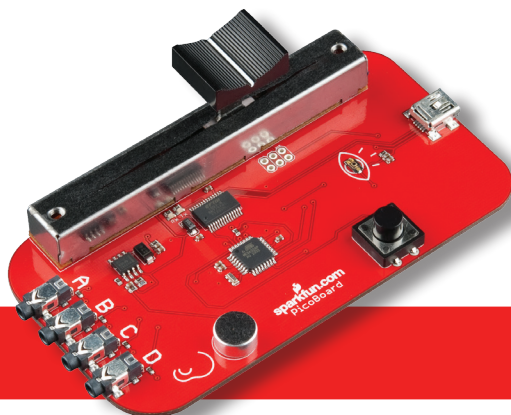


## PicoBoard Lab Pack



Thank you for your purchase of the Pico Board Lab Pack. The Labpack includes:

- 10 PicoBoards
- 10 Add-on Packs, which include:
  - Square Force Sensitive Resistor
  - Turn Potentiometer
  - Thermistor
  - Hobby Motor (Generator)
  - Red Arcade Button – Red
  - Green Arcade Button – Green
  - Toggle Switch
  - Reed Switch & Magnet
  - 6 Foot Mini-B USB Cable - 6 Foot

## What's on the PicoBoard?

Note: Currently, the PicoBoard is only compatible with Scratch 1.4.

The PicoBoard is an integrated sensor board that ties directly into the Scratch programming environment. Using Scratch and the PicoBoard, you can quickly build programs that interact with the outside world.

**Slider:** Changes values from 0 to 100 based on the position of the slider.

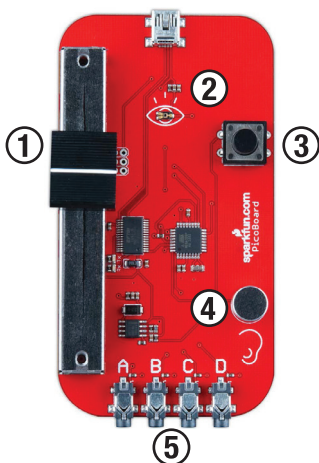
**Light Sensor:** Changes values from 0 to 100 based on the amount of light on this sensor.

**Button:** The position or state of the button controls the button pressed value (true or false).

**Sound Sensor:** Changes values from 0 to 100 based on the amount of sound it detects.

**Auxiliary Connections (A, B, C, & D) - Alligator Clips:** These are generic connections to any resistive sensor. As the resistance changes, so does the input value. This sensor can also be setup as a digital detector to detect whether the alligator clips are connected.

### INPUT DESCRIPTIONS



#### ① Slider

Change the values by sliding the knob back and forth.

#### ② Light Sensor

Measures the amount of light hitting the sensor.

#### ③ Button

A button is digital input. It can be either “on” or “off,” like a switch.

#### ④ Sound Sensor

Measures how loud something is - use this sensor to move your sprite based on sound!

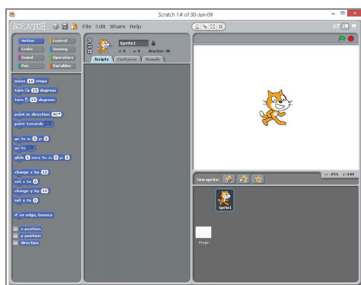
#### ⑤ Auxiliary Inputs (A, B, C, & D)

These inputs allow you to connect up to 4 advanced sensors.

# Getting Started

- **Download Scratch**

Currently, the PicoBoard is only supported on Scratch 1.4. You can download it for free from MIT at: [http://scratch.mit.edu/scratch\\_1.4//](http://scratch.mit.edu/scratch_1.4//)



- **Install the FTDI Driver**

The PicoBoard uses an FTDI chip to communicate over USB with your computer. You will need the standard FTDI driver for this to work. Visit our tutorial at: [www.sparkfun.com/ftdi](http://www.sparkfun.com/ftdi), and follow the directions for installing the driver for your operating system.

