Hands-On AI Projects for the Classroom

A Guide for Secondary Teachers

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The International Society for Technology in Education (ISTE) is a nonprofit organization that works with the global education community to accelerate the use of technology to solve tough problems and inspire innovation. Our worldwide network believes in the potential technology holds to transform teaching and learning.

ISTE sets a bold vision for education transformation through the ISTE Standards, a framework for students, educators, administrators, coaches and computer science educators to rethink education and create innovative learning environments. ISTE hosts the annual ISTE Conference & Expo, one of the world's most influential edtech events. The organization's professional learning offerings include online courses, professional networks, year-round academies, peer-reviewed journals and other publications. ISTE is also the leading publisher of books focused on technology in education. For more information or to become an ISTE member, visit **iste.org**. Subscribe to ISTE's YouTube channel and connect with ISTE on Twitter, Facebook and LinkedIn.

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ISTE online course, ***Artificial Intelligence and Their Practical Use in Schools***

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Foreword

Welcome to the *Hands-On AI Projects for the Classroom* series, a set of guides for teachers who are seeking instructional and curricular resources about artificial intelligence (AI) for various grade levels and across a range of subject areas.

We know that the jobs of the future will increasingly demand knowledge of how to leverage and collaborate with AI as a tool for problem-solving. Unfortunately, most students today are not on a trajectory to fill those jobs. To prepare students, all educators need to understand the implications, applications, and creation methods behind AI. After all, teachers are the most important link in developing the new generation of AI-savvy learners, workers, and leaders.

That's why ISTE has partnered with General Motors (GM) to lead the way regarding AI in education. Anticipating the explosion of interest in AI in education, we teamed up with GM to create scalable professional learning experiences to help educators bring AI to their classrooms in relevant ways, and to support students' exploration of AI-related careers.

These guides are an extension of our work and feature student-driven AI projects curated from educators in the field, as well as strategies to support teachers in implementing the projects in a variety of K–12 classrooms. The projects engage students in both unplugged and technology-infused activities that explore key facets of AI technologies.

The *Hands-On AI Projects for the Classroom* series is just one of the resources ISTE is creating to help educators implement powerful AI projects to prepare students for their futures.

We are convinced that the language of future problem-solving will be the language of AI, and that educators must accelerate their understanding of AI in order to guide the next generation. We are here to help you make that happen!

Joseph South
ISTE + ASCD Chief Innovation Officer

Introduction

What Is AI?

AI pervades learning, working, and living in the modern world. In fact, AI technologies are being developed and applied across all fields of study—from science and government to language acquisition and art. We believe that, in order to be successful in school and in life, *all* K–12 students need a foundational understanding of what AI is, how it works, and how it impacts society. We also believe students need to learn to use AI tools effectively and ethically in their academic lives and beyond. Because of this, AI education is important across *all* subject areas, not just computer science classes.

Yet, even if we believe that, most of us as K–12 educators and education leaders have not had much education in AI ourselves. After seeing the hype about AI in the news and social media, you might find yourself wondering: What exactly is AI? And if you are, you are not alone. In fact, even professionals in the field of AI do not always agree on the answer. Nevertheless, it is important to know what we mean in this guide when we refer to AI.

According to John McCarthy, who first coined the term, artificial Intelligence is "the science and engineering of making intelligent machines, especially intelligent computer programs" (McCarthy, J., 2007)[1]. A technology powered by AI is capable of such things as using sensors to meaningfully perceive the world around it, of analyzing and organizing the data it perceives, and of autonomously using that data to make predictions and decisions.

In fact, the autonomous decision-making nature of AI technologies is part of what helps us to distinguish technologies that are and are not AI. For example, autonomous decision-making separates the non-AI automatic doors at your grocery store—which do use sensors to perceive, but open in response to simple if-then conditional statements—from AI-powered, self-driving cars that use sensors to perceive and analyze visual data, represent that data as a map of the world, and make time-sensitive, life-and-death decisions about which direction to move in next, and at what speed.

At their best, AI technologies accomplish tasks that are difficult or impossible for humans to accomplish by themselves. While early AI made decisions based on a preprogrammed set of data and actions, many newer AI technologies use machine learning to improve based on novel data as it is presented. When trained well, AI software is able to efficiently and effectively process, recognize patterns in, and extrapolate conclusions from large data sets across various fields of study. Some AI tools can even use what they have learned to generate new examples of data, text, art, and code based on the patterns that were detected. Similarly, robots powered by AI have the potential to complete tasks that are physically complicated, demanding, or even dangerous for their human counterparts. The projects in this guide and in the other volumes of the *Hands-On AI Projects for the Classroom* series reveal these capabilities to K–12 students across various subject areas and grade levels.

You can learn more about AI and access supporting resources in **Appendix A: Unpacking Artificial Intelligence**.

1 McCarthy, J. (2007). What is artificial intelligence? Retrieved from jmc.stanford.edu/articles/whatisai/whatisai.pdf

Why Is It Important to Teach About AI in Your Courses?

Over the last decade, the majority of articles about the use of AI in K–12 education focused on two general areas: automating administrative tasks, such as taking attendance and grading assignments or increasing student performance through AI-supported assessment, personalized learning, and increasing engagement in typically mundane rote learning. Recently, attention has shifted to generative AI tools like ChatGPT, prompting both potential time-saving planning applications for teachers and concerns about what will happen when students use these types of tools to generate art, essays, or code.

However, these conversations barely scratch the surface when it comes to AI's potential for impacting students' lives—not only in the classroom but throughout their daily activities. The driving purpose of this guide is to look beyond the kinds of strategies mentioned above to consider not only how AI makes life easier at a superficial level, but also what students need to know and understand about AI to ensure they become thoughtful users and even creators of these powerful tools.

This guide is for educators who teach core academic subjects in grades 6–12. Why devote a guide to these areas of study? Once the stuff of science fiction, AI now permeates nearly every facet of our lives, and while most of us are aware of tools like virtual assistants or navigators, we may not be cognizant of ways that AI is impacting society. For example:

- As the field of AI expands, it is critical that students are aware of the ethical and societal implications of AI systems and how they are designed and regulated.
- AI-supported tools that are used to create and distribute information—both factual information and disinformation—challenge students to become increasingly sophisticated consumers of media.
- The use of chatbots and virtual assistants to support learning and productivity across content areas requires that students understand what these AI agents are and how they work.
- The use of AI for solving problems related to science and the environment calls for students to investigate how this is accomplished.

These examples point out the importance of all students understanding the degree to which AI is being used to influence what and how we learn, consume media, and solve problems. Awareness at this level does not require specific technical expertise. Educators with little or no prior experience with AI may still help their students become more informed about AI technologies. Educators can help by identifying instances of AI use, exploring the ethics of machines influencing decisions we make, and understanding enough about AI concepts that they can remind students that AI is a tool created by humans.

Until recently, conventional wisdom has suggested that instruction about AI should be confined to computer science courses at the high school level and above. However, the use of AI is becoming so pervasive throughout society that a basic understanding of what AI is and what its capabilities are is becoming as necessary as more traditional literacy

skills like reading, writing, and computation. The Department of Homeland Security is strongly urging airports to implement facial recognition software to screen passengers. AI tools are being used to generate information in various formats—text, video, audio, and images. How can the consumer decide if this information is reliable versus meant to mislead? Virtual assistants and chatbots are becoming so realistic that it is sometimes difficult to distinguish between them and humans. Medical experts and scientists are exploring the use of AI to recognize and diagnose diseases. Each of these examples emphasizes that, while most of the people who design these tools will likely be coming from math, science, and computer science disciplines, we are all end-users and therefore must be participants in the conversation if these tools are to effectively meet our needs.

Considerations for Developing and Implementing AI Projects

This guide provides student-driven projects that can directly teach subject area standards in tandem with foundational understandings of what AI is, how it works, and how it impacts society. Several key approaches were taken into consideration in the design of these projects. Understanding these approaches will support both your understanding and implementation of the projects in this guide, as well as your own work to design further activities that integrate AI education into your curriculum.

Our Student-Driven Approach

The projects in this guide use a student-driven approach to learning. Instead of simply learning *about* AI through videos or lectures, the students completing these projects are active participants in their AI exploration. In the process, students work directly with innovative AI technologies, participate in "unplugged" activities that further their understanding of how AI technologies work, and create various authentic products– from chatbots to prototypes– to demonstrate their learning.

Each project's student-driven activities are divided into three sections: Getting Started, Take a Closer Look, and Culminating Performances.

Getting Started activities hook students' interest, activate prior knowledge, and introduce them to the project's objectives.

Take a Closer Look activities develop students' AI understanding by providing students with scaffolded, guided learning activities that make connections between AI concepts and subject-area content. Students will learn key

vocabulary, discover and analyze how real-world AI technologies work, and apply AI tools as they relate to subject-area problems.

Culminating Performances challenge students to synthesize their learning, complete a meaningful performance task, and reflect on the societal impact of what they have learned.

Moreover, in this guide, students' exploration of AI is framed within the standards, concepts, and depth that would be appropriate to the core academic subjects in grades 6–12. Depending on the level of your students and the amount of time you have available, you might complete the entire project from Getting Started to Culminating Performances, you might pick and choose from the listed activities, or you might take students' learning further by taking advantage of the additional extensions and resources provided for you. For students with no previous experience with AI education, exposure to the guided learning activities alone will create an understanding of their world that they likely did not previously have. And for those with some background in computer science or AI, the complete projects and resources will still challenge their thinking and expose them to new AI technologies and applications across various fields of study.

In addition to deciding which project activities you will implement, you can also modify the projects themselves as needed to support learning at various grade and ability levels. You might provide simpler explanations and vocabulary definitions; assign students to work as individuals, small groups, or a whole class; or adjust the output of the Culminating Performance to better suit their abilities. For example, Project 3: Using AI to Solve Environmental Problems can be completed by students in science or English language arts courses in either middle or high school; however, instruction regarding machine learning and classification algorithms should deepen as they get older. Early and repeated success with these and other AI learning activities can encourage students to continue their exploration into important field-relevant AI applications in the future.

Frameworks and Standards

When making decisions about what to teach about AI in K–12 classrooms, we recommend considering related educational standards and frameworks. In terms of frameworks for teaching AI, this guide references the Five Big Ideas in AI (shown in Figure 1).

The Five Big Ideas in AI serve as an organizing framework for the national AI in K–12 education guidelines developed by the **AI4K12 Initiative**. These guidelines articulate what all K–12 students should learn about AI. Each of the projects in this guide illuminates one or more of the first four foundational concepts—perception, representation and reasoning, learning, and natural interaction—as well the societal impact that the concept has in the context of the project.

