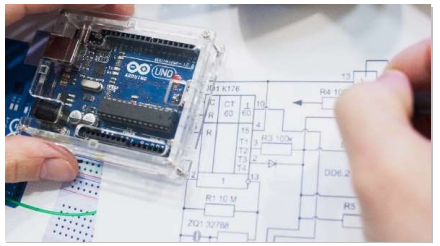

COMPLETE

pathways to engineering and technology employment

Workshop 6/24/19

This material is based upon work supported by the National Science Foundation under Grant No. 1801177.

Welcome!

Since last workshop in March (QUICK recap)…

- Hired Juliette as Coordinator!
- Juliette created a website

www.completepathways.com

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Since last workshop in March…

- Participated in BPSTIL College & Career Fair
  - Mikey presented to ~200 students
  - Doug hosted a table
  - Thank you for including us!

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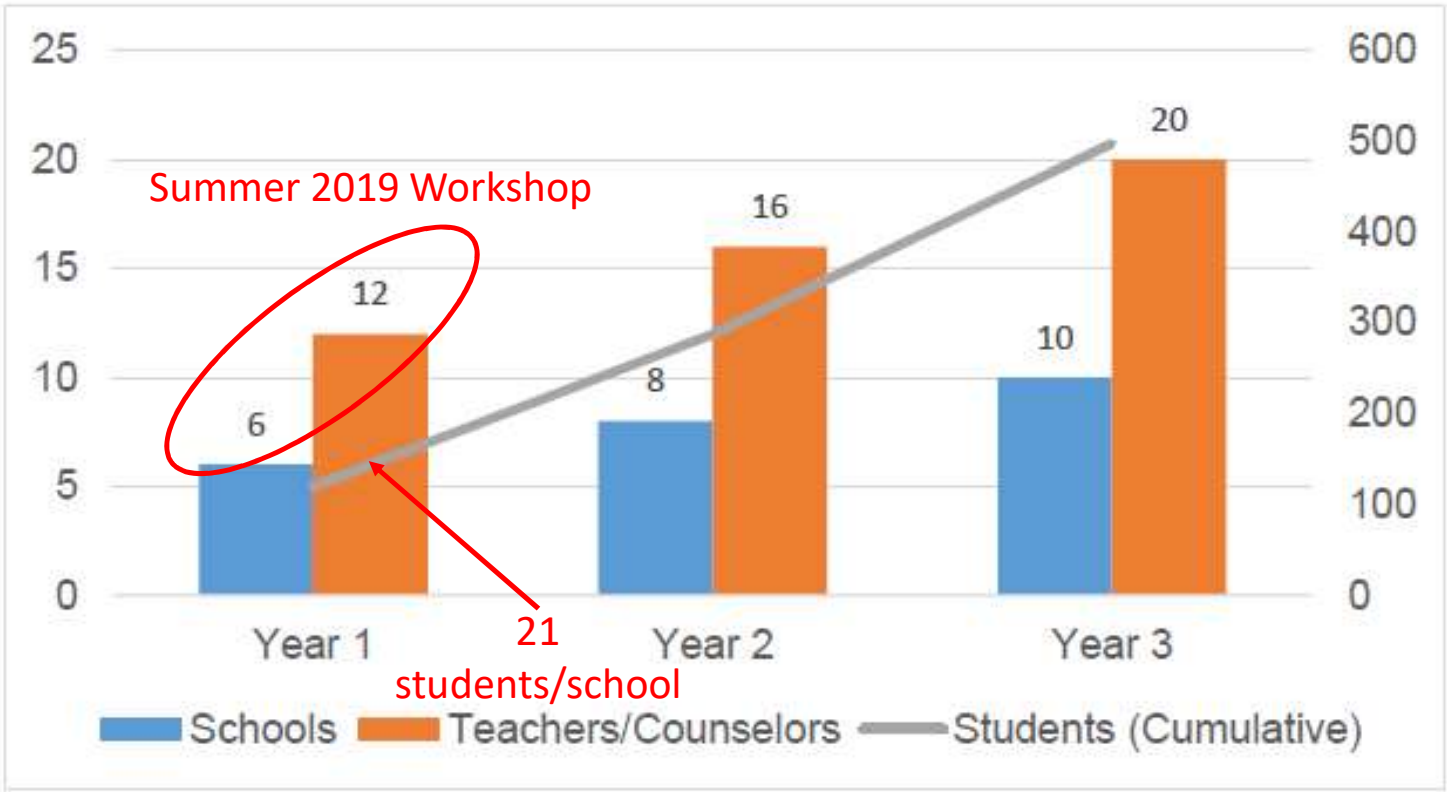
Since last workshop in March…

