Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Button & Buzzer Example

```
/*This sketch shows how to use the button pin attached to A5 to trigger the buzzer attached to pin 7 on the ProtoSnap LilyPad Development Board to make sounds */


//Define the buzzer pin and the values of each sound


int buzzerPin = 7;

int buttonPin = A5;

int buttonState = 0;


const int C = 1046;

const int D = 1175;

const int E = 1319;

const int F = 1397;

const int G = 1568;

const int A = 1760;

const int B = 1976;

const int C1 = 2093;




void setup() {

  // put your setup code here, to run once:


pinMode (buzzerPin, OUTPUT);//define the buzzer pin as an OUTPUT

pinMode (buttonPin, INPUT_PULLUP); //input_pullup is used so that the value on the button will not be floating

}
```

```
void loop() {
  // put your main code here, to run repeatedly:

buttonState = digitalRead (buttonPin);
if (buttonState ==LOW) {
//choose what notes to play and how long to delay each note
tone (buzzerPin, C);
delay (500);
tone (buzzerPin, D);
delay (500);
tone (buzzerPin, E);
delay (500);
tone (buzzerPin, F);
delay (500);
tone (buzzerPin, G);
delay (500);
tone (buzzerPin, A);
delay (500);
tone (buzzerPin, B);
delay (500);
tone (buzzerPin, C1);
delay (1000);}

else {noTone (buzzerPin);}


}
```

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Student Worksheet: Button

Name:_____

/*This sketch allows the button pin attached to A5 on the LilyPad Protosnap Development Board to trigger both the LED lights and the Vibe motor */

```
int LED1 = 5;
int LED2 = 6;
int LED3 = A2;
int LED4 = A4;
int LED5 = A3;
int vibePin = 3;
int buttonPin = A5;
int buttonState;
```

What code was added for the button? What is the purpose of each code?

_____

_____

_____

_____

_____

```
void setup() {
  // put your setup code here, to run once:
pinMode (LED1, OUTPUT);
pinMode (LED2, OUTPUT);
pinMode (LED3, OUTPUT);
pinMode (LED4, OUTPUT);
pinMode (LED5, OUTPUT);
pinMode (buttonPin, INPUT_PULLUP);
pinMode (vibePin, OUTPUT);
}
```

What special setup code is used *only* for the button? What is this code needed?

_____

_____

_____

_____

_____

```
void loop() {
  // put your main code here, to run repeatedly:
buttonState = digitalRead(buttonPin);


if (buttonState ==LOW) {
digitalWrite(vibePin, HIGH);
digitalWrite (LED1, HIGH);
digitalWrite (LED2, HIGH);
digitalWrite (LED3, HIGH);
digitalWrite (LED4, HIGH);
digitalWrite (LED5, HIGH);
 }


else {
  digitalWrite (vibePin, LOW);
   digitalWrite (LED1, LOW);
digitalWrite (LED2, LOW);
digitalWrite (LED3, LOW);
digitalWrite (LED4, LOW);
digitalWrite (LED5, LOW);
}
}
```

How is the *HIGH* and *LOW* function of the button different than other Lilypad components?

_____

_____

_____

_____

_____

_____

_____

Coding Task 3 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Teacher Edition: Button Worksheet

Name:_____

/*This sketch allows the button pin attached to A5 on the LilyPad Protosnap Development Board to trigger both the LED lights and the Vibe motor */

```
int LED1 = 5;
int LED2 = 6;
int LED3 = A2;
int LED4 = A4;
int LED5 = A3;
int vibePin = 3;
int buttonPin = A5;
int buttonState;
```

What code was added for the button? What is the purpose of each code?

"buttonPin" was added to define where the button is located on the LilyPad ProtoSnap board

"buttonState" was added as a variable to read whether the button is/is not pushed

```
void setup() {
  // put your setup code here, to run once:
pinMode (LED1, OUTPUT);
pinMode (LED2, OUTPUT);
pinMode (LED3, OUTPUT);
pinMode (LED4, OUTPUT);
pinMode (LED5, OUTPUT);
pinMode (buttonPin, INPUT_PULLUP);
pinMode (vibePin, OUTPUT);
}
```

What special setup code is used *only* for the button? What is this code needed?