Additionally, the ISTE Standards and Computational Thinking Competencies can help frame the inclusion and development of AI-related projects in K–12 classrooms. The **ISTE Standards for Students** identify the skills and knowledge that K–12 students need to thrive, grow, and contribute in a global, interconnected, and constantly changing society. The **Computational Thinking Competencies for Educators** identify the skills educators need to

THE FIVE BIG IDEAS IN AI

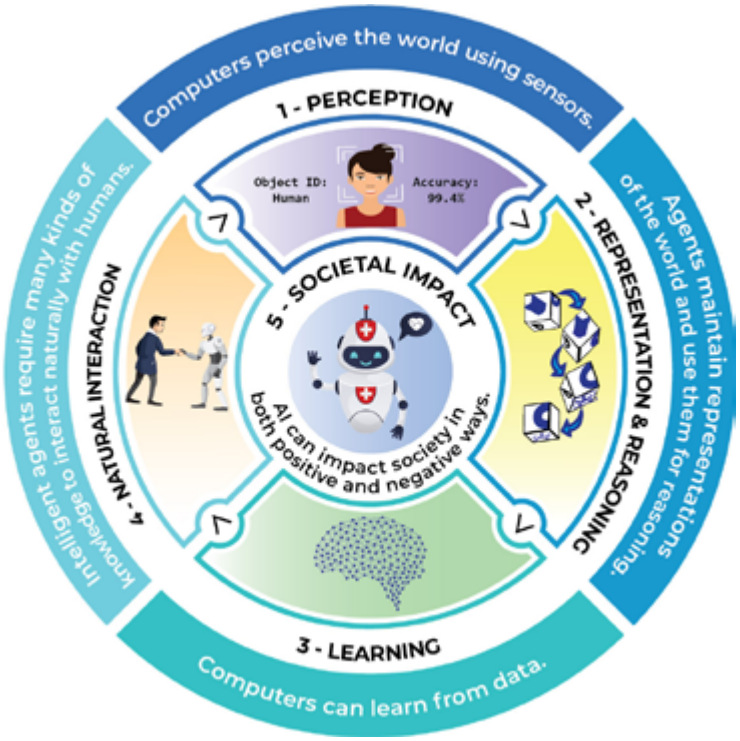

FIGURE 1. Five big ideas in AI. Credit: AI4K12 Initiative. Licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

successfully prepare students to become innovators and problem-solvers in a digital world. Together, the standards and competencies can give us a language and lens for understanding how these AI projects fit into the greater goal of teaching all students to become computational thinkers. Each of this guide's projects will indicate alignment points with both the ISTE Standards for Students and the Computational Thinking Competencies.

Finally, another way to think about technology use in these student-driven projects is with the SAMR model developed by Dr. Ruben Puentedura. This model classifies the use of technology into four categories: Substitution, Augmentation, Modification, and Redefinition. While uses of technology at the substitution and augmentation level might enhance learning or the performing of tasks, uses at the modification and redefinition level transform the learning experience or task into something that was previously inconceivable, difficult, or even impossible. Many of the activities in this guide will push students' use of technology to the modification and redefinition levels. And while other activities might have students engage with AI technologies conceptually through unplugged activities, or work with AI technologies at the substitution or augmentation level of SAMR, each of the new understandings students walk away with will empower them to understand, use, and possibly even create AI technologies that will fundamentally redefine the way humans live and work.

How to Use This Guide

There are many courses, workshops, seminars, and other learning opportunities both online and offline that focus on the fundamentals of AI. There are also resources that target very tech-savvy educators who have backgrounds in AI concepts and the programming skills necessary to teach students how to code AI-based projects. However, when it comes to the educators who are themselves in the early stages of learning about AI, very little is available to help them transfer what they are learning into meaningful, student-driven classroom activities. That's where the *Hands-On AI Projects for the Classroom* series of guides comes in.

Each guide in this series offers information and activity suggestions that educators can use—regardless of their own experience and background—to ensure their students are afforded opportunities to engage in meaningful activities related to AI. Each guide consists of three parts: Introduction, Projects, and Appendices. Let's briefly review each section.

Introduction

Each of the guides in the *Hands-On AI Projects for the Classroom* series is directed toward a specific group of educators: elementary, secondary, teachers of electives, and computer science teachers. In addition to this How To section, the introductory section of each guide includes the following information:

- An overview of the *Hands-On AI Projects for the Classroom* series
- A discussion entitled "What Is AI?"
- An explanation of how AI fits into the context for that guide
- Considerations for designing and implementing AI-related projects

Project Design

For ease of use, every project in each of the guides is designed using a consistent format, as follows.

Project Overview

The project overview offers an explanation of what the project is, how it ties to research-based standards, and what students will learn and be able to do as a result of completing the project. Specific sections include a brief overview of the project; the subject, target grades, and estimated duration of the project; objectives for the project; and a listing of relevant standards addressed, such as the ISTE Standards for Students, ISTE Computational Thinking Competencies, AI4K12 Five Big Ideas in AI, and content-area standards.

Preparation

Preparation provides the information educators need in order to put the project into action with students. This section includes a list of materials required for project completion; a list of supporting resources for the educator, if applicable; and a list of planning tasks to complete prior to implementation, such as selecting tools, reviewing online resources, etc.

Instructions

Each project includes instructions for:

- Getting Started activities that hook students' interest, activate prior knowledge, and introduce them to the project's objectives.
- Take a Closer Look activities that develop students' AI understanding by providing students with scaffolded, guided learning activities that make connections between AI concepts and subject area content.
- Culminating Performances that challenge students to synthesize their learning, complete a meaningful performance task, and reflect on the societal impact of what they've learned.

While we have provided links to resources to support these activities, in most cases, these activities could be successfully implemented with a variety of similar tools. Moreover, new or improved tools may become available in coming years. Consider the tools and resources listed in the guides simply as suggestions.

Additionally, the inclusion of any material is not intended to endorse any views expressed, or products or services offered. These materials may contain the views and recommendations of various subject-matter experts as well as hypertext links to information created and maintained by other public and private organizations. The opinions expressed in any of these materials do not necessarily reflect the positions or policies of ISTE. ISTE does not control or guarantee the accuracy, relevance, timeliness, or completeness of any outside information included in these materials.

Moreover, prior to using any of the cited resources with students, it is imperative that you check the account requirements for each resource against your school/district student data privacy policy to ensure the application complies with that policy. In addition, some resources' Terms of Service may require parental permission to be COPPA and FERPA compliant for students younger than thirteen years of age.

Extensions

Extensions include strategies and resources for expanding or enhancing the project to support extended student learning.

Glossary and Appendices

Glossary

The glossary includes definitions for terms found in the projects that may be unfamiliar or need explanation for students.

Appendix A: Unpacking Artificial Intelligence

Appendix A provides basic explanations and resources for understanding and teaching fundamental AI concepts.

Appendix B: Alignment to ISTE Standards and AI4K12 Big Ideas

This section provides a high-level overview of how the projects in all five guides in the *Hands-On AI Projects for the Classroom* series align with the ISTE Standards for Students, ISTE Computational Thinking Competencies, and AI4K12 Five Big Ideas in AI.

PROJECT 1
AI Chatbots

While people might once have associated AI with robots or chess playing, today's students often interact with AI chatbots on a daily basis. AI chatbots like Siri, Alexa, Google Assistant, and ChatGPT are commonly found on students' smartphones, computers, and home devices, but how much do students know about how they work and how they can be used?

Project Overview

In this inquiry-based project, students will learn how AI uses natural language processing to converse in a human-like way, then apply this knowledge to develop a model for how an AI virtual assistant or conversational agent might perform a task related to their subject area coursework.

> We want our students to have an understanding of AI and how it works before they leave middle school, so we are developing a scope and sequence for teaching AI to them. Most students are familiar with chatbots, so this AI chatbot project would fit nicely as a way to start introducing them to AI.
>
> — Julie Snyder, Technology and Engineering Teacher, Mellon Middle School

SUBJECT

Appropriate for all subject areas.

ESTIMATED DURATION

5–7 hours

TARGET GRADES

6–12

VOCABULARY

chatbot
conversational agents
extract
hallucination
large language model (LLM)
natural language processing
prompt engineering
sensor
virtual assistants

OBJECTIVES

At the end of the project, students will be able to:

- Explain what natural language processing is.
- Compare and contrast the strengths and weaknesses of virtual assistants and conversational agents.
- Explain how a virtual assistant or conversational agent can be used to perform subject area tasks.

STANDARDS

ISTE Standards for Students

1.2. Digital Citizen

d. Students manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.

1.5. Computational Thinker

d. Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

1.6. Creative Communicator

c. Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.

ISTE Computational Thinking Competencies

5.1. Computational Thinking

e. Recognize how computing and society interact to create opportunities, inequities, responsibilities and threats for individuals and organizations.

5.2. Equity Leader

e. Communicate with students, parents and leaders about the impacts of computing in our world and across diverse roles and professional life, and why these skills are essential for all students.

AI4K12 Five Big Ideas in AI

1. Perception

Computers perceive the world using sensors.

4. Natural Interaction

Intelligent agents require many kinds of knowledge to interact naturally with humans.

5. Societal Impact

AI can impact society in both positive and negative ways.

Content Area Standard(s)

This project has been designed for implementation in a variety of secondary classrooms. When possible, we recommend selecting relevant content area standards related to understanding the use of technology or other modern advances in that field.

Preparation

MATERIALS

- Computer(s) or tablet(s) with internet connection for accessing tools and resources online.
- Teacher computer and projector.
- Tool: Botframe

SUPPORTING RESOURCES FOR EDUCATORS

- Video: "Natural Language Processing #7"
- Article: "A Simple Introduction to Natural Language Processing"
- Article: "A Complete Guide to Natural Language Processing"
- Article and video: "What are Chatbots?"
- Article: "Chatbots vs ChatGPT: Understanding the Differences & Features"

ADVANCED PREPARATION

Test out each of the chatbots students will be using and confirm that they will run both on student devices and the school network.

> **NOTE:** Since AI tools, like chatbots, are rapidly advancing, please be sure to review account requirements for each resource against your school/district student data privacy policy to ensure the application complies with that policy. In addition, some resources' Terms of Service may require parental permission to be COPPA and FERPA compliant for students younger than thirteen or eighteen years of age.

Instructions

GETTING STARTED

Activity 1: Discussion

In this activity, students activate prior knowledge on the topic of AI chatbots through class discussion.

1. Give students the definition of a **chatbot**: a software program that simulates conversation with a human. Simple chatbots can interact with humans using predetermined questions, answers, and statements that are coded into their programming. More advanced chatbots use AI for additional features like speech-to-text, text-to-speech, processing large vocabulary or knowledge bases, and learning from past conversations.
2. Ask students: Have you ever used an AI chatbot like Apple's Siri, Amazon's Alexa, Google Assistant, Snapchat's My AI, or ChatGPT? What did you use it for? What tasks did it perform? How was talking with the AI agent similar to talking to a human? How was it different? Have you ever been unsure if you were talking to a human or a chatbot?

TAKE A CLOSER LOOK

Activity 2: Experimenting With AI Chatbots

In this inquiry-based activity, students will interact with two types of AI chatbots: virtual assistants and **conversational agents**. They will discuss the strengths and weaknesses of each form of chatbot.

1. Tell students that in this activity they are going to learn about two types of AI chatbots: virtual assistants and conversational agents.
2. Have students interact with and watch the demos of several virtual assistants and conversational agents. You can use the ones listed below or supplement this list with examples of chatbots related to your specific subject area. As they interact with each chatbot, students should ask it to complete several basic tasks, such as booking an appointment, setting a timer, or calculating a math problem; and also try to hold a conversation with it about several everyday topics like hobbies or thoughts about the world.

