PHYSICAL COMPUTING
WEEK 02

a word about
TESTING AND DEBUGGING

WHEN TO EMAIL ME

1. Did you run a google search and read the results?

2. Did you ask your friends in class?

3. Did you post on the student forums?

4. Did you search the arduino forums? http://forum.arduino.cc/

5. Did you post to the arudino forums and give it a few hours?

5. Did you walk away from the problem then try again it?
Still stuck? Email.

If I can find your problem on the first page of google, I'm not going to reply.
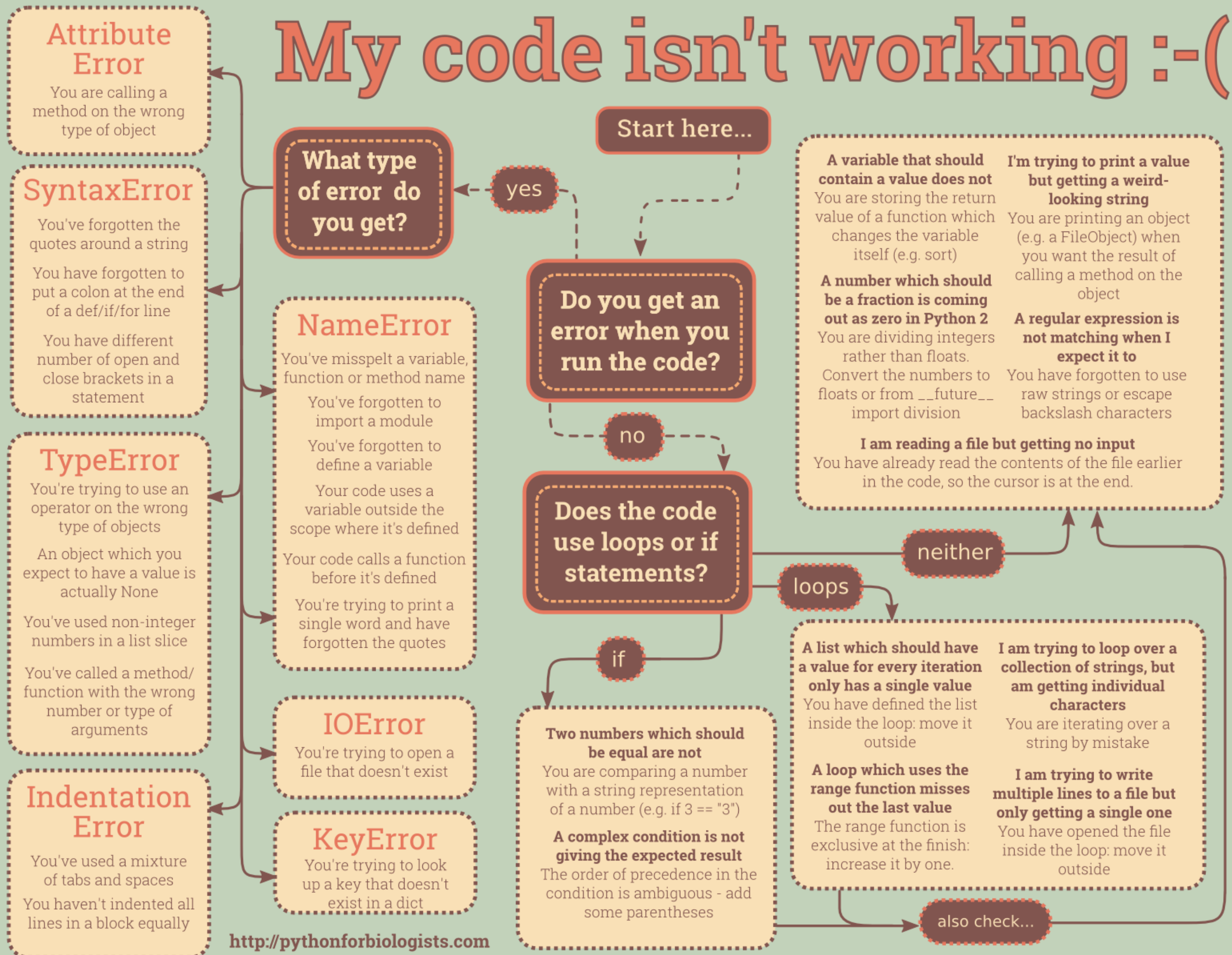**Not because I don't like you but because this is poor, poor dev practice.**

**IF YOU LEARN ONLY ONE SKILL IN COLLEGE,
LEARN TO FIND YOUR OWN ANSWERS THROUGH DEBUGGING.**

99 little bugs in the code.
99 little bugs in the code.
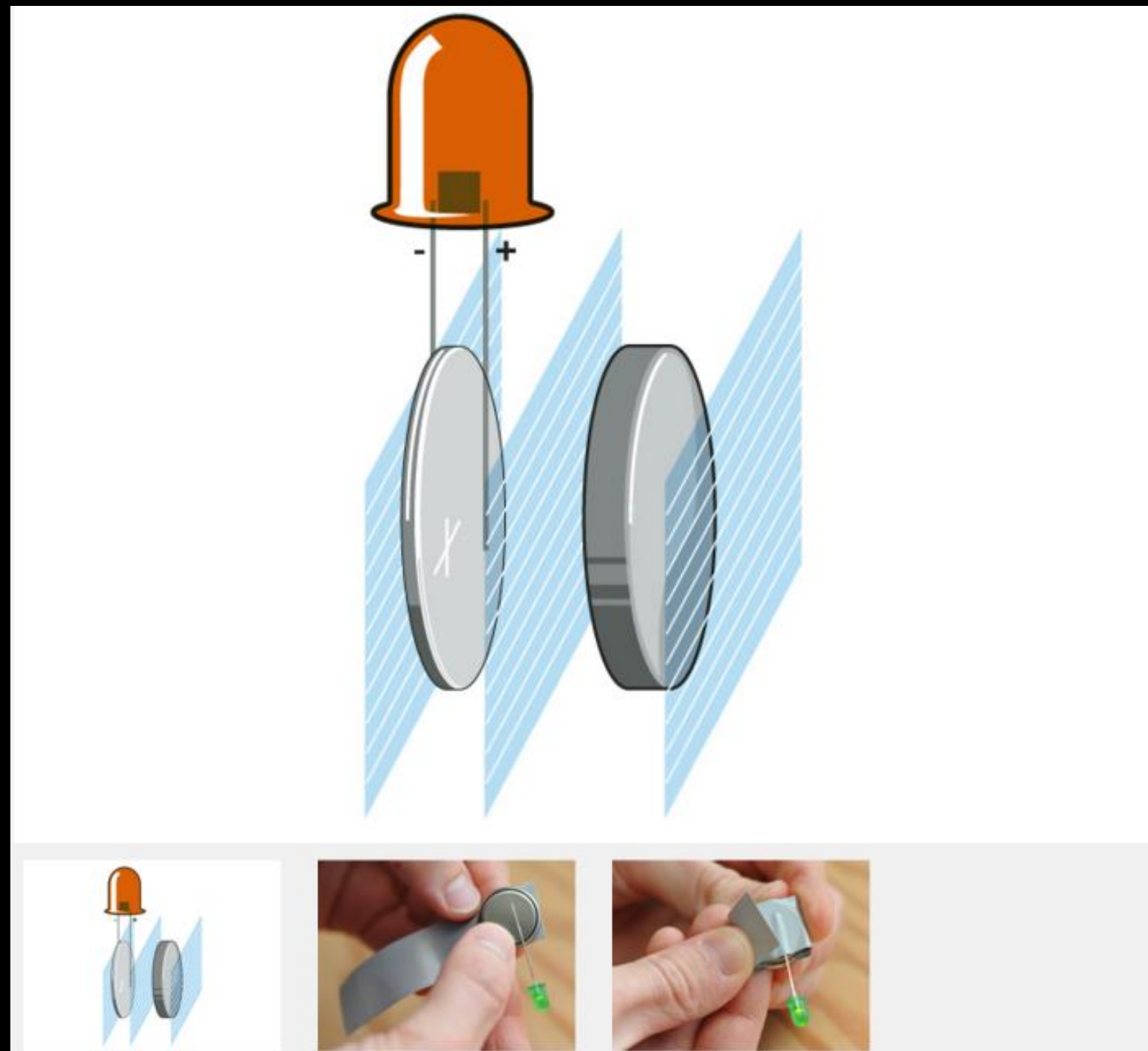Take one down, patch it around.

