis. Rather, it enhances his ability to provide the best possible medical care to his patients.	Carefully consider this scenario and try to identify the rewards and risks associated with this robot for the future of healthcare. Rewards: • Doctors can make more informed diagnoses • Automated ability to access millions of previous scans for comparison • Improves productivity Risks: • Support costs • Reluctant healthcare professionals

[10] https://aethon.com/why-mobile-robots-from-aethon/
[11] https://www.zebra-med.com/solutions

WOULD YOU RATHER? ACTIVITY PROMPTST

- Would you rather recover from surgery on your own or use PARO?
- Would you rather have your medical record digitized or in paper format?
- Would you rather have a doctor or the da Vinci Robotic System perform your operation?
- Would you rather have a radiologist read your medical scan or only rely on a report from Zebra's Imaging Analytics?
- Would you rather continue learning about robots used in the medical field or not?
- Would you rather have human interactions or use The Tug for deliveries?
- Would you rather support continued research of robotic advancements or not support it?
- Would you rather trust the advice of a doctor who consults DataRobot or one who does not?