



Year-Round Training Guide

MODULE 8:

Science Inquiry and Programming Robots

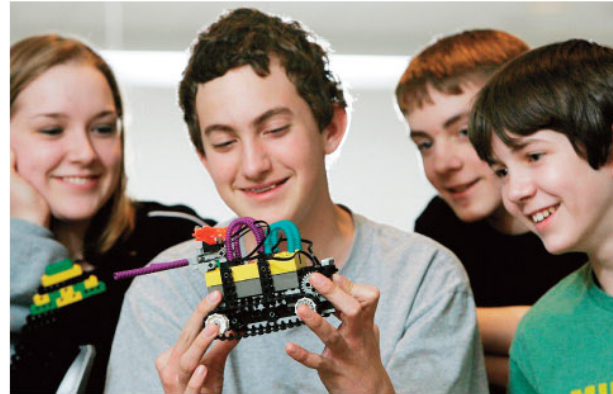




MODULE 8: **Science Inquiry and
Programming Robots**



**4-H Robotics:
Engineering
for Today
and Tomorrow**





4-H Robotics Curriculum

4-H Robotics Introduces Youth to:



- Basic physical science concepts related to robotic systems
- The Scientific Inquiry Process
- The Engineering Design Process
- Technology tools for learning and communications
- An exploration of SET careers



4-H Robotics Curriculum

- **Virtual Robotics:** Youth utilize an interactive computer game environment to learn about the science and engineering of robots.
- **Junk Drawer Robotics:** Youth make use of everyday objects to design, build and learn about robots.
- **Robotics Platforms:** Youth employ robotics kits to understand robotics and programming and develop their own robot designs.





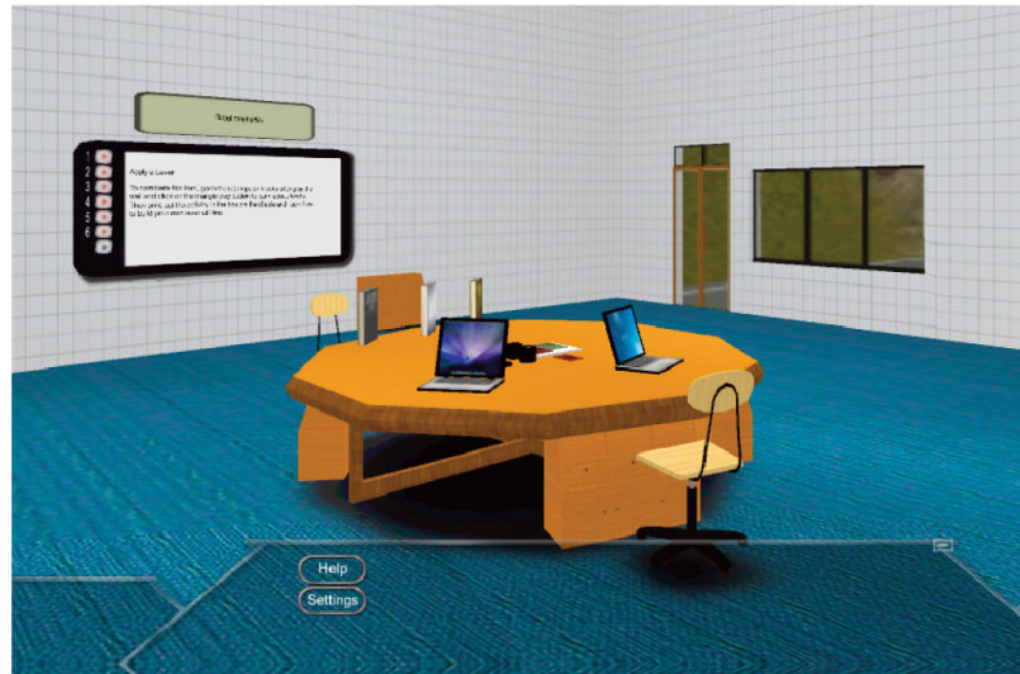
Track 1:

Virtual Robotics

Youth build skills and knowledge about robotics as they play an interactive computer game.

The learning experience includes videos, simulations, and animations—all in an interactive virtual robotics lab.

Curriculum is delivered on a DVD.





Track 2:

Junk Drawer Robotics

Youth design, construct and test robots that lift, move or float.

Each level focuses on one aspect of robotics and the science, engineering and technology behind it.

Designed to be a teen-led program.

Curriculum includes three printed presenter's guides and a youth Robotics Notebook.





