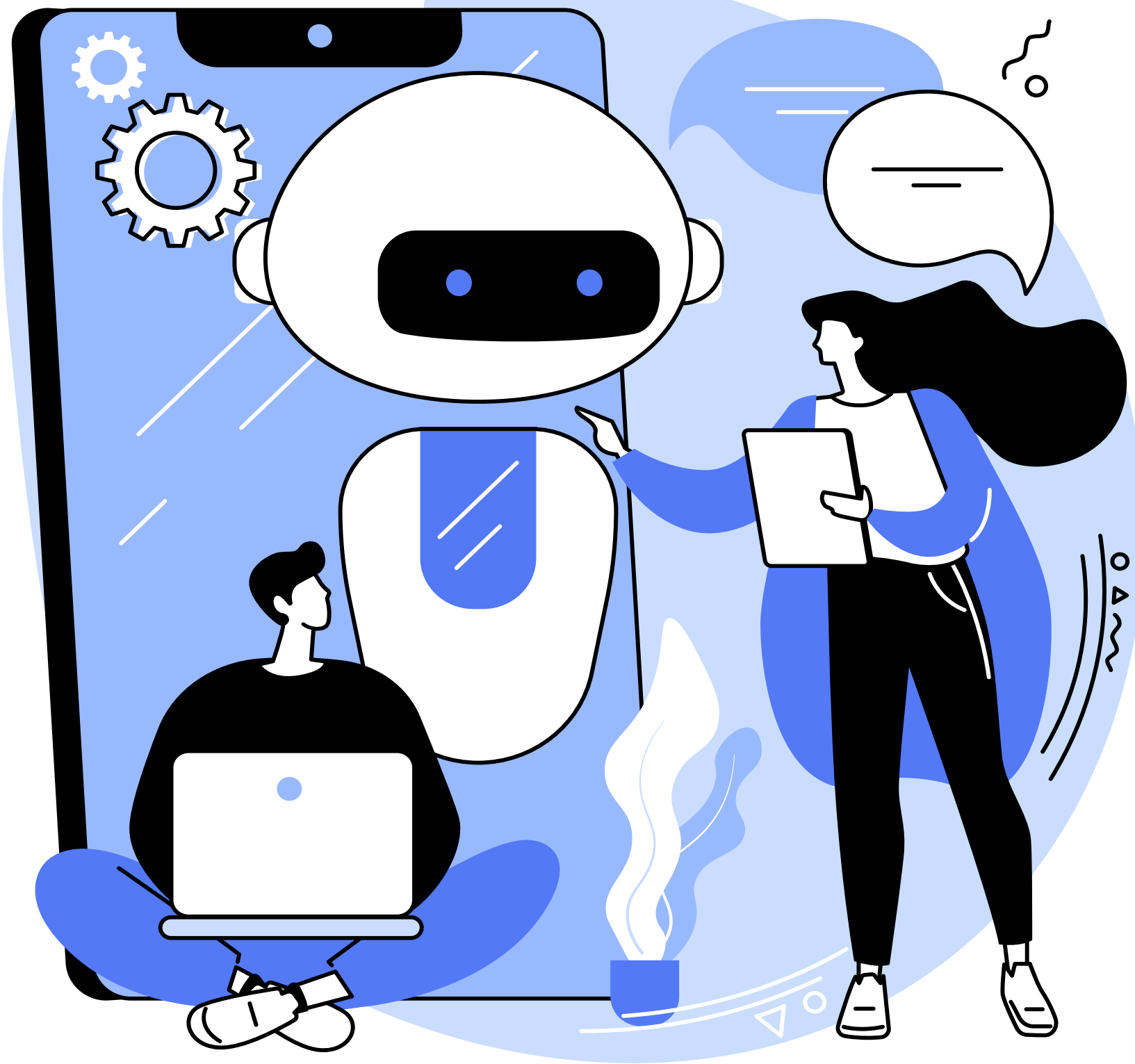




RET PROJECT

Molly Bush and
Chelsea Thompson

ABOUT US



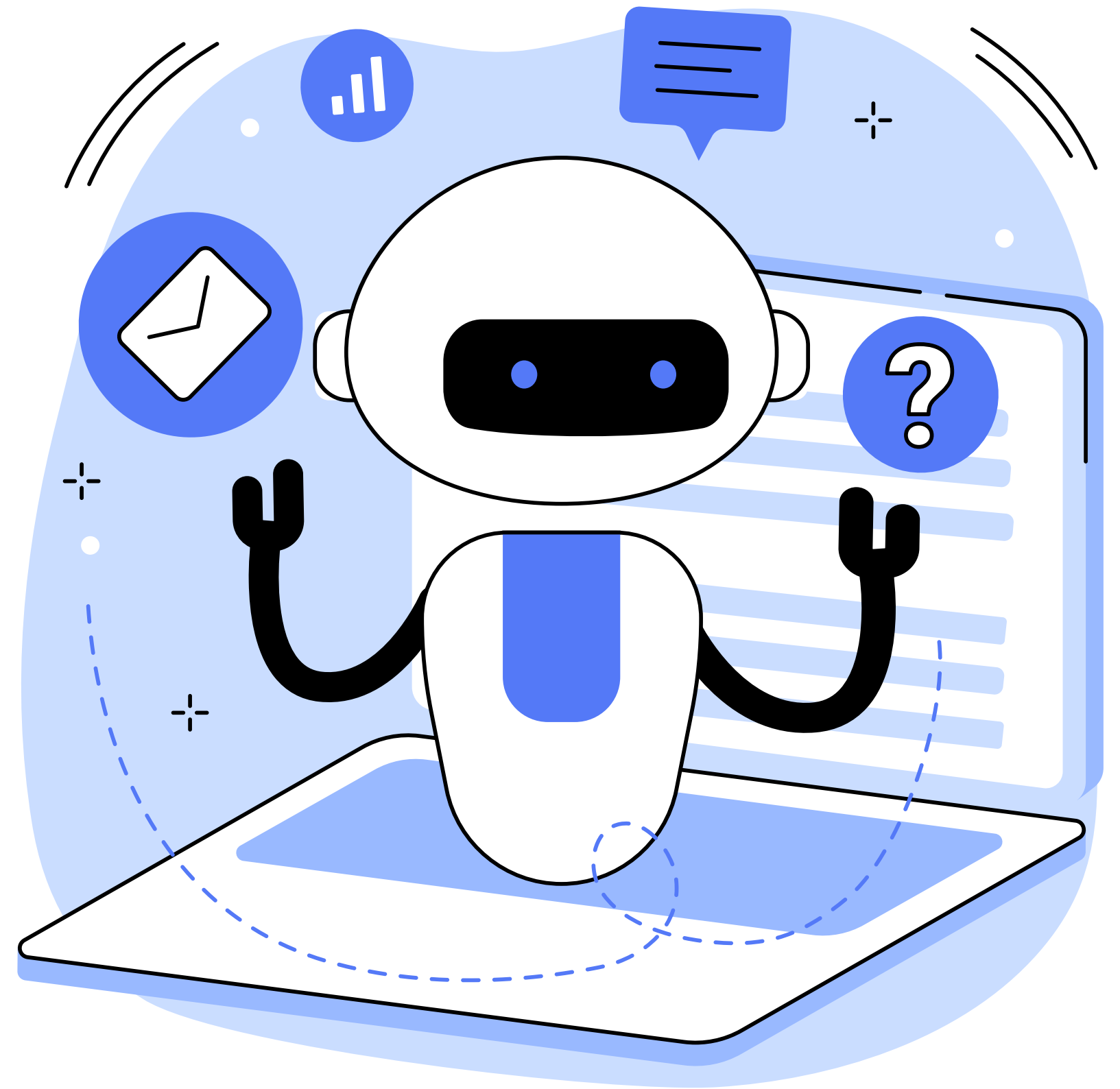
Molly Bush
Grissom Middle School
6/7th Grade Science Teacher



Chelsea Thompson
Discovery Middle School
8th Grade Science Teacher

OUR MODULE

At the end of this module, students will be able to explain how artificial intelligence relies on data centers and computing systems, evaluate the energy and environmental impacts of those technologies, and apply foundational computer science concepts through hands-on programming challenges to design, analyze, and communicate potential solutions for more sustainable computing.



7TH GRADE STANDARDS

MS-PS3-3

Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

SEP.6: Constructing Explanations and Designing Solutions

Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process, or system.

MS-PS3-4

Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS-ESS3-1

Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes

CC.2:

All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.

