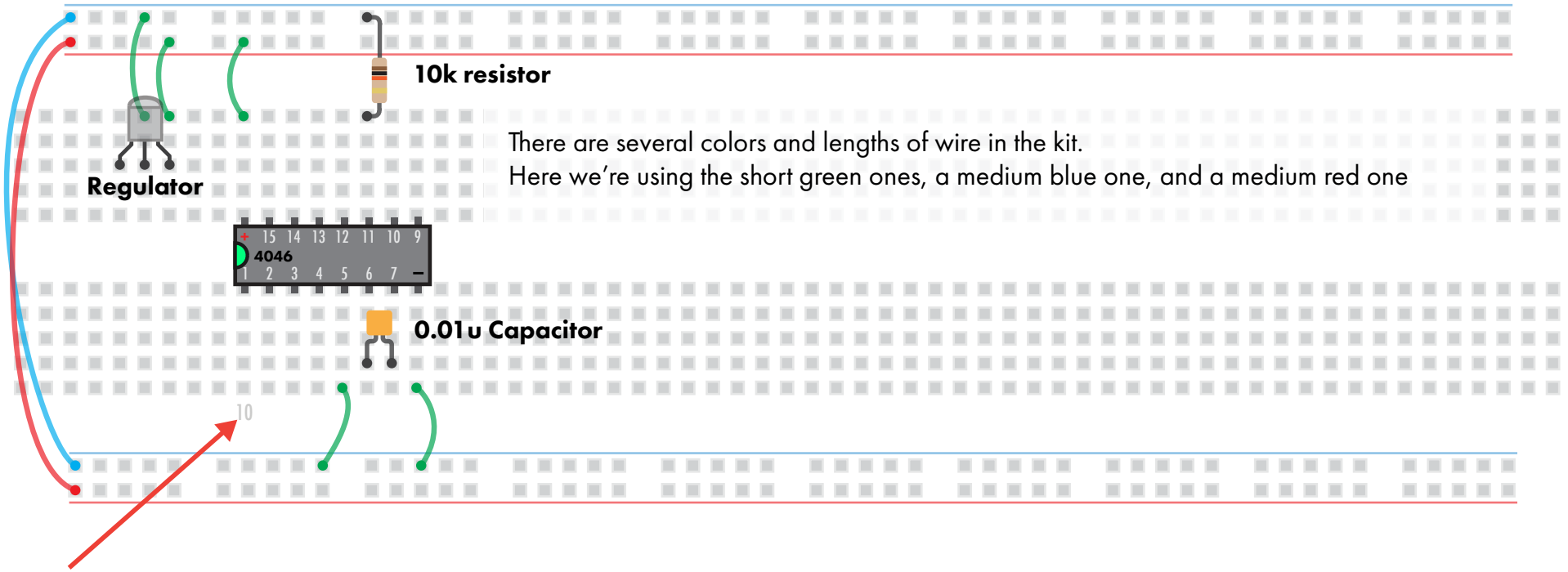
Step 1
Chip and Power Wires

Make sure the blue line is on the top before starting

The 10k Ohm resistor and .01u Farad capacitor do not have a direction and can be installed in either direction.



Put the chip in so the pins on the left are in the column marked "10",
We could put it anywhere on the breadboard but this makes sure we'll have enough space for the other parts.