> **NOTE:** Since the data entered may be sent out to be processed by the AI, students should not offer any personally identifiable information.

- **Cleverscript virtual assistant**: This virtual assistant can answer questions about maps, definitions, translations, and calculations.
- **Google Duplex**: This video demonstrates a virtual assistant that performs phone call tasks using human-like communication.
- **Eliza, the Rogerian Therapist**: The original version of this chatbot was one of the first conversational agents mistaken for being human in the 1960s.
- **A.L.I.C.E.**: This conversational agent won several awards in the 1990s.
- **Kuki**: A recent award-winning conversational agent. *Note: At the time of publication, students under 13 are not authorized to use this app, and students ages 13–17 need a parent or guardian's approval.*
- **Cat-GPT**: The Plain Cat-GPT conversational agent option does not require a log-in and uses a model they call GPT-Meow. Spoiler alert: It only returns responses that include cat memes and the word "meow."
- **AI Characters**: A collection of conversational agents that simulate chats with historical figures, fictional characters, and more.

3. Display a blank Venn diagram. Write "virtual assistant" in one circle and "conversational agent" in the other. Ask students to reflect on their interactions with the chatbots and identify characteristics that the virtual assistants and conversational agents have in common and those that differ. Possible answers include:

   Virtual assistants. Follow directions to perform discrete tasks, such as managing to-do lists, taking notes, setting timers or appointments, or looking up information. Have access to a knowledge base and can only answer questions about that information. Often used for customer service. Serve a specific purpose.

   Conversational agents. Natural, human-like interaction. Asks questions and talks about a wide variety of topics, even personal ones. Can make small talk.

   Both. Able to recognize human language. Able to hold a conversation. Limited or no understanding of topics beyond their knowledge base. Ask questions of the user. Cannot always recall what they already said. Don't always make sense.

4. Conclude the activity by sharing these definitions to summarize what they've learned.
   - Virtual assistant: an AI software agent that performs specific tasks based on a user's commands or questions.
   - Conversational agent: an AI software agent designed to have a natural dialogue with a user.

Activity 3: How Does a Chatbot Work?

In this activity, students will take a deeper look at how chatbots work. Students will consider how the quality of an AI's **natural language processing** (NLP) affects its ability to interact naturally with humans.

1. Project these two videos about chatbots: "**How do Chatbots work? Simply Explained**" and "**The Turing test: Can a computer pass for a human? —Alex Gendler**."
2. Reinforce the following concepts, building on the content of the videos:
   - AI chatbots are powered by natural language processing.
   - Natural language processing is the AI technology used to understand and interact with human language.
   - Natural language processing powers technologies like voice experiences and assistants, text predictors, grammar checks, and language translators.
   - For a chatbot to perceive and understand what people are saying, the AI uses **sensors** to receive input in the form of text or voice.
   - The AI must decipher sounds, syntax, semantics, and context to **extract** meaning.
   - To appropriately respond, the AI must be able to generate coherent sentences.
3. Share with students that, in recent years, a new type of chatbot has become very popular: chatbots based on large language models (LLMs). LLMs are AI programs that have been trained on huge amounts of written data in order to be able to read and generate text in natural human languages.

   Activate students' prior knowledge by asking them if they've ever heard of or used AI tools that are powered by LLMs, such as **ChatGPT**, **Claude**, or **Bard**.

4. Depending on your school or district policy around these types of LLM-based AI tools, either deliver a class demonstration or allow students to experiment with one or more of these tools. Using the suggestions below or ideas of your own, interact with the AI as a virtual assistant, asking it to complete specific tasks related to your class content, as well as interact with it as a conversational agent, making small talk. Some of these chatbots can even role play, responding as though it is a tutor, a marketing director, or even an historical figure. Encourage students to consider both the strengths and limitations of the interactions.

   - Write a 250 word explanation of _____ in a way middle or high schoolers can understand. (Examples: Einstein's laws of relativity, the pythagorean theorem, the themes of Scythe by Neal Shusterman)
   - Here are my class notes about _____: *include notes* Create 10 flashcards that I can use to study this content.
   - Roleplay as a tutor and ask me questions about _____. Ask me the questions one at a time. If I get the answer wrong, give me a hint and ask me again. If I still get it wrong, explain the right answer to me.
   - Give me a list of instructions for how to _____. (Examples: divide fractions, write a haiku)
   - Hello. How are you today?
   - What is your favorite color?
   - Roleplay as my friend and have a conversation with me about favorites. What is your favorite color?

   Ask students: Do you think these types of chatbots are examples of conversational agents or virtual assistants, and why? After listening to their responses, tell students that these advanced chatbots based on LLMs often blur the lines between virtual assistants and conversational agents. In fact, people are still exploring all the different ways that they might be used.

5. Show the video, "**How Chatbots and Large Language Models Work**," which explains how these AI tools work. Review key points from the video, emphasizing that LLMs can use complex predictions to generate not only simple conversational responses, but also essays, poems, and even code. While AI does not actually understand the words in the input or output, these advanced AI tools do a good job of simulating human language. Let them know that, because these chatbots are merely predicting the next best letter or word to output instead of understanding the data or question, these AI tools sometimes get things wrong or even make up information. When an AI does this, it is called a **hallucination**.

6. Conclude this activity with a class discussion. Ask students:

   - Based on your interactions with and observations of AI chatbots, how well do you think they are doing at simulating human conversation? As chatbots become more human-like, what might be the ethical considerations of telling or not telling people that they are communicating with an AI?
   - Why do you think some chatbots do a better job than others? How might chatbots benefit from combining the abilities of both virtual assistants and conversational agents into one AI entity?
   - What might be the benefits of using chatbots in homes, schools, or businesses? What might be the challenges or risks?
   - Do you think it is important for everyone to have a basic understanding of how AI chatbots work? Why or why not?

CULMINATING PERFORMANCES

Activity 4: Design an AI Chatbot

In this culminating performance, students will create a model of an AI chatbot application within your subject area or class.

1. Divide students into groups of 2–4. Have each group brainstorm a list of at least 3 ways that an AI chatbot might be used in your subject area or class. While students might imagine AI chatbot applications like those in science fiction, encourage them to work within the current capabilities of AI chatbots, which typically serve a specific, narrow purpose and are limited by the strengths and weaknesses of natural language processing. For example, an AI chatbot might help quiz students while they study for a test, retrieve definitions for vocabulary while the student reads a short story, make calculations while students perform a science experiment, conduct a poll in a social studies class, comfort students when they are feeling anxious, or schedule parent-teacher conferences. If you would like students to create chatbots as a culminating project for a unit, you can tell them to brainstorm applications related to that unit's content, such as figurative language, the civil rights movement, the periodic table, or converting measurements.
2. Next, have each group select one of their ideas to develop further. Students should use a planning tool like **Botframe** to create a model demonstrating how their chatbot would work, and prepare to present it to the class. Remind students to think about the realistic strengths and weaknesses of an AI chatbot's natural language processing and make sure to reflect that in their model and presentation. Depending on the amount of time you allot for this project, you might have students present an explanation or walk-through of their model by acting out a commercial that advertises their chatbot application. When presenting the commercial, students might simply read the script during their performance or they might be encouraged to consider costumes, props, or memorizing their lines.
3. Conclude the activity by having students present their models or perform their commercials for the class.

Activity 5: Reflect

In this activity, students should discuss the following questions to reflect on the societal impact of AI chatbots:

- How realistic do you think the AI chatbot applications you imagined in your presentations (or commercials) are? Which chatbot do you think would be the most beneficial to humans, and why?
- When you interacted with the online chatbots, you were told not to enter any personally identifiable information. What might be some of the privacy concerns when using chatbots, either for personal reasons or for tasks related to this subject area?
- How might you decide when the convenience of using a chatbot outweighs the privacy risks?
- What advice might you give to people about using AI chatbots to help perform tasks at home, school, or work?

Extensions

Following are some ways to expand students' exploration of AI-powered chatbots:

1. Extend students learning about chatbots by having them code their own. Here are several options of tutorials in Scratch, App Inventor, and Python that explore different aspects of chatbot technologies.
   - This "**Beginner Tutorial – How to Make a Chatbot in Scratch**" tutorial from Lemonerdy allows students to use block-based code to create an interactive version of their botframe chatbot simulation. Great for beginning coders!
   - This "**How to Make Your Own Alexa-Like Chatbot with AI in Scratch**" block-based coding tutorial helps students create an interactive chatbot that can learn new prompts and responses from the user.
   - Use this App Inventor embedded **Therapist Bot Tutorial** to have students create a simplified version of the Eliza bot they experimented with earlier in the project.
   - Try out the "Chatbots" worksheet from **Machine Learning for Kids** to have students create a chatbot that answers questions about a topic of their choice. In the process, students will train their own machine learning model and integrate it into a Scratch or Python program.
   - Create an app powered by a large language model with App Inventor's **ChatGPT App Tutorial**, which uses a ChatGPT API to integrate powerful natural language processing capabilities into a block-based program.
2. Students can create voice experiences for the Alexa chatbot through the user-friendly **Alexa Skills Blueprint** platform. Alexa skills are individual apps or tasks that the chatbot is programmed to perform. Skills blueprints include a variety of formats, from sorting games to quizzes to storytelling. Once created, they can be tested and run on Alexa-enabled devices.
3. The practice of crafting descriptive prompts in order to get the best output from an AI tool is called **prompt engineering**. Extend students' learning about interacting with chatbots by exploring strategies for writing initial and follow-up prompts that would get virtual assistants to respond in a way that is closest to what the user wants or expects. Prompt engineering skills can help students with practical life skills, such as interacting with a bank customer service bot, and with academic skills, like using a large language model chatbot to create study aids.

> **NOTE:** The tools in these extensions may require an account and may collect students' data. Please check their terms and conditions of use and children's privacy policy against your school/district student data privacy policy to ensure the applications comply with that policy. In addition, the applications may require parental permission to be COPPA and FERPA compliant for students younger than 13 years of age.

PROJECT 2

Developing a Critical Eye

What does it mean to be a discriminating consumer of information in the age of AI? According to two researchers from the Pew Research Center, Katerina Eva Matsa and Lee Rainie, trust in the news media is declining. In a video produced by the Pew Research Center, "**Trust in America: Do Americans Trust the News Media**," Matsa states, "The challenges that Americans are facing, parsing through the news online is in this new environment of misinformation, with a large share of Americans saying that made-up news creates confusion and it's really a big problem for society." The solution to these challenges lies with understanding how AI is being used to create and distribute disinformation. This understanding also requires focusing on critical thinking skills and increased focus on information literacy.

Project Overview

In this project, middle and high school students will be challenged to learn about several AI-supported tools that are used to create and/or distribute information—both reliable information and disinformation. Class members will work in pairs or small groups to identify important topics in the news, and design 1–2 page plans describing how AI-supported tools could be employed to create and disseminate information campaigns, using both reliable information and disinformation, on those topics. Student teams will share their plans with the class.

