A KIBO Rover – 1 hour

For more lessons like this, visit www.kinderlabrobotics.com/ai

Overview: *Students will create a rover robot that uses its sensors and programming to explore a new environment and operate independently. KIBO will illustrate the "sense – think – act" cycle that is fundamental to both robotics and AI.*

Learning Goals: Students will:

- Understand that AI and robot behavior can be understood as "sense – think – act."
- Be able to create a program for KIBO that uses sensor data to act independently.
- Understand that robots and AI's ability to operate independently is limited by their sensors and programming.

Materials/Resources:

- One KIBO 18 kit or higher per 2-4 students
- **Optional**: A variety of craft and recycled materials for building and decorating.

New to KIBO? Watch the Videos!
If this is your first time using KIBO, we encourage you to check out our short tutorial videos at **kinderlabrobotics.com/getting-started**.

Lesson Plan

Inspire: Sense – Think – Act

"Today we will create KIBO Rovers to explore a new environment. We'll use what we know about KIBO's **sensors** and **programming** to make KIBO operate on its own."

"Rovers and explorers are real-world robots that sometimes have to operate far away from people, so they need to be able to act on their own." Ask students to share ideas for places that would be interesting to explore but difficult for humans to go to. This could include other planets like Mars or Venus, difficult to reach places like dark caves, or environments like the deep sea where humans can't survive. What about these places make robots more suited for exploration?

"Sometimes scientists can remote-control these explorer machines, like they were driving a car. But other times they use artificial intelligence to let these explorer robots make

decisions themselves about what to do next. Robots can use their sensors and their programs to decide what to do. We call this the '**sense – think – act**' cycle."

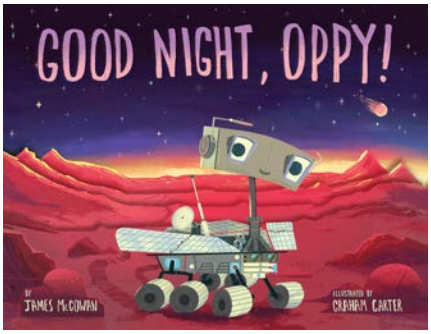
Talk to the students about each of these steps:

- **Sense**: robots use their sensors to gather information. Ask the students to recall examples of KIBO's sensors and what they can detect.
- **Think**: robots use their programs to make decisions based on what their sensors tell them. Ask the students to recall examples of KIBO's conditional programming blocks (WAIT FOR CLAP, IF/END-IF) and how they represent decision-making.
- **Act**: robots act (such as by moving) based on their decision. The actions they can take are also determined by their program.

With a KIBO equipped with the **sound sensor** (ear), demonstrate this program:

Discuss with the students how KIBO's sensors and program illustrate each element of **sense – think – act**. Ask students to share ideas for more complicated programs that use this cycle. We will explore their ideas in the group activity.

Connect: Read *Good Night, Oppy!*



Read *Good Night, Oppy!* by James McGowan and Graham Carter[1]. This book follows the NASA Opportunity rover on its mission to Mars. Several AI and robotics related themes are included, such as what sensors Opportunity used to explore its environment and how the Earth team communicated with the rover across long distances. For older students, the book includes optional side passages with additional material about space exploration.

Afterward, reflect with the students on the way the author represented the communication between Opportunity and the NASA team on Earth. What decisions was Opportunity making using the sense – think – act cycle?

[1] If you don't have access to the book, a teacher-created read-aloud video is linked from KinderLab's curriculum website at kinderlabrobotics.com/curriculum.

Engage: Exploring a Distant World

"Now it's time to create our own robotic rovers!" Each group will design a KIBO program to explore an environment using the sense – think – act structure. Allow students to design their own programs including the following elements:

- Wheels and motors to allow KIBO to explore the environment;
- At least one sensor;
- Conditional program elements such as REPEAT: UNTIL…, IF/END-IF or WAIT FOR CLAP driven by the sensor;
- An action to take based on the sensor input.

Here are examples of programs the students might create, drawing on prior work they've done with sensor programming. Share these examples if students need guidance:

KIBO will travel forward once, then check if the environment is dark. If so, it will turn on its light to make the environment safer for human explorers later.

KIBO will keep rolling forward, checking to see if an obstacle is near. When it reaches an obstacle, it will beep to let the scientists know it found something!

Tip: Optionally, students can use the IF NOT block from the Advanced Coding Extension Set to create more sophisticated "think" behavior.

Students can use art and craft materials to decorate their rovers. What features might be useful in navigating the environment they're exploring: fins and tanks for an undersea robot, or big wheels and solar panels for a Mars explorer? Let the students be inspired by their imaginations when decorating their KIBO rovers!

Reflect: Advantages and Disadvantages of AI Explorers

Allow each group to demonstrate their rover robot. They should explain how their robot engages in the sense – think – act cycle. They should also describe the environment their robot is exploring, and how the independent action of the AI program allows the robot to perform its task.

Discuss with the students: Compared to humans exploring dangerous or challenging environments, what are the advantages of AI-driven robotic explorers? What are the problems or limitations? What if a robot encountered something completely unexpected?

AI4K12 Guidelines

KinderLab's AI activities were developed in alignment with the Artificial Intelligence for K–12 initiative's (AI4K12) curriculum guidelines. These guidelines are a collaboration between AAAI and CSTA. The complete AI4K12 guidelines, sample activities, readings, and other resources are at ai4k12.org. This KIBO Rover activity addresses the following AI4K12 guidelines:

- 1-A: Sensing
- 1-B: Processing
- 2-C: Reasoning