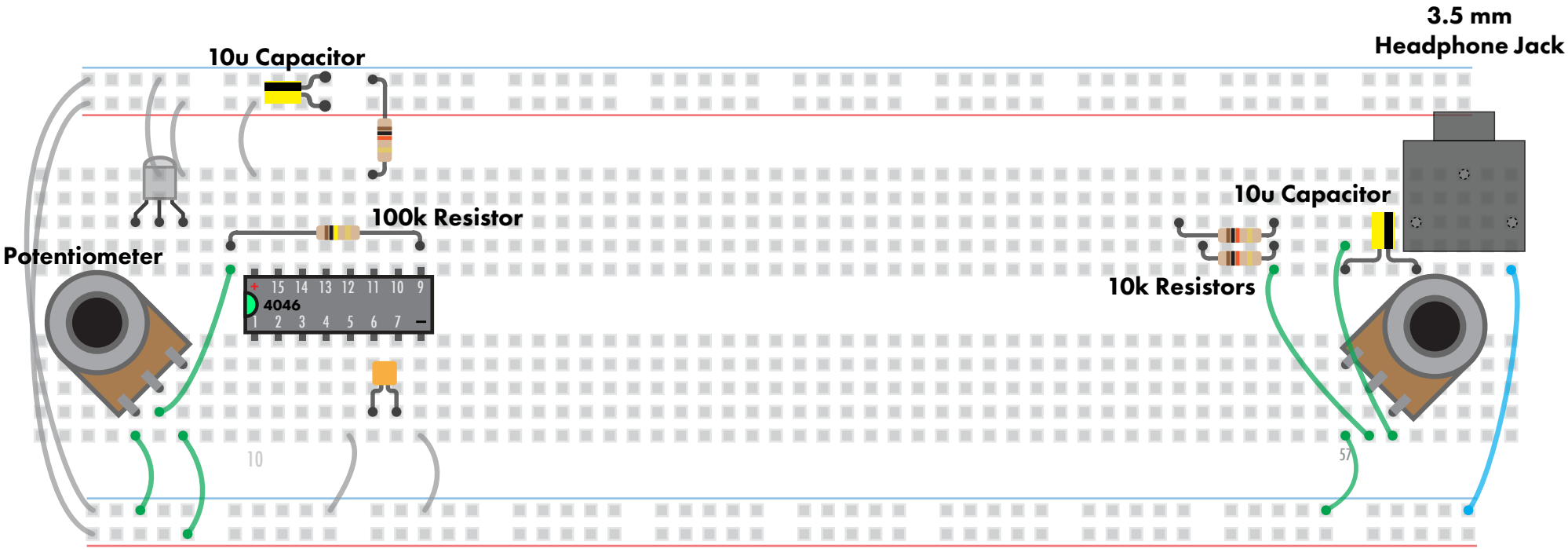
The chip has a half circle notch on one side painted green. Make sure it is on the left.
If the chip is in backwards it might get damaged when powered on.

The regulator is there to turn the 9 Volts from the battery into 5 Volts. This is required by one of the chips we'll install later.
Make sure it is insalled with the flat side facing you.