127 little bugs in the code...

My code isn't working :-(

Start here...

Do you get an error when you run the code? — yes →

What type of error do you get?

Attribute Error
You are calling a method on the wrong type of object

SyntaxError
You've forgotten the quotes around a string

You have forgotten to put a colon at the end of a def/if/for line

You have different number of open and close brackets in a statement

NameError
You've misspelt a variable, function or method name

You've forgotten to import a module

You've forgotten to define a variable

Your code uses a variable outside the scope where it's defined

Your code calls a function before it's defined

You're trying to print a single word and have forgotten the quotes

TypeError
You're trying to use an operator on the wrong type of objects

An object which you expect to have a value is actually None

You've used non-integer numbers in a list slice

You've called a method/function with the wrong number or type of arguments

IOError
You're trying to open a file that doesn't exist

KeyError
You're trying to look up a key that doesn't exist in a dict

Indentation Error
You've used a mixture of tabs and spaces

You haven't indented all lines in a block equally

no →

Does the code use loops or if statements?

— **neither** →

— **loops** →

— **if** →

if:

Two numbers which should be equal are not
You are comparing a number with a string representation of a number (e.g. if 3 == "3")

A complex condition is not giving the expected result
The order of precedence in the condition is ambiguous - add some parentheses

loops:

A list which should have a value for every iteration only has a single value
You have defined the list inside the loop: move it outside

A loop which uses the range function misses out the last value
The range function is exclusive at the finish: increase it by one.

I am trying to loop over a collection of strings, but am getting individual characters
You are iterating over a string by mistake

I am trying to write multiple lines to a file but only getting a single one
You have opened the file inside the loop: move it outside

neither / also check...:

A variable that should contain a value does not
You are storing the return value of a function which changes the variable itself (e.g. sort)

A number which should be a fraction is coming out as zero in Python 2
You are dividing integers rather than floats. Convert the numbers to floats or from __future__ import division

I'm trying to print a value but getting a weird-looking string
You are printing an object (e.g. a FileObject) when you want the result of calling a method on the object

A regular expression is not matching when I expect it to
You have forgotten to use raw strings or escape backslash characters

I am reading a file but getting no input
You have already read the contents of the file earlier in the code, so the cursor is at the end.

also check...