An INPUT_PULLUP code is used for the button. When the button is not being pushed it is in a floating state which can make the button unreliable. In order to make it consistent – the "INPUT_PULLUP" code must be used.

```
void loop() {
  // put your main code here, to run repeatedly:
buttonState = digitalRead(buttonPin);


if (buttonState ==LOW) {
digitalWrite(vibePin, HIGH);
digitalWrite (LED1, HIGH);
digitalWrite (LED2, HIGH);
digitalWrite (LED3, HIGH);
digitalWrite (LED4, HIGH);
digitalWrite (LED5, HIGH);
 }


else {
  digitalWrite (vibePin, LOW);
   digitalWrite (LED1, LOW);
digitalWrite (LED2, LOW);
digitalWrite (LED3, LOW);
digitalWrite (LED4, LOW);
digitalWrite (LED5, LOW);
}
}
```

How is the *HIGH* and *LOW* function of the button different than other Lilypad components?

When the INPUT_PULLUP code is used – the button will read LOW when it is pushed and HIGH when it is open. This is opposite of other components that read HIGH when they are ON and LOW when they are OFF.

Coding Task 3 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Student Worksheet: Buzzer

Name:_____

```
/*This sketch shows how to use the buzzer attached to Pin 7 on the ProtoSnap LilyPad Development
Board  to make sounds */


//Define the buzzer pin and the values of each sound
int buzzerPin = 7;


const int C = 1046;
const int D = 1175;
const int E = 1319;
const int F = 1397;
const int G = 1568;
const int A = 1760;
const int B = 1976;
const int C1 = 2093;


void setup() {
  // put your setup code here, to run once:


pinMode (buzzerPin, OUTPUT);//define the buzzer pin as an OUTPUT
}
```

What values are defined for the buzzer? How are these values defined?

_____

_____

_____

_____

_____

```
void loop() {
  // put your main code here, to run repeatedly:

//choose what notes to play and how long to delay each note
tone (buzzerPin, C);
delay (500);
tone (buzzerPin, D);
delay (500);
tone (buzzerPin, E);
delay (500);
tone (buzzerPin, F);
delay (500);
tone (buzzerPin, G);
delay (500);
tone (buzzerPin, A);
delay (500);
tone (buzzerPin, B);
delay (500);
tone (buzzerPin, C1);
delay (1000);
}
```

What code is used to turn the buzzer on? If you wanted to create an alarm, what code would you use?

_____

_____

_____

_____

_____

Coding Task 4 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Teacher Edition: Buzzer

Name: _____

```
/*This sketch shows how to use the buzzer attached to Pin 7 on the ProtoSnap LilyPad Development
Board  to make sounds */


//Define the buzzer pin and the values of each sound
int buzzerPin = 7;


const int C = 1046;
const int D = 1175;
const int E = 1319;
const int F = 1397;
const int G = 1568;
const int A = 1760;
const int B = 1976;
const int C1 = 2093;


void setup() {
  // put your setup code here, to run once:


pinMode (buzzerPin, OUTPUT);//define the buzzer pin as an OUTPUT
}
```

What values are defined for the buzzer? How are these values defined?

When using the buzzer – the tones of the buzzer must be defined. The code "cons tint ___" is used to define the tones. The tones are different frequencies the buzzer can read. These frequencies are a selection of tones the buzzer can read.

```
void loop() {
  // put your main code here, to run repeatedly:

//choose what notes to play and how long to delay each note
tone (buzzerPin, C);
delay (500);
tone (buzzerPin, D);
delay (500);
tone (buzzerPin, E);
delay (500);
tone (buzzerPin, F);
delay (500);
tone (buzzerPin, G);
delay (500);
tone (buzzerPin, A);
delay (500);
tone (buzzerPin, B);
delay (500);
tone (buzzerPin, C1);
delay (1000);
}
```

What code is used to turn the buzzer on? If you wanted to create an alarm, what code would you use?

Since the frequencies of each tone were defined earlier in the code, we can use the "tone (buzzerPin, _____)" to play the tones. "delay" is used to determine how long each tone will play.

Coding Task 4 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Student Worksheet: LED Light

Name:_____

```
/* This sketch will turn on/off the 5 LED lights located on ports 5,6,A2, A4, & A3 on a LilyPad Protonsap
Development Board.

The purpose of this sketch is to introduce students to the basic programming language of Arduino*/

//define the LED lights that the program will be using

int LED1 = 5;
int LED2 = 6;
int LED3 = A2;
int LED4 = A4;
int LED5 = A3;
```

What is the purpose of this section of code?

_____

_____

_____

_____

_____

```
void setup() {
  // put your setup code here, to run once:

//In this section you will define whether each integer defined in your setup is an output or an input.

pinMode (LED1, OUTPUT);
pinMode (LED2, OUTPUT);
pinMode (LED3, OUTPUT);
pinMode (LED4, OUTPUT);
pinMode (LED5, OUTPUT);
}
```

What is the purpose of this section of code?

