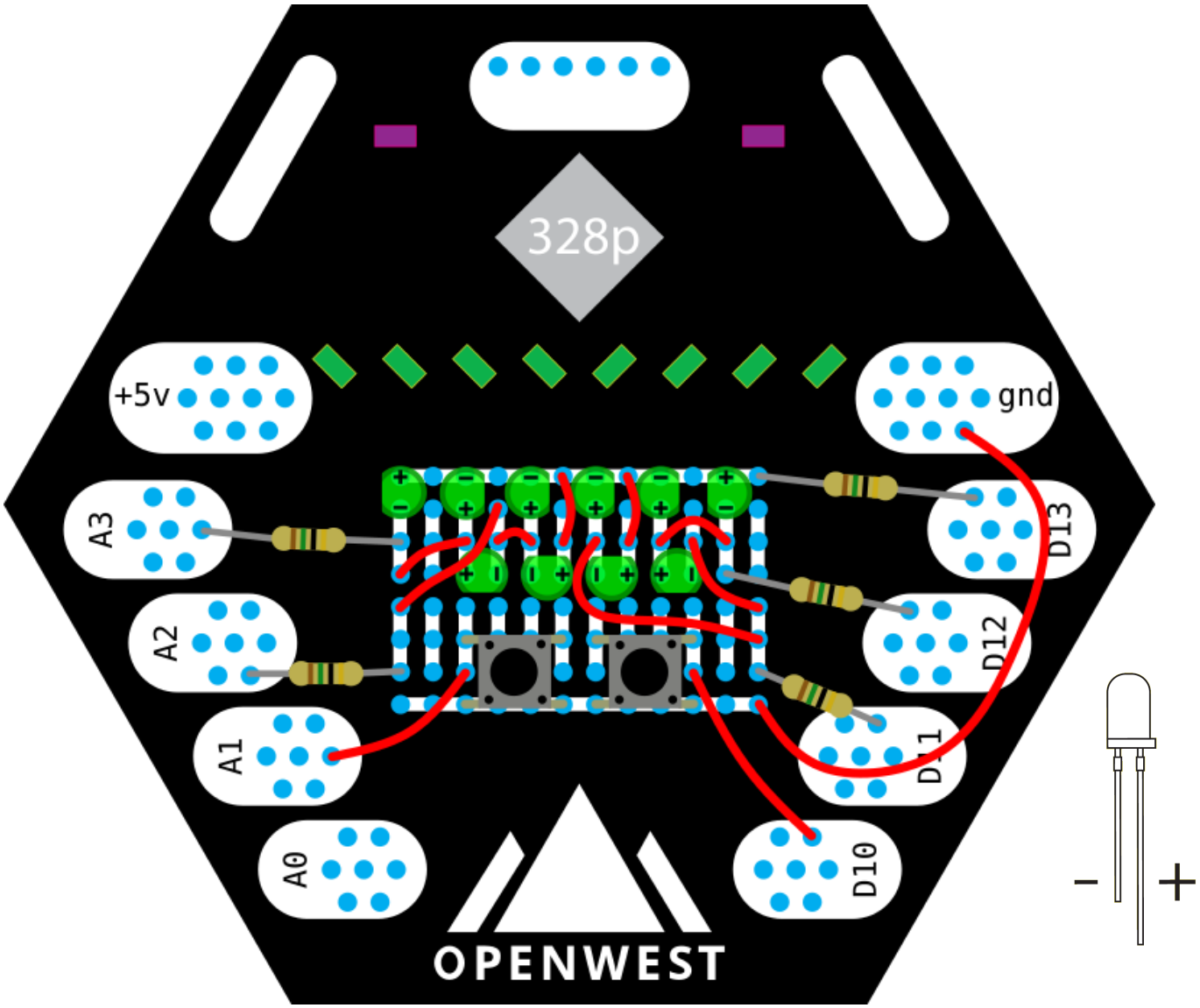
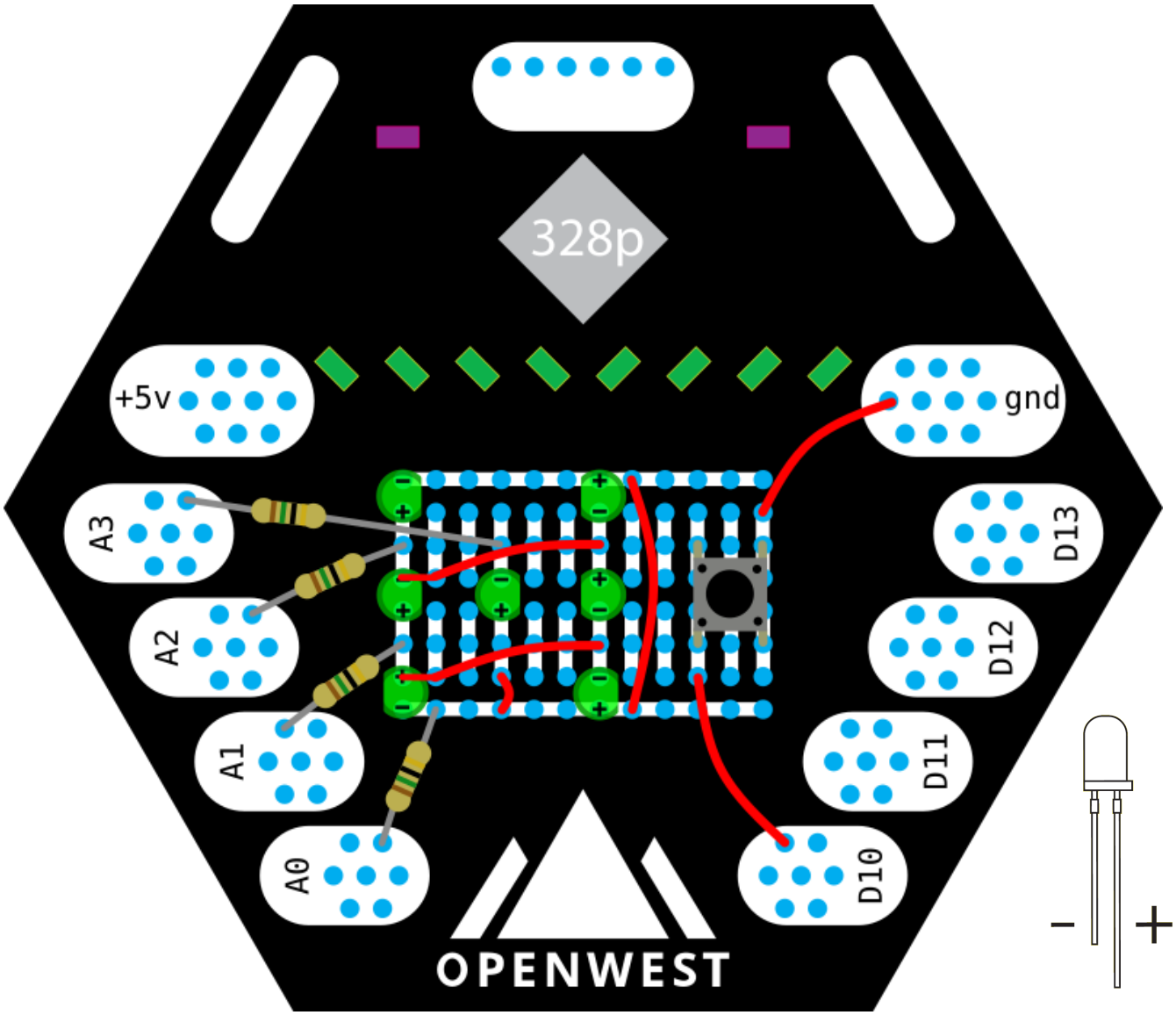
OpenWest 2017 Badge Add-on Kit – **Binary Clock**



- This add-on kit includes 10 LEDs, 5 resistors, and 2 buttons.
- **NOTE: LEDs are polarized.** Don't put them in backwards! Look carefully at the diagram to see which way to put each one. The legs on the LED are different lengths. Negative is shorter, Positive is longer. There is also a flat spot on the side of the LED. Match it with the diagram. **If you aren't sure which way it goes, please ask!**
- Basic Theory
    - A binary clock shows the time in binary, one row each for hours, minutes, and seconds. The binary clock is read from right to left, with each light representing one bit. Starting from the right side, the lights represent 1,2,4,8,16,32. You add the lighted numbers to get the time. You'll notice the hours row only has 4 lights. That's because we only need to count up to 12 (I know, 24 hours for military time, but we're trying to keep this simple, ok?)