http://pythonforbiologists.com

Sensors and actuators
INPUT AND OUTPUT

https://www.youtube.com/watch?v=m6kJsdkZEIQ
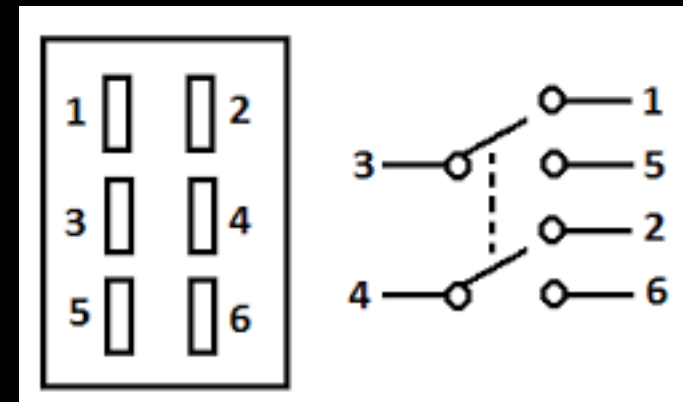
BUTTONS
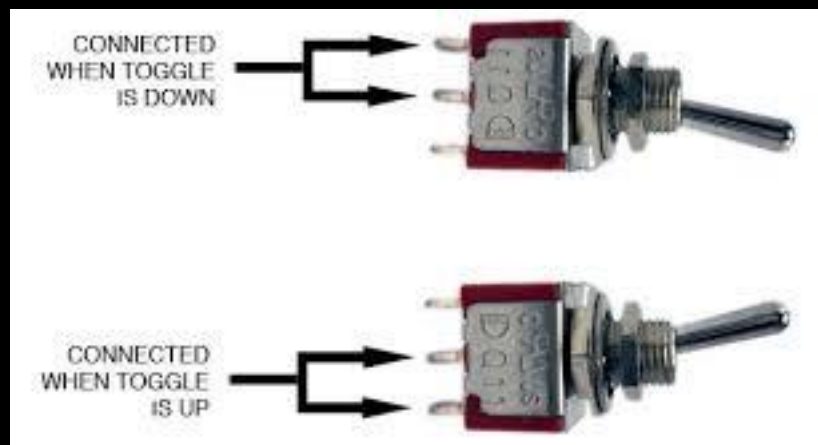
Poles - primary contact
Throws - number of switches active at a given time
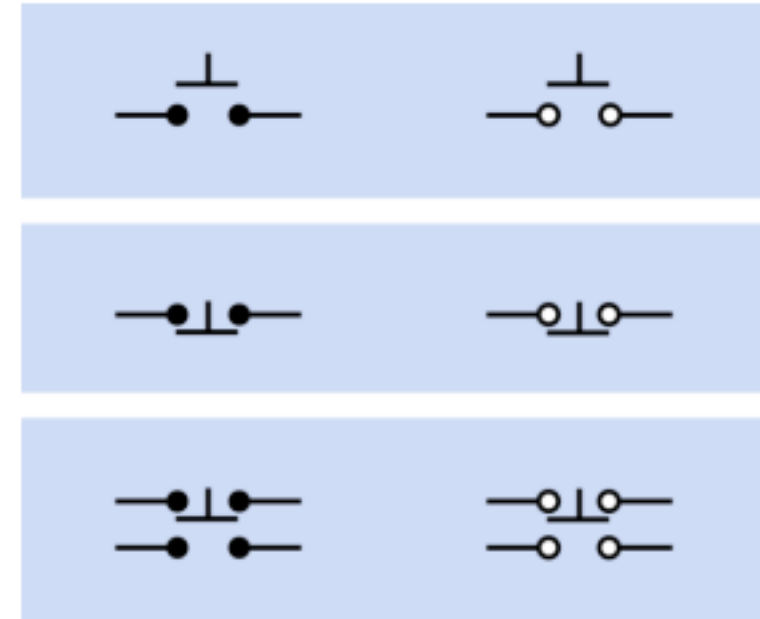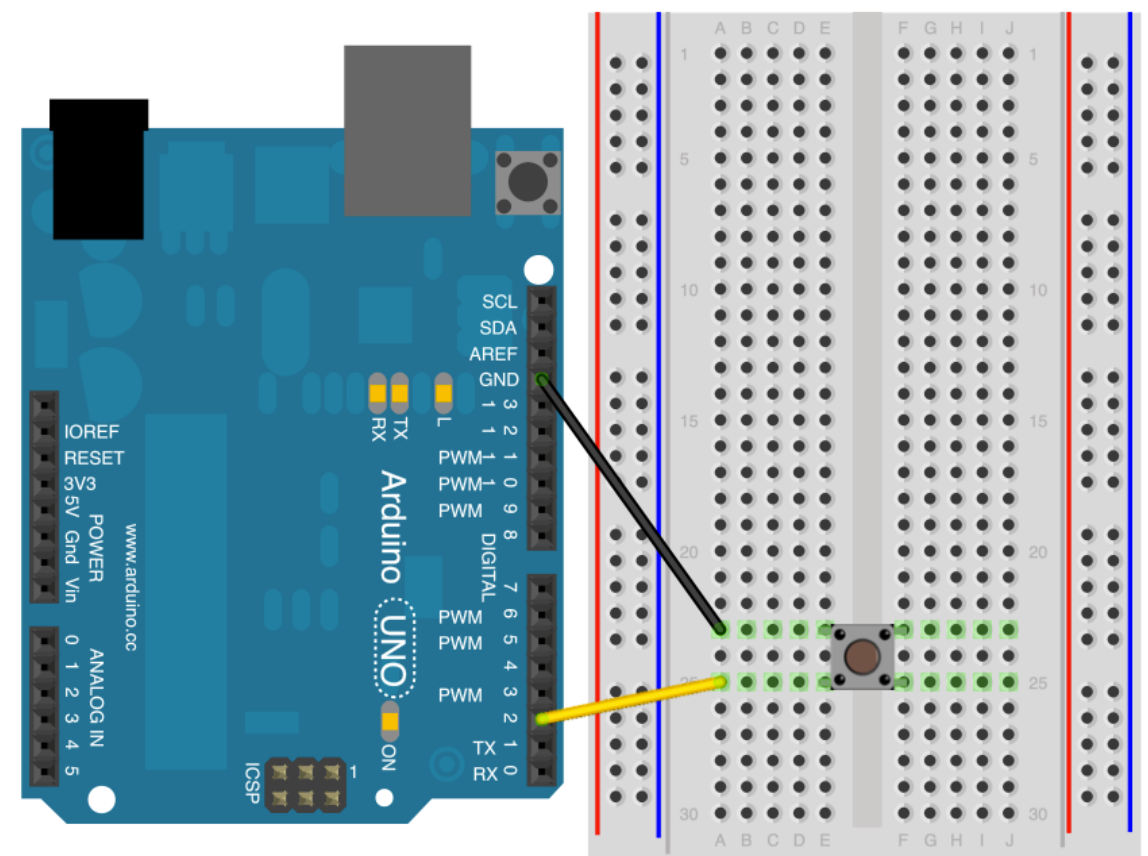

