Activity 2 - Lesson Plan

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An additional resource: www.jodyculkin.com/wp-content/uploads/2014/03/arduino-comic-2014.pdf

Learning Outcomes

Students will,

1. Wire a breadboard LED light circuit to an Arduino UNO microcontroller board
2. Program the Arduino to make the LED blink on and off

This activity should take 1 hour to complete. It assumes free access to a black-and-white printer, a classroom with a whiteboard, blackboard, or chart-paper, and computers capable of connecting to the Arduino with a USB cable and running two programs[1]. Both programs can be run in a web browser, or downloaded for offline use. At least one computer per three students is recommended.

Materials and Costs per Student

Item	Qty.	Cost per Student[2]	Expendable[3]	Supplier
LED Assorted 3mm 5mm	2	0.04	y	Aliexpress
Resistors 220 ohm, 1/4 watt	1	0.01	y	Aliexpress
Jumper cables MM 10cm	2	0.04	y	Aliexpress
Breadboard 400 point	1	1.49	n	Aliexpress
Arduino UNO with cable	1	6.62	n	Aliexpress
Total Cost per Student		**$8.20 CAD**		

Lesson

Before class: install the necessary software[1] on the computers and confirm that the Arduino UNO is recognized by the computer when plugged in. Assemble the LED light circuits shown on the student handout, leaving them disconnected from the Arduino.

1. Review rock-slide analogy of electricity
2. Review LED light circuit
3. Introduce the Arduino UNO microcontroller
4. Introduce digital output pins
5. Introduce programming concepts: sequential execution (top to bottom), loops, functions (blocks)
6. Present example program using digitalWrite() and delay() to blink the light
7. Students form groups and connect the pre-assembled LED light circuit to the Arduino
8. Check students' circuit connections as they are completed, then have them start using BlocklyDuino to write their programs
9. Help students upload their code; iterate
10. For students who get the light blinking, present them with an exploration challenge.

Review

In the last activity, we used a rock-slide analogy to explain electricity:

- The height of the hill represents voltage
- The sliding rocks represent current
- Trees represent resistance
- Current always flows from high to low voltage

We also looked at the circuit diagram used to light up an LED (draw the circuit diagram from Activity 1 on the board).

Introduction to the Arduino UNO Microcontroller Board

The Arduino UNO is an electronics prototyping board that has a microcontroller on it. Microcontrollers are like small computers. They can act as the brain of a project. We can attach sensors to the Arduino, and control how the Arduino reacts to those sensors. For example, we could attach a light sensor, then turn on an LED when the light in the room becomes dark. The Arduino could also be used to blink the LED every second, since it allows us to write instructions about time. We write instructions (programs) for the microcontroller on the computer, then upload them to the microcontroller through a USB cable.

Digital Output

Computers often use keyboards for input, and a screen for output. Similarly, a microcontroller can read inputs and write outputs on its pins. Instead of writing light to a screen, or reading keystrokes from a keyboard, the pins read and write voltage levels. Digital output on the pins of the Arduino can be either ON or OFF. Previously, we talked about the (+) and (-) sides of a battery. The Arduino microcontroller provides +5V and GND. So for the Arduino, ON is represented by 5V and OFF is represented by 0V (GND). (modify the led light circuit diagram, replacing the battery power supply with a Arduino digital output pin and GND)

Programming the Arduino

Programs run from top to bottom, one instruction after the other. We will use two blocks (functions) to make the LED blink:

1. DigitalWrite: takes two values, first the pin number we will be writing a value to; second, the digital value (HIGH or LOW)
2. Delay: takes one value, the number of miliseconds to stop before proceeding with the next instruction.

Example program on the student handout. The pin number in DigitalWrite should match the pin number where the LED circuit is attached. The circuit diagram is on the student handout. When the students have a program they want to try uploading to the board, copy the code from BlocklyDuino, paste it into the Arduino IDE, check that the board is connected and selected under Tools > Port, and click Upload (Ctrl + U). *Additional details here.*

Challenge and Explore

Evaluate the students' understanding of the learning objectives by asking them to try the following:

- Can you get the LED to turn on and off two times per second?
  - Skill: basic programming concepts - changing function inputs
- Can you make the LED turn on for 3 seconds, then off for 1?
  - Skill: basic programming concepts - changing function inputs
- Can you add a second LED to the circuit make two LEDs alternate turning on and off?
  - Skill: microcontroller digital outputs
  - Skill: basic programming concepts
  - Skill: circuit building

1. Arduino IDE and BlocklyDuino, or a similar visual programming tool for the Arduino. ↩

2. Currency is CAD, 2017-06-10. Assuming one set of parts per student. ↩

3. Likely to be broken or lost during the activity. ↩