

# Touch-sensitive drawing



Interactive painting 'Awake' by Sofia Aronov.

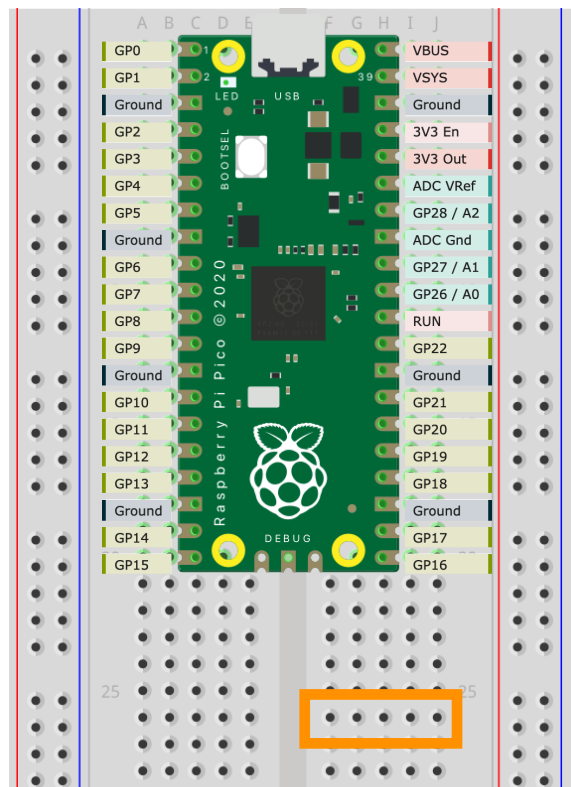
To make things touch-sensitive, we will use this green circuit board, a Pico microcontroller. It has a lot of pins on its sides. As you can see in the schematic, some pins have specific functions like input/output of power (those are marked red) and some are 'general purpose' (the green labels). Those can be used to connect lots of electronic components like sensors or motors.

The Pico you have in front of you is pre-programmed to make our artworks touch-sensitive. It is pushed into what is called a **breadboard** (the white thing with all the small holes).

The holes on the breadboard are connected to each other in rows of five, like the ones in the orange rectangle in the schematic.

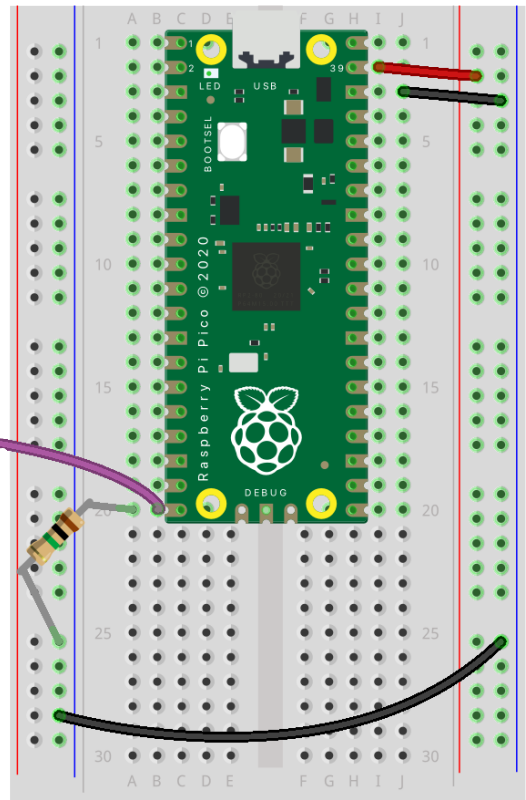
If we want to connect wires and components to each other, we only have to push them into holes on the same row.

The holes along the red and blue lines are connected to each other vertically. Red is for plus and blue for minus, like on a battery.



Make all connections just like in the schematic:

- Get a crocodile cable with a male connector. Push its pin into the breadboard, right next to the last pin on the left side of the Pico
- push one leg of a resistor (the stripey thingie) in the same row
- push the resistor's other leg in one of the holes next to the blue line
- Use a male-male wire (preferably black or blue) to connect both blue line columns of the breadboard with each other.  
*Make sure NOT to put it into a hole next to the red line!*



## Drawing

Let's start with drawing a first 'button'.

It can be a simple shape. Leave room for three more drawings.

It should go to the edge of the paper so you can connect an alligator cable to it, like in this example:



We're using a 9B graphite crayon, which is soft and conducts electricity well. Put the graphite on **really thick**. If you make lines that are too thin then the drawing will not form a good connection to the microcontroller.