> I think this could be a powerful project for language arts and social studies teachers to collaborate on. For example, using it in a civics course where students are examining how technology plays a role in policy-making.
>
> — Lynn Erickson, Instructional Technology Specialist, Stafford Public Schools

SUBJECT

English language arts
with cross-curricular Extensions.

TARGET GRADES

8–12

ESTIMATED DURATION

10–12 hours

VOCABULARY

artificial intelligence
bot
deepfake
disinformation
generative adversarial network (GAN)
misinformation

OBJECTIVES

At the end of this project, students will be able to:

- Identify and explore ways information, both reliable information and disinformation, is created and distributed through use of AI-supported tools including, but not limited to, deepfake videos, distorted images, audio recordings, and bots.
- Select topics in the news and develop 1–2 page plans for AI-supported information campaigns, using either reliable information or disinformation, on those topics.
- Evaluate and offer constructive feedback on AI-supported information campaign plans developed by other student teams.

STANDARDS

ISTE Standards for Students

1.3. Knowledge Constructor

b. Students evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.

d. Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

1.6. Creative Communicator

d. Students publish or present content that customizes the message and medium for their intended audiences.

ISTE Computational Thinking Competencies

5.1. Computational Thinking

e. Recognize how computing and society interact to create opportunities, inequities, responsibilities and threats for individuals and organizations.

5.2. Equity Leader

b. Construct and implement culturally relevant learning activities that address a diverse range of ethical, social and cultural perspectives on computing and highlight computing achievements from diverse role models and teams.

e. Communicate with students, parents and leaders about the impacts of computing in our world and across diverse roles and professional life, and why these skills are essential for all students.

AI4K12 Five Big Ideas in AI

3. Learning

Computers can learn from data.

4. Natural Interaction

Intelligent agents require many kinds of knowledge to interact naturally with humans.

5. Societal Impact

AI can impact society in both positive and negative ways.

Common Core State Standards for English Language Arts

CCSS.ELA-LITERACY.RI.6.1 through RI.11-12.1: Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

CCSS.ELA-LITERACY.RI.6.6 through RI.11-12.6: Determine an author's point of view or purpose in a text and explain how it is conveyed in the text.

CCSS.ELA-LITERACY.RI.6.8 through RI.11-12.8: Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

CCSS.ELA-LITERACY.W.6.1 through 11-12.1: Write arguments to support claims with clear reasons and relevant evidence.

CCSS.ELA-LITERACY.W.6.2 through 11-12.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

CCSS.ELA-LITERACY.W.6.4 through 11-12.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-LITERACY.W.6.8 through 11-12.8: Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.

Preparation

MATERIALS

- Computer(s) or tablet(s) with internet connection for accessing tools and resources online.
- Writing materials: paper, pens, pencils.

SUPPORTING RESOURCES FOR EDUCATORS

- Article: "**Artificial Intelligence and Disinformation**"
- Article: "**Dating apps need women. Advertisers need diversity. AI companies offer a solution: Fake people**"

- Article: "Deepfake Video and Audio Recordings"
- Article: "It takes a few dollars and 8 minutes to create a deepfake. And that's only the start"
- Article: "How Google's Fight Against Disinformation Is Changing SEO"
- Article: "MIT made an AI that can detect and create fake images"
- Article: "State of Art Computational Propaganda"
- Article: "Can A.I. Stop Fake News?"
- Article: "How to Fact Check: AIO Editing Tips & Tools for Perfectly Accurate AI Content"
- Article: "Weapons of Mass Distraction: Foreign State-Sponsored Disinformation in the Digital Age"

ADVANCED PREPARATION

Familiarize yourself with all the resources and tools listed in the instructions. Ensure they will work on the school network. If any are blocked, try to find a substitute, or request to have them unblocked.

Post the link to the article and video, "Dictionary.com's 2018 Word Of The Year Is …" and to the AI-supported tools listed in Activity 2 so students have access to them.

Instructions

GETTING STARTED

Activity 1: Introduction

In this activity, students will read an article and work in pairs/trios to compare and contrast the terms **misinformation** and **disinformation**. They will then engage in a conversation about AI and disinformation, including how disinformation is generated and distributed on social media platforms.

1. Ask students to think about what sources people use when they want to gather information about a topic that's new to them. Responses will vary, but may include print material like reference books or magazines as well as digital media like instructional videos, podcasts, and online reference materials consisting of text and images.
2. Introduce students to **AI** and AI-generated media. Key points should include:
    - A description of what AI is, and that people across all fields are using AI to create informational text, images, video, and audio. Supporting resources can be found in Appendix A: Unpacking Artificial Intelligence.
    - Tell students that Dr. Melvin Kranzberg was a professor of the history of technology at the Georgia Institute of Technology. Dr. Kranzberg developed Six Laws of Technology. The first law states: "Technology is neither good nor bad; nor is it neutral." What he meant by this is that while in and of itself, technology is not good or evil, it does lead to unintended consequences. For example, the people who developed AIs that can

write articles good enough to publish did not necessarily anticipate that someone might use these tools to flood the internet with misinformation and disinformation. Unreliable information generated with AI tools is often difficult to differentiate from accurate information.

- Tell students that as they complete this project they will learn how people use AI-powered tools to create and distribute misinformation and disinformation. This project will help them improve their skills at evaluating the quality of information.

3. Have students pair up or form trios. Distribute paper and ensure students have pens/pencils. Ask them to each individually draw a table with three columns. Label the column on the left "Misinformation—Differences." Label the middle column "Misinformation & Disinformation—Similarities." Label the column on the right "Disinformation—Differences." Ask students if they have heard the terms misinformation and disinformation. Direct their attention to the link to "**Dictionary.com's 2018 Word Of The Year Is …** ." Ask them to read the article individually and add notes to the table they drew in the correct columns. If possible, have students watch the video that is embedded on the article page on their own as well, but if necessary, show the video to the entire class after they have read the article. Give student pairs/trios a few minutes to compare the notes they took individually and identify how the terms are similar and how they differ. Engage students in a class discussion about their findings. The critical point they need to understand is that misinformation and disinformation differ in one critical way—misinformation relates to incorrect information that is shared in the belief that it is true while disinformation is incorrect information intentionally shared to mislead.

4. Ask the class to brainstorm a list of ways they think AI might be used to create disinformation. Post the list where all students can see it. Explain that there are several common ways AI is used for this purpose, including AI-generated text, images, video, and audio. Project the following links to show students examples of each type of AI-generated artifact:

   - **AI Detector for ChatGPT, GPT4, Bard & More**: A tool to detect automatically generated text: Take time to discuss each example with the class. When reading the AI-generated text, ask students: Does it make sense?
     Why or why not?
   - **Which Face Is Real?**: Which Face Is Real? challenges viewers to look closely at each image and decide if it is a real person or AI-generated. Allow students to look at several pairs of photos and guess which one in each pair is a real person.
   - **What is deepfake AI?**: A thorough exploration of deepfakes including what they are, how they work, how they are created, their impact on viewers, and more.
   - **Voice Cloning Experiment**: This voice cloning site provides several very short audio samples of a person's voice. Those voice samples are then used to create a statement made in the same voice that is completely AI-generated (the listing in bold type is the best example in each voice sample).

5. Explain to students that these AI-supported technologies are sometimes used to create disinformation. Ask them to consider why this might be problematic. Also ask if the same tools could be used to support the creation of accurate information. Can they identify situations where the answer might be yes and other times

when the answer might be no? Answers will vary, but might include: AI-generated text could be fact-based depending on how the AI was trained; the ethical use of AI-generated images would depend on how the images are presented; deepfake videos might be used in harmless ways, but most are not; and there are benign ways AI-supported voice-generated clips could be used, such as dubbing over a mistake in a recording.

6. Now have students brainstorm a list of ways AI might be used to spread information and disinformation across the internet. Again, post the list in a place where it can easily be seen by students. Mention that some common ways used to spread information and disinformation include targeted marketing (specifically identifies narrow audiences for various kinds of information and disinformation), search engine optimization (helps push information and disinformation to the top of search results), and **bots** (automate the sharing of information and disinformation to reach millions of targeted consumers). Share the following examples of information distribution methods.
    - In a classic example of targeted marketing, Cambridge Analytica, a political consulting group, illegally acquired data belonging to 87 million Facebook users. The data were collected from Facebook users who took an online quiz, but Cambridge Analytica also took data that belonged to the Facebook friends of the person who took the quiz. The data were used to distribute disinformation to specifically targeted audiences.
    - Researcher Robert Epstein of the American Institute for Behavioral Research and Technology conducted a study where he found that Google's search algorithms and personalization of search results—which means different users see different search results—results in biased search results that impact people's opinions about issues.
    - In February 2023, a viral video recording of Paul Valles, one of four candidates running for mayor in Chicago appeared to show the candidate making a statement in support of "refunding the police." Within a day, the video was found to be a deepfake, but Valles lost the election to another candidate who opposed that point of view.
7. Ask students why the use of information distribution tools was problematic in these examples. Then ask if the same distribution tools can be used to spread accurate information. After giving them a few minutes to share their ideas, tell students that during the next two activities in this project they will learn more about how AI can be used to create and distribute information and disinformation.

TAKE A CLOSER LOOK

Activity 2: Creating Information and Disinformation Using AI

In this activity, students will explore hands-on examples of ways that AI-supported online tools can be used to create various types of information and disinformation.

1. As a review, ask students to identify the four common ways AI-supported tools can be used to generate information and disinformation that were specified in Activity 1. You may need to remind them that the categories were: text, images, video, and audio. Have students regroup into their pairs or trios from Activity 1. Explain that during this activity they will learn more about AI-supported online tools that can be used to create various forms of information and disinformation.

2. Ask students to work in their pair or trio to explore the following list of AI-supported tools and write a brief review of each category: text, images, video, and audio. Their review should include:
   - How each tool can be used to generate information and disinformation.
   - What they see as being strengths and weaknesses of these tools.
   - Whether the products created by these tools appear to be genuine, or if there are obvious clues that a product might not be trustworthy? Point out that AI-generated text may not make sense, even when it's factually accurate; AI-generated images may not "look right" (e.g., missing ear, odd hairline); deepfake videos also may not "look right" (e.g., mouth and audio out of synch); and AI-generated audio may sound robotic in terms of fluency and pronunciation.
3. Following are the AI-supported tools students will explore:
   - Text: **AI Article Generator**. Let an AI write a news article for you.
   - Text: **AI Characters**. Converse with a chatbot.
   - Image: **DragGAN: An AI Based Image Editing Tool**. Watch this demo of DragGAN, a free artificial intelligence photo editor demo that allows users to manipulate images.
   - Image: **This Person Does Not Exist**. View images of faces created with a **generative adversarial network** (GAN).
   - Image: **Generated Photos**. View a gallery of faces created with a GAN.
   - Video: **Deepfake Videos Explained**. View a CBC Kids News spot featuring deepfake videos.
   - Video: **AI Brings Mona Lisa to Life**. Watch as the Mona Lisa appears to talk.
   - Video: **Samsung's new AI technology brings photos to life**. See an overview of several deepfake videos created by Samsung.
   - Audio: **Online Tone Generator**. Type a sentence or two, select a voice, and click play.
   - Audio: **BigSpeak**. Type a sentence or two, select a voice, and click play.
   - Audio: **Watson Text to Speech Demo**. Type a sentence or two, select a voice, and click play.

