Building a DumbPhone

A) Set-up

1. For this we will be using Tinkercad. Go to:

   www.tinkercad.com

   To use Tinkercad you either need a **free account** or **classroom code**.

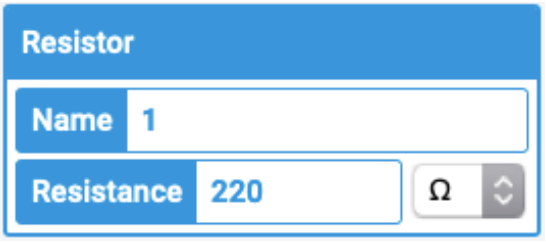
2. After logging in, click **Circuits** and **Create new Circuit**.

3. In the top right, find **Components** and change it to list **All** rather than Basic. Then find and assemble the following components in the Build Area:

   1x **Arduino Uno** 1x **Breadboard Small** 1x **LCD 16 x 2**

   1x **Piezo Speaker** 1x **Resistor** 1x **Keypad 4 x 4**

4. Click on your **resistor** and change its **resistance** to **220 Ω**.



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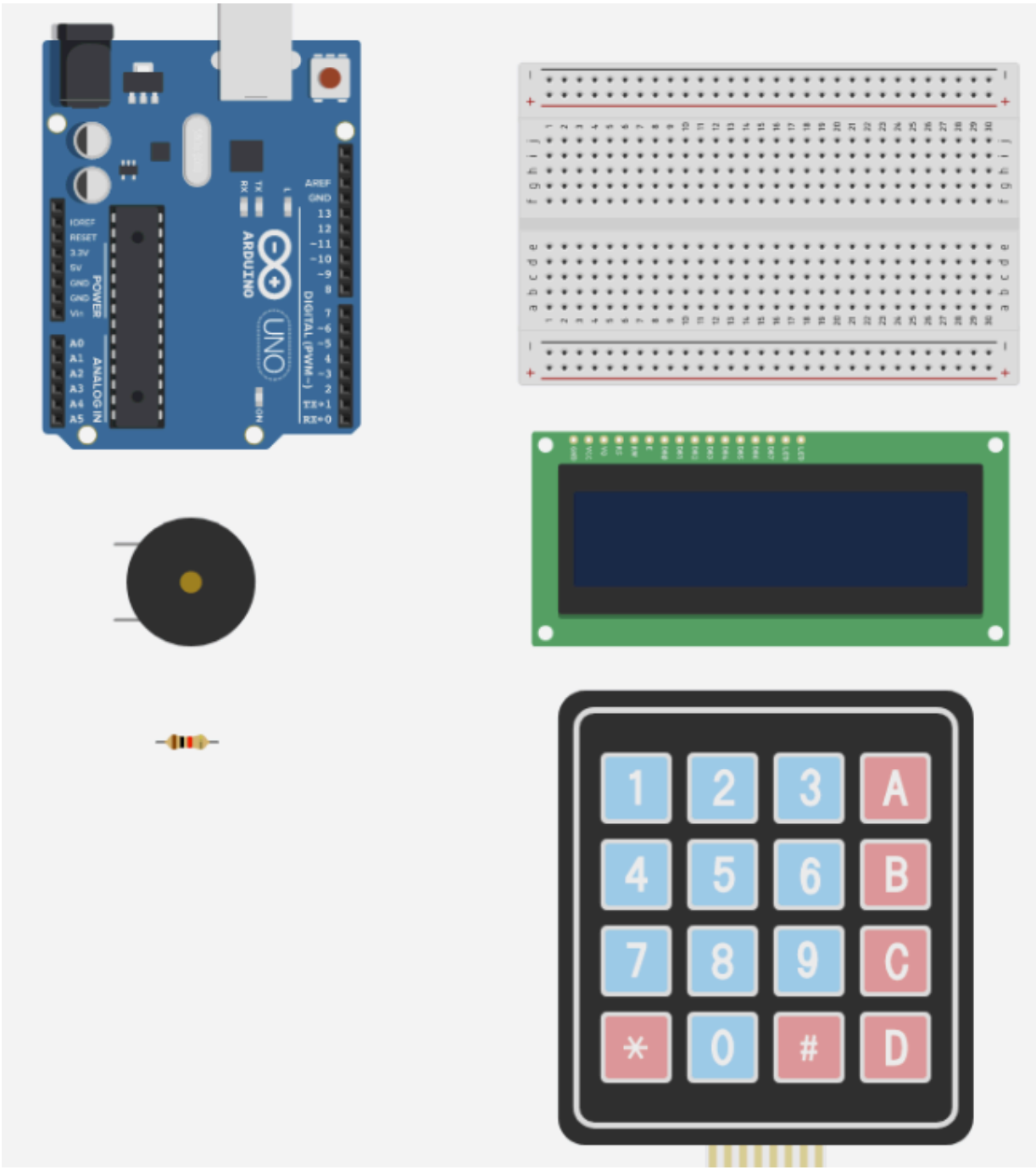
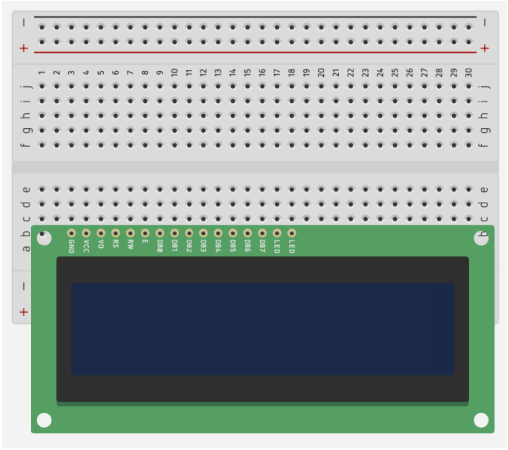
B) Assembling the Components