Once you are done, clip the alligator cable coming from your breadboard onto the drawing.

## Powering up the Pico

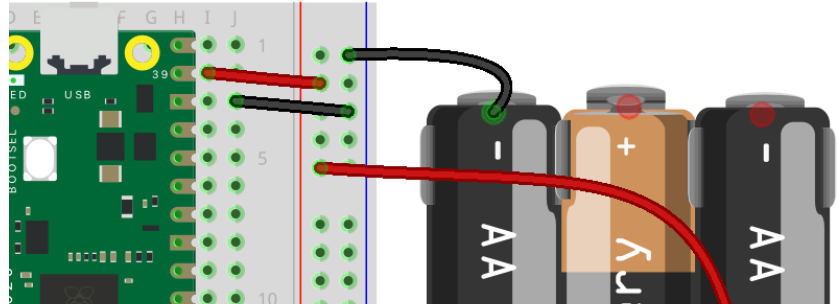


One way to power the Pico is using a battery pack (one with 3 AA batteries).

*MAKE SURE YOU GET THIS RIGHT or the Pico will break:*

Connect the **red wire** from the battery pack to a hole next to the **red line**.

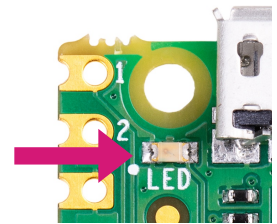
The **black wire** should go to a hole somewhere next to the **blue line**.



Your workshop host already put two short wires in the breadboard to connect the Pico to the red and blue 'power rails'.

Once it gets power, the LED light on the Pico should blink a few times. If it doesn't, then check if all wires are in the right rows.

Now you should be able to touch your drawing and see the LED on the board change when you do!



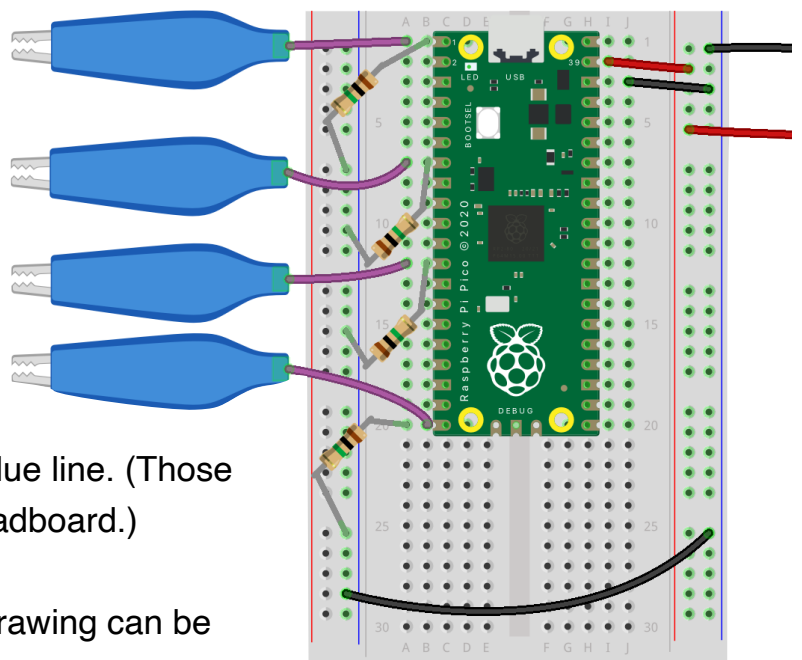
## Adding more touch-sensitive drawings

Let's add three more touch-sensitive areas to your artwork.

First, add three sets of resistors and cables to the breadboard, like in this schematic.

The new resistors connect the 1st pin, the 7th and the 12th pin to the blue line. (Those numbers are also printed on the breadboard.)

Now draw the extra 'buttons'. Your drawing can be anything, as long as there are four separate parts in total. Each part needs a connection to the edge so you can connect an alligator



cable to it (it's easiest if all start at the same edge). You can draw your lines anyway you like as long as the four parts have at least one finger's width between them.

Once you have made the drawings, connect the alligator clamps to them. Restart the Pico by taking out one wire of the battery for a second and putting it back in.