_____

_____

_____

_____

_____

```
void loop() {

  // put your main code here, to run repeatedly:

//In this section write the code that will tell the computer how to turn on/off your LED lights.

//the use of the code "digitalWrite" will turn an OUTPUT on or off (HIGH = On, LOW = OFF), repeat the code for each LED light defined


digitalWrite (LED1, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED1, LOW);

digitalWrite (LED2, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED2, LOW);

digitalWrite (LED3, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED3, LOW);

digitalWrite (LED4, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED4, LOW);

digitalWrite (LED5, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED5, LOW);

}
```

What codes are used in this section? What does each code mean?

_____

_____

_____

_____

_____

Coding Task 1 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Teacher Edition: LED Light

Name:_____

```
/* This sketch will turn on/off the 5 LED lights located on ports 5,6,A2, A4, & A3 on a LilyPad Protonsap
Development Board.

The purpose of this sketch is to introduce students to the basic programming language of Arduino*/

//define the LED lights that the program will be using

int LED1 = 5;
int LED2 = 6;
int LED3 = A2;
int LED4 = A4;
int LED5 = A3;
```

What is the purpose of this section of code?

The purpose of this section of code is to define all variables that will be used throughout the code itself. This is very similar to the ingredients section of a recipe -all variables that will be used should be listed in this section. Variable names can be changed as long as they are consistent throughout the coding sketch.

```
void setup() {
 // put your setup code here, to run once:

//In this section you will define whether each integer defined in your setup is an output or an input.

pinMode (LED1, OUTPUT);
pinMode (LED2, OUTPUT);
pinMode (LED3, OUTPUT);
pinMode (LED4, OUTPUT);
pinMode (LED5, OUTPUT);
}
```

What is the purpose of this section of code?

This part of the code defines whether the components will be INPUTs or OUTPUTs.

```
void loop() {

  // put your main code here, to run repeatedly:

//In this section write the code that will tell the computer how to turn on/off your LED lights.

//the use of the code "digitalWrite" will turn an OUTPUT on or off (HIGH = On, LOW = OFF), repeat the code for each LED light defined


digitalWrite (LED1, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED1, LOW);

digitalWrite (LED2, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED2, LOW);

digitalWrite (LED3, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED3, LOW);

digitalWrite (LED4, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED4, LOW);

digitalWrite (LED5, HIGH);

delay (500); // how long the light will stay on in milliseconds

digitalWrite (LED5, LOW);

}
```

What codes are used in this section? What does each code mean?

The code "digitalWrite" is used for components that turn on/off. digitalWrite HIGH is used to turn components on, digitalWrite LOW is used to turn components off. "delay" is used to determine how long a component will remain turned on/off. Arduino reads in milliseconds (1000 ms = 1 second).

Coding Task 1 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Student Worksheet: Light Sensor

Name:_____

/* This sketch will turn on/off the 5 LED lights located on ports 5,6,A2, A4, & A3 on a LilyPad Protonsap Development Board using the light sensor located on Pin A6.

The purpose of this sketch is to introduce students to the basic programming language of Arduino*/

//define the LED lights that the program will be using

```
int LED1 = 5;
int LED2 = 6;
int LED3 = A2;
int LED4 = A4;
int LED5 = A3;
int lightSensorPin = A6;
int light = 100;
```

What code was added for the light sensor? What is the purpose of each code?

_____

_____

_____

_____

_____

```
void setup() {
  // put your setup code here, to run once:

pinMode (LED1, OUTPUT);
pinMode (LED2, OUTPUT);
pinMode (LED3, OUTPUT);
pinMode (LED4, OUTPUT);
pinMode (LED5, OUTPUT);
pinMode (lightSensorPin, INPUT);
}
```

```
void loop() {
  // put your main code here, to run repeatedly:

if (analogRead (lightSensorPin) <20){

digitalWrite (LED1, HIGH);
digitalWrite (LED2, HIGH);
digitalWrite (LED3, HIGH);
digitalWrite (LED4, HIGH);
digitalWrite (LED5, HIGH);}

else {
  digitalWrite (LED1, LOW);
  digitalWrite (LED2, LOW);
  digitalWrite (LED3, LOW);
  digitalWrite (LED4, LOW);
  digitalWrite (LED5, LOW);}

}
```

What is the purpose of the if…else… statement?

_____

_____

_____

_____

_____

Coding Task 2 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Teacher Edition: Light Sensor

Name:_____

/* This sketch will turn on/off the 5 LED lights located on ports 5,6,A2, A4, & A3 on a LilyPad Protonsap Development Board using the light sensor located on Pin A6.