    - The on-board LEDs are used for showing seconds. The middle row is minutes, and the bottom row is hours.
    - You use the buttons to change the time up or down by minutes.
    - Since we're limited on the number of connections for LEDs, we're using a technique called charlieplexing. Since LEDs are diodes, they only let electricity flow one way. Charlieplexing takes advantage of this by connecting pairs of LEDs backwards, and changing which side is connected to positive, and which to negative. This allows each LED to be turned on individually. We can take this a step further, due to the way pins work on microcontrollers. Each pin can be in one of three states, High, Low or High Impedance. High is connected to positive voltage, Low is connected to ground, and High Impedance essentially means it's disconnected. This allows us to connect pairs of LEDs in a large matrix to control many LEDs with just a few pins. Now, there are drawbacks to this setup. It's complicated to connect, and it's complicated to control. It involves switching a lot of pin states, and can be confusing. Another drawback is that only one LED can be turned on at a time. To get around this, we flash each LED quickly, and rely on persistence of vision to make it look like they're on all the time.

For more info and color images, visit github.com/theTransistor

OpenWest 2017 Badge Add-on Kit – **LED Dice**



- This add-on kit includes 7 LEDs, 4 resistors, and 1 button.
- **NOTE: LEDs are polarized.** Don't put them in backwards! Look carefully at the diagram to see which way to put each one. The legs on the LED are different lengths. Negative is shorter, Positive is longer. There is also a flat spot on the side of the LED. Match it with the diagram. **If you aren't sure which way it goes, please ask!**
- Basic Theory
    - The electronic die has LEDs arranged in the same pattern as a six-sided die. When you press the button, the die flashes through random numbers, finally landing on one. You can use it as a replacement for a single die in a game.