Step 2

Potentiometers and Headphone Jack

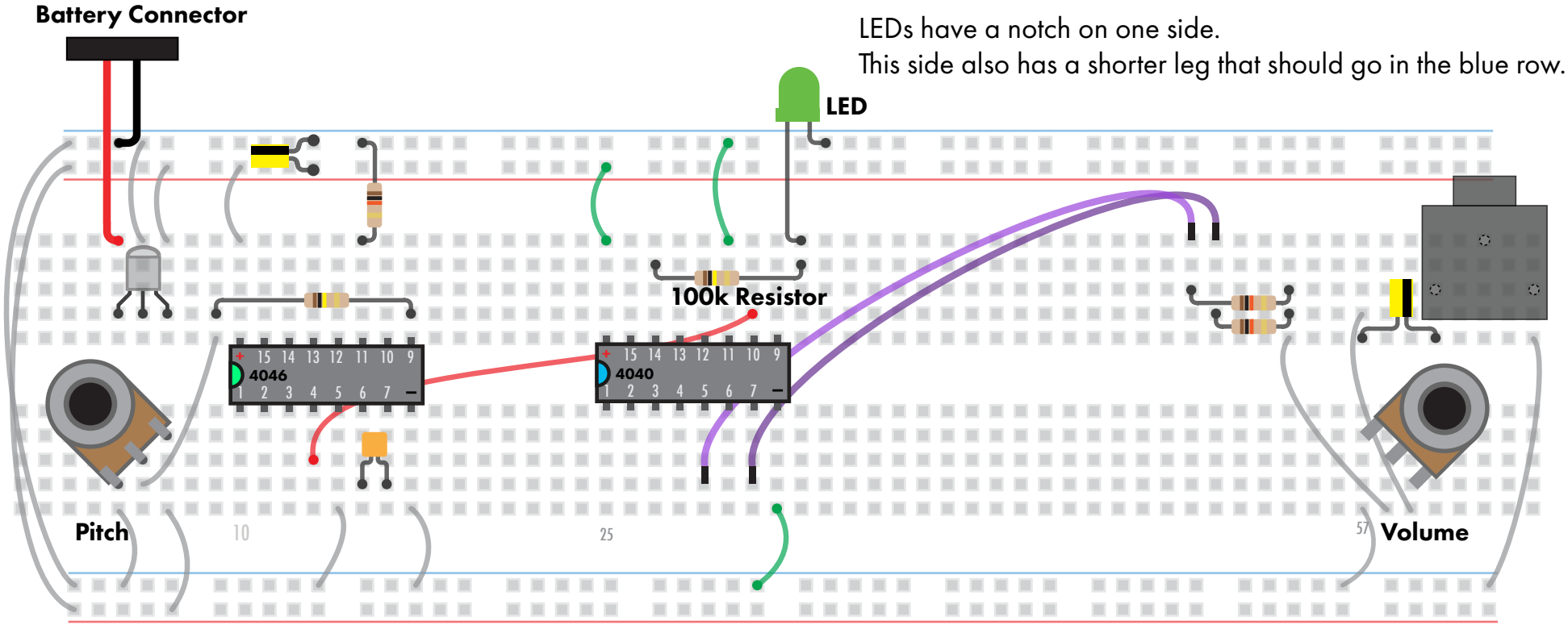
The 10u capacitors are polar meaning they need to be installed in a specific direction.
They have black stripes on one side. This side also has a shorter leg.



A potentiometer or pot is a variable resistor. It will allow us to change how fast the circuit is oscillating and the output volume.
They are installed in at an angle as shown and will not fit in the breadboard otherwise.

Step 3
4040 and First Sounds

Install the battery connector wires.
Don't install the battery unitll you are sure everything is in the correct place.



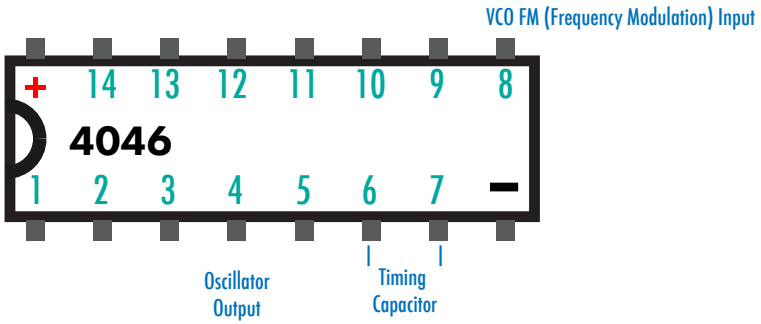
Before attaching the battery make sure both chips have the notch on the left and all of the wires are going to the correct places.
If the small wires going to the red and blue bus lines are flipped you might damage the chips.

Once you are sure everything is correct attach the battery and plug in your headphones.
You'll hear a tone controlled by the left potentiometer. The right pot controls volume.

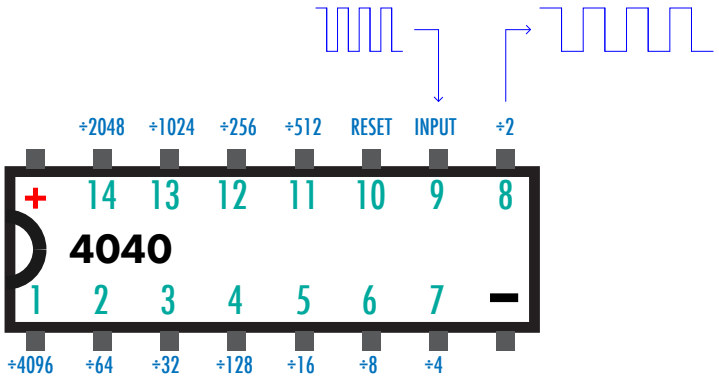
The purple wires with black ends are jumper wires. These types of wires are made to be repositioned.
They are hooked up so we can hear two differnt octavesof the main oscialltor.
Try conncting them to any two pins from 1-7 on the 4070.