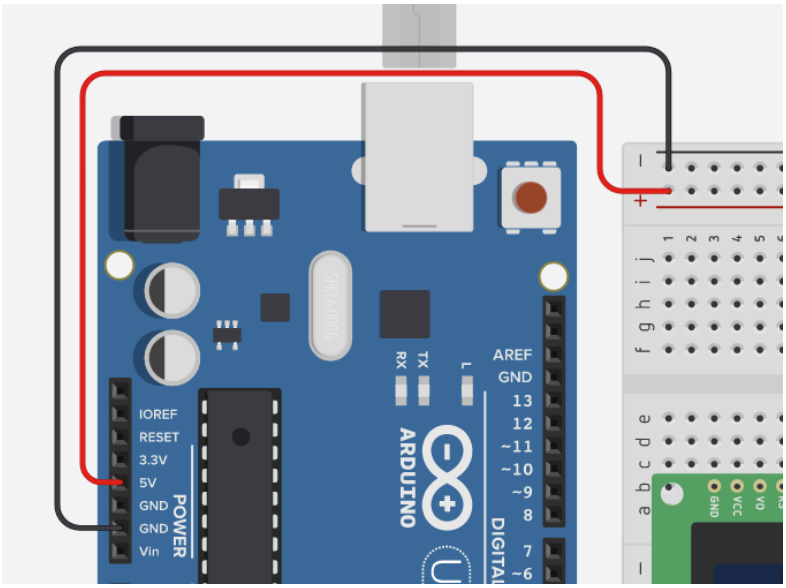


C) Setting up the Breadboard

5. First we need to attach the LCD to the Breadboard.



6. Then, we should power the breadboard by connecting the **+ line** to **5V** and the **- line** to the **GND** on the Arduino.



