

# Introduction to Arduino™

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## *Course Syllabus*



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## TABLE OF CONTENTS

<b>Table of Contents</b> .....	<b>2</b>
<b>1. Introduction to Arduino</b> .....	<b>3</b>
1.1. Introduction .....	3
1.2. Materials .....	4
<b>2. SYLLABUS</b> .....	<b>4</b>
2.1. Resources .....	5
2.2.1 QUARTER 1.....	5

# 1. INTRODUCTION TO ARDUINO

## 1.1. INTRODUCTION

The intent of this syllabus is to provide a practical guide that educators can follow for sixth grade that is a quarter-long course introducing students to combining electronics and coding using Arduino Uno R3. This course provides exposure to writing programs (Sketch) that give instructions to the microcontroller on the Arduino board. Students will follow a design phase inclusive of flowcharts, coding in Sketch, and peer feedback. The culminating project involves students programming using Sketch so the Arduino board can receive an input such as motion detection and turn it into an output such as turning on a light. This Project Based Learning (PBL) project will provide students with the opportunity to work through the design phase using electronics and coding.

Differentiation will be addressed through pre-assessment and student need while working through the software program. Voice and choice will give students the option to choose the problem, criteria and constraints for the culminating project. While working through this course, higher-level students will design their own project using more complicated coding and additional hardware. This is scaffold so students begin with given sketches and directions, progress to writing own sketch, and then create new code and combination of hardware based on the final product.

Formative assessment monitors student learning using student samples of programs, reflections, flowcharts, observations, weekly check-ins, peer critique, and logbook entries. Summative assessments include quizzes and the culminating project. Quizzes cover terms and physical use of the software to show mastery.

Engineering logbooks provide a location for students to record information obtained during the course. The logbooks will provide a structure to record struggles, strengths, questions, sketches, ideas and general thoughts. Logbook entries will be assessed on a weekly or biweekly basis. A rubric will assess each section of the logbook entries for completeness and accuracy of information.

In order to allow students to progress at their own pace the classroom will need to have a visible question board. This tool provides a central location for the students to ask questions, get answers, obtain assignments and rubrics. This way the students can become more independent learners by checking the board, then a peer, and lastly the teacher. A collaborative culture is necessary for students to work and this process of using a class question board encourages collaboration. The board will also provide students with assignments to work at their own pace once they become acclimated to the Arduinos.

Students will have the opportunity to continue class discussions or ask classmates questions using an on-line discussion board. This can be accomplished using [classroom.google.com](https://classroom.google.com). The students can post questions or comments for peers to respond. This will provide an additional format for seeking out assistance from peers.

Students will practice a Growth Mindset using critique. The design process includes revision and feedback so students can learn from mistakes. Revisions and feedback will take place throughout the process and when students finish programming. It is important to designate time during the design process to give and receive feedback to ensure the work is strong.

## 1.2. MATERIALS

- Arduino Uno Rev3 Ultimate Starter Kit +LCD Module
- Lenovo Netbooks

## 2. SYLLABUS

The course provides an entry level experience with electronics and programming. Course concepts include problem solving techniques, program design, hardware identification, circuitry and coding. The course uses computer programming challenges from Vilros and Adafruit Industries. The purpose of the course is to integrate computer science with engineering.

This course is divided into three sections to introduce electronics and programming.

### Section 1:

- Hardware identification

### Section 2:

- Review of circuits

### Section 3:

- Introduction to Arduino Uno Rev3

The course ends with a student choice PBL project using the design process.

Goals of this course:

1. Introduce students to hardware and software .
2. Help students feel confident in their ability to write code.
3. Prepare 6<sup>th</sup> grade students for entry into computer science and engineering pathways in 7<sup>th</sup> and 8<sup>th</sup> grades.
4. Learning and practice the process of troubleshooting.

Upon completion of this course students will be able to:

1. Explain the process of developing a program
2. Think critically about how to solve a problem
3. Recognize debugging as an application of the design process

#### 4. Create a PBL project using Arduino Uno Rev3

### 2.1. RESOURCES

The resources used during this course are downloadable from the internet. Students use the assigned resources providing the opportunity to extend learning using additional programs. Tutorials to introduce each section are provided below:

- 1) Arduino lessons 1 - 16: <https://learn.adafruit.com/series/learn-arduino>
- 2) Arduino lessons 1 - 12: Vilros Ultimate Starter Kit Guide (included in Vilros Arduino Uno Rev3 Ultimate Starter Kit +LCD Module)

### 2.2.1 QUARTER 1

The flow of the daily activities is flexible based on student progress and needs.