Here's a brief description of the two analog chips we're using.

They are not "computer chip". They aren't programmed and are more like plumbing.
They are set up to do a specific things and they do them very efficiently but are not very flexible.
Chips like these were first used in the 1960s but can still be found in some electronic devices today.



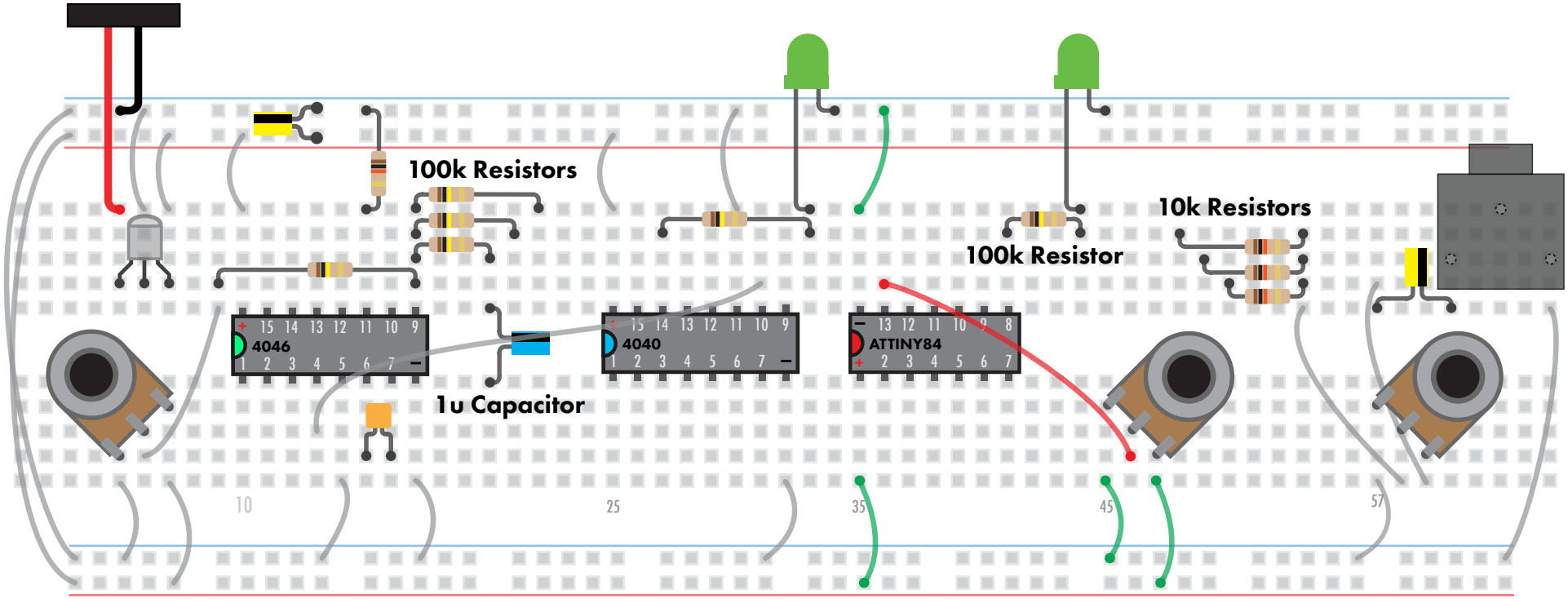
The 4046 is a Phase Locked Loop with VCO. We're only using the VCO or Voltage Controlled Oscillator.
The output pitch is determined by the voltage at pin 8 and the size of the timing capacitor. The higher the voltage the higher the pitch.
So far we're been using a potentiometer to send this pin 0 to 5 Volts.