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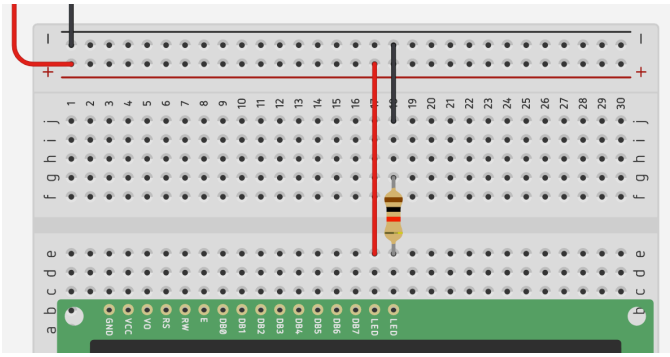
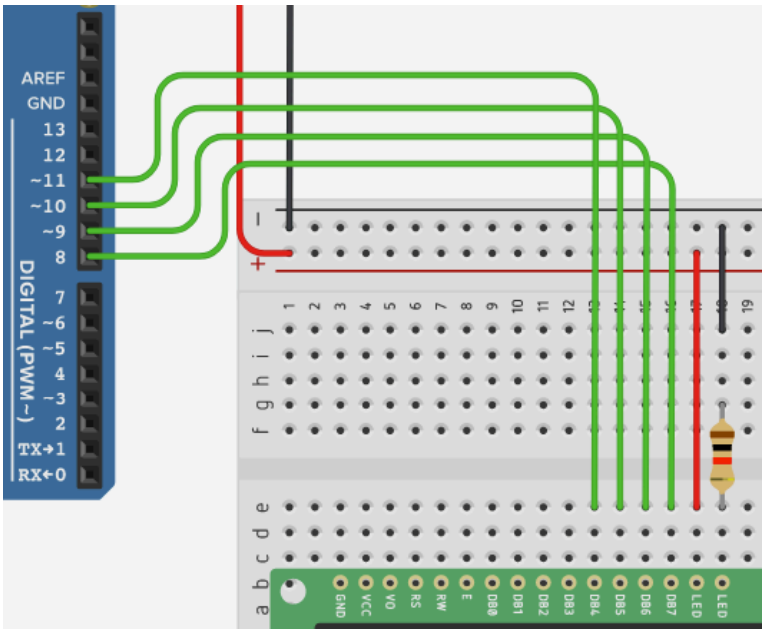
D) Connecting the LCD

7. Start by attaching the resistor to the **rightmost** pin of the LCD. Then connect this resistor to the **- line**. Next, connect the next pin along of the LCD to the **+ line**. We have now powered the backlight.



8. Now we can hook up the **Data Buses** of the LCD to the Arduino. Do so in this order:

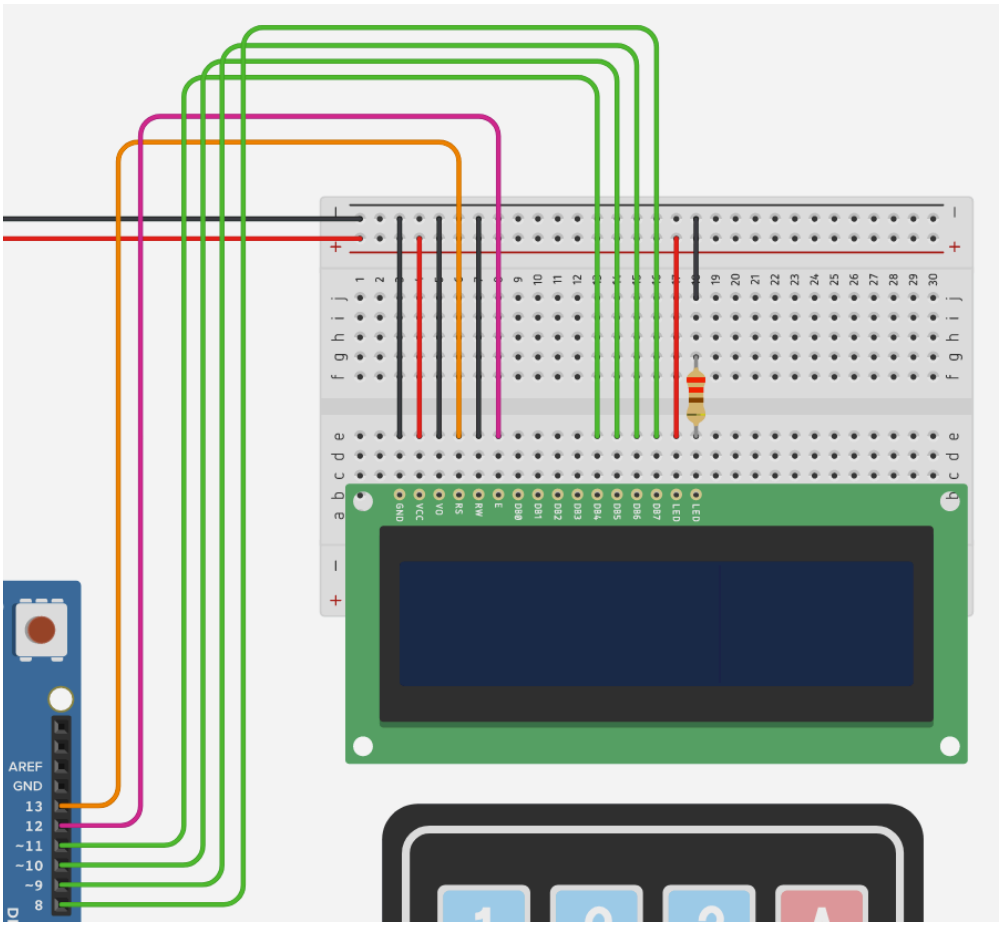
DB7 goes to **Pin 8**
DB6 goes to **Pin 9**
DB5 goes to **Pin 10**
DB4 goes to **Pin 11**