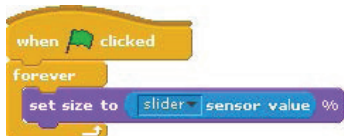
## A Simple Test

Here's a quick way to test your setup to make sure everything is working properly.

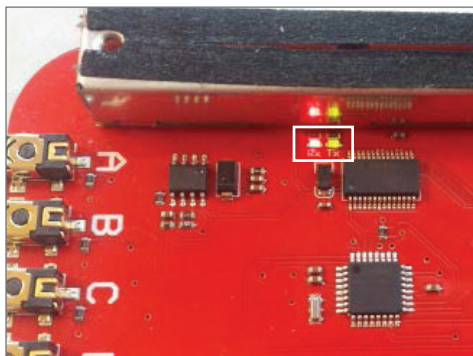
Using the USB cable, connect the PicoBoard to your computer, and open up Scratch. To test the functionality, let's play with the Scratch sprite's size feature using the **set size to 100 %** block. Find these blocks and string them together. Move the **slider sensor value** block into the set size block to replace the size by the sensor value.



Your blocks should look something like this:



Click the green flag or the "hat" block to start your program. In a few seconds, you should see the red / green lights on your PicoBoard start flashing. Move the slider back and forth and watch what happens!

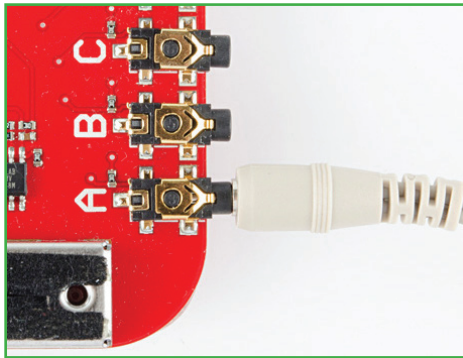


**The red / green lights indicate data is being received (RX) and transmitted (TX) between the PicoBoard and your computer.**

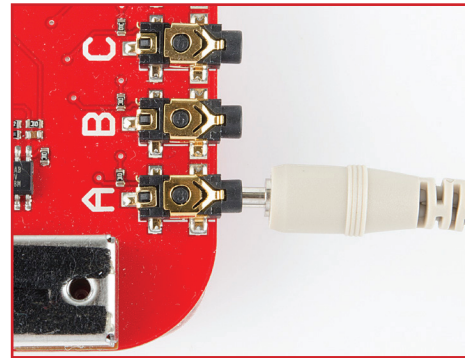
# How To Add The Advanced Sensors In Your Kit To Your Picoboard

The four additional ports (A-D) allow the PicoBoard to be connected to a number of other additional sensors. The PicoBoard measures the resistance across the two alligator clips. When plugging in the PicoBoard connectors, make sure that you push the connector all the way in.

- Plug an alligator clip into one of the PicoBoard end connectors. There are four end connectors. They are A, B, C, or D.



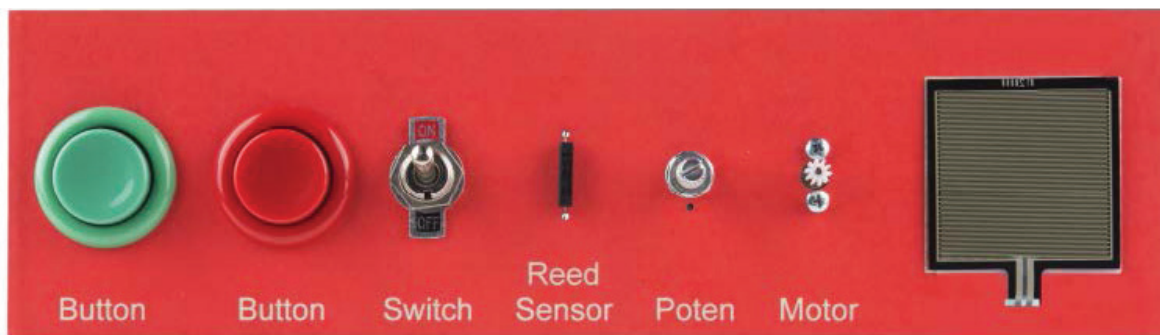
**CORRECT: Plugged in all the way**



**INCORRECT: Not plugged in all the way**

## Extra sensor add-ons:

The Lab Pack includes a number of extra sensors for you and your class to explore with. These sensors include:



## Button Assortment:

- 2 x Concave Arcade buttons
- 1 x Toggle Switch
- 1 Reed (Magnetic) Switch Sensor

Switches allow us to electrically connect or disconnect a path for electricity between two metal connections. The Reed switch works similarly, but is activated in the presence of a magnet.