The 4040 is a 12-stage binary ripple counter. That means an incoming square wave's frequency is divided in half 12 times.
If your input is 440 Hz then pin 8 would output 220Hz, pin 7 outputs 110Hz and pin 6 outputs 55Hz, all at the same time.
This lets you build a complex sound by combining outputs. Or we can use the slow divisions and modulators.
It also just so happens that it sounds very musical as dividing a frequency by two gives you one octave down from the original tone.

Step 4
Sequencer

Remove the battery and jumper wires before continuing.



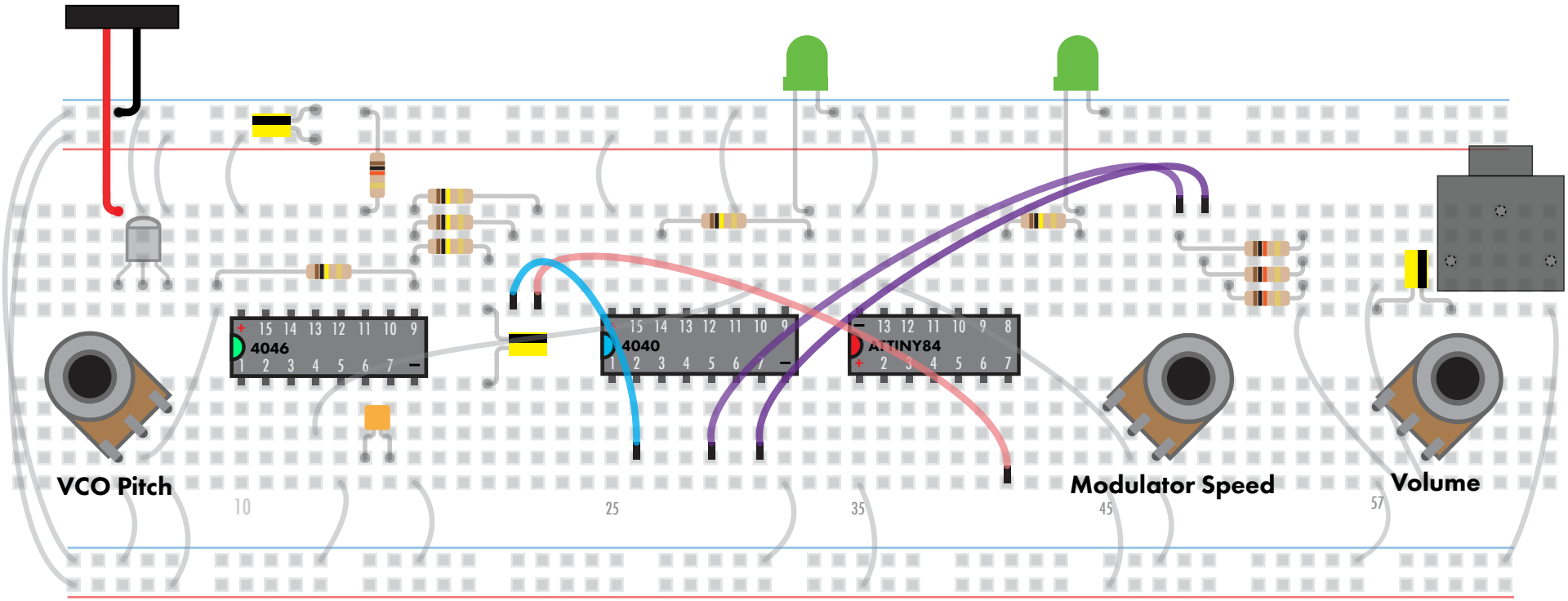
Add three 100k resistors to pin 9 of the 4046. This is where we'll patch in other voltages to change the pitch.
One of the 100k resistors is also attched to a 1u capacitor.

Add another 10k resistor on the right. These three resistors act as out output mixer.

The ATTINY84 goes in at pin 35. Notice that thewires that go to the red and blue bus lines are different than the other chips.
Attached to this chip is another 100k resistor and LED and a potentiometer.

If we power it on now we'll see the new light blink randomly with it's speed of change controlled by the new potentiometer.