1p1t
on

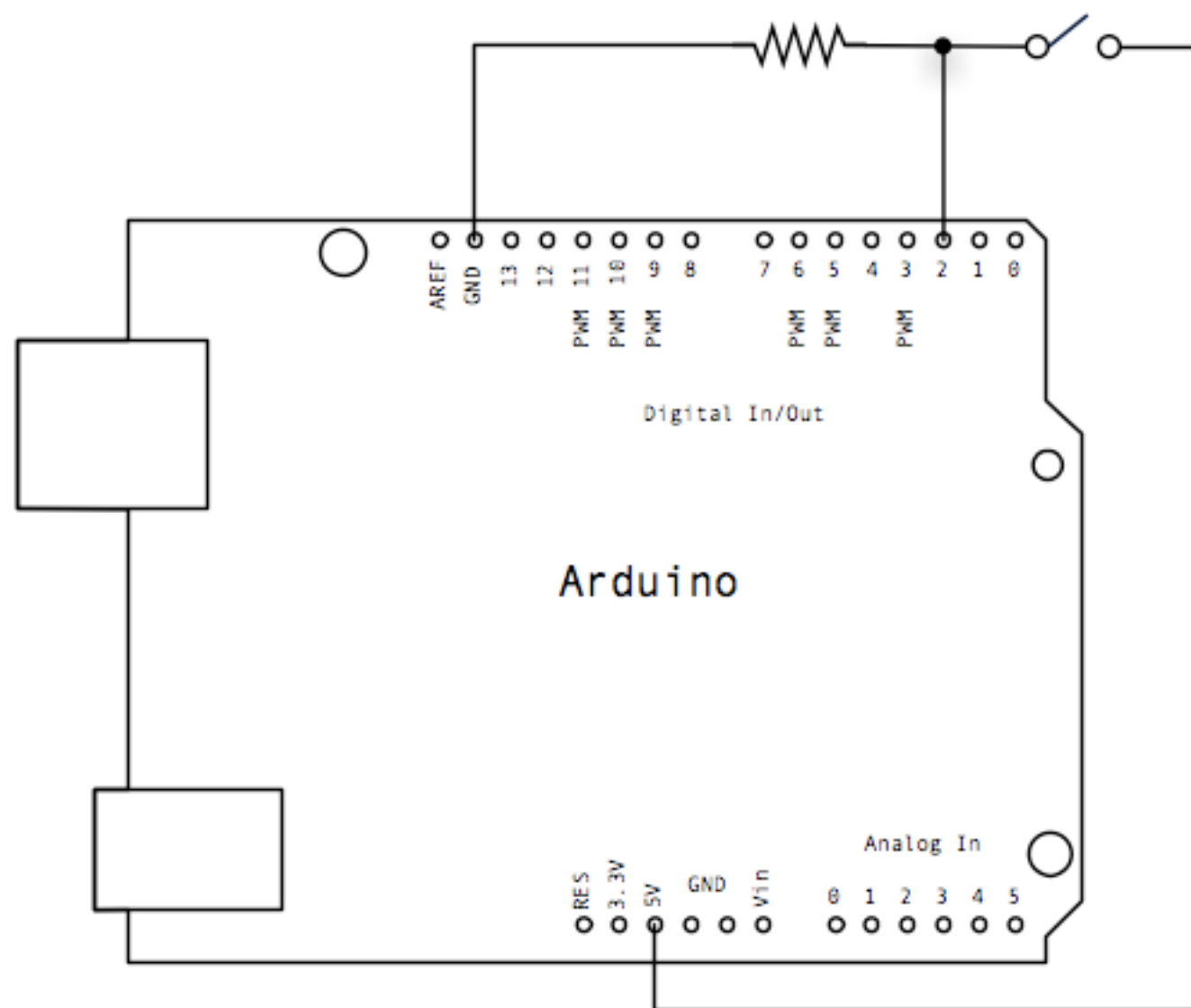

2p2t

2p1t
on or off

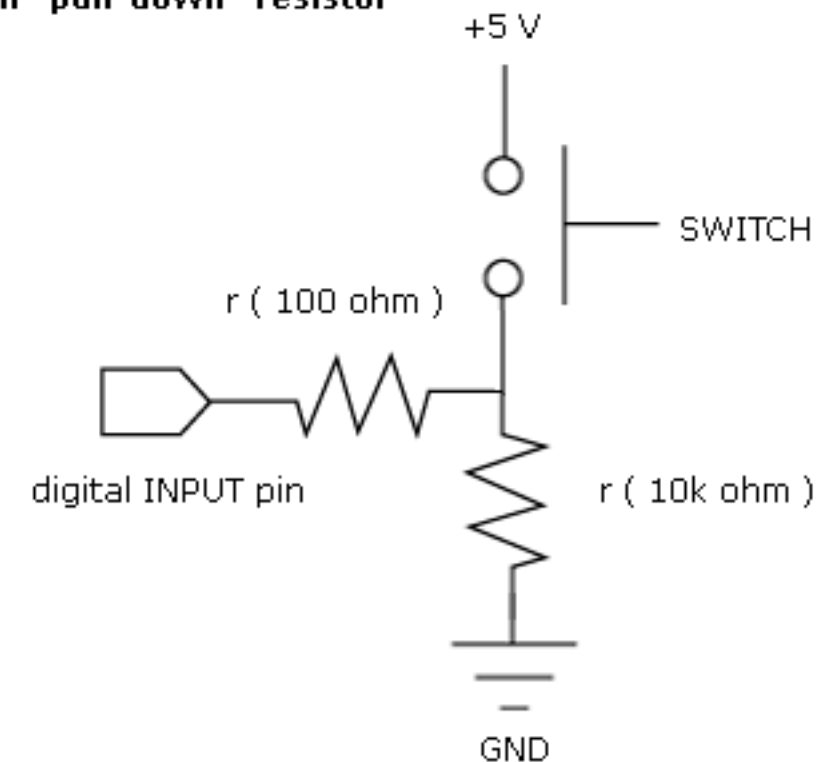And so on...

THE PUSH BUTTON

a single pushbutton may close
or open two separate pairs of contacts

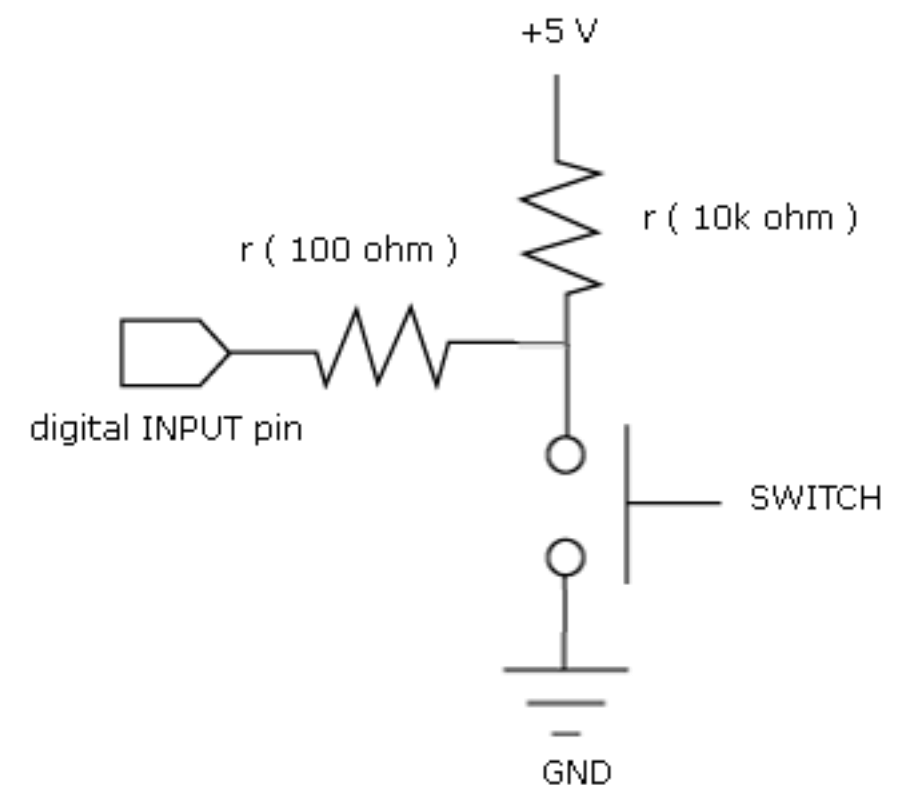# Current flows down the path of least resistance