Activity 3: Disseminating Information and Disinformation Using AI

In this activity, students will research ways AI-supported distribution strategies are used to spread information and disinformation.

1. Remind students of the brief class discussion that took place during Activity 1, which focused on three AI-supported distribution strategies: targeted marketing, search engine optimization, and bots. Explain that in this activity students will work in teams to investigate one of these distribution strategies, focusing on how the strategy works and ways it might be used to distribute information and disinformation. Teams will then share this information with classmates.

2. Divide the class into six groups of equal size. Assign one distribution strategy to each team, so that each strategy is being researched by two teams. Explain to students that each team will have one class period to research its strategy and one class period to prepare an information sheet about the strategy. The information sheet could be in the form of a hardcopy or digital handout, flyer, poster, or infographic, and should include the following:
    - Name of strategy
    - Definition of strategy
    - Explanation of how the strategy is used to distribute information, including the role of AI
    - Explanation of how the strategy is used to distribute disinformation, including the role of AI
    - Summary of the pros and cons of using this strategy to distribute this information
3. Each team will share its one-page information sheet with the class. Teachers may distribute copies of these information sheets to each team or post these documents online for the whole class to access.

CULMINATING PERFORMANCES

Activity 4: Brainstorming Topics for Campaigns

In this activity, student teams will create plans for informational campaigns using AI-supported tools to create and disseminate information that is either accurate or disinformation (one-half of the campaigns are based on accurate information and one-half on disinformation). While completing the activity, students will conceptually explore real-life applications of AI tools used to inform or disinform consumers. When teams' completed campaign plans are shared, students will discuss each plan to decide which are most compelling and why. Students should not actually create or launch the campaigns. Students may use the tools previewed in Activity 2 or other appropriate options.

1. Ask students to brainstorm a list of issues that are currently in the news. Create a class list of the topics mentioned by individual students. Select one from the list to use as a model. For example, let's say that a student mentioned scientists' concerns about disappearing permafrost. Explain to students that melting permafrost is measurable and undeniable. There are scientific explanations about why this is happening, but there are also people who deny the explanations. Tell students that for this assignment, one class team will plan an online campaign that uses AI-supported tools to identify or create and distribute factual information about melting permafrost, while another team will plan an online campaign that uses AI-supported tools to identify or create and distribute disinformation about melting permafrost. Model the process for brainstorming a plan for the accurate information campaign using the following steps:
    - Remind students that they explored four kinds of content that can be created using AI-supported tools: text, images, video, and audio. Say they will use a mind map to create an initial outline. Write the main idea, "The World's Permafrost Is Melting" in the center of the mind map. Draw four main topic circles or rectangles that connect to the main idea. Label them: text, images, video, and audio. Model brainstorming the specific kinds of text, images, videos, and audio (e.g., articles, photographs, video clips, or podcasts) that could be used to support the main idea. Add these ideas to the mind map, connecting them to the main idea.

- Say that they will be distributing the information online. Brainstorm ideas for ways this material could be formatted for online distribution, such as social media posts, an online poster, or a website. Add these to the mind map, linking them to indicate which format could be used for each specific kind of text, image, video, or audio. (There may be more than one format option for each.) An example mind map is shown in Figure 2.

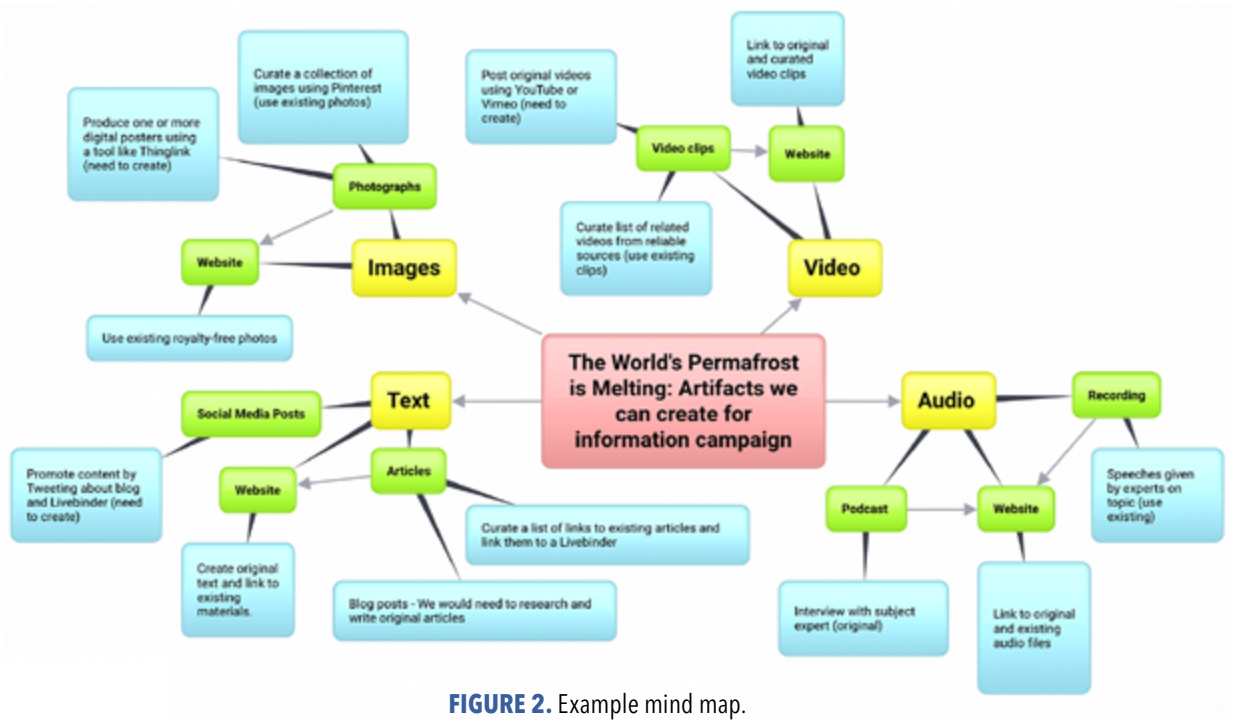

FIGURE 2. Example mind map.

- Ask students if they would need to create all content on their own, or if they would be able to find existing material like articles, images, video, or audio clips that they could fact-check and use as a source of information for the campaign. Mark each specific type of content on the mind map either "use existing" or "need to create." In the course of the conversation, help students conclude that in this example they would probably need to research and write social media posts, use an online tool like **Piktochart** or **Canva** to create an online poster, and create some content for a website if they decided to build one, but they could also probably use existing images, video, and audio if they conducted an online search to find copyright-free material that they could fact-check.
- Tell students that for the purposes of this example, they should imagine creating an online poster to share factual information about melting permafrost, and promoting the poster through social media. The AI-supported distribution methods they will use are search engine optimization and bots.
- Point out that the mind map they've created can now serve as a draft outline for their information campaign. Point out that if they were assigned the disinformation campaign for this project, they would

need to create more of the content, because it might be difficult to find existing text, images, videos, and audio that denies that the permafrost is melting. In that case they would need to generate text, alter images, and possibly create a video or fabricate an audio clip of someone claiming that the permafrost isn't melting. Brainstorm what kinds of tools could be used to create faked content.

- Tell students that the final step for their project will be to take the mind map they've created and create a 1–2 page proposal for the campaign. The proposal needs to include all the elements in the mind map: title; types of content; format(s) for content; sources of content (existing, or created for this purpose and how); and how the information or disinformation will be distributed.

2. Choose three topics from the list brainstormed by students. Divide the class into six teams. Assign two teams to each of the three topics—one team will design an information campaign and the other a disinformation campaign. Answer any questions students have. Remind students that they are not actually creating or launching these campaigns. Instead, they are to use what they have learned to create a presentation about their plan to the class.
3. Give the teams two class periods to create the mind map and a 1–2 page proposal for their campaign.
4. Teams should make brief (10-minute) oral presentations of their proposals, during which teams should pitch their proposals without identifying them as accurate information or disinformation. The class should critique each proposal, stating which they find most compelling, which they think are based on accurate information, and which they think are based on disinformation, and why. At the conclusion of the presentations, be sure to reveal which campaigns were information and which were disinformation.

Activity 5: Reflect

In this activity, students will discuss the following questions to reflect on their learning and consider the societal impact of using AI.

- What did you learn about AI-supported tools that can be used to create content? What are some of the pros and cons of having an AI generate content instead of a person?
- What did you learn about AI-supported tools that can be used to distribute content online? What are some of the pros and cons of having an AI distribute content instead of a person?
- How will you apply these skills to avoid being misled when you use social media or other online resources?

Extensions

Here are four ways to expand students' abilities to recognize factual information and disinformation:

1. Extend this project into other subject areas by looking at content-specific topics. For example, a civics class might develop campaigns based on government policies, while a health class might develop campaigns focused on diets.

2. **GROVER** is a machine learning model that is both a generator and discriminator of fake news created by AI. A generator is an AI able to produce believable fake news stories. A discriminator is able to analyze news stories to determine if they were written by an AI. When students use a critical eye to analyze media to determine if it is disinformation, they are also acting as discriminators. For this extension, students should read more about GROVER on the website; use GROVER to generate fake news stories and see if they are able to find characteristics in the articles that can help them discriminate between news written by a human or by an AI; and use the "detect" feature to test GROVER's ability to correctly identify news stories as written by a human or an AI.
3. CNN has created an interactive page called "**When Seeing Is No Longer Believing**." Work through the content and activities presented here as a class or have student teams review the page. Topics include:
   - What are deepfakes?
   - Can you identify deepfakes?
   - A history of video manipulation.
   - How are deepfakes different from genuine media?
   - Many more topics are covered.

   Have students break into small groups to discuss what they learned during this activity and how they will apply this information.
4. Why is fact-checking critical? Persistent repetition of misinformation and disinformation leads many people to believe something is true, even when it is not. Watch this brief video with your students: **The Easiest Quiz of All Time**. It illustrates why it's important to fact check even things we're quite sure about. Discuss students' reactions to the video and brainstorm a list of fact-checking tips and resources they can use.

PROJECT 3

Using AI to Solve Environmental Problems

Project Overview

Environmental projects, whether protecting endangered species or addressing global climate change, are important to many students and also to many AI developers. In this project, students will try out an AI-powered application designed to address an environmental challenge, explore several AI projects aimed at sustainability and environmental protection, and propose an AI-powered solution to a local environmental problem they identify.

> At a time when students often feel overwhelmed by anxiety for the health of our planet, this project affirms that AI is one of the extraordinarily powerful tools we can all use to help save the earth.
>
> — **Anna Clarke, Lead Teacher, Lakeland Montessori Middle School**

SUBJECT

Science and/or English language arts

TARGET GRADES

6–12

ESTIMATED DURATION

10–12 Hours

VOCABULARY

artificial intelligence
classification algorithm
features
machine learning
training data

OBJECTIVES

At the end of the project, students will be able to:

- Describe how AI is currently being used to solve real-world environmental problems.
- Develop a presentation on how AI might be used to help solve a real-world environmental problem that they identify.