Step 5
First Patch



There are lots of ways to patch your new Seq Synth. First let's try this:

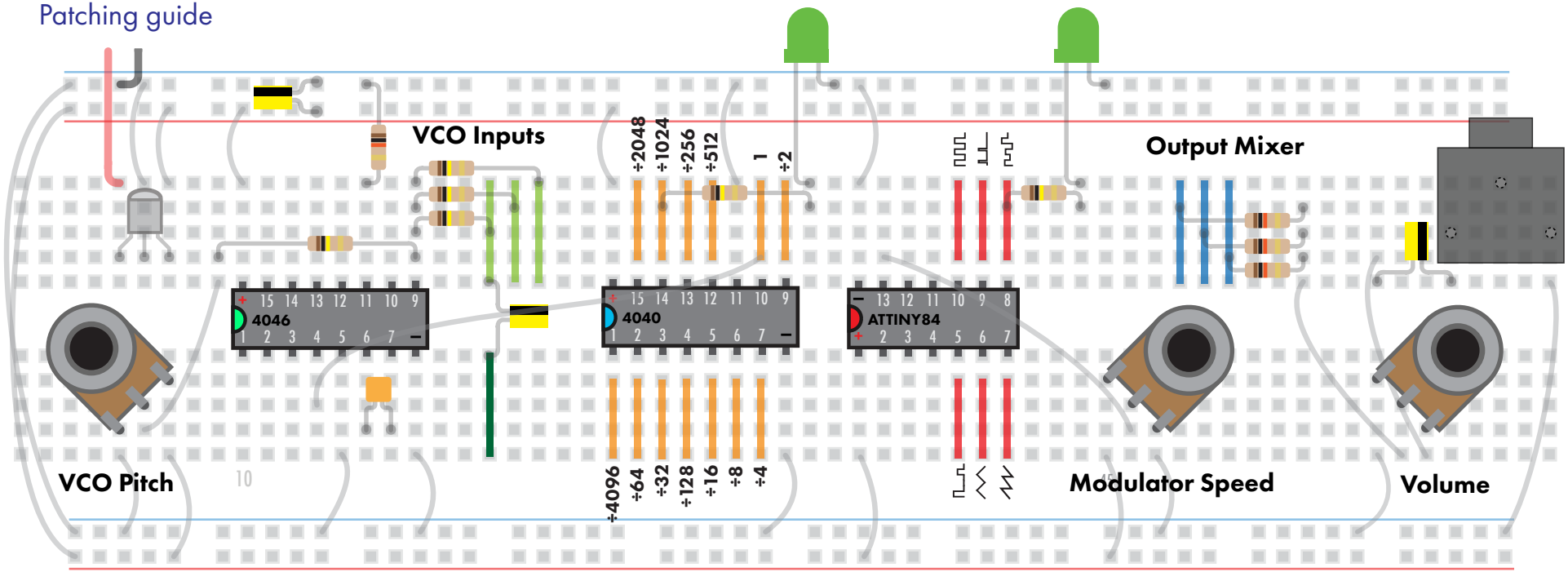
The two purple jumper wires select the pitches of the oscillator we will hear. First connect one, then the other to see how the sounds changes. Turn the pot on the left to change the pitch.

Next add the pink jumper wire. This will modulate the frequency of the VCO with a fast ramp wave.
The speed of the modulator is controlled by the middle pot.

Last add the blue jumper wire. This will modulate the VCO frequency with it's own output.

Step 6

Patching guide



Try making your own patch!
You won't break anything by patching but just wire one output colum to one input colum. Multiple things patched to one input won't work well.

The red pins are sequencer outputs. Attach these to the VCO input pins to change the pitch (more about each output on the next page).