    - There is a limitation to this electronic die. It's not going to be truly random. Computers aren't good at random, so while it's not good enough for Vegas, it'll work just fine for casual games.
    - Since we're limited on the number of connections for LEDs, we're using a technique called charlieplexing. Since LEDs are diodes, they only let electricity flow one way. Charlieplexing takes advantage of this by connecting pairs of LEDs backwards, and changing which side is connected to positive, and which to negative. This allows each LED to be turned on individually. We can take this a step further, due to the way pins work on microcontrollers. Each pin can be in one of three states, High, Low or High Impedance. High is connected to positive power, Low is connected to ground, and High Impedance essentially means it's disconnected. This allows us to connect pairs of LEDs in a large matrix to control many LEDs with just a few pins. Now, there are drawbacks to this setup. It's complicated to connect, and it's complicated to control. It involves switching a lot of pin states, and can be confusing. Another drawback is that only one LED can be turned on at a time. To get around this, we flash each LED quickly, and rely on persistence of vision to make it look like they're on all the time.
    - Regarding the charlieplexing, I know we only need 8 connections for 7 LEDs and one button. However, plans were changed after parts were ordered, and the resistor value is too low to directly power the LEDs, so they are still being charlieplexed.

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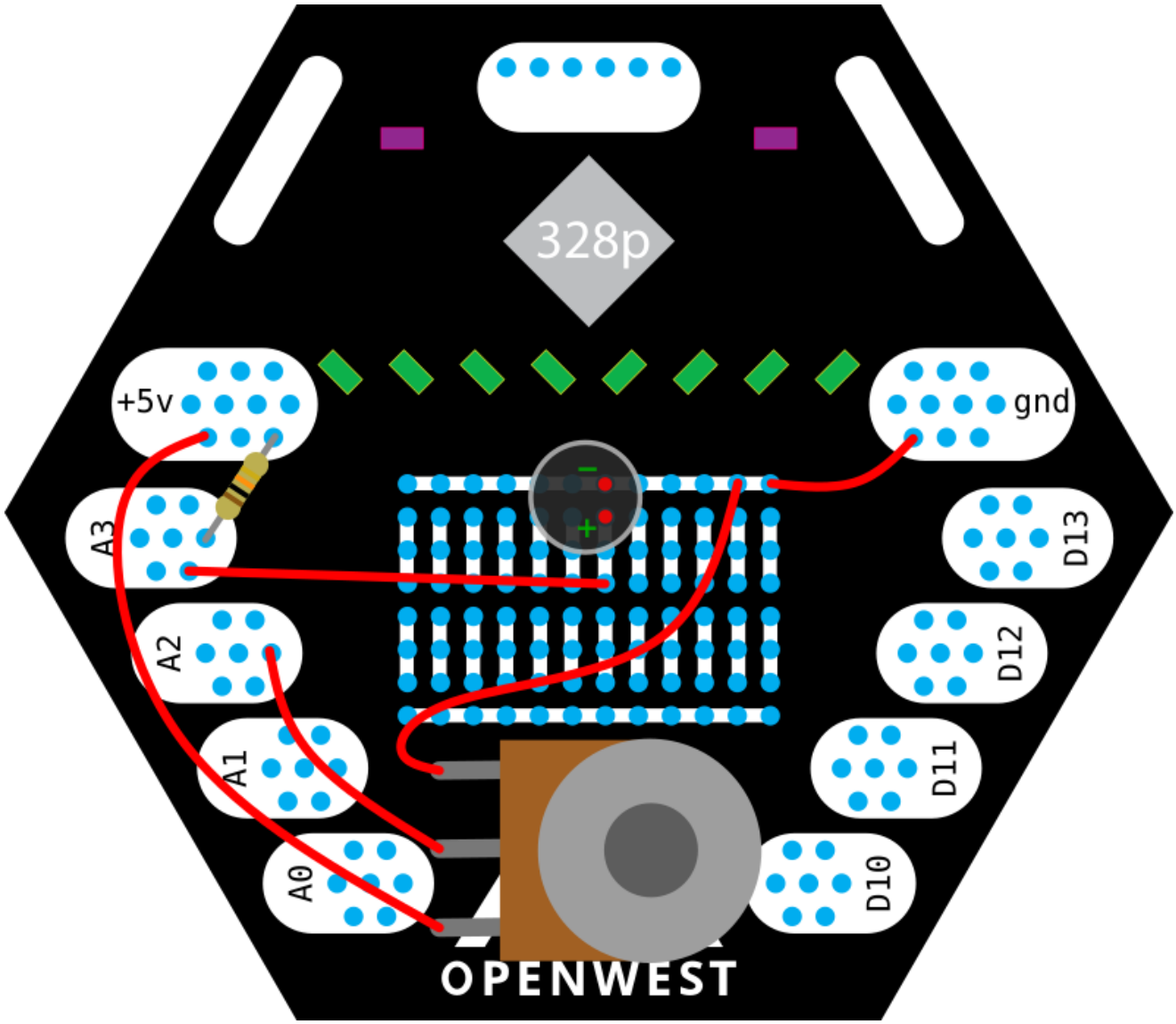
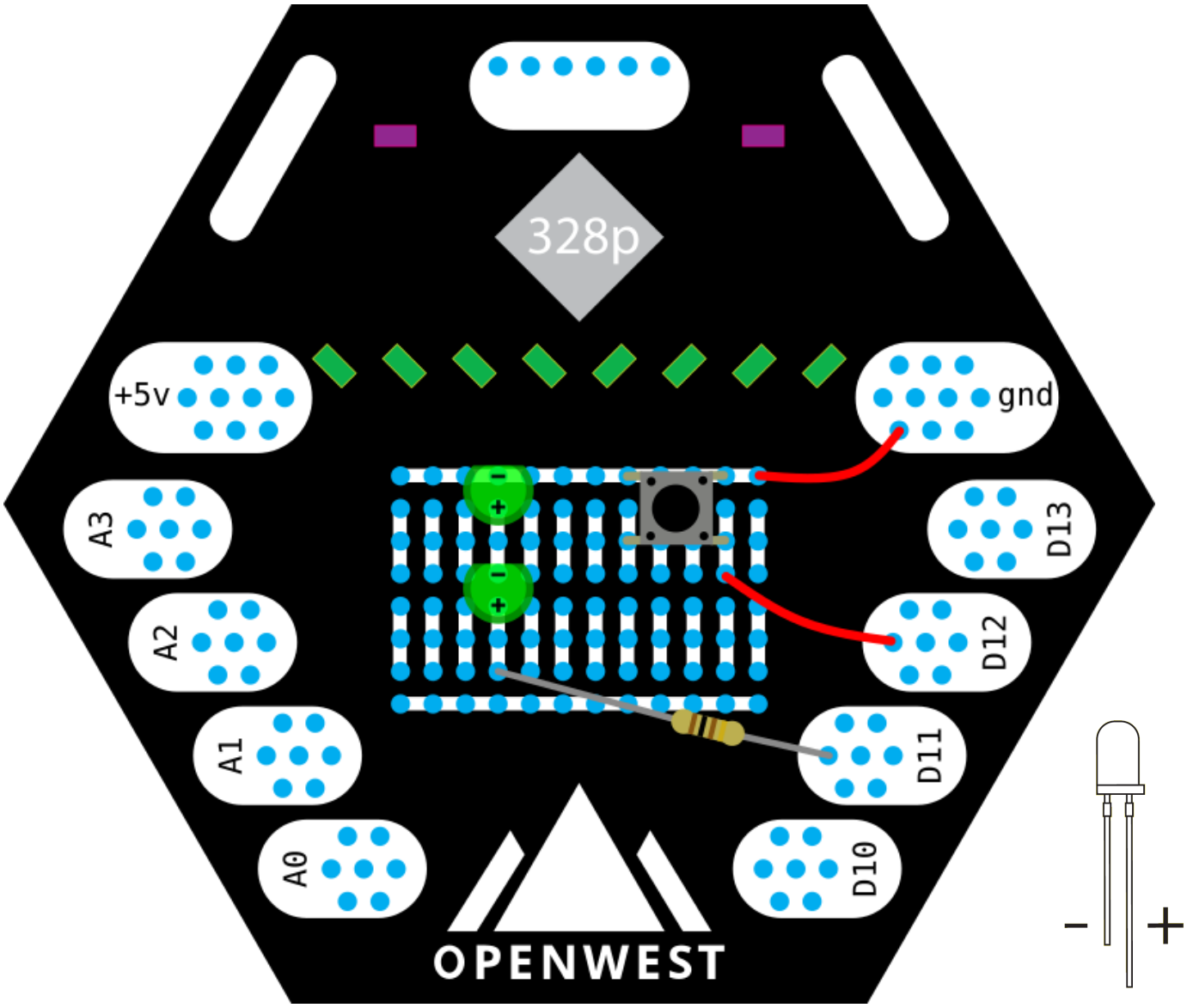
OpenWest 2017 Badge Add-on Kit – **VU Meter**



- This add-on kit includes 1 electret microphone, 1 potentiometer, and 1 resistor.
- **NOTE: The microphone is polarized.** Don't put it in backwards! Look carefully at the diagram to see which way to put it. On the bottom of the microphone, there are small green traces on the negative side. Match it with the diagram. **If you aren't sure which way it goes, please ask!**