Day 1 **Class Activity** – How computers work & introduction of logbook use

**Instruction** – Course expectations and syllabus. Provide students with old processors to take apart and identify parts.

- Have students display all hardware pieces and then identify each piece with a sticky note and the name of the part.
- Place the sticky note on the part.
- Have students Gallery Walk around the room to observe how peers have labeled parts of the processor. When instructed, students may move the labels based on observations.
- Acquire one set of computer cards from the instructor (name on front and diagram on back) and place them on the parts.
- Introduce proper use of engineering logbook.

**Questions** – How many parts are in your processor? Can you identify and label each part? Did you correctly label each part? What do you think is the function of this part? Why do you think this? What evidence do you see in the part that would help you understand?

**Assessment** – Logbook contains sketches and correct labeling of each part.

**Logbook Entry** – Sketch and label each part in your logbook. Reminder: date entry

**Resource(s)** – GCF LearnFree Basic parts of the processor:  
[https://www.gcflearnfree.org/print/computerbasics/inside-a-computer?playlist=Computer\\_Basics](https://www.gcflearnfree.org/print/computerbasics/inside-a-computer?playlist=Computer_Basics)

Day 4 **Class Activity** – Analogy of how computers work

**Instruction** – Review computer parts from previous lesson.

- Get out the parts of the processor and ask students to create an analogy for how the part works.
- Share analogies with small groups and then pick one analogy to share with the class.
- Students can write down peer’s analogies in their engineering logbook.
- Show Youtube video: Howstuffworks on computer parts.

**Resource(s)** – GCF LearnFree Basic parts of the processor:  
[https://www.gcflearnfree.org/print/computerbasics/inside-a-computer?playlist=Computer\\_Basics](https://www.gcflearnfree.org/print/computerbasics/inside-a-computer?playlist=Computer_Basics)

HowStuffWorks TECH video: [computer.howstuffworks.com/microprocessor.htm](http://computer.howstuffworks.com/microprocessor.htm)

**Logbook Entry** – Notes analogy – include sketches of parts

Day 6 **Class Activity** – Understanding microprocessors

**Instruction** – Provide students with items that contain a microprocessor (e.g., calculator, handheld gaming device, thermostat, alarm clock, stereo system, computer, cell phone, iPod, RC car, etc.)

**Questions** – What do these items have in common? How do they work? Have students find a partner and open up the item. Ask them to identify the microprocessor. Compare the microprocessor with groups looking for similarities and differences. Draw a diagram of the microprocessor in your engineering logbook. Is this similar to the one in the processor?

**Logbook Entry** – Notes & struggles and concerns

Day 7 **Class Activity** – Introduction to Circuits

**Instruction** – Review of circuits. Student will sketch an electric circuit (any type) in their Engineering logbook.

Large group demonstration of how a circuit works.

- Have students form a circle.
- Explain that the circle represents a circuit (closed or open?).
- Give each student an object (e.g., paper clip). Explain that the object represents electrons inside a wire conductor. Wire conductors are full of electrons.
- Pick a student to be the battery in this circuit. Put a + (plus) on the left hand of the student and a – (negative) on the right hand.
- Begin passing the object to the right. When a student receives the object, the object in his/her hand needs to be passed along because this represents electrons moving down the wire.
- Explain that electrons share the same negative charge so they repel one another. This allows the electrons (object) to continue moving in the same direction. This is an example of an electrical current.
- Have a student step back while passing the object and ask students what happens to the electrons. What is this called? Next have students use the interactive website: [interactivesites.weebly.com/electricity-and-energy.html](http://interactivesites.weebly.com/electricity-and-energy.html) to work through 4-5 circuits. Before students leave, give them conductive dough ([www.SquishyCircuits.com](http://www.SquishyCircuits.com)) to experiment with lighting up a light build. Wrap up with review of terms (electron, current, closed circuit, open circuit)

**Questions** – What items do you use daily that have a circuit? What is a circuit?

**Logbook Entry** – Notes

**Resource(s)** – Conductive dough (12 containers), paper clips or the same object for each student. Squishy Circuits recipe to make conductive dough: [www.SquishyCircuits.com](http://www.SquishyCircuits.com)  
Interactive website for circuits: [www.interactivesites.weebly.com/electricity-and-energy.html](http://www.interactivesites.weebly.com/electricity-and-energy.html)

Day 9 **Class Activity** – Physical components of an Arduino Uno Rev3

**Instruction** – Water pipe analogy for flow of current.

- Set up 8-10 areas with PVC piping and water.
- Place students in groups of 4 and ask them to make the water flow through the pipe. (flow of current- review this idea with them).
- Pour water into the hose (input), turn the valve on/off (switch), pinch the hose (resistance).
- Discuss the terms with the students and have them write down these terms in their engineering logbook.