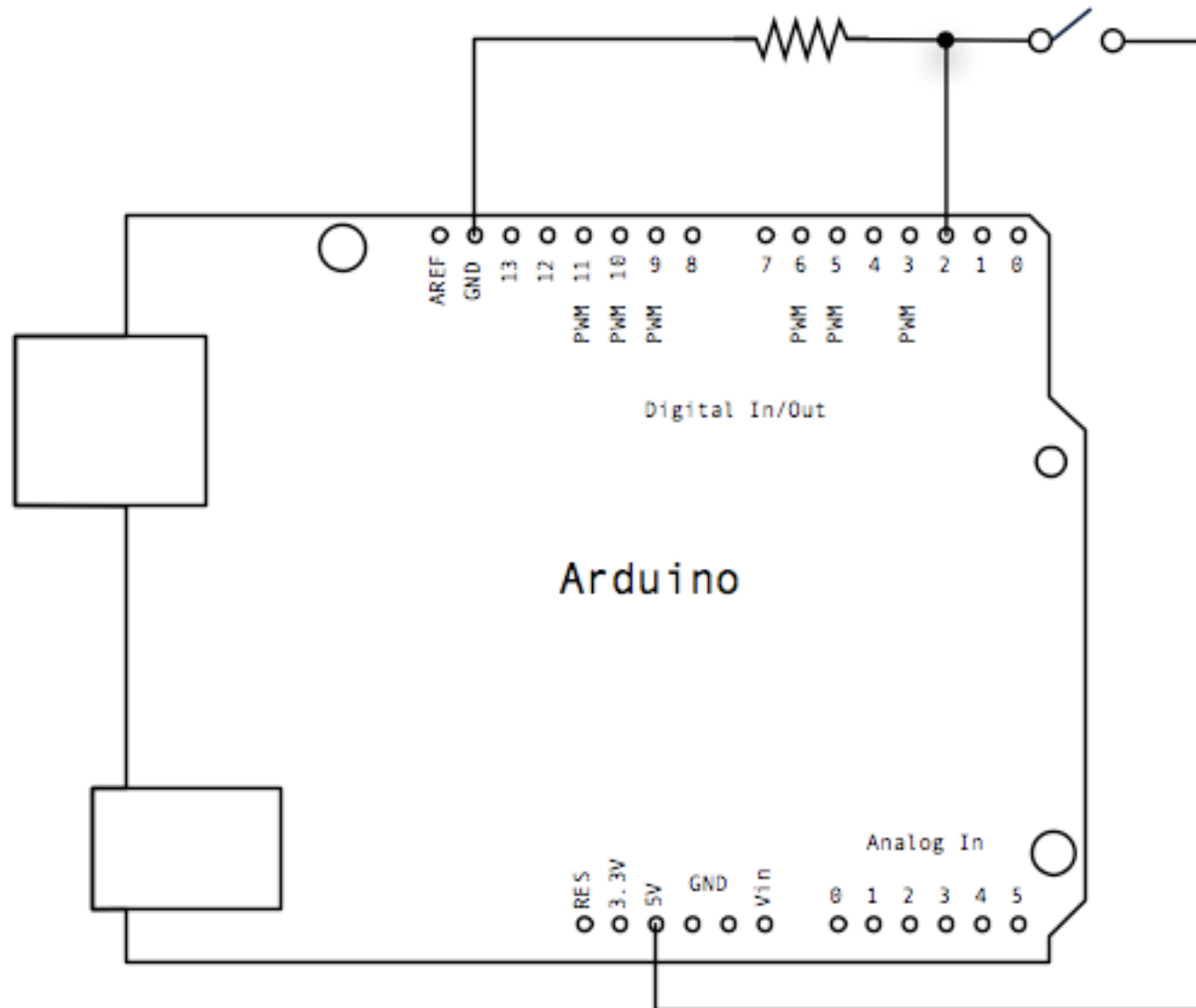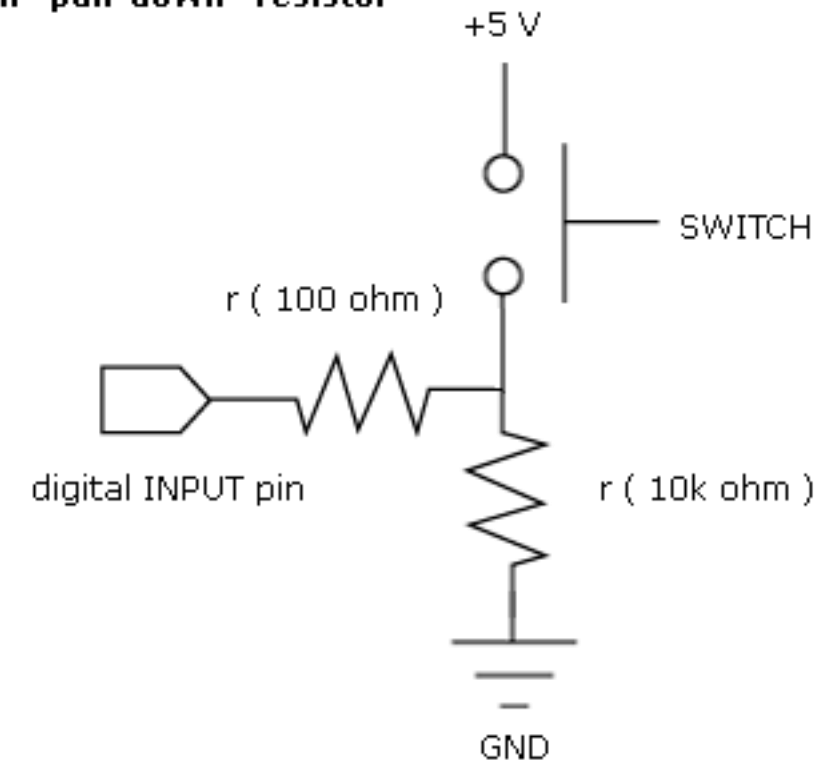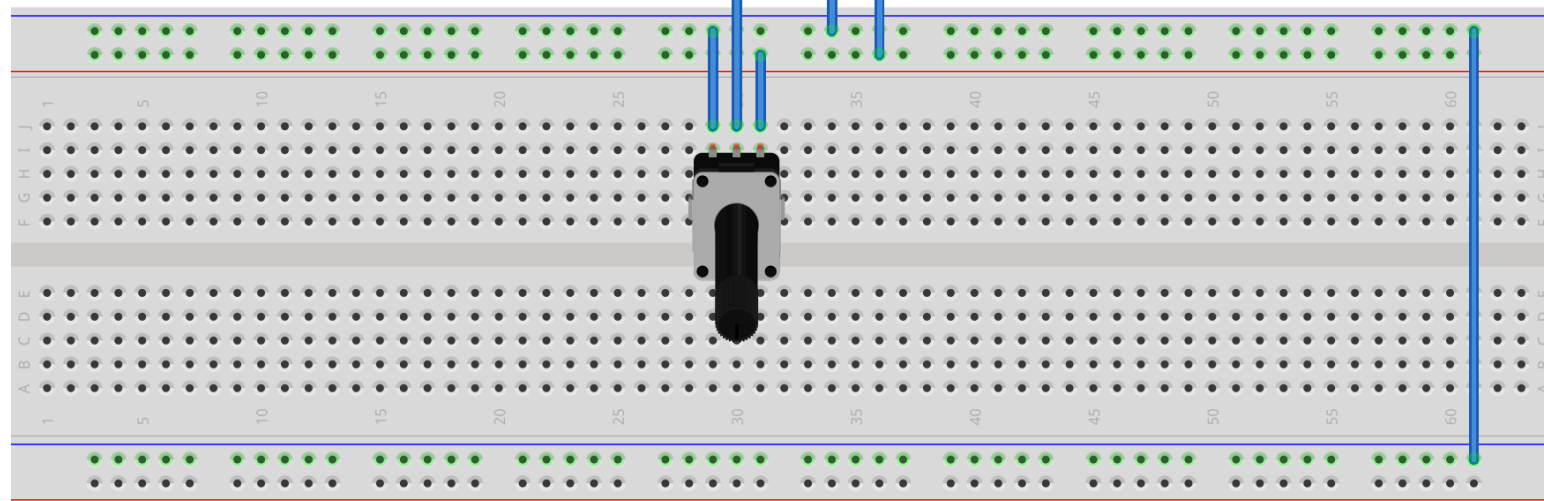Switch with "pull-down" resistor

+5 V

SWITCH

r (100 ohm)

digital INPUT pin

r (10k ohm)