STANDARDS

ISTE Standards for Students

1.1. Empowered Learner

- **d.** Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

1.3. Knowledge Constructor

- **d.** Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

1.4. Innovative Designer

- **a.** Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

1.5. Computational Thinker

- **a.** Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.

1.7. Global Collaborator

- **d.** Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.

ISTE Computational Thinking Competencies

5.1. Computational Thinking

- **b.** Learn to recognize where and how computation can be used to enrich data or content to solve discipline-specific problems and be able to connect these opportunities to foundational CT practices and CS concepts.

5.2. Equity Leader

- **e.** Communicate with students, parents and leaders about the impacts of computing in our world and across diverse roles and professional life, and why these skills are essential for all students.

5.3. Collaborating Around Computing

- **a.** Model and learn with students how to formulate computational solutions to problems and how to give and receive actionable feedback.

5.5. Integrating Computational Thinking

- **b.** Empower students to select personally meaningful computational projects.
- **c.** Use a variety of instructional approaches to help students frame problems in ways that can be represented as computational steps or algorithms to be performed by a computer.

AI4K12 Five Big Ideas in AI

2. **Representation and Reasoning**
   Agents maintain representations of the world and use them for reasoning.
3. **Learning**
   Computers can learn from data.
5. **Societal Impact**
   AI can impact society in both positive and negative ways.

Next Generation Science Standards

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Common Core State Standards for English Language Arts

CCSS.ELA-LITERACY.WHST.6-8.7: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-LITERACY.WHST.9-10.7/11-12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Preparation

MATERIALS

- Student mobile devices with internet access (1 per student or group).
- Teacher device and projector.
- Listed online articles, tools, and resources.
- Sticky notes and writing utensils. Alternatively, an online application like **Miro** or **Figma** can be used with virtual sticky notes
- App: **Seek by iNaturalist**, **Naturalist User Guide**, and **iNaturalist Teacher's Guide**.

> **NOTE:** iNaturalist, which is used in this project, offers a web-based alternative to Seek by iNaturalist that can be used by students aged 13+. The reason for mentioning the age restriction here is that the Seek by iNaturalist mobile app does not require students to set up a personal account, but the web application does.

SUPPORTING RESOURCES FOR EDUCATORS

- Article: "Artificial Intelligence—A Game Changer for Climate Change and the Environment"
- Resources: iNaturalist Computer Vision Explorations and The Latest Computer Vision Model Updates
- Guide: Using AI for Social Good
- Resource: Microsoft's AI for Earth Initiative
- Article: "From Computational Thinking to Computational Action"
- Article: "What is Design Thinking and Why Is It So Popular?"

Instructions

GETTING STARTED

Activity 1: What Can AI Do?

In this activity, students will consider the capabilities of **artificial intelligence** by watching a video and completing an affinity diagramming activity. If students are unfamiliar with AI technologies, you may want to supplement the video in this activity with additional supporting resources, such as those found in Appendix A: Unpacking Artificial Intelligence.

1. Display the question "What can AI do?" on a whiteboard, bulletin board, or wall.
2. Give 3–4 sticky notes to each student. Project the first 06:33 minutes of the video "A planetary computer for Earth" or another video clip that provides an overview of how AI is being used to address environmental and sustainability challenges. As students watch the video, have them write down facts or ideas about what AI can do on the sticky notes. Each sticky note should list only one fact or idea.
3. After the video, have students place the sticky notes under the posted question. Work with students to organize the notes into categories by discussing how they might label different types of AI capabilities and examples. Then cluster their ideas using the categories they identify.
4. Tell students that in this project they will be looking at projects that use AI capabilities to positively impact environmental problems. Keep the sticky notes displayed and let students know they will return to this activity later in the project.

TAKE A CLOSER LOOK

Activity 2: Using an AI-powered Environmental Tool

In this activity, students will use an AI-powered tool, **Seek by iNaturalist**, to identify plants and animals in their immediate environment. The Seek by iNaturalist mobile app provides real-time computer vision for organism identification, while offering privacy safeguards for children of all ages including no required accounts and no collection of personally identifiable information. Students who are aged 13+ or who have a parent's permission can (optionally) log in with an iNaturalist account to share their observations with the greater iNaturalist community in accordance with the guidelines in their **Teacher Guide**. If your class does not have access to iOS or Android mobile devices, students aged 13+ can create an account on the web-based iNaturalist platform to engage with its AI computer vision feature or to share their observations. The **Seek by iNaturalist User Guide** shows a comparison of the two platforms and provides instructions for the Seek Camera computer vision function.

1. Introduce students to the Seek by iNaturalist app and demonstrate how to use the Seek Camera computer vision function to identify organisms.
2. Explain to students that modern AIs use **machine learning** to quickly process large amounts of data (numbers, text, images, sounds), find features and patterns in those data, and perform a task, such as classification or prediction. In the Seek app, the AI uses a **classification algorithm** to identify the correct labels for the kingdom, phylum, class, order, family, genus, and species of a living organism in an image. While being trained, the Seek AI was given millions of images, along with their correct labels, as **training data**. The AI used those data to create a model of **features**—unique measurable properties—common to each species. The AI uses that model to classify new data samples with a label to a certain degree of confidence. Plus, as members of the iNaturalist community add new observations of various species to the data set, the AI is able to identify more and more species.
3. Direct students to look at the image(s) you used in the demonstration. Ask them: What visual features do you think the AI identified in this image that helped it correctly classify this plant or animal? What features are unique to this species compared to others that are similar?
4. Have students use their mobile devices during class time or after school to identify 3–5 living organisms. Depending on their access to devices, they could do this as individuals or in small groups. (Please note: The iNaturalist database and application focuses on species that are naturally found in the wild and not placed there by humans. While students might use the app to identify garden plants, pets, or zoo animals, students should not upload observations of them to the iNaturalist database.)
5. Conclude the activity with a class discussion about students' experiences using this AI tool.
    - What was your experience like using this AI-powered tool?
    - What kinds of organisms did you find? Was the app able to correctly identify each of your photos all the way to the species? Did it identify any incorrectly? Was it unable to identify any of the organisms in your images? Why do you think it was sometimes more accurate and sometimes less accurate?
    - What might be the benefit of having an application that can correctly identify thousands of species around the world? How could an application like this be used to address environmental or sustainability challenges?

Activity 3: How AI Helps Solve Environmental Problems

In this activity, students will take their inquiry into the capabilities of AI further as they look into an environmental AI project. In the process, students will learn more about how AI works and the types of problems AI may help solve.

1. Have students work in groups of 2–4 to choose an environmental AI project to investigate. Students can choose from the projects listed below or explore projects listed by Google's **AI for Social Good**, Microsoft's **AI for Earth**, **AI for Good**, **Wildlife.ai**, or other resources.
   - **Lynch Lab**: This research lab uses a variety of methods, including harnessing AI to analyze satellite data of penguin guano (excrement) to discover and understand penguin colonies. **Learn more**.
   - **Plant Village**: This program recognizes diseases in leaves and advises farmers about what steps to take to address them. **Learn more**.
   - **Pattern Radio: Whale Songs**: This project uses AI to process and identify whale songs in recordings, faster and more accurately than can be done by humans. **Learn more**.
   - **The Ocean Cleanup**: This project is using computer vision and AI to identify plastic in oceans. **Learn more**.
2. Direct students to use the articles and other resources provided and/or their own research to learn about the project they select. Groups should try to answer the following questions and prepare a 3–4 minute presentation for the class.
   - Briefly summarize the project. What is the problem that is being solved? How is AI technology part of the solution?
   - What makes the problem difficult for humans to solve without AI assistance?
   - How does the AI in the project work? Does it use machine learning? If so, what type of data was it trained on and/or does it process?
   - Is this AI technology being implemented in an ethical way? Are the data collected without harming anyone or anything? What do people do with the information from this AI project? How might people misuse information from this AI project?
   - Do you think that AI is an appropriate tool for solving this problem?
3. Have each student group present their findings. As they do, have their classmates write down new facts or ideas about what AI can do on sticky notes. Again, each sticky note should list only one fact or idea.
4. Following the presentations, have students add any new sticky notes to the categories on the wall and briefly discuss the new AI capabilities or applications they discovered. Help students conclude that an AI's ability to outperform humans at tasks such as classification or prediction make it a useful technology in addressing many environmental and sustainability challenges.

CULMINATING PERFORMANCES

Activity 4: Proposing an AI Solution to a Community Problem

In this culminating performance, students will use a **design thinking process** to identify a way AI might be used to solve a real-world environmental problem. In addition to learning more about an environmental issue and potential uses of AI, students should also explore their own capacity for creating computational solutions to real world problems.

Divide students into groups of 2–4, then have them work through the 5 step design thinking process below.

1. Empathize. In this step, students will ask: What are the environmental or sustainability problems I notice in my community? How do these problems affect the people around me? Students might find inspiration in the United Nations' list of **17 Sustainable Development Goals**. They should identify one specific local environmental or sustainability challenge to explore further. Have students research the issue. Suggest interviewing people in the community who are affected by the situation to understand the issue better.
2. Define the problem. Students should synthesize their research and explain the problem in detail, including the ideal outcome of a solution that works.
3. Ideate. Have students imagine how they might solve the problem using AI. When developing their solution, students should consider the following questions:
   - What makes the problem difficult for humans to solve without AI assistance?
   - How would the AI in the project work? Would it use machine learning? If so, what type of data will it be trained on and/or will it process?
   - How does the AI fit into the larger solution to the problem?
4. Create a prototype. Have students create a multimedia artifact, such as an infographic, video, or slideshow, that includes diagrams or descriptions about how the AI would function in the proposed solution.
5. Test. In this step, students will share their solution, garner feedback, and identify possible improvements. While multimedia products will be shared with classmates, ideally students would also be able to share their idea with the community members who would be most impacted by the problem and possible solution. Students should ask them for feedback and advice about their proposed solution.

Finally, before turning in their final product, students should have time to consider the feedback, make revisions to their prototype, and think about whether they feel it would be worthwhile to take their project further (through work in the current course or through other means).

Activity 5: Reflect

In this activity, students should discuss the following questions to reflect on their learning and consider the societal impact of using AI technologies to solve environmental problems:

- In what way do you think including an AI technology in your solution changed the way you approached solving the problem you identified?

- What ethical questions should a company or organization consider before trying to implement the solution you described? What unintended consequences might your solution cause?
- How do you think AI technologies will create and improve solutions to environmental and sustainability challenges?

Extensions

Here are three ways to expand students' exploration of AI and machine learning to solve real-world problems.