Track 3:

Robotics Platforms

Youth apply the engineering processes of designing, building and programming robots.

Youth build skills and knowledge and apply what they have learned to a challenge activity.

Curriculum is delivered on a DVD.

Makes use of a commercial robotic kit such as LEGO® MINDSTORMS®, VEX®, TETRIX® or CEENBoT™.





MODULE 8: Science Inquiry and Programming Robots



NXT Robots

LEGO® Robotics Kits



**RCX (1998)
Brick**



**NXT (2006)
Kit**



**EV3 (2013)
Kit**



MODULE 8: Science Inquiry and Programming Robots



Robotics Platforms





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Robotics Platforms

Module 6, Page 2

The screenshot shows the 4-H Robotics Curriculum website. On the left is a navigation menu with a 4-H logo at the top. The menu is organized into three levels: Level 1 (Modules 1-5), Level 2 (Modules 6-10), and Level 3 (Module 11). Module 6 is currently selected. The main content area is titled 'ROBOTICS PLATFORMS MODULE 6' and has four page tabs: PAGE 1, PAGE 2 (active), PAGE 3, and PAGE 4. The active page is 'Exploring Robotic Sensors', which is marked as 'INFORMATION'. The text on this page explains that robotic sensors gather information about their surroundings and can be used to make decisions. It asks the user to think about what a robot should detect and what it should do with that information. Below this is a section titled 'Exploring The Ultrasonic Sensor', marked as a 'BUILDING ACTIVITY'. It explains that an ultrasonic sensor measures distance and provides a list of four steps for an activity: 1. Watch a video 'How to See Sensor Values.' 2. Connect the sensor to a microprocessor. 3. Turn on the microprocessor and view the output. 4. Rotate the sensor to detect different locations. A video player is shown at the bottom of the page.

4-H Robotics Curriculum

- Level 1
 - Module 1
 - Module 2
 - Module 3
 - Module 4
 - Module 5
- Level 2
 - ▶ **Module 6**
 - Module 7
 - Module 8
 - Module 9
 - Module 10
- Level 3
 - Module 11

ROBOTICS PLATFORMS
MODULE 6

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Exploring Robotic Sensors

INFORMATION

Robotic sensors gather information about their surroundings. In robotics, anything that can be detected can potentially be used as information for the robot. That sensor information can then be used to make decisions. What kinds of things can you imagine you would like a robot to detect? What would you have your robot do with that information?

How do the sensors in your kit work? To use sensors on your robot effectively, you need to know at least three things (1) What it is sensing, (2) What type of information the sensor provides (including the scale and range of values), and (3) Its sensitivity to the stimulus (Where it senses, line of sight, and zone of detection). As you learn to use the sensors, you will also want to know what types of things interfere with the sensor or could cause faulty information.

Exploring The Ultrasonic Sensor

BUILDING ACTIVITY

The ultrasonic sensor, if you haven't already guessed it, measures distance. Let's play around with it to see just how well it works.

1. Watch the short video, "How to See Sensor Values."
2. Connect the ultrasonic sensor to the microprocessor as shown in the video.
3. Turn on the microprocessor and view sensor's output.
4. Rotate the sensor around without moving it forward or backward so that it detects different locations and watch how the numbers change.

Video: How to see sensor values



Robotics Platforms

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ROBOTICS PLATFORMS
MODULE 6

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4-H Robotics Curriculum

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Discover The Sensor's Zone Of Detection PROGRAMMING ACTIVITY

Set the microprocessor with the attached ultrasonic sensor on the edge of a table or chair so that it is pointing toward a wall about a meter away and with no obstructions in its path. The ultrasonic sensor should give a stable reading of about 80 to 100 cm.

1. From a distance of about 20 centimeters to the side of the sensor move the flat object out perpendicularly to the baseline while watching the sensor readings. Locate the point at which the sensor first detects the object.
2. Take note of the sensor readings when your object is at the edge of detection. Does the reading fluctuate? Even if you hold the object as motionless as possible, you may find that the sensor bounces between readings. There may not be a clean edge of detection. Measure and record the distance from the baseline to the point where the sensor first detects the object.