GND

Switch with "pull-up" resistor

+5 V

r (10k ohm)

r (100 ohm)

digital INPUT pin

SWITCH

GND

AREF GND 13 12 11 10 9 8 7 6 5 4 3 2 1 0

PWM PWM PWM PWM PWM PWM

Digital In/Out

Arduino

Analog In

RES 3.3V 5V GND Vin 0 1 2 3 4 5

digitalRead(pinNumber)

se this function to measure
a closed (or open) connection

Switch with "pull-down" resistor

+5 V

SWITCH

r (100 ohm)

digital INPUT pin

r (10k ohm)

GND

Switch with "pull-up" resistor

+5 V

r (10k ohm)

r (100 ohm)

digital INPUT pin

SWITCH

GND

AREF
GND
13
12
11 PWM
10 PWM
9 PWM
8
7
6 PWM
5 PWM
4
3 PWM
2
1
0

Digital In/Out

Arduino

Analog In

RES
3.3V
5V
GND
Vin
0 1 2 3 4 5
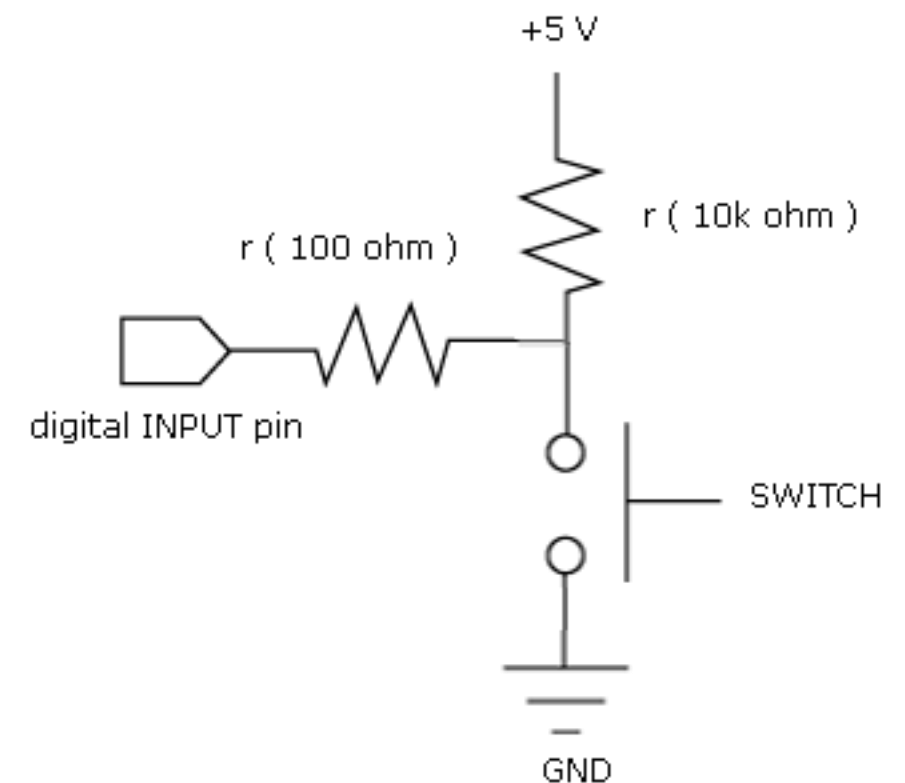
THE POTENTIOMETER

A variable resistor

wiper turns with dial

resistive material

A

W

B

linear   log

Ω

θ

resistor

A ———⋁⋁⋁⋁⋁——— B

W
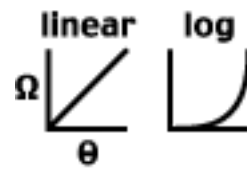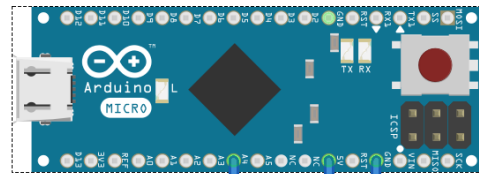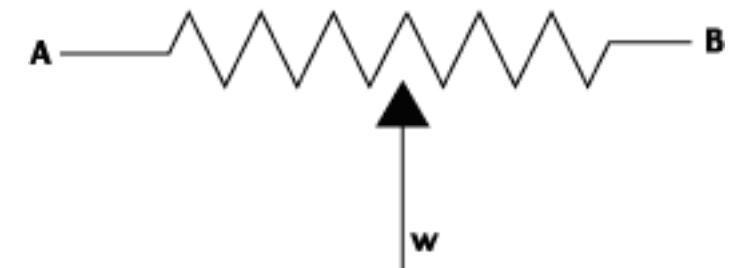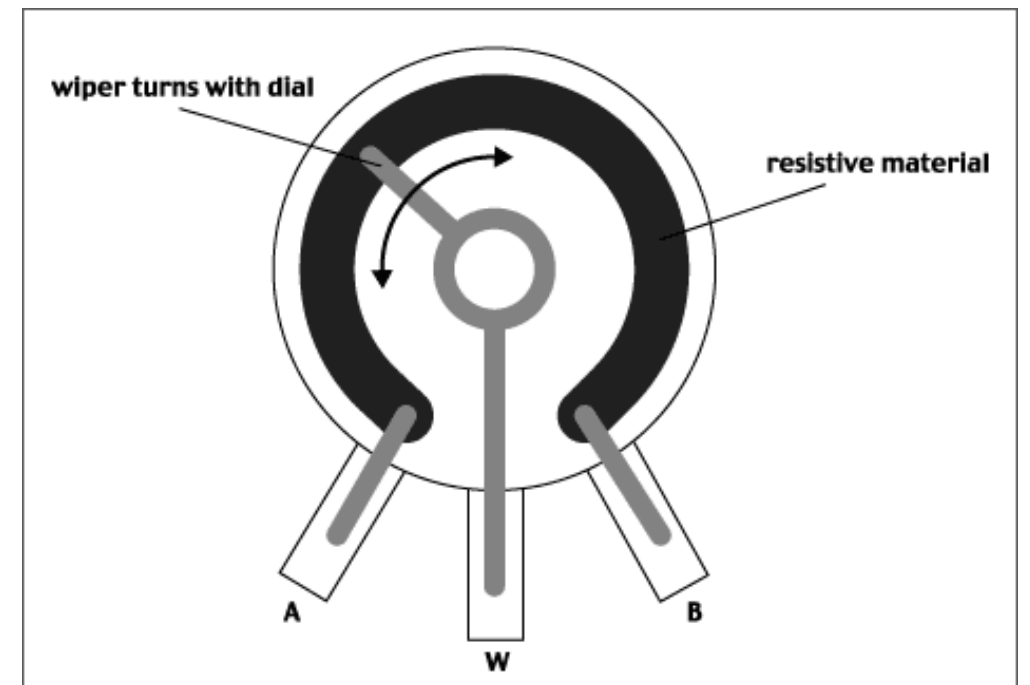
potentiometer

fritzing

ALL YOU NEED IS A WAY TO MEASURE THAT CHANGE
AND THAT'S WHAT YOU CAN DO WITH A MICRO CONTROLLER.