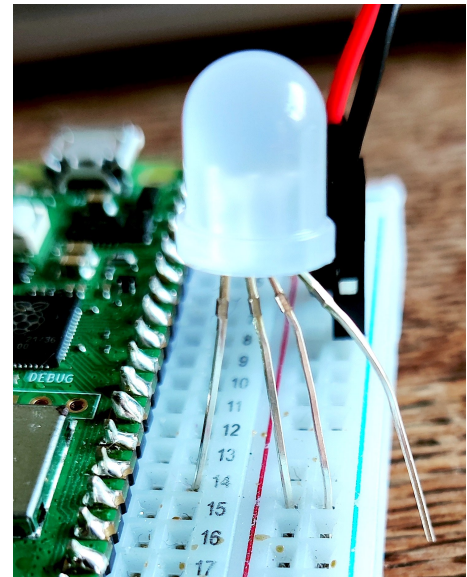
Now test if the new parts work! (Check all connections if not all drawings make the LED blink. The top-left pin of the Pico may only sense touching when you are also touching the Pico's USB connector at the same time. More on that later.)

## More colour

We can make your interactive artwork more interesting by adding another output: an Neopixel LED. It will be able to respond to each separate part of your drawing with **different colours!**

The Neopixel LED has four legs. You may have to bend them a little to fit the breadboard.

Take one of the wires from the battery out of the breadboard (make sure they do not touch the Pico or other things while you continue).



Hold the LED in front of you so the longest leg is the third one.

Now push the LED into the breadboard so that

- the first (left) leg is in the same row as pin 14 of the Pico
- the second leg is in the red column
- the third (longest) leg is in the blue column
- the last leg one we will not use. Just bend it so it sticks out over the edge.

Double-check to see if the legs of the LED are not touching each other.

Re-attach the battery.

Touching your touch-sensitive drawing should now make you see colours!  
(Holding the drawing for longer changes the output ;-)

## Making sounds

Let's try a different output: sound!  
We'll connect a small amplified speaker to the Pico.

Take two cables with alligator clips on one end and male connectors on the other end.

Connect one alligator clip to the top of the plug from the speaker and one to the bottom part, like so >>

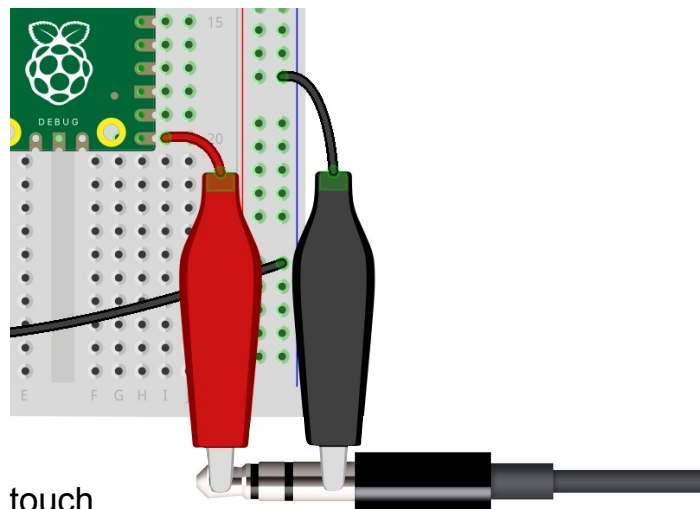


Take the other end of the cable connected to the tip of the plug and push it into the breadboard, in the row next to the bottom right pin of the Pico.

Plug the other cable into a hole next to the blue line.

Turn the speaker on.

You should now hear different sounds when you touch your drawing!



## Pressure-sensitive

The drawing you connected to the top-left pin is not just touch-sensitive but also pressure-sensitive. Or rather, the sound changes with how much of your skin is in contact with the drawing.

You may need to touch the USB connector at the same time as touching the drawing (because this part is more sensitive and needs a good ground connection).

## What's next?

Did you have fun making your drawing touch-sensitive? If so, then you might be happy to know that there are a lot more things you can turn into interactive artworks by making them touch-sensitive.

You can make your own conductive paint and put it on anything you can think of. You could also use copper tape, metal wire, tin foil or even conductive fabric.

Water and metal objects also conduct electricity, so those work well too.

Plants and flowers contain a lot of water, so you can even make plants touch-sensitive!



Singing plant by Mads Hoby

In addition to all those inputs, there is also a world of possible *outputs*. You can project an animation onto a drawing or painting, just like in the aforementioned artwork *Awake*. You could also have a video start and stop when people touch something, or lights turn on or off, or mechanics start to move, or a smoke machine starts...