Measure the distance you go before sensor sees you

Detection Zone

Detection Border

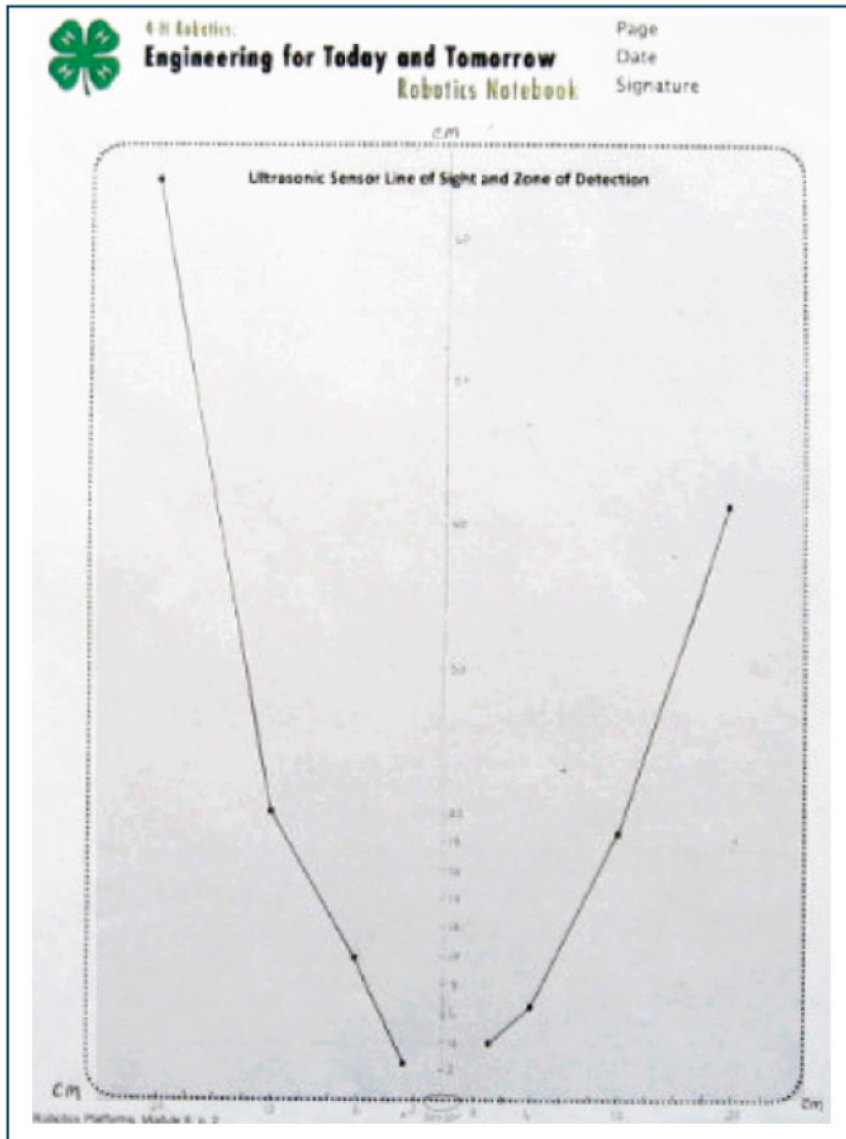
Baseline

Ultrasonic Sensor

Zone of Detection Example



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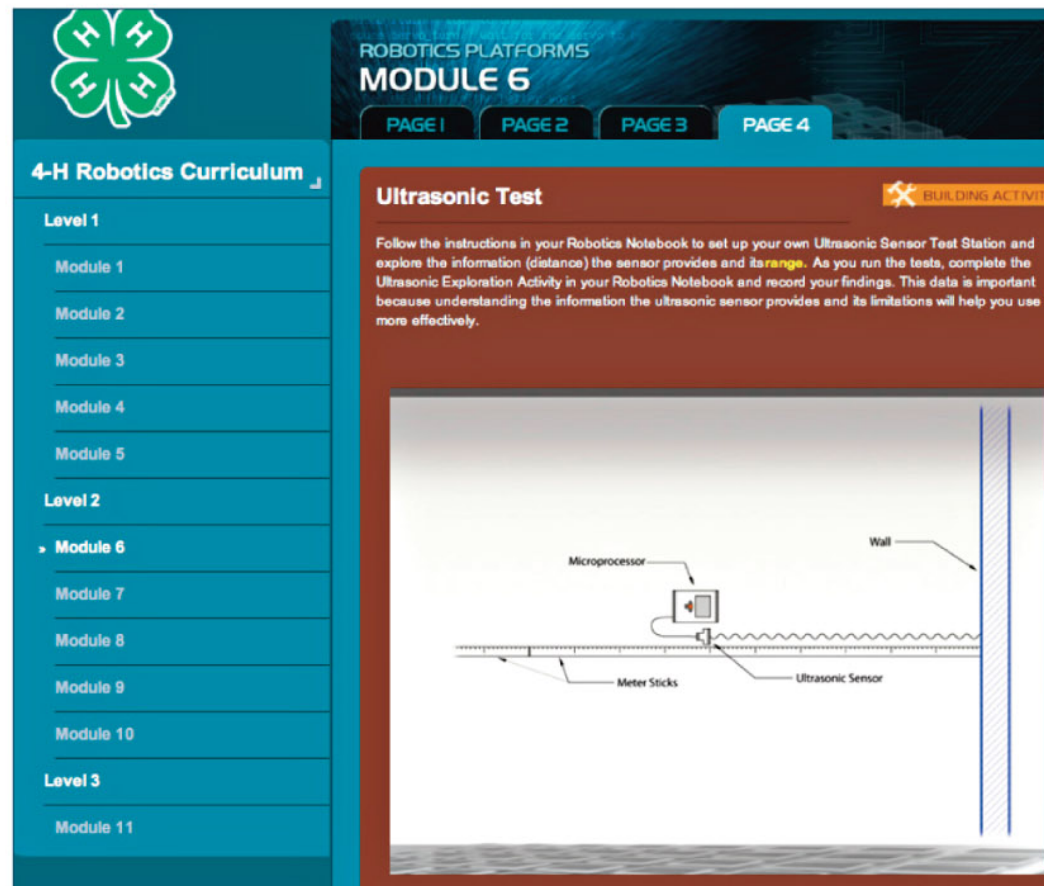
Zone of Detection

Sample Sketch



Robotics Platforms

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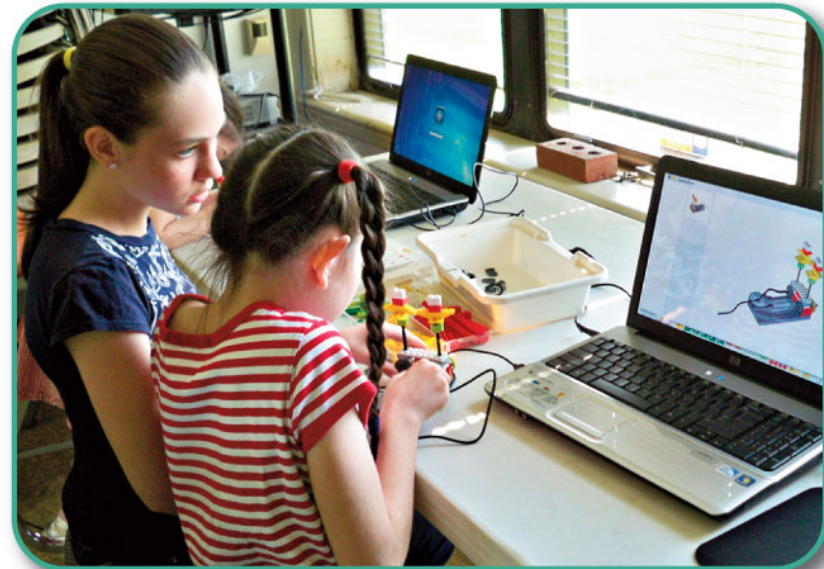


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Inquiry Is

- Asking my own questions and finding answers
- Designing and doing my own investigation
- Using my data to answer my questions
- Sharing my answers with others





Inquiry Does

- Develop self-directed learners
- Support and develop curiosity about the world
- Lead youth to deeper understanding of the world by following their own path





Approaches to Inquiry

Structured Inquiry



- Youth use set procedures to investigate the hands-on problem they are given.
- Youth discover relationships between variables and generalize from the data they collect.
- Youth have the opportunity to share their conclusions and apply what they have learned.



Approaches to Inquiry

Guided Inquiry

- Youth determine their own procedures to investigate the hands-on problem they are given.

Open Inquiry

- Youth ask their own question and determine the problem and procedures for their investigation.