The purpose of this sketch is to introduce students to the basic programming language of Arduino*/

//define the LED lights that the program will be using

```
int LED1 = 5;
int LED2 = 6;
int LED3 = A2;
int LED4 = A4;
int LED5 = A3;
int lightSensorPin = A6;
int light = 100;
```

What code was added for the light sensor? What is the purpose of each code?

The "int lightSensorPin" is used to define which pin the light sensor is located on. The light sensor also needs an additional variable for the light reading. The variable "int light" is used to set a threshold for the light sensor.

```
void setup() {
  // put your setup code here, to run once:

pinMode (LED1, OUTPUT);
pinMode (LED2, OUTPUT);
pinMode (LED3, OUTPUT);
pinMode (LED4, OUTPUT);
pinMode (LED5, OUTPUT);
pinMode (lightSensorPin, INPUT);
}
```

```
void loop() {
  // put your main code here, to run repeatedly:

if (analogRead (lightSensorPin) <20){

digitalWrite (LED1, HIGH);
digitalWrite (LED2, HIGH);
digitalWrite (LED3, HIGH);
digitalWrite (LED4, HIGH);
digitalWrite (LED5, HIGH);}

else {
  digitalWrite (LED1, LOW);
  digitalWrite (LED2, LOW);
  digitalWrite (LED3, LOW);
  digitalWrite (LED4, LOW);
  digitalWrite (LED5, LOW);}

}
```

What is the purpose of the if…else… statement?

The purpose of the if…else.. statement is to use the light sensor to set a condition. In this example, if the light sensor reads below 20 (i.e. it is "dark") then the LED lights will turn on. If it does not read "dark" the lights will be turned off until the light sensor senses a reading below 20.

Coding Task 2 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Light Sensor and Vibe Motor Example

/*This sketch uses the light sensor attached to the A6 pin on the LilyPad Protosnap Development Board to turn on/off the LEDs and the vibe motor Created by: Christina Martin*/

```
int ledPin1 = 5;

int ledPin2 = 6;

int ledPin3 = A2;

int ledPin4 = A4;

int ledPin5 = A3;

int lightSensorPin = A6;


int light = 100;


int vibePin = 3;

int buttonPin = A5;


void setup() {

  // put your setup code here, to run once:

pinMode (ledPin1, OUTPUT);

pinMode (ledPin2, OUTPUT);

pinMode (ledPin3, OUTPUT);

pinMode (ledPin4, OUTPUT);

pinMode (ledPin5, OUTPUT);

pinMode (lightSensorPin, INPUT);

pinMode (vibePin, OUTPUT);

}
```

```
void loop() {
  // put your main code here, to run repeatedly:

if(analogRead (lightSensorPin) <20){
digitalWrite (vibePin, HIGH);
digitalWrite (ledPin1, HIGH);
delay (100);
digitalWrite (ledPin1, LOW);
digitalWrite (ledPin2, HIGH);
delay (100);
digitalWrite (ledPin2, LOW);
digitalWrite (ledPin3, HIGH);
delay (100);
digitalWrite (ledPin3, LOW);
digitalWrite (ledPin4, HIGH);
delay (100);
digitalWrite (ledPin4, LOW);
digitalWrite (ledPin5, HIGH);
delay (100);
digitalWrite (ledPin1, LOW);}

else {
digitalWrite (vibePin, LOW);
digitalWrite (ledPin1, LOW);
digitalWrite (ledPin2, LOW);
digitalWrite (ledPin3, LOW);
digitalWrite (ledPin4, LOW);
digitalWrite (ledPin5, LOW);}
}
```

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
RGB LED Light Sensor Example

```
/*This sketch uses the light sensor to change the color of the RGB LED light*/
int redPin = 9; // define red pin

int greenPin = 11; //define green pin

int bluePin = 10; //define blue pin

int lightsensorPin = A6; //define the light sensor

int light = 100; //set the value of light


void setup() {

  // put your setup code here, to run once:

pinMode (redPin, OUTPUT); //set red led as output

pinMode (greenPin, OUTPUT);//set green led as output

pinMode (bluePin, OUTPUT); //set blue led as output

pinMode (lightsensorPin, INPUT); //set light sensor as input


}
void loop() {

  // put your main code here, to run repeatedly:

 //when the light sensor pin reads above 20 the RGB led will be blue and when it reads below 20 the
RGB led will turn red - a value of 0 turns the light on - a value of 255 turns the light off

if (analogRead (lightsensorPin)<20){ //analog read the light sensor

analogWrite (redPin, 0); //turn red light on

analogWrite (greenPin, 255);//turn green light off

analogWrite (bluePin, 255);}//turn blue light off

else {

analogWrite (greenPin, 255);//turn green light off

analogWrite (bluePin, 0);//turn blue light on

analogWrite (redPin, 255);}//turn red light off

}
```