- Added 6 more schools (so 7 total, putting us AHEAD of our goal!)

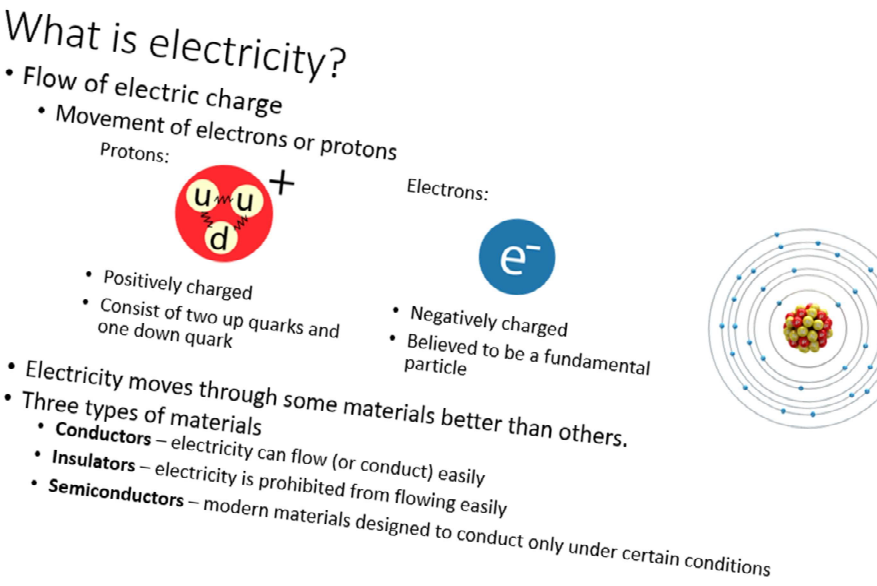


Since last workshop in March…

- Added 6 more schools
  - Team effort!
    - Visits to school boards
    - Online application process
    - Emails to 15 schools
  - Marketed with stories and “universal” Jump Start course code
  - Asked each school to nominate a “sparkster” and a “connector” (based on your feedback that the connector may not be a counselor)
  - Marketed a “lower” participation level option to schools

Curriculum Development/Feedback

- Parallel work: Lessons, projects, and online videos for career info.
- Adjusted timeline for feedback, but still targeting sharing the first draft of all lessons by kickoff workshop on 7/30 (right?).
- DWCS is also doing the complete course in 2019-2020, not sure if they're starting in the fall or spring.
- Still targeting getting feedback by when school starts or first few weeks of school? As long as we have solid lessons for first few weeks.



Any more updates from BPSTIL?

Making a Sous Vide: Instrumentation and Control Project

Michael Swanbom, PhD, PE

Project COMPLETE Workshop

6/24/19

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This material is based upon work supported by the National Science Foundation under Grant No. 1801177.

Let's Make a Sous Vide!

- Cooking device that maintains an elevated temperature in a vessel
- Gives us practice:
  - Devising and reading a temperature sensor using a microcontroller
  - Controlling a high-current device (heating element) using the microcontroller

