Electronics Workshop Overview

Inspiring students to pursue careers in engineering, science, technology, and mathematics through robotics design…

The following workshop supports students as they acquire a foundation in electrical components and become familiar with the BEST IR Sensor Kit. The workshop is broken down into 6 sections. Section 5 and 6 are optional. They are similar in content but are dependent on attaching the IR System to a breadboard or the VEX Cortex Brain.

A secondary workshop goal is to support hubs in building at least one IR sensor system (transmitter & receiver) for each team that will participate in the hub. The workshop provides the forum for completing this effort while giving the students the education needed to complete additional kits they receive at kickoff.

Module	Goal	Materials Needed	Time
Module 1: Introduction to Electronics	To define the basic concepts of electricity.	• Electronics Fundamentals PowerPoint	
Module 2: How to Solder	To solder thru-hole components. Practice soldering using the provided discrete components and protoboards.	• Comic Book "How To Solder" Document (PDF) https://mightyohm.com/blog/2011/04/soldering-is-easy-comic-book/ • Comic Book Companion Guide • Blank thru-hole Prototyping Boards • Grab bag of resistors or other spare components • Soldering iron, 30-40 watts or temperature controlled. The tip should be no larger than 1/8" diameter, with a chisel or conical tip. • Damp sponge or another tip cleaner • Soldering Materials: Using solder with a small diameter (less than 0.030") is recommended. • Small wire cutters • Something to hold the small PC board while you solder. (ex. "bulldog clip or binder clip").	

Module	Goal	Materials Needed	Time
Module 3: BEST IR Sensor Theory of Operation	To analyze the schematic of the BEST IR (InfraRed) Sensor System and explain how the circuit operates.	• IR Sensor Operation Presentation Power Point • BEST IR Sensor Theory of Operation Document (For advanced users)	
Module 4: Assembling the BEST IR Circuit Boards	To solder the components onto the printed circuit boards (PCBs) for the BEST IR system.	• BEST IR System Assembly Instructions Document • Best IR Sensor Kit • Soldering iron, 30-40 watts or temperature controlled. The tip should be no larger than 1/8" diameter, with a chisel or conical tip. • Damp sponge or another tip cleaner • Soldering Materials: Using lead with a small diameter (less than 0.030"), is recommended. • Small wire cutters • Something to hold the small PC board while you solder. (ex. "bulldog clip or binder clip"). • Multimeter (optional)	
Module 5: Testing and Adjustment of the IR Sensor System	To power the IR Kit circuit boards, test for proper operation and adjust the sensitivity.	• Testing and Adjustment of IR Sensor System document • Assembled IR Sensor Circuit Boards • 5v Power Supply o Mini test hook probes (recommended) • 3-wire servo cables (2) • Solderless breadboard (optional) • Oscilloscope or frequency counter (optional)	
Module 6: Using the BEST IR Sensor System with VEX Cortex (**Optional**)	To attach the BEST IR Sensor System to a VEX Cortex microcontroller and demonstrate the multiple uses of the Sensor.	• Using the BEST IR Sensor System with VEX Cortex document • Two #4 screws (if mounting to a robot) • VEX Cortex Brain & battery • 3-wire servo cables (2) • 4-wire cable (optional: future UART option) • Oscilloscope or frequency counter (optional)	

Module	Goal	Materials Needed	Time
Module 7: Breadboard Test Setup (**Optional**)	To conduct simple sensitivity tests and test the BEST IR Sensor System operation using a simple breadboard test circuit.	• Breadboard Test Setup document • Assembled BEST IR Sensor Kit • 5V Power Supply o Mini test hook probes (recommended) • 3-wire cables (2) • Solderless breadboard, wires • Few electronic components (see document) • Oscilloscope or frequency counter (optional)	

Next Generation Science Standards (MS)	Next Generation Science Standards (HS)	Common Core (MS)	Common Core (HS)
MS-PS1-2	HS-PS1-3	RST.6-8.1	RST.9-10.7
MS-PS1-4	HS-PS2-6	RST.6-8.3	RST.11-12.1
MS-PS1-6	HS-PS1-2	RST.6-8.7	WHST.9-12.2
MS-PS2-3	HS-PS1-4	WHST.6-8.7	WHST.9-12.7
MS-PS2-4	HS-PS1-5	WHST.6-8	WHST.11-12.8
MS-PS2-5	HS-PS2-4	MP.2	WHST.9-12.9
MS-PS3-2	HS-PS2-5	MP.4	MP.2
MS-PS3-3	HS-PS1-4		MP.4
MS-PS3-4			HSN-Q.A.1
			HSN-Q.A.2

Cross Cutting Concepts (Next Generation Science)
Patterns - Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena
Energy and Matter - Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system
Stability and Change - Much of science deals with constructing explanations of how things change and how they remain stable
Scientific Knowledge Assumes an Order and Consistency in Natural Systems - Science assumes the universe is a vast single system in which basic laws are consistent
Cause and Effect - Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects
Systems and System Models - When investigating or describing a system, the boundaries and initial conditions of the system need to be defined