



Machine Learning

OBJECTIVES

Students will:

- **Research** and **summarize** problems facing an industry or field of their choice, as well as the role that AI already plays in this field.
- **Develop** a recommendation for how machine learning could help solve one of these problems.
- **Consider** the biases that may exist in training data-sets for this solution.

OVERARCHING QUESTION

How can AI systems contribute to problem-solving?

ACTIVITY SUMMARY

Students will take on the role of an Artificial Intelligence researchers as they investigate how artificial intelligence (AI) and machine learning could be used to solve problems in a field of their choice. They will develop a specific recommendation for how machine learning could contribute to solving one of these problems. Further, they will consider the training data an AI system would need to make this possible. Lastly, they will review the work of their peers to identify biases that may exist.

MATERIALS

- Devices with internet access, at least enough for half the class
- Sticky notes, one per student
- *Designing Solutions Handout*, one per student
- Device with the ability to project video, one for the instructor

CHALLENGE

1. Begin by asking students to tell a partner about a problem they recently had to solve. Encourage students to discuss:
 - How did you solve this problem? What did you do first, second, third, etc.?
 - Do you think a machine would be capable of solving this problem too?
2. Tell the class that today they will be exploring the potential of AI and machine learning. Explain and review that AI is a broad science that focuses on creating machines that can process information and produce results similar to those which humans are capable of.

Machine learning is a smaller subset of this science. It gives machines the ability to improve and learn through experience,

without being programmed. Machines accomplish this by learning from data sets compiled by humans so they can eventually recognize patterns and make decisions on their own.

3. Go on to tell students that they will now be challenged to take on the role of an AI researcher. Play the AI Researcher Career Profile Video available at <https://stemcareerscoalition.org/careers-portal>, and ask students to listen for the different responsibilities that these researchers can have.

Then explain that in their role of AI researcher today, students will investigate the potential of machine learning in one of the following fields:

- Education
 - Healthcare
 - Transportation
 - Manufacturing
 - Agriculture
 - Business
4. Give students a while to find a partner and select one field that interests them. Then, distribute one Designing Solutions Handout to each pair, and elaborate on the challenge by reading aloud the bullets listed under *Step 1: Define the Challenge*. Summarize the challenge by explaining that students will apply what they learn from their research to consider how machine learning could help solve one issue facing their field.
 5. After answering questions, prepare student-pairs to perform research to better understand the challenge:
 - Write the following website on the board and instruct pairs to begin their research with this source to better understand AI and machine learning: northeastern.edu/graduate/blog/artificial-intelligence-vs-machine-learning-whats-the-difference.
 - From there, encourage students to perform their research using reputable internet sources.
 - Explain that students will have about 20 minutes to complete their research.

DESIGN

1. Bring the class back together and take a few minutes to clarify students' understanding of machine learning. Explain that machine learning is most beneficial in situations where predictions need to be made or large amounts of data need to be sorted. A machine (or AI system) learns how to do this by reviewing labeled training data sets developed by humans, so they can later apply what they learned from these classifications as they make their own decisions.

If helpful, provide the following example: Let's say that the agricultural field would like to use technology to detect crop disease. To do this, the AI system must be exposed to a wide range of data. The data training-set would begin with basic classifications such as pictures labeled "crop" and "not a crop." The AI system would then need to learn, through additional labeled data, what a healthy crop looks like versus an unhealthy crop; all of the possible warning signs of disease; crop abnormalities that are not indicative of disease; and so on. Eventually, it will be able to independently identify signs of disease based on what it learned from all of the previous classifications. This process is called supervised learning.

2. Call on a student to read the handout's *Step 2: Create a Design* section aloud. Elaborate on the *Learning* bullet by explaining that students should try to think backwards and begin with the broadest and most basic data that the machine would have to recognize, followed by smaller and more detailed elements.
3. Tell the class that they will have an additional 20 minutes to complete the *Design* portion of their handout. If additional internet research would be helpful, they may continue using their devices to complete this step.

SOLVE

1. When there are about 10–15 minutes left in the class period, pair student partners together. Instruct each group to briefly share their recommendations.
2. Then read the *Step 3: Analyze Solutions* portion of the handout aloud. Explain that data scientists use the patterns and information in datasets to help companies solve problems like this one. Play the Data Scientist Career Profile Video available at <https://stemcareerscoalition.org/careers-portal> to help students better understand this career. Then reiterate that student pairs will take on the role of data scientists as they work together to identify any risk of bias in each other's recommendations. If needed, define bias as an "inclination or prejudice for or against one person or group, especially in a way considered to be unfair." If time allows, they may edit their recommendations to address any biases they identified.

STANDARDS

Next Generation Science Standards

- Engineering Design:
 - 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.
 - 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.
- ITEEA Standards for Technological Literacy:
 - Standard 4. Students will develop an understanding of the cultural, social, economic, and political effects of technology. To recognize the changes in society caused by the use of technology, students should learn that:
 - Ethical considerations are important in the development, selection, and use of technologies

Step 1: Define the CHALLENGE

Your challenge as an AI researcher is to:

1. Understand the role AI currently plays in the field you selected.
2. Research and summarize a few key issues or problems facing the field you selected.
3. Consider how machine learning could be used to help solve one of these problems.

As you perform research, jot notes below.

Step 2: Create a DESIGN

Overview: Machine learning is best at making predictions or sorting large amounts of data to make conclusions. Select one problem from your research that you believe machine learning could positively impact. Then develop a recommendation for this field that outlines *how* AI could be used to make a difference.

Requirements: Your recommendation must include:

1. **Problem Identification:** What problem in your field could benefit from machine learning? How could machine learning contribute to a solution? Try to identify a small, tangible, and specific contribution.
2. **Training Data:** What data would a machine need to recognize to accomplish this task? Work backwards from general to specific as you identify data that would need to be included in training data-sets.
3. **Impact:** Once the AI system is functioning autonomously, what effect could it have on this field?

Jot notes below and then complete your recommendation in a format of your choice on a separate piece of paper.

Step 3: Analyze SOLUTIONS

Once your recommendation is complete, share it with your peers. Then take on the role of a data scientist as you consider:

Because machines learn to make decisions based on training data that is curated by humans, the risk of bias exists. Look carefully at your suggested training data-sets and consider: Is there any room for prejudice? If so, how can we remove this risk?