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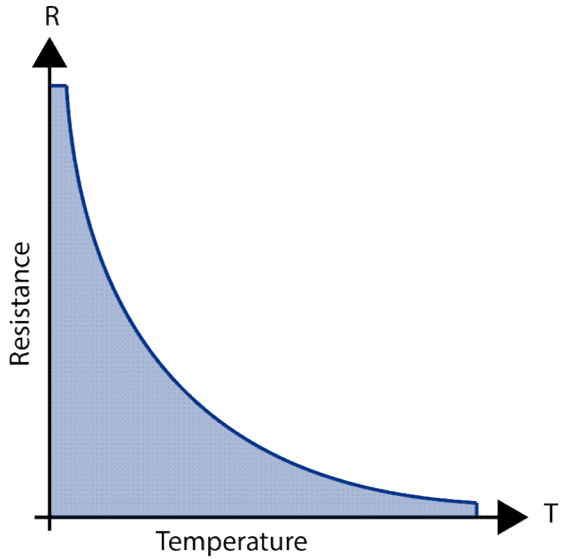
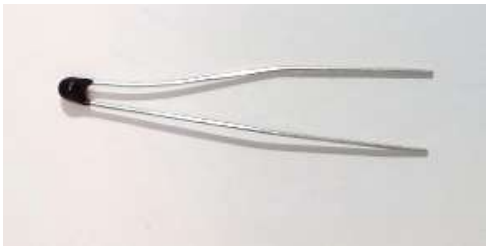
What is a Thermistor?

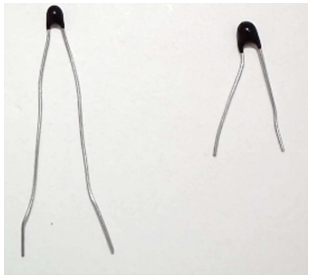
- Measures electrical resistance changes with temperature
  - Resistance decreases as temperature increases



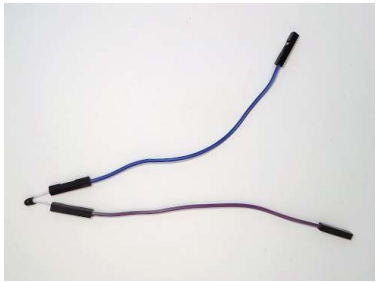
Circuit Diagram Symbol:



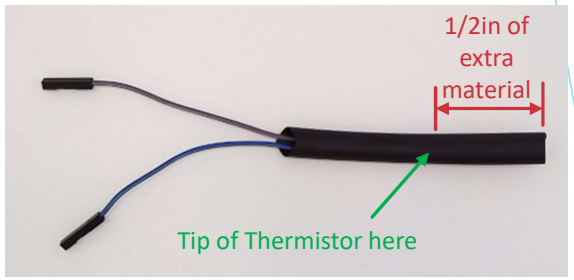
Waterproofing Thermistor



Clip approx. 1/2in off of thermistor legs

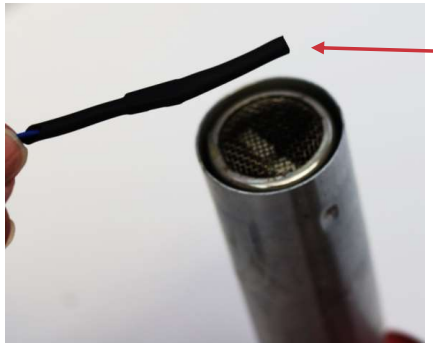


Attach wire extensions to each leg



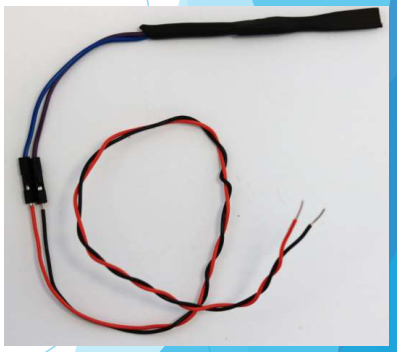
Cut heat shrink material to approx. 3in and slide it over the thermistor

Note: Leave approx. 1/2in of material passed the thermistor to be used as for a seal



Shrink material using heat gun

Clamp end of heated material to seal in the thermistor
Be sure to not crush the thermistor when clamping material



Strip wires jumper wires and connect them to wire extensions

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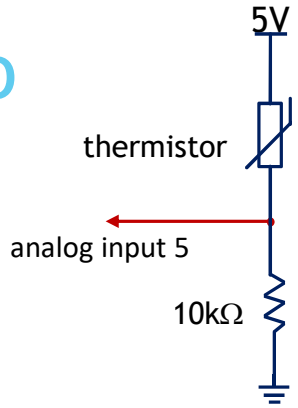
Interpreting Signal Using Arduino