**Turn / Rotary Potentiometer** - The 10K Potentiometer is effectively the same as the slider -- however, instead of moving the slider back and forth, you simply turn the knob on the potentiometer.

**Motor** - Traditionally, a motor is an output device, but when connected to the PicoBoard, you can use the motor as a generator. Spin the motor and see what happens to your input values.

**Force Sensitive Resistor** - Resistance changes as a force (pressure) is applied on the surface.

**Thermistor** - A thermistor is a special type of resistor whose resistance varies significantly with temperature. As the temperature increases, the resistance of a thermistor decreases.

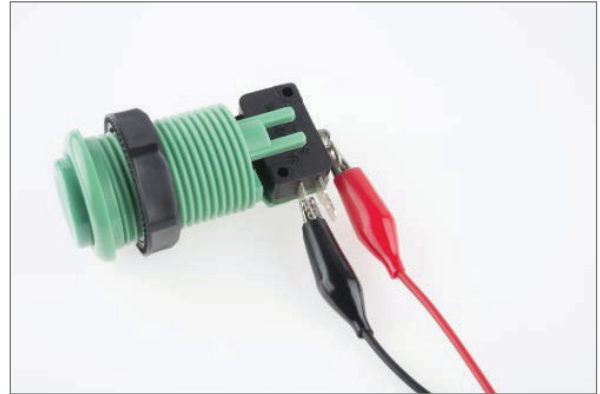
# Digital Sensors

These sensors are all just switches. A digital sensor is either open or closed. Sometimes we call this ON or OFF. With the PicoBoard, you will see input values of either 0 or 100. The add-on kit comes with four different switches.

①  
+  
②

**Red & Green Arcade Buttons** - The arcade button uses a limit switch that has three connection tabs. One connection tab is “normally open” (NO) and the other one is “normally closed” (NC).

Connect one alligator clip to the innermost tab, and connect the other alligator clip to the outermost tab.



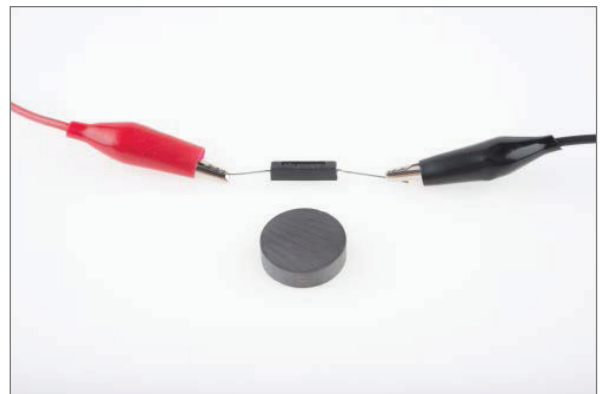
③

**Toggle Switch** - This is a standard ON / OFF switch. There are two tabs on the back of this sensor.



④

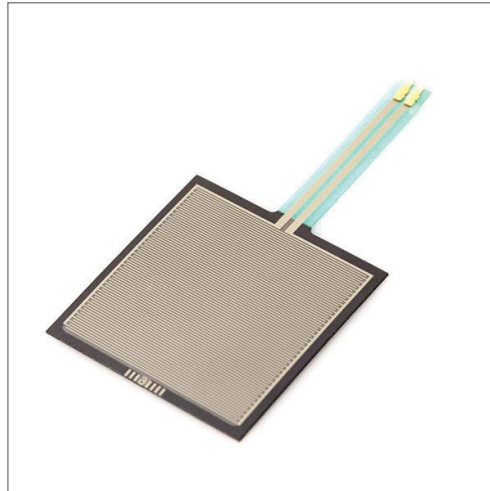
**Magnetic Reed Switch & Magnetic Disk** - A reed switch is activated or controlled by the presence of a magnet. Bringing a magnet close to this reed switch causes the switch to close. Reed switches are often used to detect the opening of doors and windows in burglar alarms, but can be used in any other applications where you want to detect a change in proximity. Simply connect the alligator clips to the two legs of the Reed switch.