- Basic Theory
    - This sound meter uses the microphone to pick up sounds around you and display the level using the on-board LEDs. The potentiometer allows you to adjust the sensitivity.
    - This is a super-simple circuit, and suffers from a lack of sensitivity. Microphones generate very small voltages in response to sound waves. Normally, you would use a pre-amplifier to boost this tiny signal before sending it to your microcontroller. We've skipped the pre-amp to keep this kit simple. This means that we have a very small voltage to work with, so small variations won't be easy to see.

OpenWest 2017 Badge Add-on Kit – **TV-B-Gone**



- This add-on kit includes 2 IR LEDs, 1 resistor, and 1 button.
- **NOTE: LEDs are polarized.** Don't put them in backwards! Look carefully at the diagram to see which way to put each one. The legs on the LED are different lengths. Negative is shorter, Positive is longer. There is also a flat spot on the side of the LED. Match it with the diagram. **If you aren't sure which way it goes, please ask!**
- Basic Theory
    - This is a simplified version of the popular TV-b-gone kit. When you press the button, the IR LEDs emit power-off commands for popular TV brands. One of the on-board LEDs blinks when each code is transmitted. There are over 100 codes, and it can take 30+ seconds to send them all.
    - This kit has a limited range compared to the real thing. It will only transmit 5-10ft, depending on how accurately you point the device at the TV's IR receiver. This limitation is due to the limited power we can pull out of the single battery on the badge, as well as trying to minimize disruption to TVs at the conference :) The real TV-b-gone uses transistors to supply more current to the LEDs, thus allowing a longer range.
    - Once you've assembled the kit, use your cell phone camera to see if the IR LEDs are flashing.