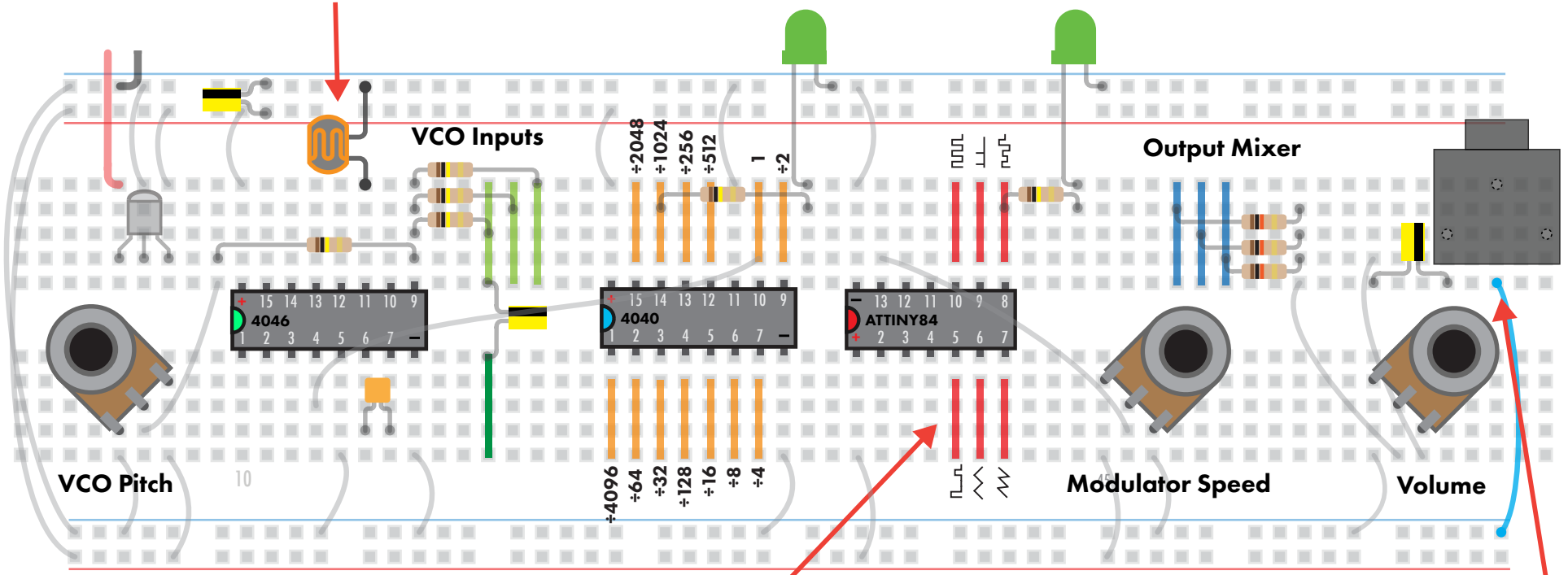
The orange pins outputs which are octave divisions of the main oscillator.
"1" Is the VCO itself and is the highest. "÷2" would be one octave down and ÷4 would be 2 octaves and so on.
After 128 they start to get too low to hear but they mefoce great modulators.

The green blue pins are the VCO inputs. You can change the pitch with up to three different things.
Try patching any of the red or orange outpts to one of these three colums.
The dark green pin is another input pin that acts a little differently.

The blue pins are the audio output mixer. You can attach three different orange pins here to output them to the headphone jack.

Step 7
Mods

You can also control the pitch of the oscillator with light!
Replace this resistor with a photocell.
Now the pitch knob and the amount of light hitting the photocell will change the pitch



The ATTINY84 is a microcontroller, a digital chip that can be programed to do differnt things using the Arduino platform.

You can find more about the code at bleeplabs.com/AustinWeek

It must be powered with 5 Volts. Plugging the red 9V wire into the red bus wire will destroy the chip.

Sequencer output pins:
5 - Random pulses of different levels
6 - Slow Triangle wave
7 - Fast ramp wave
8 - Random voltage steps
9 - Random short pulses of the same level
10 - Fast square wave

The output is mono but sounds like stereo in headphones.
If you plug this into an amplifier be sure to use a mono plug.

If that is not an option move this wire to here

Thanks for coming to the workshop!
You can learn more about this circuit and more at bleeplabs.com/AustinWeek