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Teacher Edition: LGB LED Light

Name:_____

```
/*This sketch demonstrates how to use the RGB led.  This sketch turns on the 3 colors (Red, Green Blue)
individually and then uses variations of red, green, and blue to make different colors.*/

int redPin = 9; // define red pin
int greenPin = 11; //define green pin
int bluePin = 10; //define blue pin

void setup() {
  // put your setup code here, to run once:
pinMode (redPin, OUTPUT); //set red led as output
pinMode (greenPin, OUTPUT);//set green led as output
pinMode (bluePin, OUTPUT); //set blue led as output


}


void loop() {
  // put your main code here, to run repeatedly:
 //a value of 255 turns the light off
 //a value of 0 turns the light on
 //for mixing colors - use values between 0 and 255
```

Why does each pin have to be defined separately?

The RGB LED is three LED lights in one component. Each light must be controlled through its own pin and therefore must be defined as individual variables.

```
analogWrite (redPin, 0);
analogWrite (greenPin, 255);
analogWrite (bluePin, 255);
delay (500);
```

Why is an analog function used instead of the digital function?

A "digital" function is used for components that turn on/off. An "analog" function is used for a component with a range of values. Each light of the RGB can be turned on within the range of 0-255 to create mixed colors using the RGB LED lights. The "analog" function is used to read these varying values.

```
analogWrite (greenPin, 0);
analogWrite (redPin, 255);
analogWrite (bluePin, 255);
delay (500);
analogWrite (bluePin, 0);
analogWrite (greenPin, 255);
analogWrite (redPin, 255);
delay (500);
 analogWrite (redPin, 100);
 analogWrite (greenPin, 255);
analogWrite (bluePin, 100);
delay (500);
analogWrite (bluePin, 180);
analogWrite (greenPin, 100);
analogWrite (redPin, 255);
delay (500);
analogWrite (greenPin, 150);
analogWrite (redPin, 150);
analogWrite (bluePin, 150);
```

How does a value of *0* effect the code? How does a value of *255* effect the code? How can colors be mixed?

A value of 0 turns the light on at full brightness, a value of 255 turns the light off completely. To mix colors, turn each color on between the range of 0-255.

```
 delay (500);
 analogWrite (redPin, 255);
 analogWrite (greenPin, 255);
 analogWrite (bluePin, 255);
 delay (1000);
}
```

Coding Task 5 Completed _____

Module 10: Connected Vehicle Safety Applications: Smart Work Zones
Lesson 2: Introduction to LilyPad Arduino
Student Worksheet: LGB LED Light

Name:_____

/*This sketch demonstrates how to use the RGB LED. This sketch turns on the 3 colors (Red, Green Blue) individually and then uses variations of red, green, and blue to make different colors.*/

```
int redPin = 9; // define red pin
int greenPin = 11; //define green pin
int bluePin = 10; //define blue pin
```

Why does each pin have to be defined separately?

_____

_____

_____

_____

_____

```
void setup() {
  // put your setup code here, to run once:
pinMode (redPin, OUTPUT); //set red led as output
pinMode (greenPin, OUTPUT);//set green led as output
pinMode (bluePin, OUTPUT); //set blue led as output
```

```
void loop() {
  // put your main code here, to run repeatedly:
 //a value of 255 turns the light off
 //a value of 0 turns the light on
 //for mixing colors - use values between 0 and 255
```

```
analogWrite (redPin, 0);
analogWrite (greenPin, 255);
analogWrite (bluePin, 255);
delay (500);
```

Why is an analog function used instead of the digital function?

_____

_____

_____

_____

_____

```
analogWrite (greenPin, 0);
analogWrite (redPin, 255);
analogWrite (bluePin, 255);
delay (500);
analogWrite (bluePin, 0);
analogWrite (greenPin, 255);
analogWrite (redPin, 255);
delay (500);
 analogWrite (redPin, 100);
 analogWrite (greenPin, 255);
analogWrite (bluePin, 100);
delay (500);
analogWrite (bluePin, 180);
```

How does a value of *0* effect the code? How does a value of *255* effect the code? How can colors be mixed?

_____

_____

_____

_____

_____

```
 analogWrite (greenPin, 100);
 analogWrite (redPin, 255);
 delay (500);
 analogWrite (greenPin, 150);
 analogWrite (redPin, 150);
 analogWrite (bluePin, 150);
 delay (500);
 analogWrite (redPin, 255);
 analogWrite (greenPin, 255);
 analogWrite (bluePin, 255);
 delay (1000);
}
```

Coding Task 5 Completed _____