8TH GRADE STANDARDS

MS-ESS3-3

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4

Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems

ESS3.C: Human Impacts on Earth Systems

Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

MS-ESS3-5

Essential Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over time.

CC.2:

Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

MIDDLE SCHOOL COMPUTER SCIENCE STANDARDS

6-8.DI.1

Use the basic steps in algorithmic problem-solving to design solutions (e.g., problem statement and exploration, examination of sample instances, design, implementing a solution, testing, and evaluation).

6-8.DI.3

Represent data in a variety of ways (e.g., text, sounds, pictures, and numbers), and use different visual representations of problems, structures, and data (e.g., graphs, charts, network diagrams, flowcharts).

6-8.PA.2

Implement problem solutions using a programming language that includes looping behavior, conditional statements, logic, expressions, variables, and functions.

6-8.PA.3

Demonstrate dispositions amenable to open-ended problem solving and programming (e.g., comfort with complexity, persistence, brainstorming, adaptability, patience, propensity to tinker, creativity, accepting challenge)

6-8.IC.2

Analyze the positive and negative impacts of technology on one's personal life, society, and our culture.

6-8.IC.4

Describe ethical issues that relate to computers and networks (e.g., security, privacy, ownership, and information sharing), and discuss how unequal distribution of technological resources in a global economy raises issues of equity, access, and power

6-8.DI.4

Understand the notion of hierarchy and abstraction in computing including high-level languages, translation, instruction set, and logic circuits.

6-8.DI.5

Demonstrate interdisciplinary applications of computational thinking and interact with content-specific models and simulations to support learning and research.

LESSON SCOPE AND SEQUENCE

1

CS Intro to Energy and Data Centers

1. How is Electricity Created?
1. Energy Resources; Renewable vs Nonrenewable
1. How much energy does a data center use?
1. Environmental Impacts
1. Final Assessment

Synchronous

2

Micro:bit Bootcamp

[What is a computer?](#)
[Variables](#)
[Conditionals](#)
[Iteration](#)
[Mini Project](#)

Synchronous

3

Micro:bit Challenges

Flashing Heart	Coin Flipper
Name Tag	7 Seconds
Smiley Buttons	Hot Potato
Dice	Heads Guess!
Love Meter	Reaction Time
Micro Chat	Tug-Of-LED
Pet Hamster	Magic Button Trick
Countdown	Snap the Dot
Morse Chat	Salute!
Clap Lights	Karel the LED
Blow Away	Crashy Bird
Cat Napping	
Rock Paper Scissors	

Asynchronous

PRESENTATION AND RESOURCES

This curriculum combines curated, research-based resources with original lessons and activities. Synchronous science lessons are taught by the classroom teacher, while asynchronous computer science challenges are delivered through Canvas, giving students greater choice, autonomy, and flexibility. All lesson materials, resources, and supply lists are linked in the accompanying Google Sheets document, with implementation supported by RET funding.

Energy and Impact of Data Centers			
Lesson Slides	Lesson Topic	CS Standards	Materials
Lesson 1	How electricity is created	6.PS.3 – Explain that energy can be transferred through electrical systems. 6.PS.4 – Develop models to describe energy transformations. 6-8.CD.1 – Design projects combining hardware and software components. 6-8.DI.4 – Use diagrams and flowcharts to represent systems and processes.	NEED Lesson Slides
Lesson 2	Energy Resources; renewable vs nonrenewable	6.ESS.2 – Evaluate Earth's natural resources and their use. 6.ESS.3 – Analyze how humans depend upon and affect Earth's resources.6-8.DI.2 – Collect, organize, and analyze data using computational tools. 6-8.DI.4 – Create visual representations of data and decision-making.	Energy InfoBook
Lesson 3	How much energy does a data center use?	6.PS.3 – Energy transfer. 6.ESS.3 – Human impacts on Earth's systems through resource use. 6-8.CD.1 – Understand hardware systems that collect, process, and exchange data. 6-8.CD.3 – Explain interactions among computing devices, networks, and systems. 6-8.DI.2 – Analyze real-world energy data.	Drive File Lesson and Materials
Lesson 4	Environmental impacts	6.ESS.3 – Evaluate environmental impacts of human activities and resource use. 6.ETS.1 – Evaluate competing design solutions based on constraints and impacts. 6-8.IC.1 – Evaluate the impacts of computing on society and the environment. 6-8.DI.2 – Analyze environmental data.	AI Environmental Impact
Lesson 5	Final Assessment	6.ETS.1–6.ETS.4 – Engineering Design Process: Define problems, evaluate solutions, optimize designs using evidence.6-8.DI.1 – Decompose a complex problem. 6-8.DI.4 – Create diagrams and models. 6-8.CD.1 – Design a computing system. 6-8.IC.1 – Explain societal and environmental impacts of computing.	Energy is Everything