- analogRead values can be converted to voltage drop across the 10kΩ resistor

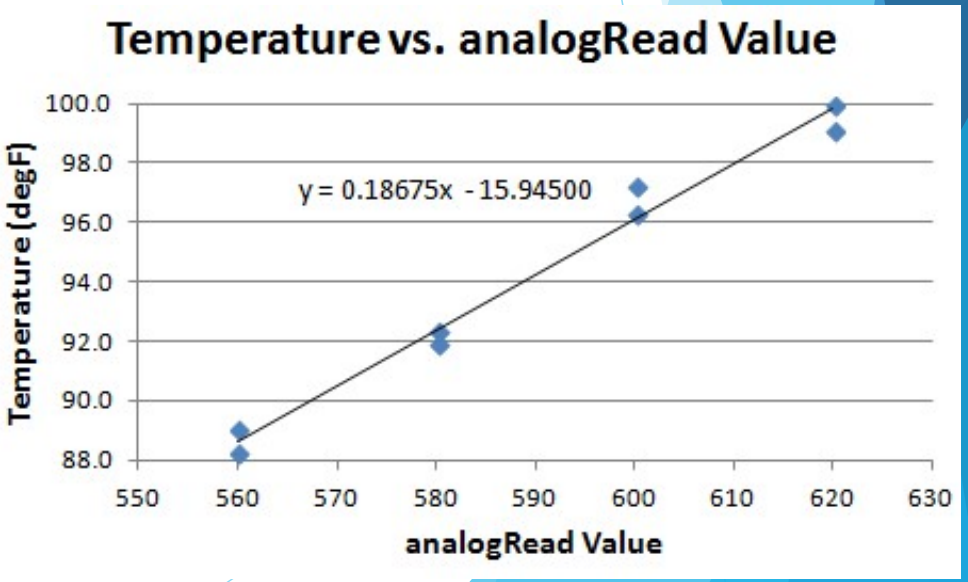
$$voltage = \texttt{analogRead}\ value \cdot \frac{5\ volts}{1023}$$



- analogRead values can also be calibrated to temperatures using a curve fit

```
temp = 0.18675*sensorValue - 15.945
```

	analogRead Value	Temperature (degF)
rising temp	560	89.0
	580	91.9
	600	97.2
	620	99.9
falling temp	620	99.1
	600	96.3
	580	92.3
	560	88.2



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What are relays?

- Relays are switches that are turned on and off using electricity
- Relays allow a low-power signal to control a large amount of power
- Relays are all around us