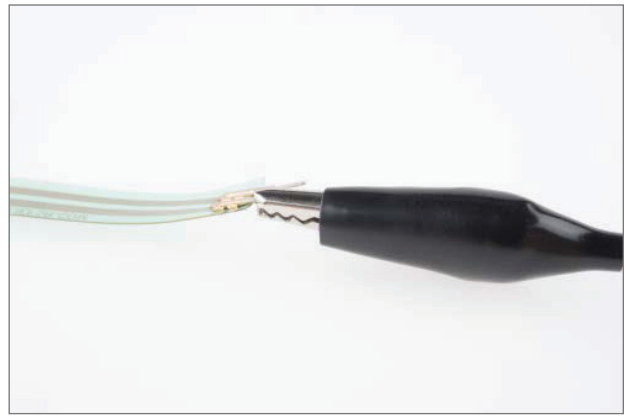
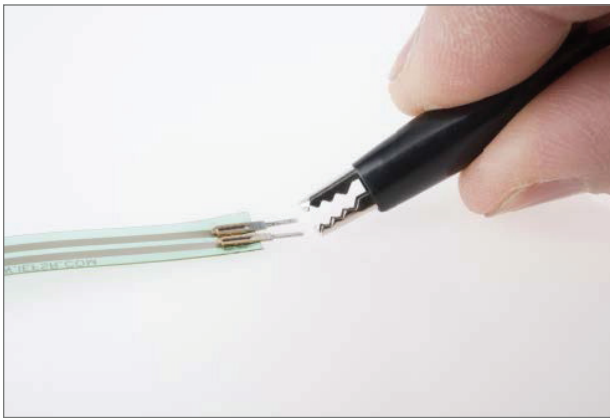
## Analog Sensors

These sensors will allow you to read in a value from 0 to 100 with the PicoBoard. The value read in is determined by the resistance between the two alligator clips. In the lab pack add-ons, we have included the following analog sensors:

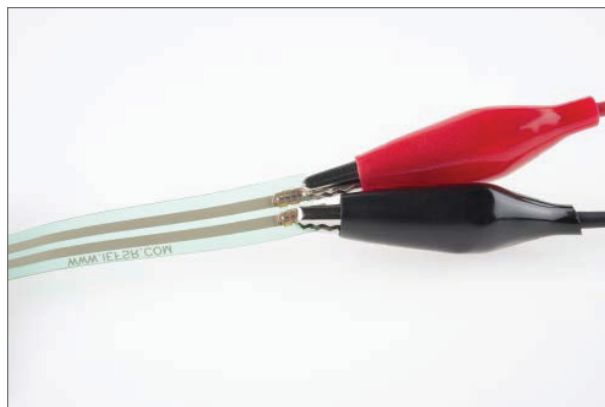
- ⑤ **Square Force Sensitive Resistor (FSR)** - A force sensitive resistor has a square sensing area that is approximately 1.75" x 1.75". The resistance will depend on how much pressure is being applied to the sensing area. The harder the force, the lower the resistance. When no pressure is being applied to the FSR, its resistance will be larger than  $1\text{M}\Omega$ .



Attach the alligator clip extensions (regular alligator clip wires) onto the two metal prongs on the end of the Force Sensitive Resistor.