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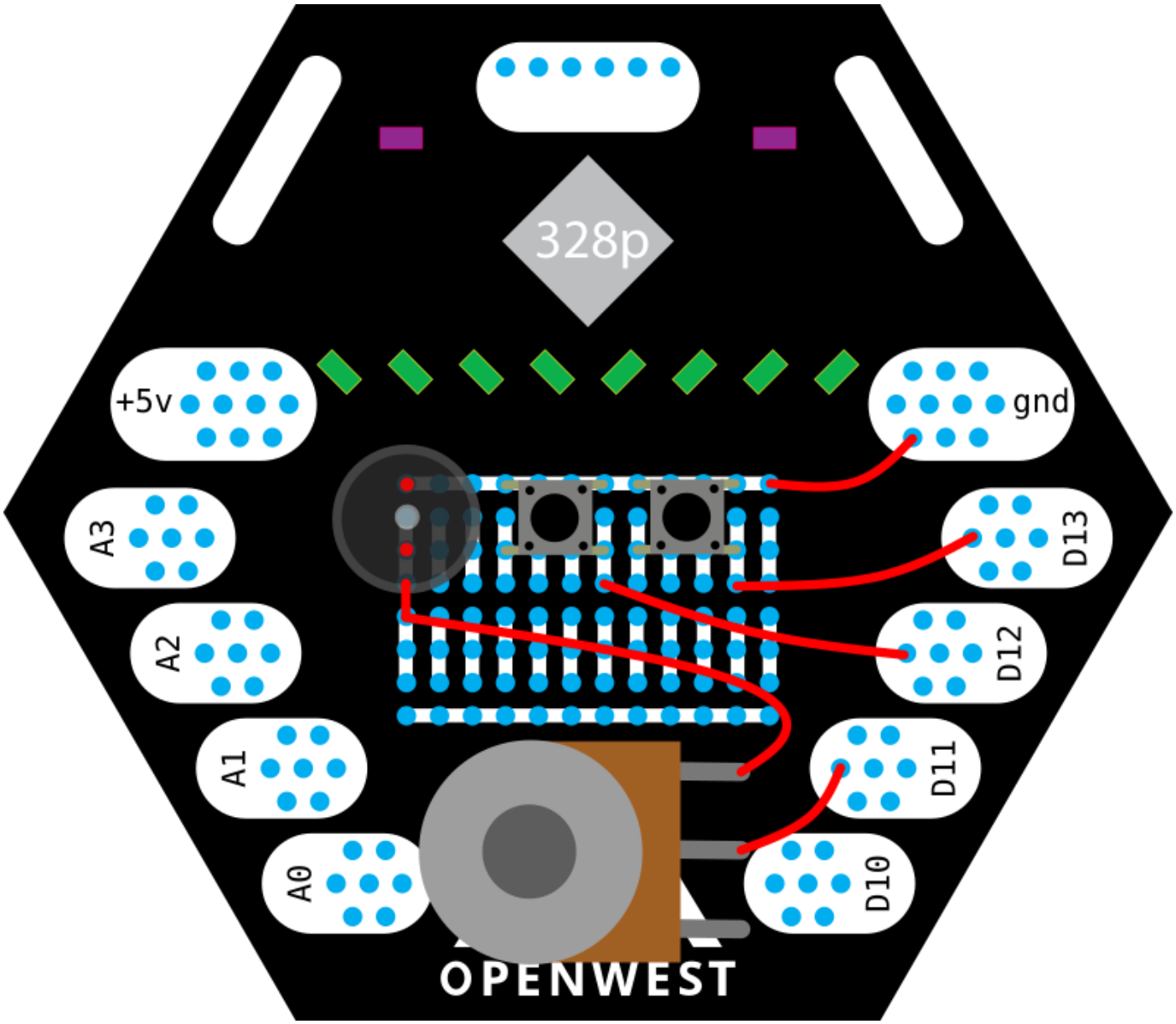
OpenWest 2017 Badge Add-on Kit – **Chiptunes**



- This add-on kit includes 1 piezo buzzer, 1 potentiometer, and 2 buttons.
- Basic Theory
    - The piezo buzzer is used to play simple tunes. The potentiometer allows for some volume adjustment. The left button selects the tune (indicated by which LED is lighted). The right button starts/stops the tune.
    - The sound is produced by sending electronic pulses to the buzzer at the correct frequency for the desired note. By running through a list of different frequencies, simple melodies can be produced. You'll probably notice that some notes are louder than others. This is because the buzzer is tuned to emit a particular frequency, so it's more efficient at that frequency, resulting in a higher sound level.