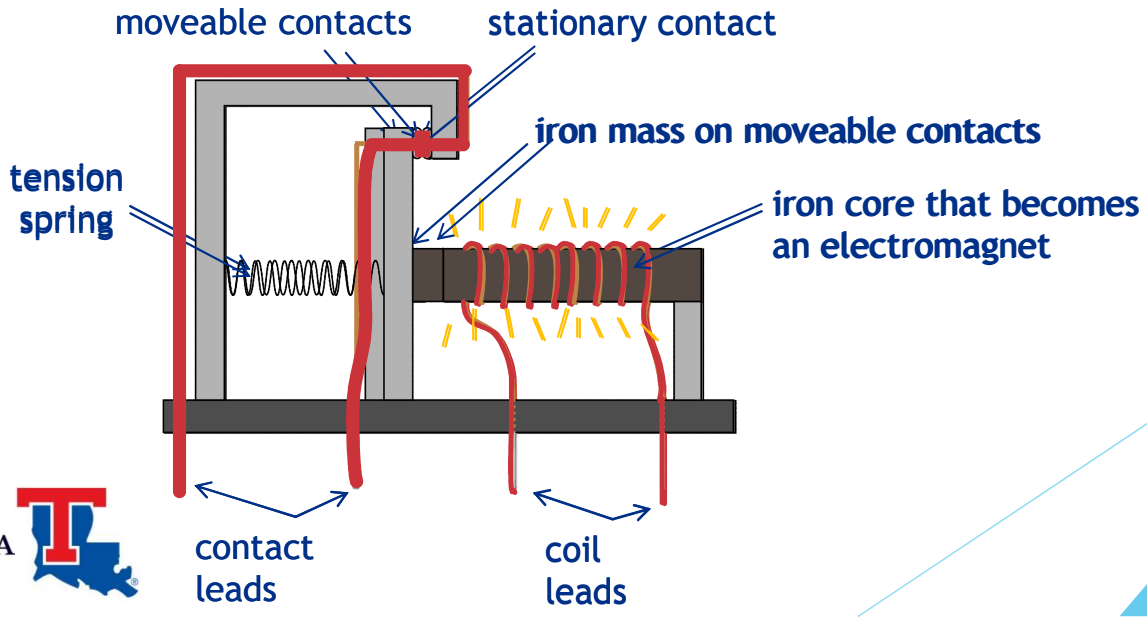
Automobiles

Refrigerator - turns on compressor when temp gets low

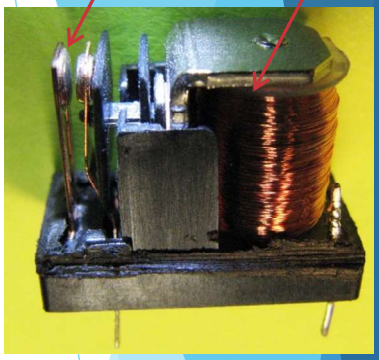
Industrial Controls

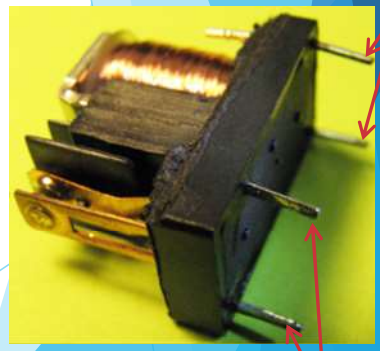
How do relays work?

- Relays pass a small current through a coil which causes the iron core to become magnetized
- This electromagnet attracts an iron mass on the moveable contact causing it make contact with the stationary contact
- With the contacts touching, a much larger current can pass to drive the load of the circuit