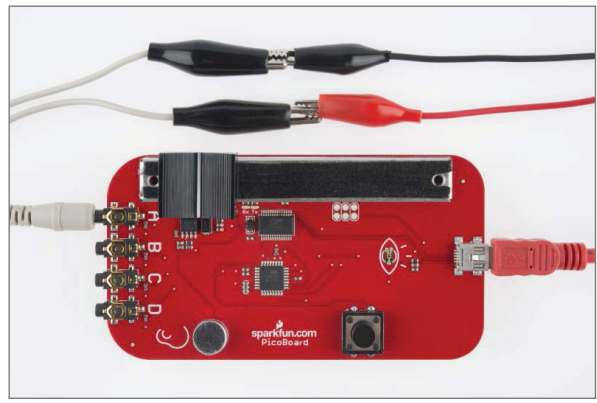
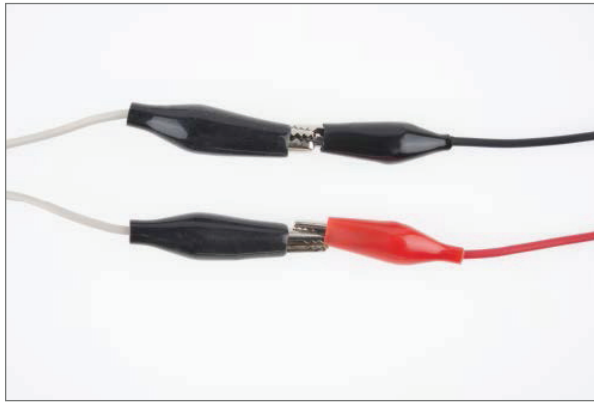


When clipping, make sure that the metal clips are fully seated and touching the metal part of the sensor. Make certain that they do not touch each other.





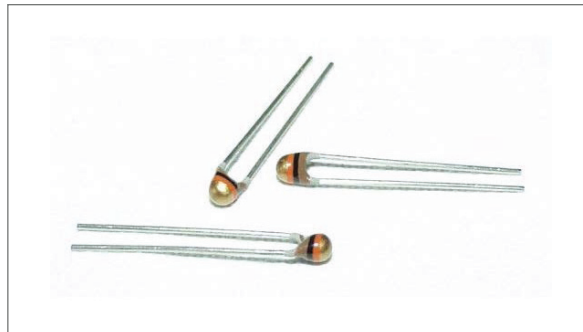
Connect the other end of the alligator clips to the 2.5mm audio / alligator clips so that you can connect this to the PicoBoard:



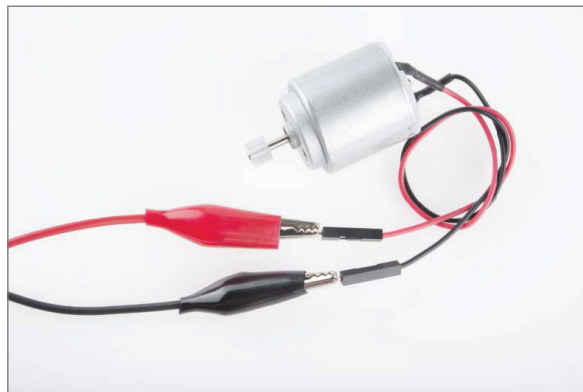
- ⑥ **Turn Potentiometer** - similar to the slider on the PicoBoard, but one that turns. Connect one alligator clip to the center connection point. Connect the other alligator clip to either of the two remaining connection points:



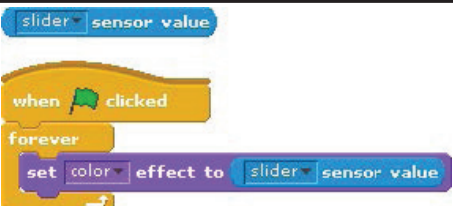
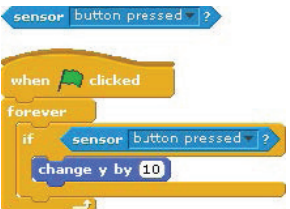
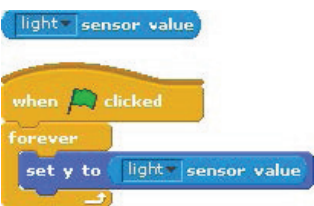
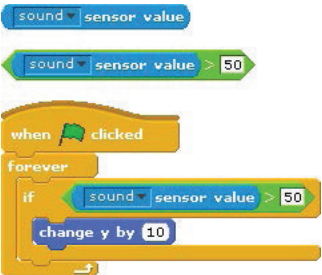
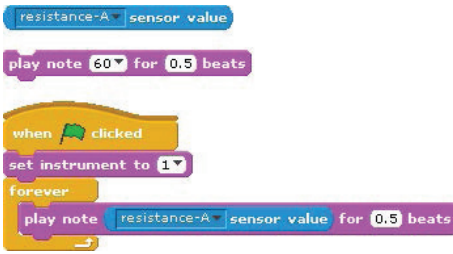
- ⑦ **Thermistor 10K (PTH)** - A thermistor is a device that changes resistance depending on the temperature. This one is nominally 10k Ohm at 25 degrees C and has a lower resistance the higher the temperature. This is called a Negative Thermal Coefficient (NTC) Thermistor.



- ⑧ **Hobby Motor** - A motor is technically not a sensor, but when connected to the PicoBoard, if we manually spin the motor, we can measure the voltage being generated with the PicoBoard. Give it a try. How high can you get?



## Quick Reference

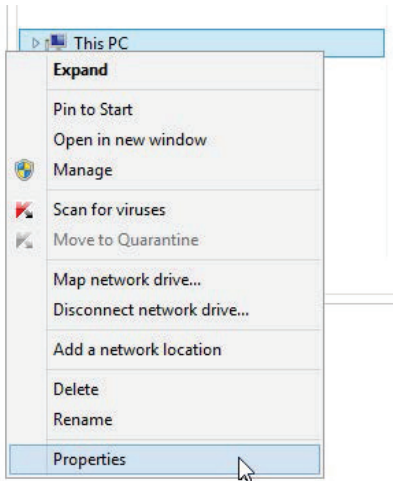
Sensor	Action	Scratch Blocks
Slider	You've already played around with this sensor. It is what engineers call a slide potentiometer. This sensor is also called a variable resistor. This sensor changes continuously on a scale from 0 to 100. Instead of changing Scratch's size, try using the "set [color] effect block - this is also under the Looks Palette.	
Button	The button can be in only one of two positions - either up or down. Notice that the shape of this sensor block is different? It's a logic / boolean block. Your sprite can be programmed to react when you push this button. Make your sprite jump or change colors. How might you change this so that the sprite jumps when the button is pressed?	
Light	<p>The light sensor has an "eye" icon next to it. Like the slider, this sensor value varies from 0 - 100 depending on the amount of light available.</p> <p>Just like with the slider, you can use this sensor block to replace any numeric value. For example, make your sprite react to light or shade using the data coming from this sensor, or use it as a "game controller" in a game like pong.</p>	
Sound	<p>Use this sensor to program your sprite to react when this sensor detects sound. This sensor also varies from 0 - 100. It picks up the vibrations in the air and converts it to an electrical signal.</p> <p>Can you make your sprite jump up in surprise if you yell into the sensor? Or, perhaps shrink in size if you simply whisper into the sensor.</p>	
A, B, C, D	<p>Free-for-all. There are four connections on the end of the PicoBoard. Connect just about any variety of sensors using the alligator clips. These inputs monitor the resistance between the alligator clips. Connect these things up to flex sensors, temp sensors, or just connect them up to pieces of aluminum foil to make your own switch!</p> <p>With this example code, be mindful of those around you - this can make a lot of noise -- Turn down your volume, and use headphones, if you have them.</p>	