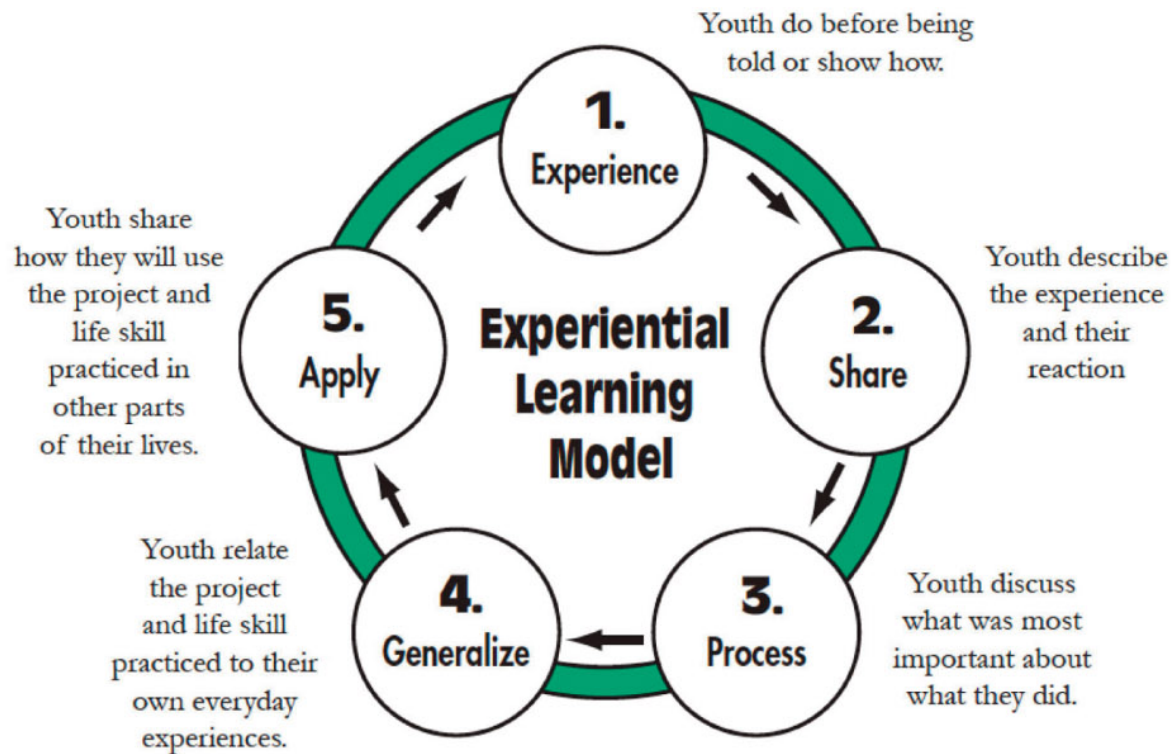
Program a Robot

Your challenge is

to use the ultrasonic sensor and program your robot to move up to an object and stop as close as you can without knocking it over or running into it.



Experiential Learning Model



Pfeiffer, J. W., & Jones, J. E., *Reference Guide to Handbooks and Annuals* 1983, John Wiley & Sons, Inc. Reprinted with permission from John Wiley and Sons, Inc.



Asking Good Questions



- Select six good questions.
- Identify where each question fits in the Experiential Learning Model.
- Decide if you need additional questions to cover all components of the model.
- Write additional questions if needed.



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Progressive Challenges

Progressive Challenges are a tool you can use as a leader to keep a diverse group engaged.