C8 Bootcamp		
Lesson 1	What is a computer?	Inputs/outputs
Lesson 2	Variables	Variables
Lesson 3	Conditionals	If/Then; Rules
Lesson 4	Iteration	Looping
Lesson 5	Mini Project	Final Assessment
Microbit Challenges		
Student Instructions	What Students Learn	Primary Indiana C8 Standards*
Flashing Heart	Create a simple LED animation, download code to the micro:bit, understand sequencing and timing.	Algorithms & Programming (sequencing), Program Development, Testing
Name Tag	Display scrolling text, edit strings, transfer code to the micro:bit.	Input/Output, Algorithms & Programming, Program Development
Smiley Buttons	Use buttons as inputs to display different LED images. Introduces events and user interaction.	Input/Output, Events, Selection (Conditionals)
Dice	Use the accelerometer to detect shaking and generate random numbers.	Sensors, Randomization, Variables, Events
Love Meter	Combine button inputs with random values to calculate a score.	Variables, Randomization, Selection
Micro Chat	Send messages wirelessly between two micro:bits using radio communication.	Networks & Communication, Data Transmission
Pet Hamster	Use sensors and variables to keep a virtual pet "alive."	Sensors, Variables, Conditionals
Countdown	Build a digital countdown timer using loops and variables.	Variables, Iteration (Loops), Algorithms
Morse Chat	Encode and send messages using radio communication.	Networks, Data Representation, Communication
Clap Lights	Use the microphone to trigger LED responses.	Sensors, Events, Conditionals
Blow Away	Detect blowing into the microphone and trigger actions.	Sensors, Input, Events
Cat Napping	Combine multiple sensors to create a responsive program.	Sensors, Variables, Selection, Program Design
Rock Paper Scissors	Create a simple game using randomization and the accelerometer.	Events, Randomization, Algorithms
Coin Flipper	Simulate a coin flip using randomness.	Randomization, Algorithms
7 Seconds	Build a timing game that challenges reaction and precision.	Variables, Timers, Algorithms
Hot Potato	Multiplayer game using radio communication and timers.	Networks, Events, Variables
Heads Guess!	Build a guessing game using user input and conditional logic.	Selection, Variables, Input
Reaction Time	Measure how quickly a user responds to a visual cue.	Variables, Timers, Input, Data Collection
Tug-Of-LED	Multiplayer game requiring button inputs and communication.	Events, Input, Collaboration, Radio
Magic Button Trick	Build a simple interactive magic trick using hidden logic.	Variables, Selection, Algorithms
Snipe the Dot	Fast-paced reaction game using LEDs and buttons.	Events, Timing, Input, Variables
Salute!	Multiplayer reaction game using communication between devices.	Networks, Events, Variables
Karel the LED	Program a character to navigate a grid, introducing algorithmic thinking.	Sequencing, Algorithms, Debugging
Crashy Bird	Build a simple side-scrolling game using variables, collision detection, and events.	Variables, Events, Iteration, Program Design



RET CONNECTION

This module leverages knowledge and resources gained through the University of Notre Dame Computing RET program. Students will explore concepts introduced during the summer research experience, including computational thinking, large language models, data center infrastructure, energy consumption, human-computer interaction, and the societal and ethical implications of emerging technologies.