analogRead(pinNumber)
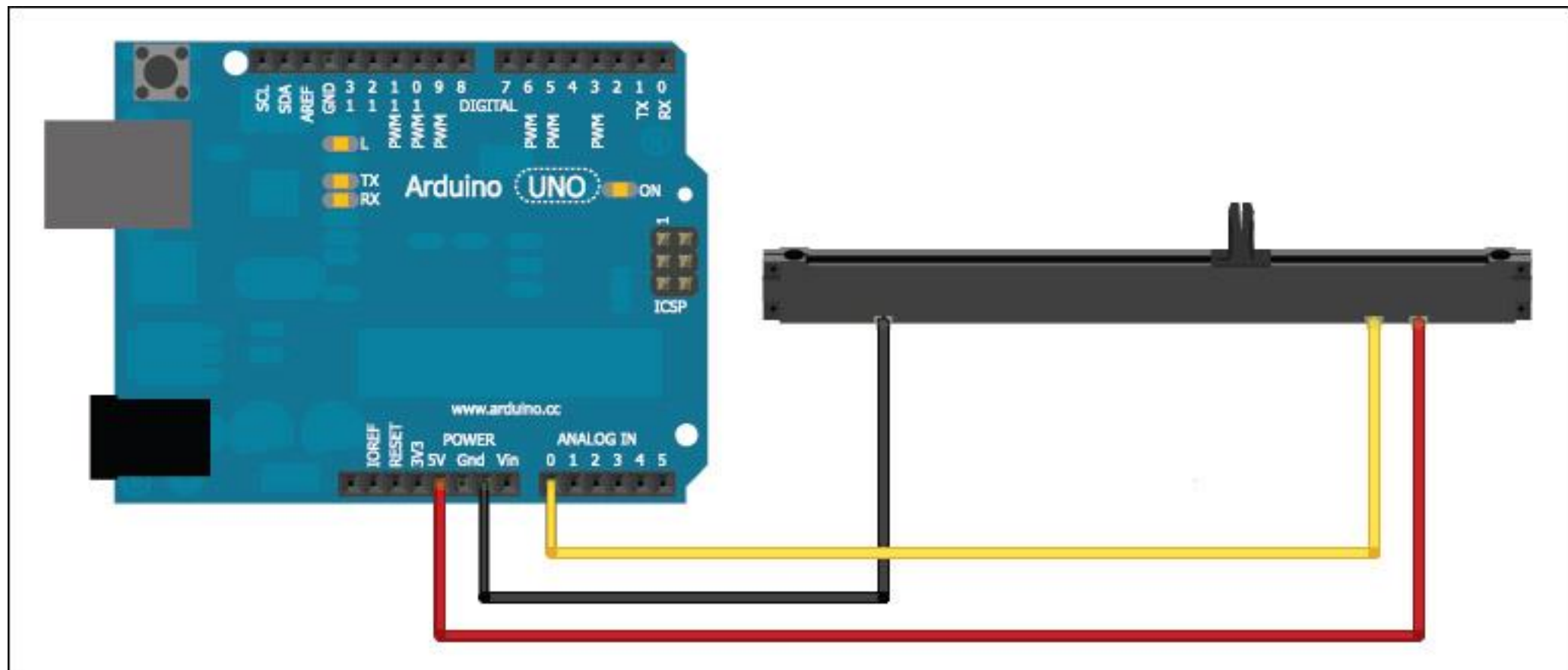
use this function to measure resistance

wiper turns with dial

resistive material

A

W

B

resistor

A —/\/\/\/\/\— B

W
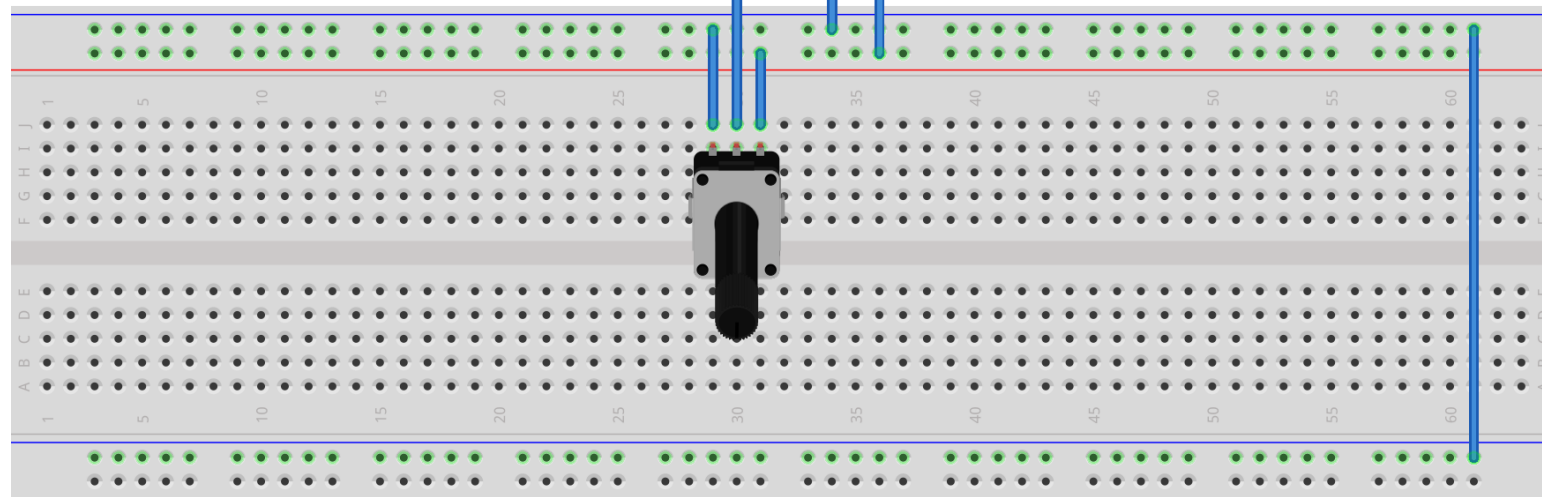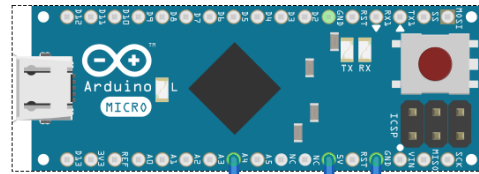
potentiometer

