CodeHS

Intro to Physical Computing with Arduino Syllabus

1 quarter for High School (35-60 contact hours)

Course Overview and Goals

The CodeHS introduction to Physical Computing with Arduino curriculum allows students to refresh their knowledge of basic programming concepts (control structures, variables, functions, etc.) in order to control a physical device. Students will perform basic physical tasks using LEDs, motors, and sensors to see how computer programming gives physical devices the ability to interact with their environment.

Learning Environment: This course utilizes a blended classroom approach. The content is provided through a mix of web-based and physical exercises, with students writing and running code in the browser and then downloading code to their physical devices for further testing and exploration. Teachers utilize tools and resources provided by CodeHS to leverage time in the classroom and give focused 1-on-1 attention to students. Each unit of the course is broken down into lessons. Lessons consist of video tutorials, short quizzes, pseudocode exercises, physical explorations, example programs, and written programming exercises, adding up to over 30 hours of hands-on programming practice in total.

Programming Environment: Students write and run programs in the browser using the Tinkercad simulator and will download their programs to their Arduino devices using Arduino software for further testing.

More information: Browse the content of this course at https://codehs.com/course/8050

Prerequisites

This course is designed to reinforce understanding of computer science concepts by applying them to physical devices. It is assumed students have introductory knowledge of variables, control structures, and functions. Students should have completed (or be concurrently enrolled in) an introductory programming course.

The following courses would work as a concurrent prerequisite:

- Intro to Python with Tracy
- Intro to Programming with Karel
    - **Note:** This course does not cover variables, so teachers will likely need to supplement instruction in the physical computing course.
- Intro to Computer Science in JavaScript
- Intro to Computer Science in Python
- AP Computer Science Principles
- AP Computer Science A

Course Breakdown

Unit 1: Intro to Arduino (1-2 weeks/5-10 hours)

Browse the full content of this unit at https://codehs.com/library/course/8050/module/11669

Objectives / Topics Covered	• Intro to physical computing • Goal Setting • Comments • Pseudocode • Analog vs. digital • Variables • Breadboards • Potentiometers • Debugging

Example Assignments / Labs	• 5 explorations
	• 12 exercises total
	• Example exercises:
	  ○ Morse Code
	  ■ Send a message using Morse code and your LED.
	  ● Think of one letter you want to send. Translate the letter to Morse code. Make the LED blink to match the Morse code translation. Switch programs with a friend and translate each other's letter!
	  ○ Opposite Blinking LEDs
	  ■ Blink two LEDs opposite one another. One LED should be lit while the other is off. After 1 second, the lit LED should turn off and the unlit LED should turn on. After 1 second, they should switch again. This should continue until the program is manually ended
	  ○ One Bright, One Fading
	  ■ Turn a yellow LED on while a red LED fades. The yellow LED should turn on and the red LED should be set to a brightness of 250. The yellow LED should stay on for two seconds. Every half a second, the red LED should decrease brightness by 50. After two seconds, both LEDs should be off for a second. This should continue until the program is manually ended

Unit 2: Program Control with Arduino (2-3 weeks/10-15 hours)

Browse the full content of this unit at https://codehs.com/library/course/8050/module/11670

Objectives / Topics Covered	• For loops • While loops • Variables • If statements • If/else statements • Using buttons • Using motors • Operators (arithmetic, comparison, and logical) • Using sensors (ultrasonic range finder, light sensor, temperature sensor) • Functions and parameters

Example Assignments / Labs	• 5 explorations
	• 10 exercises in total
	• Example exercises:
	  ○ Blinking Based on Potentiometer
	  ■ Blink an LED at a speed based on the value of the potentiometer. If the potentiometer reads a value below 500, blink the LED on and off for a quarter second each. If the potentiometer reads a value above 500, blink the LED on and off for a half second each.
	  ○ Servo Sweep with Reset
	  ■ Slowly increase the position of the servo (increasing by 1 degree every 100ms is a good speed) until it reaches 180 degrees. If at any point Button A is pressed, set the servo back to 0 for 1 full second and then start the process over again.
	  ○ Distance Warning Lights
	  ■ No LEDs should be lit if an object is detected 15cm or farther from the ultrasonic range finder. If an object is detected closer than 15 cm, light only a green LED. If an object is detected closer than 10 cm, light only a yellow LED. If an object is detected closer than 5 cm, light only a red LED.

Unit 3: Advanced Arduino (4-7 weeks/20-35 hours)

Browse the full content of this unit at https://codehs.com/library/course/8050/module/11671

Objectives / Topics Covered	• Challenges • Explore a new sensor • Build a step-by-step project • Final project

Example Assignments / Labs	• Example exercises:
	  ○ Explore a new sensor
	  ■ Research a sensor we have not studied in this course and explore how it is used. In a group, develop and present a lesson to teach your peers about your chosen sensor, including exercises where they can practice using the sensor for themselves.
	  ○ Build a step-by-step project
	  ■ Find a ready-made project online. Follow the steps to recreate the project using your Arduino and any needed materials.
	  ■ Create an updated set of directions complete with pictures and tips from your experience.
	  ○ Final project
	  ■ Use your Arduino to bring an idea to life using sensors and external components.
	  ■ Present your project to peers, administration, and family!