1. Students with computer science skills may want to create a working prototype of the AI-powered solution they imagined in their culminating performance. Students can use a tool like **Teachable Machine** or **Machine Learning for Kids** to train and test a model that could be integrated into a program or app.
2. **Wildlife.ai** is a charitable organization that uses AI to promote conservation and prevent extinction. Students can learn more about these real-world applications of AI on their website. Students can further extend their learning through a **Machine Learning for Kids** project that Wildlife.ai has developed called "**Kiwi or Stoat**." In this project, students train a machine learning model to distinguish between images of kiwis and stoats in the wild, then implement it in a Scratch program to successfully classify new images.
3. **Zooniverse** asks citizen scientists to participate in research projects by identifying objects in images. The projects range from penguin conservation to identifying spiral galaxies from telescope data. Students can explore citizen science projects that use volunteers' input to train AI, such as Alpine Bug Shot or Galaxy Zoo projects, without creating an account, or they can participate in projects with an account.

> I would use this project in my science class because it provides students with a meaningful opportunity to identify and develop potential solutions to real world problems that are significant to their community. It would be great for introducing students to scientific taxonomy and utilizing the engineering process.
>
> — **Jennifer Smith, Teacher, Monticello Middle School**

PROJECT 4
Laws for AI

With the advent of generative AI tools like ChatGPT there is increased attention on the ethical concerns related to use of these tools. In April 2023, Sam Murugesan wrote, "AI-driven content generators raise several ethical concerns related to bias, plagiarism, intellectual property, misuse, and the potential to generate misinformation, fake news, or misleading content. These could have serious ramifications, such as harming reputations, spreading false information, or even inciting violence[2]." But concerns about ethics and developing technologies are not new and definitely not confined to AI. For instance, during the early nineteenth century the Luddites destroyed textile machinery to save jobs. In the mid twentieth century, Isaac Asimov explored issues related to ethics and robotics. He suggested a framework for the behavior of those robots that had some autonomy.

Project Overview

In this project, students will begin their exploration of ethics and technology by researching the attributes of an ethical business; learn about Asimov's Laws for Robotics; explore the need for similar work in the field of AI today; and develop four original laws for AI.

> I'm excited about this project because it effectively connects literature, computational thinking, computer science principles and ethics together in a turnkey lesson plan. I would use this in my Language Arts class because students need to develop an awareness of the ethical issues surrounding the development of the ubiquitous technologies they use on a daily basis.
>
> — **Pam Amendola, English Language Arts Teacher, Dawson County High School**

SUBJECT

English language arts

ESTIMATED DURATION

5–6 hours

TARGET GRADES

6–12

2 Murugesan, S. (2023). The Rise of Ethical Concerns about AI Content Creation: A Call to Action. Retrieved from **computer.org/publications/tech-news/trends/ethical-concerns-on-ai-content-creation**

VOCABULARY

artificial intelligence
artificially intelligent robot (AI robot)
autonomy
ethical
robot

OBJECTIVES

At the end of this project, students will be able to:

- Explain how Asimov's Laws for Robots impact the portrayal of AI in the story "Runaround."
- Describe topics related to ethics and technology.
- Develop and justify four laws for AI.

STANDARDS

ISTE Standards for Students

1.2. Digital Citizen

b. Students engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.

1.3. Knowledge Constructor

d. Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.

1.6. Creative Communicator

c. Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.

ISTE Computational Thinking Competencies

5.2. Equity Leader

b. Construct and implement culturally relevant learning activities that address a diverse range of ethical, social and cultural perspectives on computing and highlight computing achievements from diverse role models and teams.

d. Communicate with students, parents and leaders about the impacts of computing in our world and across diverse roles and professional life, and why these skills are essential for all students.

5.4. Creativity & Design

c. Guide students on the importance of diverse perspectives and human-centered design in developing computational artifacts with broad accessibility and usability.

AI4K12 Five Big Ideas in AI

5. Societal Impact

AI can impact society in both positive and negative ways.

Common Core State Standards for English Language Arts

CCSS.ELA-LITERACY.RL.6.2 through 12.2: Determine a theme or central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

CCSS.ELA-LITERACY.W.6.2 through 12.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

CCSS.ELA-LITERACY.CCRA.W.6.7 through 12.7: Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

Preparation

MATERIALS

- Class set of Isaac Asimov's short story "Runaround."
- Computer(s) or tablet(s) with internet connection for accessing tools and resources online.

SUPPORTING RESOURCES FOR EDUCATORS

- Article: "The new laws of robotics – building on Asimov's science fiction legacy in the age of AI"
- Curriculum: An Ethics of Artificial Intelligence Curriculum for Middle School Students.
- Article: "Artificial Intelligence and Ethics"
- Article: "Using Asimov's 'I, Robot' to understand Morals and Ethics (Using Asimov's 'I, Robot' to understand Morals and Ethics)"
- Article: "Do We Need Asimov's Laws?"
- Article: "Artificial Intelligence: examples of ethical dilemmas"
- Article: "Layoffs at an array of big tech corporations affecting responsible AI personnel have raised concerns around long-term safety"
- Article: "It's time to address artificial intelligence's ethical problems"
- Article: "Teaching Kids the Ethics of Artificial Intelligence"
- Article: "The Ethics of Artificial Intelligence"
- Article: "Top Nine Ethical Issues In Artificial Intelligence"
- Article: "Who is Responsible When AI Makes Mistakes?"
- Article: "Duplex shows Google failing at ethical and creative AI design"

ADVANCED PREPARATION

- Read the short story "Runaround."
- Familiarize yourself with background information about why Isaac Asimov wrote the Three Laws of Robotics, and ethical concerns related to robotics and AI, by reading the articles listed in the supporting resources or conducting research on your own. Decide if you want to share any of the article links with students and if so, which ones.
- Preview the video "Ethics."

Instructions

GETTING STARTED

Activity 1. Discussion and Rapid Research

In this activity, students will participate in a discussion of what it means for individuals and businesses to behave ethically. They will complete a rapid research exercise to learn about businesses that are considered to be **ethical**.

1. Most students have a strong sense of fair play. How do they react when they believe they've been treated unfairly? What does it mean to behave ethically? Show students the video clip, "Ethics." Ask students to think about the question posed in the video. How would they answer? Volunteers may share their responses.
2. Ask students if they are aware of businesses or organizations that identify as being ethical. Can they name a business that is thought of as being ethical? Refer students to the 2023 World's Most Ethical Companies Honoree List. Ask students to form pairs, select one business from the list (monitor selections so each business is chosen just once), and then do a quick research activity to learn why that business is considered ethical, what it is doing well, and where it can improve. Student pairs will then create a one-page document that names the business and provides the information listed in the previous sentence. Post the documents in an online class space or in the classroom for students to read and review.
3. Explain to students that in the remaining activities in this project they will be exploring topics related to ethics and technology. Mention that innovations in science and technology dating back 500 years or more have caused dramatic changes in people's lives. Many of these changes are to our benefit, but that's not always the case. It's important to think carefully not just about advancements that can and are being made in technologies, but also about the positive and negative impacts these technologies will have on our world. This project helps students become aware of ethical considerations related to new and existing technologies.

TAKE A CLOSER LOOK

Activity 2: Asimov's Laws for Robotics

In this activity, students will learn about Isaac Asimov's Three Laws of Robotics: what they are, why he developed them, and how he applied them in his writing.

1. Begin this activity by drawing a Venn diagram. Label one circle "Robots" and the other circle "Artificial Intelligence;" label the intersection "AI robots." Introduce students to the concept of **artificial intelligence**, explaining what AI is and that people across all fields are using AI to power decision making, problem solving, and automation. Supporting resources can be found in Appendix A: Unpacking Artificial Intelligence. Then, in the Venn diagram, have the class brainstorm a list of **robots**, both AI and non-AI, and place them in the correct spot in the Venn diagram. Examples of **artificially intelligent robots (AI robots)** include warehouse robots that navigate the warehouse, some delivery drones, or self-driving cars. Help students to understand that AI robots are able to make **autonomous** decisions.
2. To lay the groundwork for why Asimov developed the Three Laws of Robotics, watch the video clip "**Isaac Asimov: The Three Laws of Robotics.**" Ask students why Asimov thought the laws were necessary. Help them understand that while Asimov didn't intentionally set out to create laws for robots, what he wrote did provide a framework for the behavior of those robots with autonomy within his fiction. This is also a good time to point out that although AI isn't specifically mentioned in science fiction stories like those written by Asimov, the robots described often have a great deal of autonomy, demonstrating AI. As students discussed in the Venn diagram activity, in real life some—but not all—robots are AI robots, but even the AI robots that do exist do not have the high level of autonomy typically found in science fiction.
3. Read Isaac Asimov's short story "Runaround." Then hold a class discussion that explores the following key areas:
   - Discuss how the three original Laws of Robotics were incorporated into the story and drove the story's plot.
   - Mention that later, when Asimov expanded his stories to include fully autonomous robots that were responsible for governments and civilizations, he developed what he called the Zeroth Law of Robotics, which stated, "A robot may not harm humanity, or through inaction allow humanity to come to harm." Ask students: Why do you think Asimov thought this was important to add? What is an example of how, in the absence of this law, a robot might allow humanity to come to harm through inaction?
   - Ask students to consider how literature influences readers' views of the world around them. Bring up the following additional questions: Does science fiction always accurately describe the current capabilities of various technologies? How is technology actually impacting our lives? Do we need laws today that would create a framework for how AI is developed and used? Why or why not?

Activity 3: AI's Impact on Daily Life

In this activity, students will research real-life examples of some impacts AI is having on society.

1. Review students' responses from the previous activity to this question: What kinds of impacts is AI having on our society today? Have students work with 1 or 2 classmates to find 3–4 examples of ways that AI is changing our world.
2. Have students share the examples they find with the whole class. Ask them the following questions:

- Do these impacts improve people's lives, or make them more difficult? Explain your thinking.
- Which of your examples could be considered ethical uses of AI? Did these examples show use by individuals? Students? Educators? Companies? Governments? Other groups?
- Did you find examples of unethical uses of AI? Did these examples show use by individuals? Students? Educators? Companies? Government? Other groups?
- How can individuals, companies, and other groups be encouraged to always use AI ethically?

Activity 4: Laying the Groundwork for Laws for AI

In this activity, students will consider what would need to be included if Laws for AI were written.

1. Review Asimov's Laws of Robotics and why they were written. Revisit the class discussion during Activity 2, when students first considered if laws for AI are needed. Ask students if the work they did in Activity 3 changed or confirmed their thinking about the need for laws for AI, and why?
2. Students should form teams of 3–4 and brainstorm ideas that laws for AI would need to address, based on the **AI4K12 Five Big Ideas in AI**.
3. Have students share their ideas.

CULMINATING PERFORMANCES

Activity 5: Laws for AI

For the culminating performance, students will apply their thinking about ethical uses of AI and robotics as they write an expository piece about their own laws for AI.

1. Working in teams of 3–4, have each small group identify 4 issues from their discussion during Activity 4 that they think are most important to address in laws for AI. Give teams time to write a law for each issue and to develop a one-paragraph written rationale for each law. When students are satisfied with their work, they may create a digital poster of their laws using a tool like **Google Drawing**, **Google Slides**, **Piktochart**, **Canva** or something similar. Challenge them to devise a way to hyperlink the one-paragraph rationales to each individual law.
2. Have each team present its laws to the class.