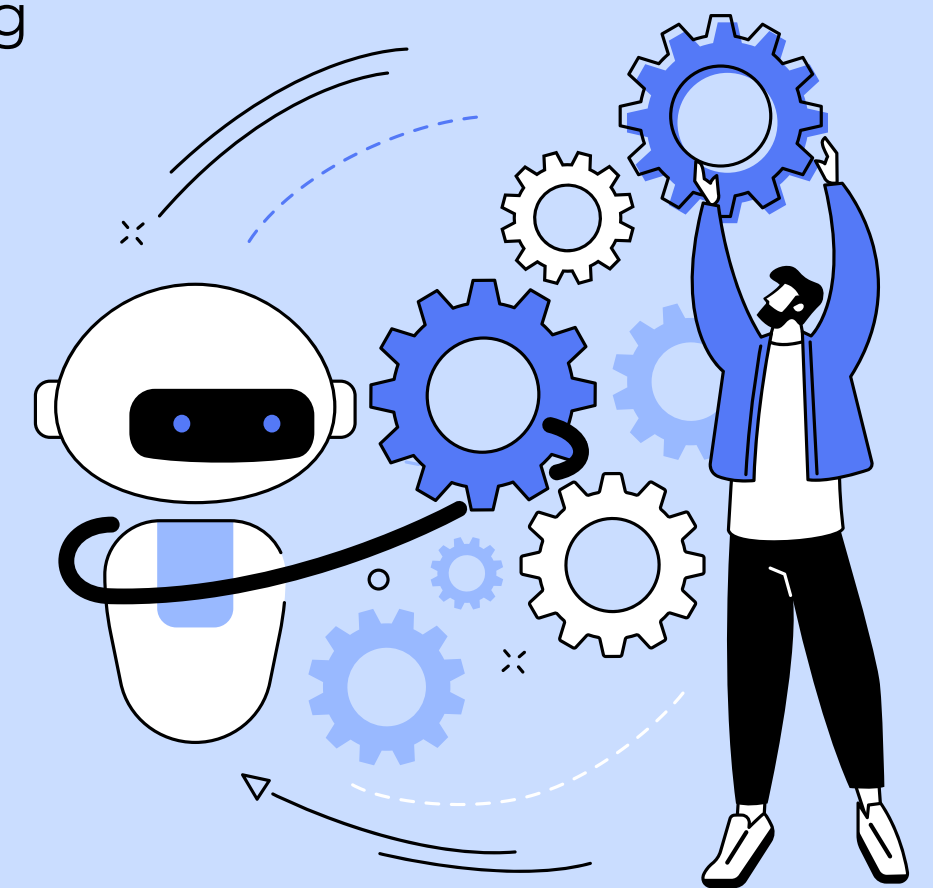
As an extension of the module, students will complete computer science coding challenges during STEM Fridays. Using micro:bits, students will complete self-paced programming challenges that reinforce foundational computer science concepts introduced through the RET experience, including inputs and outputs, variables, conditionals, algorithms, sensors, and communication between computing devices. These hands-on challenges provide opportunities for students to apply computational thinking while strengthening problem-solving, engineering design, and programming skills in authentic contexts.



REAL WORLD CONTEXT

In recent years, northern Indiana has become the home for several new multi-billion dollar data centers, including an Amazon-run Anthropic center in New Carlisle and a Google site in Fort Wayne. Recently, Microsoft broke ground on a new data center in Granger, marking the second such center in St. Joseph county alone. Hundreds of acres and local resources are being used to support these campuses that are powering artificial intelligence programs and cloud computing systems for these private companies. Demand for these services has skyrocketed - OpenAI stated in March that ChatGPT had 900 million weekly users- and the value of generative AI tools in the United States was estimated at \$172 billion at the beginning of this year.

These facilities require massive amounts of energy to operate and have a large environmental impact. To process the computing demands placed on them, data centers require profound amounts of electricity and water. Millions of servers running around the clock generate high thermal energy, requiring sophisticated cooling systems that can consume millions of gallons of water daily and heavily strain the local electrical grids. The addition of new data centers in the students' own community offers students a real-world case study right in their own backyard of how modern human technology directly impacts local and global ecosystems.



OUR RESEARCH

As part of the Notre Dame RET program, our research team investigated the reliability and limitations of AI facial recognition systems. We compiled and analyzed documented cases of wrongful arrests associated with facial recognition technology, identifying contributing factors and patterns across cases. We also explored facial recognition performance with identical and mirror twins by researching publicly available twin datasets and characteristics that may influence algorithm accuracy. This work deepened our understanding of the technical, ethical, and societal implications of artificial intelligence and informed the development of classroom lessons on AI, data, and responsible computing.





**THANK YOU FOR
LISTENING!**