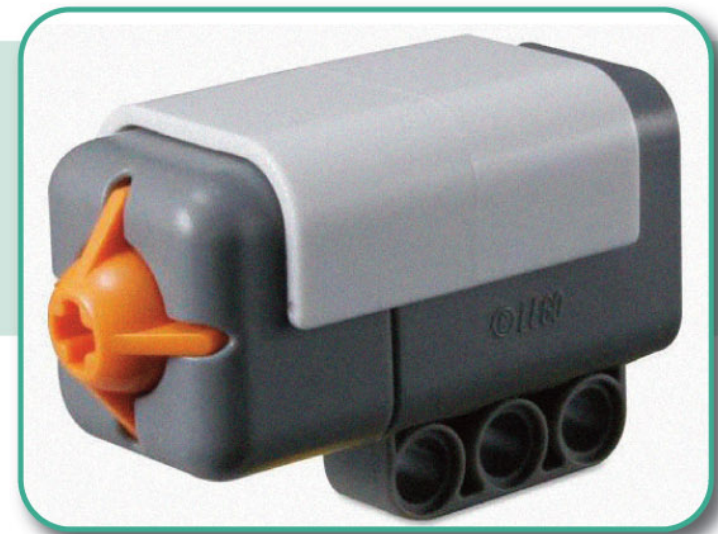
Progressive Challenges

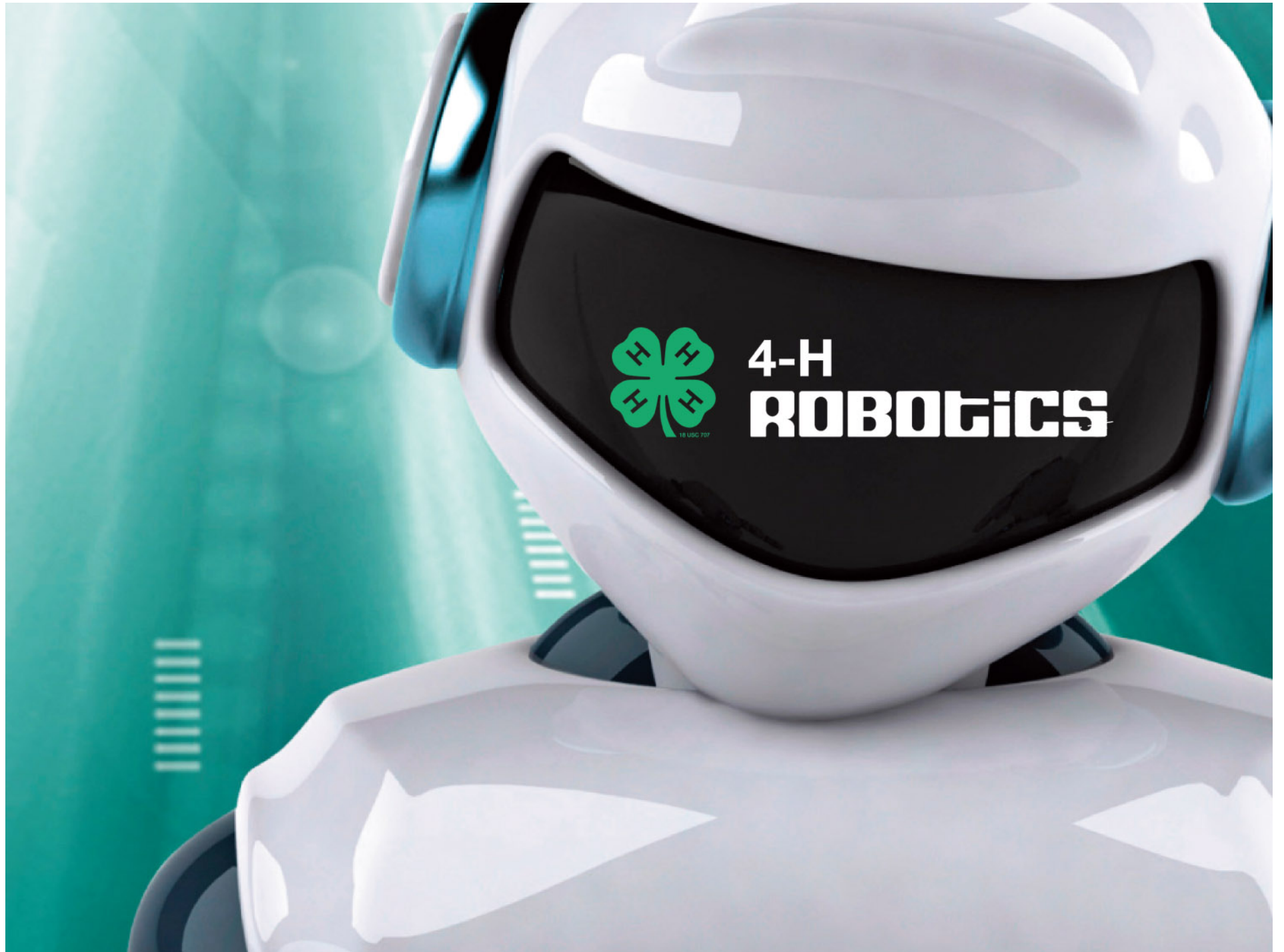
- Decide how much time to allocate.
- Create a list of challenges that build on one another.
- As a group completes a challenge, give them another challenge.
- The goal is to keep everyone engaged for the time allocated. At the end of the time each group should feel successful.



Closing and Questions

- Developed personal knowledge to draw upon when leading *Robotics Platforms*
- Utilized the sensors in the LEGO® MINDSTORMS® Kit to build and program a robot
- Developed and evaluated questions that enhance positive youth development using the Experiential Learning Model and Science Inquiry





4-H
ROBOTICS