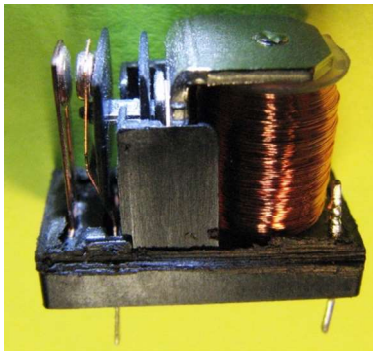
Inside the relay used here

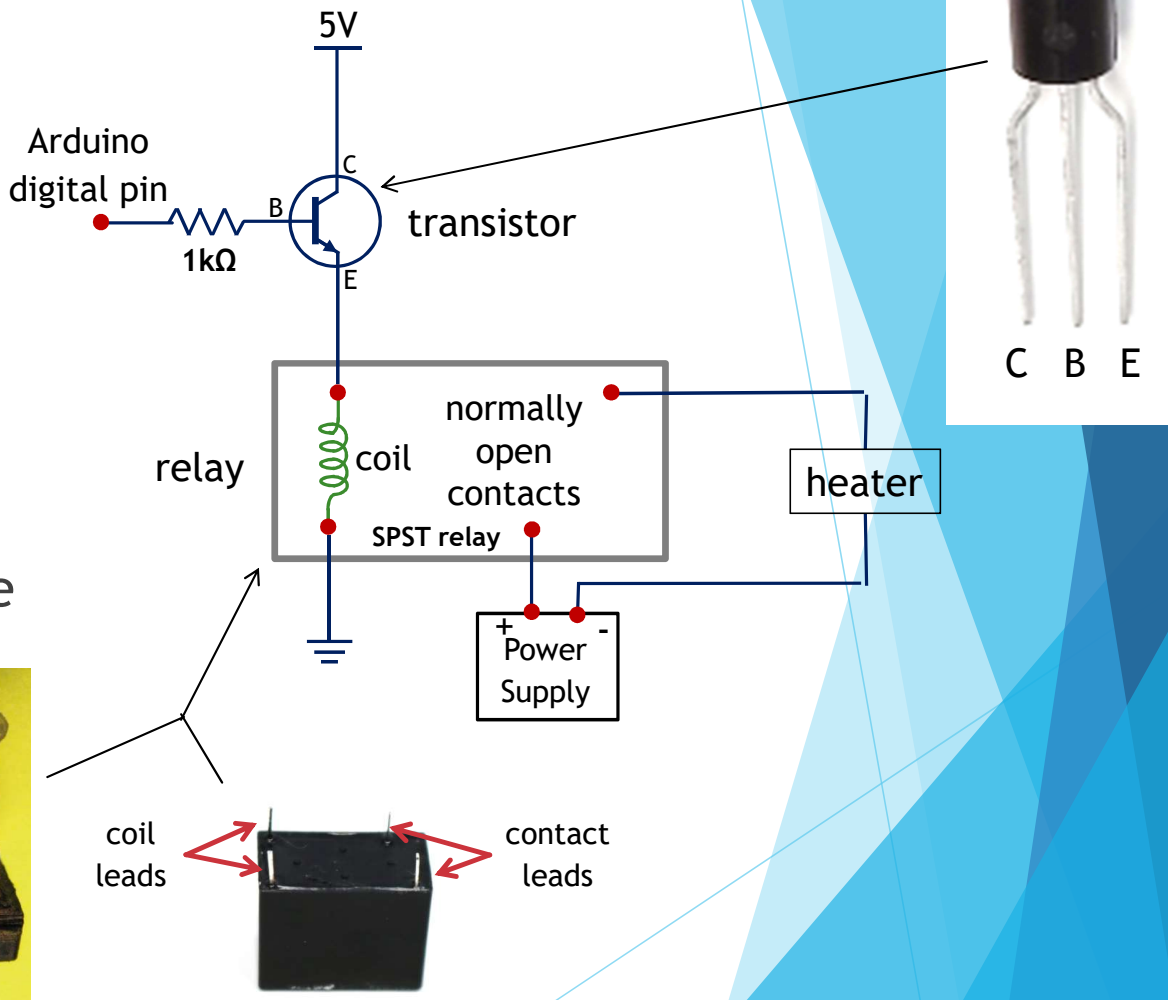


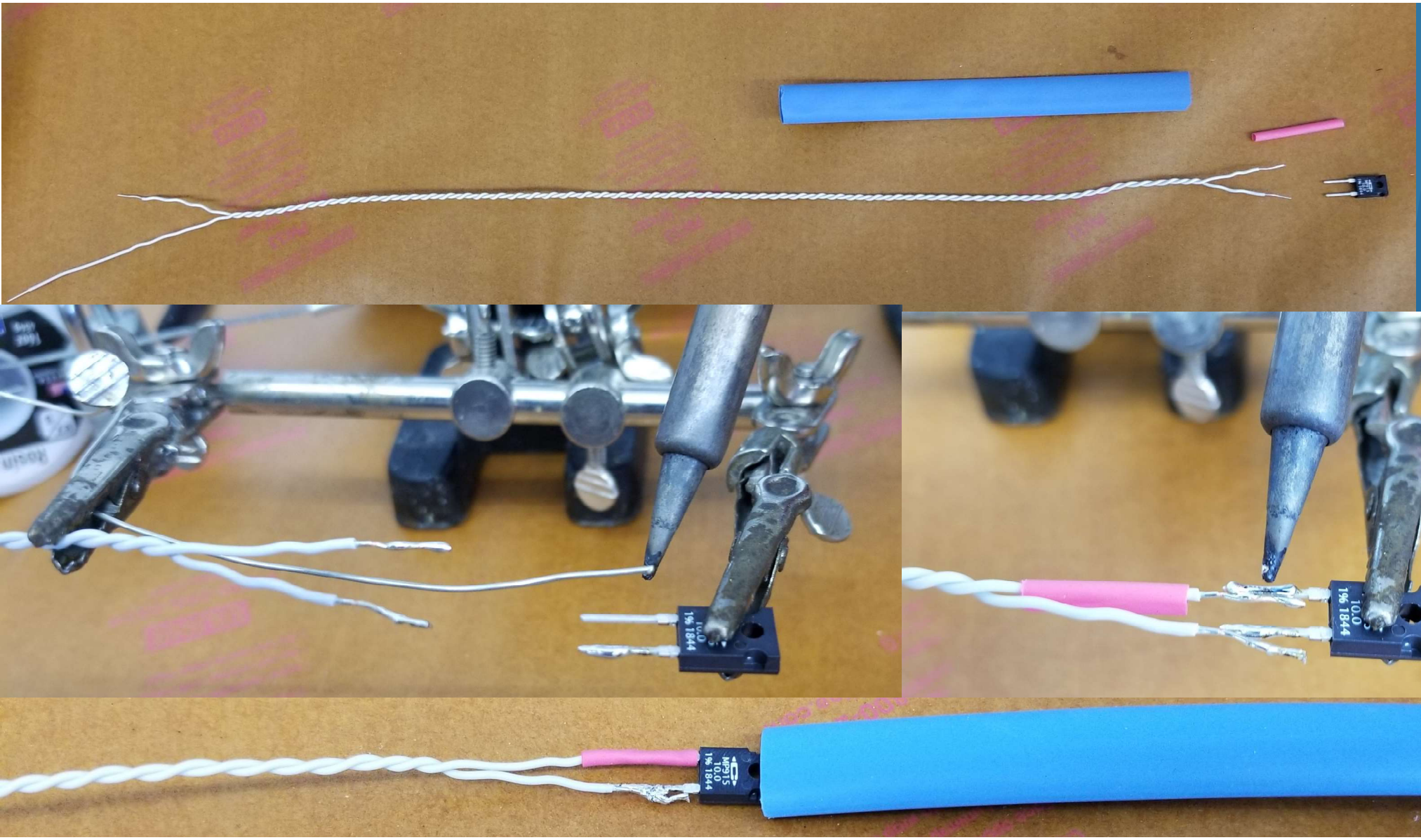


Wiring

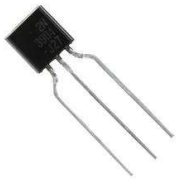
- Setting the digital output on the Arduino to HIGH switches **on** the transistor
- The transistor allows current to flow through the relay coil, closing the relay contacts
- Power from power supply energizes the heater, heating the water







Power Considerations



1. Power to switch transistor
   - source: Arduino digital I/O pin
   - max current per digital I/O pin: 20 mA

2. Power to switch relay
   - source: 5V from Arduino (from the on-board voltage regulator)
   - max current from the voltage regulator: 800 mA
   - coil current for relay: 40 mA

3. Power to heater
   - source: 9V power supply
   - max current: Up to 2A

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Arduino Program

- Senses the voltage input on analog pin 0 and stores as a number between 0 and 1023
- Computes decimal voltage value and temperature value
- Sends values back to the computer to show in the “serial monitor”
- Decides if heater needs to be turned on or off
- Sends heater state to serial monitor
- Waits 5 seconds and repeats

```
void loop() {

  sensorValue = analogRead(A0);

  voltage = sensorValue * (5.0 / 1023.0);
  temp = 0.18675*sensorValue - 15.945;

  Serial.print(sensorValue);
  Serial.print("  ");
  Serial.print(voltage);
  Serial.print("  ");
  Serial.print(temp);
  Serial.print("  ");

  if (sensorValue<589) {
    digitalWrite(9, HIGH);
    heaterState = 1;
    }
  else if (sensorValue>599) {
    digitalWrite(9, LOW);
    heaterState = 0;
    }

  Serial.print(heaterState);
  Serial.print("  ");

  if (heaterState == 1) {Serial.println("ON");}
  else                  {Serial.println("OFF");}

  delay(5000);
}
```


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Breakout Sessions

Curriculum Track

Career Info Track

(Until 10:45 AM?)
(Note taker in each group?)

Feedback for upcoming kickoff workshop?

Thank you again for being a part of Project COMPLETE!