Activity 6: Reflect

In this activity, students will discuss the following questions to reflect on their learning and consider the societal impact of using AI:

- What did you learn about ethical and unethical uses of AI?
- What kinds of issues do AI developers need to consider when developing new AI?

Extensions

Following are three ways to expand students' exploration of ethics and AI:

1. Remind students that Isaac Asimov used his Laws of Robotics to create plots for stories he wrote. Ask them to consider how they could use the laws of AI they created in their groups to develop a plot for a 2,500 word short story based on either an ethical or unethical use of AI. Have students work individually to write their short stories.
2. Explain to students that a scenario is a description of a series of events that may be real or imagined. These events usually focus on topics people care about deeply. Scenarios are typically used to help people reflect on how they would deal with the situation described. Remind students of the examples of ethical and unethical use of AI they found during Activity 3. Tell them they have an opportunity to develop 1–2 scenarios about ethical or unethical uses of AI that will be used to help other students think about important ethical questions. If your students need more concrete examples of what a scenario might look like, refer to the article "**Top Nine Ethical Issues In Artificial Intelligence**" to create one or more sample scenarios. Have students develop 1–2 scenarios of 500 words each.
3. In this project students focused primarily on laws that protect humans from AI. Flip the conversation and ask students what might happen if humans intentionally sabotaged an AI? News stories about people jumping in front of a self-driving car to test its reflexes, feeding disinformation into a neural network to skew its results, or physically damaging AI-powered robots are becoming more common. It is unclear right now how these actions might negatively impact the effects of AI on our society or even our own mental health. Have students consider current events about incidents of this type and write a Public Service Announcement about a new law for AI that addresses how human misbehavior toward AI might lead to negative outcomes.

Glossary

artificial intelligence (AI): the science and engineering of creating computer programs that can imitate human intelligence.

artificially intelligent robot (AI robot): a robot that is able to use sensors to collect information and make autonomous decisions about how to complete a task even in a changing environment.

autonomy: the capacity to act independently or without external control.

bot: an AI agent that can interact with computer systems or users.

chatbot: a software program that simulates conversation with a human.

classification algorithms: a method of categorizing data into classes based on common features.

conversational agent: an AI software agent designed to have a natural dialogue with a user.

deepfake: a video created with artificial intelligence software that looks authentic but actually manipulates the face and/or voice of a person.

disinformation: incorrect information intentionally shared to mislead.

ethical: morally right.

extract: identify or separate out.

feature: unique measurable property.

generative adversarial network (GAN): a machine learning framework in which two neural networks are set against each other in order to produce new content.

hallucination: when an AI outputs wrong or made up information

large language model (LLM): AI programs that have been trained on huge amounts of written data in order to be able to read and generate text in natural human languages

machine learning (ML): a subset of AI involving the study of algorithms and models that machines use to perform a task without explicit instructions.

misinformation: incorrect information that is shared in the belief that it is true.

natural language processing (NLP): the AI technology used to understand and interact with human language.

prompt engineering: the practice of crafting descriptive prompts in order to get the best output from an AI tool

robot: a machine that is able to perform complex tasks automatically.

sensor: a device that allows a machine to perceive the natural world.

training data: examples used to teach a machine learning model.

virtual assistant: an AI software agent that performs specific tasks based on a user's commands or questions.

APPENDIX A

Unpacking Artificial Intelligence

This section provides basic explanations of fundamental AI concepts referenced in the *Hands-On AI Projects for the Classroom* series of guides, along with resources for supporting instruction.

What Is AI?

According to John McCarthy, who first coined the term, artificial intelligence is "the science and engineering of making intelligent machines, especially intelligent computer programs" (McCarthy, 2007). A technology powered by AI is capable of such things as using sensors to meaningfully perceive the world around it, of analyzing and organizing the data it perceives, and of autonomously using those data to make predictions and decisions.

AI technologies are sometimes classified as narrow and general AI. Narrow AI makes decisions about a specialized task, sometimes even based on a specific dataset of preprogrammed actions. The DeepBlue chess program that beat a human world champion in 1996, Apple's Siri, and self-driving cars are all examples of narrow AI. In contrast, general AI could hypothetically learn and adapt to perform any task and solve any problem that a human being can. General AI does not currently exist, but there are many examples of it in fiction, such as "WallE" and Baymax from "Big Hero 6."

Learn More

Video: "**What is AI?**"

Video: "**What is Artificial Intelligence (or Machine Learning)?**"

Video: "**What's intelligent about artificial intelligence**"

Article: "**What Is Artificial Intelligence?**" by John McCarthy

Resource: "**How AI Works**"

Resource: "**Glossary of Artificial Intelligence Terms for Educators**"

Curriculum: "**AI4ALL's Open Learning Curriculum**." This free curriculum provides activities to teach students what AI is, what types of AI exist, and how to identify AI in the world around them.

How Do I Know If a Robot or Other Technology Has Artificial Intelligence?

Some robots and computer programs have AI, while others do not. A robot or software solution that has AI capabilities can do things such as recognize specific objects or faces, navigate around objects or complex maps on its own, classify or distinguish between objects, interact naturally with humans, understand or speak in a human language, recognize or express emotions, or improvise when encountering something unexpected. In these ways, the autonomous decisions made by AI are more advanced than simple automation of a task (performed a prescribed sequence of steps), which even non-AI robots and software are frequently used for. As the cost of technology decreases and the capabilities of AI technologies increase, we will likely see increased AI use across most devices and software.

Learn More

Article: "**What's the Difference Between Robotics and Artificial Intelligence**"

Article: "**How Robots Work: Robots and Artificial Intelligence**"

What Is Machine Learning?

Machine learning, a subset of AI, is the study of algorithms and models that machines use to perform a task without explicit instructions. Machine learning algorithms improve with experience. Advanced machine learning algorithms use neural networks to build a mathematical model based on patterns in sample "training" data. Machine learning algorithms are best used for tasks that cannot be completed with discrete steps, such as natural language processing or facial recognition.

Learn More

Video: "**Intro to Machine Learning (ML Zero to Hero—Part 1)**"

Video: "**How Does Machine Learning Work? Simply Explained**"

How Do Neural Networks Work?

Artificial neural networks are currently modeled after the human brain. While a brain uses neurons and synapses to process data, neural networks use layers of nodes with directed connections. Some of these connections are more important than others, so they have more weight in determining the outcome. Just like people, machines with neural networks learn through experience. As a machine processes a set of data, it recognizes patterns, assigns more weight to the most important information, learns to process inputs in order to develop the most accurate outputs, and creates a model from which to make future predictions or decisions. There are many types of neural networks, each with different design, strengths, and purposes.

Learn More

Video: "**Neural Networks and Deep Learning #3**"

Playlist: "**Neural Networks**"

Article: "**What Is Deep Learning?**"

Resource: "**Overview of GAN Structure**"

Article: "**What is GPT?**"

What Is Natural Language Processing?

Natural language processing (NLP) is the AI technology used to understand and interact with humans' natural language. NLP powers technologies such as voice experiences and assistants, text predictors, grammar checks, text analyzers (such as spam filters), and language translators.

Learn More

Video: "**Natural Language Processing #7**"

Article: "**A Simple Introduction to Natural Language Processing**"

Article: "**A Complete Guide to Natural Language Processing**"

Video: "**How Do Chatbots Work? Simply Explained**"

Article and video: "**What Are Chatbots?**"

Article: "**Chatbot vs ChatGPT: Understanding the Differences & Features**"

Video: "**How Chatbots and Large Language Models Work**"

What Is Generative AI?

Generative AI is a type of machine learning that uses advanced algorithms, such as a generative adversarial network (GAN) or a generative pre-trained transformer (GPT), in order to create new data. Based on what they have learned from training data, generative AI tools can generate text, images, video, music, code, and other types of media.

Learn More

Video: "Introduction to Generative AI"

Video: "How Dall-E 2 and Other AI Art Generators Create Images From Text | WSJ"

Article: "Generative Artificial Intelligence in education: What are the opportunities and challenges?"

Article: "What Kids Need To Know About Generative AI: Unleash Your Creativity!"

What Types of Ethical Considerations Surround AI?

There are numerous ethical considerations that surround the development and implementation of AI technologies. For example, all AI technologies are developed by humans. Whether they have been preprogrammed with a set of rules, or use training data to learn, they will have bias based on human input and decision-making. It is important that students understand that AI decisions are not objective, as well as to understand which stakeholders might benefit from certain biases in the technologies. Moreover, many AI technologies collect, store, and apply personally identifiable information about users. Students should be aware of privacy concerns related to these technologies. In addition to various activities that consider AI's societal impacts throughout all of the guides, the *Hands-On AI Projects for the Classroom: A Guide on Ethics and AI* helps to more fully illuminate these and other ethical considerations that students should explore.

Learn More

Video: "Teach AI | Prepare our students for the future"

Video: "Algorithmic Bias and Fairness #18"

Resource: UNESCO's "Ethics of Artificial Intelligence"

Report: "The Ethical Framework for AI in Education"

Article: "Artificial Intelligence and Ethics: Sixteen Challenges and Opportunities"

Video: "Do you know AI or AI knows you better? Thinking Ethics of AI" (version with multilingual subtitles)

Video: "The ethical dilemma of self-driving cars—Patrick Lin"

Video: "The danger of AI is weirder than you think | Janelle Shane"

Curriculum: "An Ethics of Artificial Intelligence Curriculum for Middle School Students"

APPENDIX B

Alignment to ISTE Standards and AI4K12 Five Big Ideas in AI

The following tables provide a big-picture view of how the projects in each guide align with the ISTE Standards for Students, ISTE Computational Thinking Competencies, and AI4K12 Five Big Ideas in AI.

Guide	Elementary				Secondary				Electives				Computer Science				Ethics			
Project	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
ISTE STANDARDS																				
1.1 Empowered Learner	x	x					x			x	x	x	x		x	x		x	x	
1.2 Digital Citizen					x			x			x			x			x	x	x	x
1.3 Knowledge Constructor	x		x	x		x	x	x			x		x				x	x	x	x
1.4 Innovative Designer		x	x				x		x	x					x	x			x	x
1.5 Computational Thinker			x	x	x		x		x		x		x	x	x	x	x			x
1.6 Creative Communicator					x	x		x			x			x					x	
1.7 Global Collaborator							x					x	x						x	
5.1 Computational Thinking				x	x	x	x		x	x	x	x	x		x	x	x	x	x	x
5.2 Equity Leader					x	x	x	x							x	x	x	x	x	x
5.3 Collaborating Around Computing	x			x			x					x	x							
5.4 Creativity & Design	x	x	x	x				x	x	x	x			x	x		x		x	x
5.5 Integrating Computational Thinking		x	x				x		x	x				x						x

Guide	Elementary				Secondary				Electives				Computer Science				Ethics			
Project	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
AI4K12 FIVE BIG IDEAS IN AI																				
1. Perception	x	x			x					x		x			x				x	
2. Representation and Reasoning	x		x	x			x		x			x	x	x	x				x	
3. Learning	x			x		x	x				x	x	x	x	x	x	x	x	x	x
4. Natural Interaction	x				x	x				x		x		x	x				x	
5. Societal Impact	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

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