E) Connecting the LCD (part II)

9. We're going to skip the next four Data Buses (DB3 to DB0) and instead start connecting from the **E Bus** on the LCD. Connect up the following pins to the right places according to the following:

E goes to **Pin 12**
RW goes to **- line**
RS goes to **Pin 13**
VO goes to **- line**
VCC goes to **+ line**
GND goes to **- line**



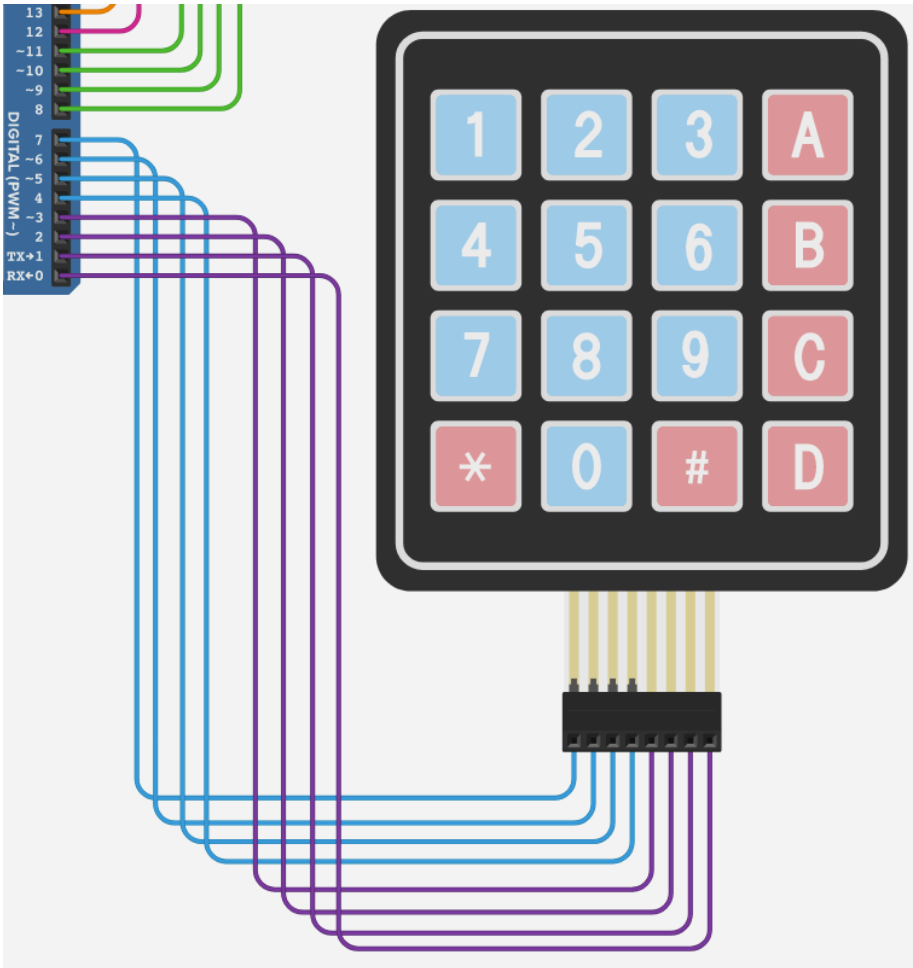
F) Connecting the Keypad

10. Now it's time to connect up the Keypad.

If you **hover your mouse** over each terminal of the keypad it will tell you its name. Use this technique to connect the keypad to the Arduino:

Row 1 goes to **Pin 7**
Row 2 goes to **Pin 6**
Row 3 goes to **Pin 5**
Row 4 goes to **Pin 4**

Column 1 goes to **Pin 3**
Column 2 goes to **Pin 2**
Column 3 goes to **Pin 1**
Column 4 goes to **Pin 0**



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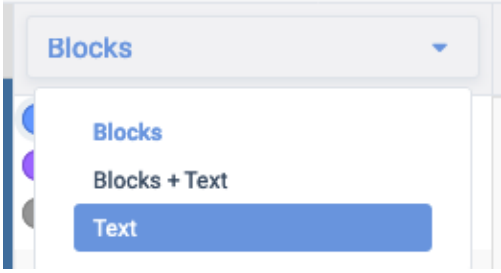
G) Finishing Touches

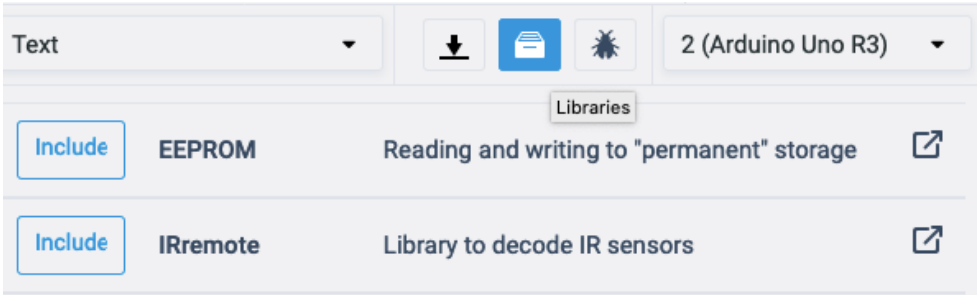
11. To make our phone sound, we need to attach the **Piezo Speaker** to the Arduino. Hovering over the legs of the Piezo reveal a negative and positive terminal. Connect the negative to **GND** and the positive to **A0**.

13. With everything connected, we can start writing the code. Click **Code** in the top right.

We need to convert to **Text Mode**. To do so, click the drop-down menu next to 'Blocks'. Then, select **Text**.



14. The last step before coding; Click the **Libraries** button and Include both **LiquidCrystal** and **Keypad**.



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H) The Code

14. Here is listed the code needed for basic functionality. Make sure to rewatch the livestream for a full explanation of each part of the code.

```
#include <LiquidCrystal.h>
#include <Keypad.h>

LiquidCrystal lcd(13, 12, 11, 10, 9, 8); //Tells Arduino the LCD Pins

const byte numRows = 4; //How many rows does the Keypad have?
const byte numCols = 4; //How many column does the keypad have?

byte rowPins[numRows] = {7,6,5,4}; //Which pin controls which row (1 to 4)
byte colPins[numCols]= {3,2,1,0}; //Which pin controls which column (1 to 4)

//Here we tell the Arduino what symbol is on which letter.
char keymap[numRows][numCols]=
{
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};

Keypad myKeypad= Keypad(makeKeymap(keymap), rowPins, colPins, numRows, numCols);

int currentCol = 0;

void setup() {
  lcd.begin(16, 2); //Tells Arduino how many columns and rows our LCD has.
  lcd.print("Enter number:");
}

void loop() {
  lcd.setCursor(currentCol, 1); //Tells LCD to start printing on second row.

  char keypressed = myKeypad.getKey();
  if (keypressed != NO_KEY){
    if (keypressed == '#') {
      lcd.clear();
      currentCol = 0;
      lcd.print("Dialing...");
    } else {
      tone(A0, 400, 50);
      lcd.print(keypressed);
      currentCol = currentCol + 1;
    }
  }
}
```