# Troubleshooting

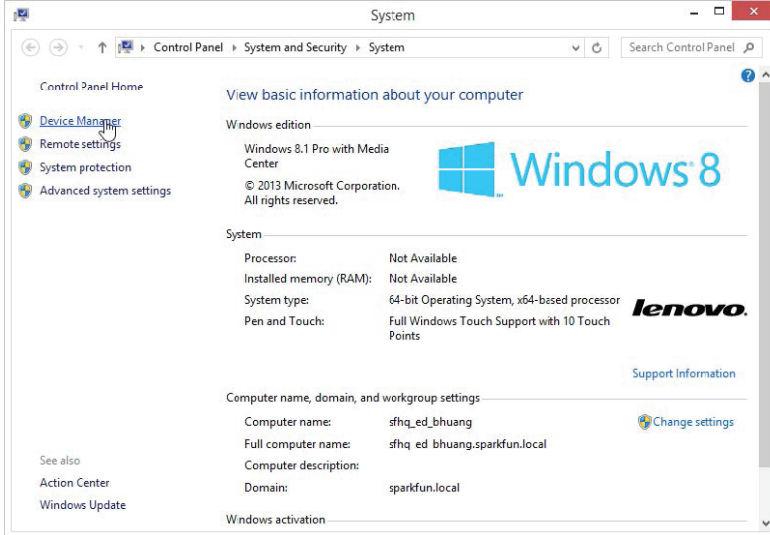
If you are not seeing the flashing red and green lights, the easiest solution is to restart Scratch. Scratch will usually find the PicoBoard automatically. On PCs, Scratch will only work for COM ports up to COM32. If you have connected several devices to your computer, you may need to release / uninstall the other devices so that the PicoBoard is enumerated with a COM port below COM32.

## Identifying your COM Port

In general, this process only applies to PC users. On a PC running Windows, right click on your “My Computer” and select Properties.

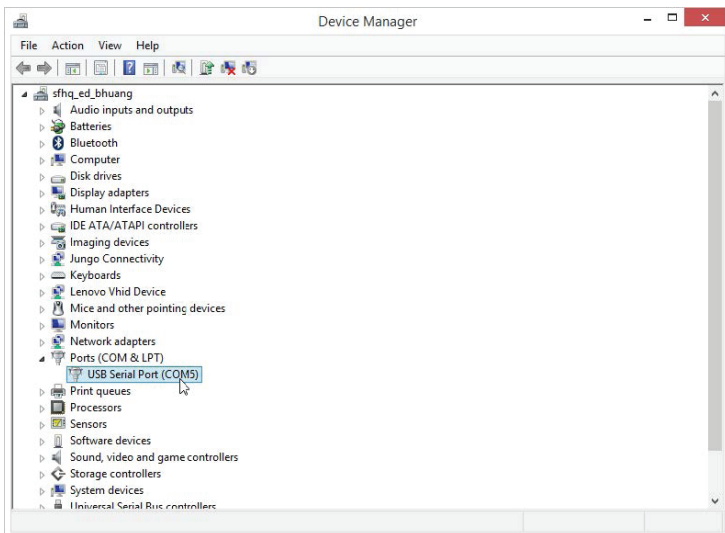


Open the **Device Manager**.





## Scroll down to **Ports (COM & LPT)**

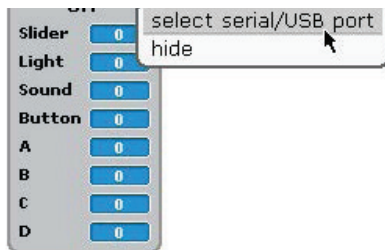


## Open the ScratchBoard Watcher

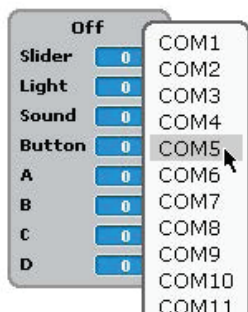
Right click on the **sensor value** reporter block and select “show ScratchBoard watcher.”



A ScratchBoard watcher dashboard will show up on the stage background. This dashboard will report back all the sensor readings from the PicoBoard. Right click on the dashboard and select “**select serial/USB port**”



Select the COM Port matching the number from the Device Manager.



Done! The PicoBoard should be connected and sending sensor data to your computer.

## Using a Mac?

This is your lucky day. On Macs, the process is much simpler. There should only be one Serial port available, and Scratch will automatically find the correct one. CommandClick on the Sensor value reporter block and click “show ScratchBoard watcher.” Scratch should automatically connect to the PicoBoard.