

# Introduction to Programming Vernier Sensors with Arduino<sup>®</sup> Microcontrollers

## Introduction

These free starter activities are designed to provide an introduction to coding as well a lesson in sensor technology using Vernier sensors and Arduino<sup>®</sup> microcontrollers. Students get excited when they see coding come to life through hands-on technology. Integrating Vernier sensor technology with Arduino shows students how the physical world connects to the computer-centric activity of learning to code.

Arduino has developed both its hardware and software as open source. The SparkFun RedBoard is equivalent (although not identical) to the Arduino Uno, and when using the Arduino software, it should be treated as an Uno.

These remote learning resources require that students have access to the following equipment:

- SparkFun<sup>®</sup> RedBoard (or equivalent) with USB cable and power supply
- Vernier Analog Protoboard Adapter or Vernier Interface Shield
- Vernier Gas Pressure Sensor<sup>1</sup>
- Computer or Chromebook<sup>™</sup> with Arduino software

This initial set of activities offers some of the material that we have posted on our Arduino web pages in a format that is easily distributed to students who have limited equipment. Once you and your students master these activities you will find a huge range of additional materials and project ideas at <https://www.vernier.com/engineering/arduino/>

## Activities

There are four activities in this series. Students begin with the basics of coding with an Arduino and quickly move to integrating our sensors into code.

- **Introduction to Arduino Programming:** Students learn how to connect Arduino to their computer or Chromebook and modify the Blink program. Success in this activity enhances student confidence in the activities that follow.
- **Using Vernier Sensors with Arduino:** Students are introduced to methods for connecting Vernier sensors to Arduino and observe the output from the sensor in the Serial Monitor.
- **Calibrating a Sensor:** Students learn how Vernier sensors convert electrical signals into sensor readings.

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<sup>1</sup> Refer to Using Other Sensors in the Tips and Other Resources section for additional information.

- **Displaying Data:** Students gain practical experience formatting output in the Serial Plotter and the Serial Monitor.

## Tips and Other Resources

### Software

Arduino microcontrollers can be programmed from several editors. The most common approach is to use a version of the Arduino IDE (Integrated Development Environment). The Arduino IDE is compatible with computers running Windows®, macOS®, and Linux. Go to <https://www.arduino.cc/en/Main/Software> and download the appropriate version.

The Arduino Web Editor is also available from this web page. It is hosted online and requires a user web account. If using a Chromebook, you will need to install a plug-in, which currently requires a monthly fee. The Web Editor has many of the same features as the downloadable version. The most notable difference is that it does not include a Serial Plotter.

### Specifying Boards and COM Ports

Here's a few helpful tips for connecting your Arduino to your computer or Chromebook. Your initial connection requires that you specify Arduino Uno as your board and to select the COM port the board uses. The board can be identified using a drop-down menu in both the software download and in the web editor.

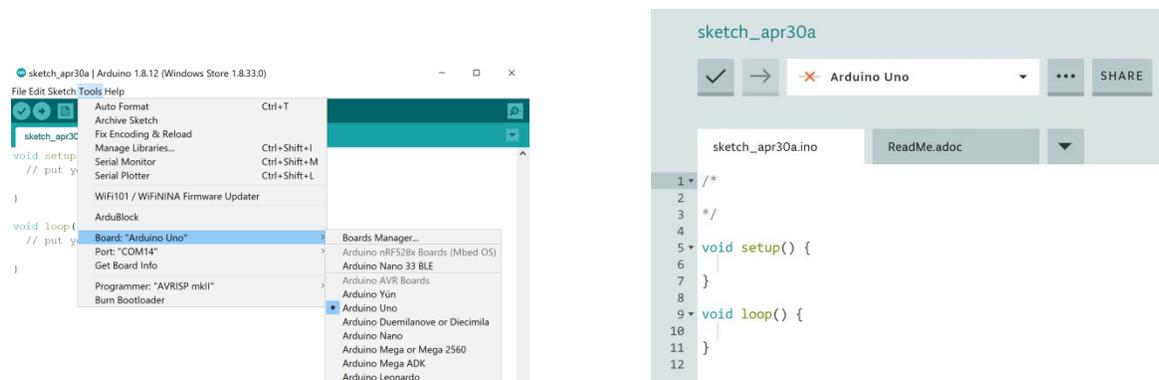


Figure 1 Selecting the appropriate Arduino board

The web editor automatically detects and selects the correct COM port, displaying it in the menu. However, in the software download, you will need to select the COM port number. There can be several COM ports identified, making it challenging to determine the correct port. It is helpful to disconnect the Arduino board from the computer and then reconnect it to determine its associated port.

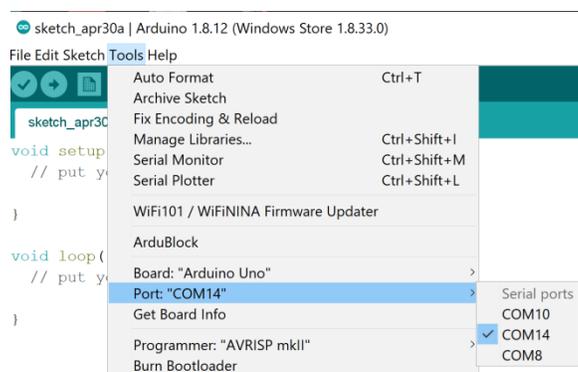


Figure 2 Identifying the COM port in the Arduino IDE software

## Using Other Sensors

These activities were developed for use with the Vernier Gas Pressure Sensor, but they can easily be modified to work with other Vernier analog sensors. Here are some points to be aware of:

- Vernier analog sensors are those with a “-BTA” at the end of the order code. Order codes are typically printed on the sensors. For example the Dual Range Force Sensor has an order code of “DFS-BTA”.
- Most analog sensors have a “negative slope” calibration curve. Our experience is that students can become more confused in this case when trying to apply data to determine the calibration equation. This is one reason that we chose the Gas Pressure Sensor for this set of activities.
- Most of our sensors have a linear relationship between voltage and the sensor reading. Of particular note, temperature probes have a non-linear relationship. In most cases, you can find the calibration equation in the sensor’s user manual on the Vernier website.

## Resources

The Arduino website has a wealth of useful information. There are reference materials and forums, among other resources available. Visit <https://www.arduino.cc/>