- Review circuits from previous lesson. Pass out an Arduino board for each group of 2 students. In the engineering logbook, have students sketch a diagram of the parts of the Arduino board and the breadboard. Color-code the diagram with labels. Next have students read the comic by Jody Culkin and write down the definitions for the terms in their engineering notebook.

**Questions** – What is an Arduino? What does it do? Does it look like pieces/parts of the processor or items you took apart? How can it be used?

**Resource(s)** – Arduino kits, water, large bowl/pan to catch water, hose, 2” PVC piping (2 – 10’ pieces), 2” PVC Compact Ball valve (to turn on/off flow of water).

[www.iodyculkin.com/wp-content/uploads/2014/03/arduino-comic-2014.pdf](http://www.iodyculkin.com/wp-content/uploads/2014/03/arduino-comic-2014.pdf).

**Logbook Entry** – Notes

Day 11 **Class Activity** – Students will work through each activity (12 lessons) for 20 days.

Debrief on previous days experiences. Review any of the steps from Adafruit for Arduino that students need clarification on and discuss similarities between lessons. Begin each class with a review of the previous lesson. While students are working on individual lessons, extend the learning. For example, for the Blink lesson, ask students to light up 2 LEDs, change the amount of time an LED flashes, etc..

**Instruction** – Students will continue to work through the Arduino lessons. The instructor will circulate around the room to answer questions and prompt understanding. When students finish with a lesson they will share results of working components and take a brief quiz over concepts.

**Resource(s)** – Adafruit lessons: <https://learn.adafruit.com/series/learn-arduino>

**Logbook Entry** – Notes, sketches and ideas from each lesson.

Day 31 **Class Activity** - Debrief on previous days experiences.

**Instruction** – Review any of the concepts learned from the Arduino lessons. Clarify ideas. Test concepts from all lessons. (e.g., Set up 12 stations and have an Arduino set up for each lesson with one mistake. This could be the sketch (code), wire, LED, etc. that students need to write down what is missing, wrong, etc..

**Resource(s)** – Arduino kits, engineering logbook

**Logbook Entry** – Write down flowcharts/pseudocodes with an explanation of what the shapes represent.

Day 32 **Class Activity** – Review the content learned since working with the Arduinos. Introduce the Arduino project.

**Instruction** – Introduce project and rubric. Review content learned from beginning of section. Inform students that information learned in previous lessons will help them design a product for the final project in the class.

**Resource(s)** – Logbook

**Logbook Entry** – Record notes, questions and concerns

Day 33 **Class Activity** – Students will design a product using Arduino boards, any of the pieces used in previous lessons and items of choice such as Legos, balsa wood, wheels, etc.

**Instruction** – Students will go through the design process beginning with researching ideas for their project and recording information in the logbooks. Students will be working in pairs on individual projects. The next 7 days will be workdays with the instructor circulating through the room to answer questions and prompt thinking.

**Resource(s)** – Logbook and rubric

**Logbook Entry** – Record information for project, questions and concerns.

Day 40 **Class Activity** – Test and refinement of product.

**Instruction** – Students will test their products with a partner to share results and look for ways to refine the design. Time left will be spent revising.

**Resource(s)** – Logbook

**Logbook Entry** – Record test results and make changes as needed.

Day 41 **Class Activity** – Independent workday

**Instruction** – Students will work independently on projects based on needs from testing.

**Resource(s)** – Logbook

**Logbook Entry** – Record any errors and changes to errors

Day 42 **Class Activity** – Students will reflect on process of Arduino project and take a post-test to show mastery of content.

**Instruction** – Students will reflect in their logbooks on the process of creating the project. The debriefing will include: name of project, criteria for project, area of growth

during project, one struggle and how the student overcame the “struggle” and one success during the project.

**Resource(s)** – Logbook, post-test

**Logbook Entry** – The reflection will be in the logbook for teacher review.