fritzing
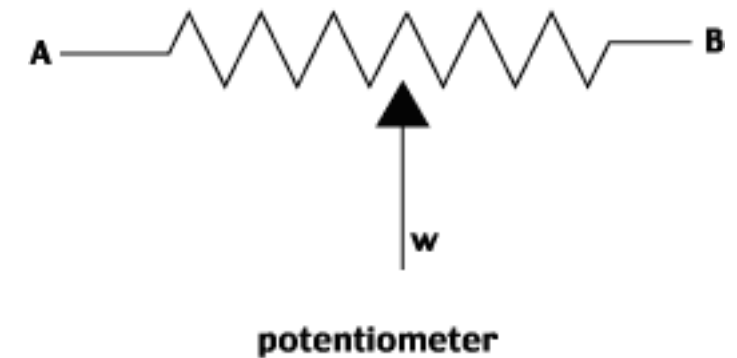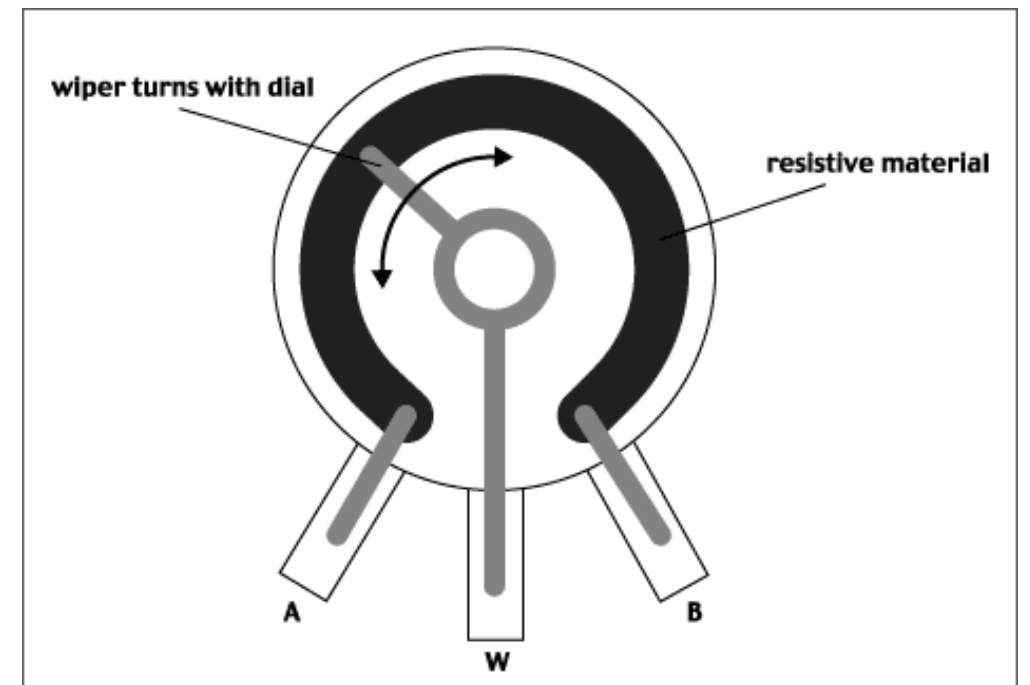
THE SLIDER

A sideways potentiometer

There are many different kinds of sensors
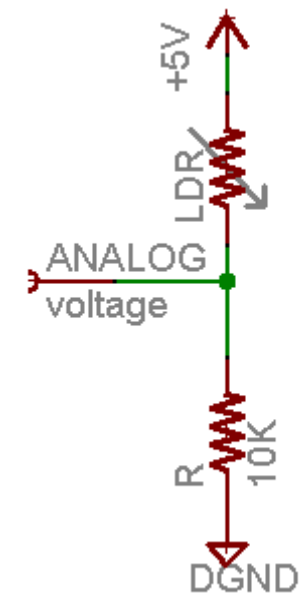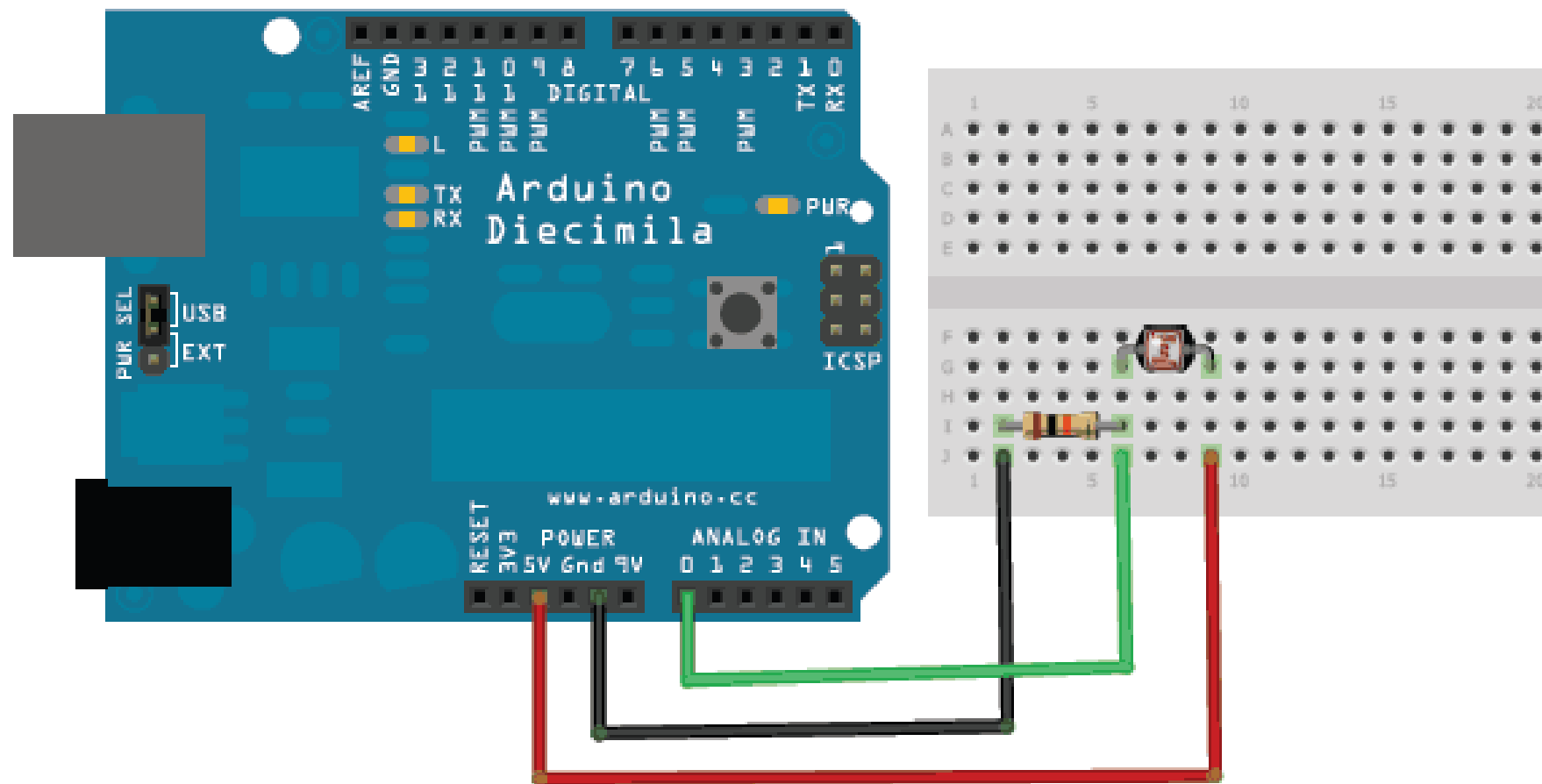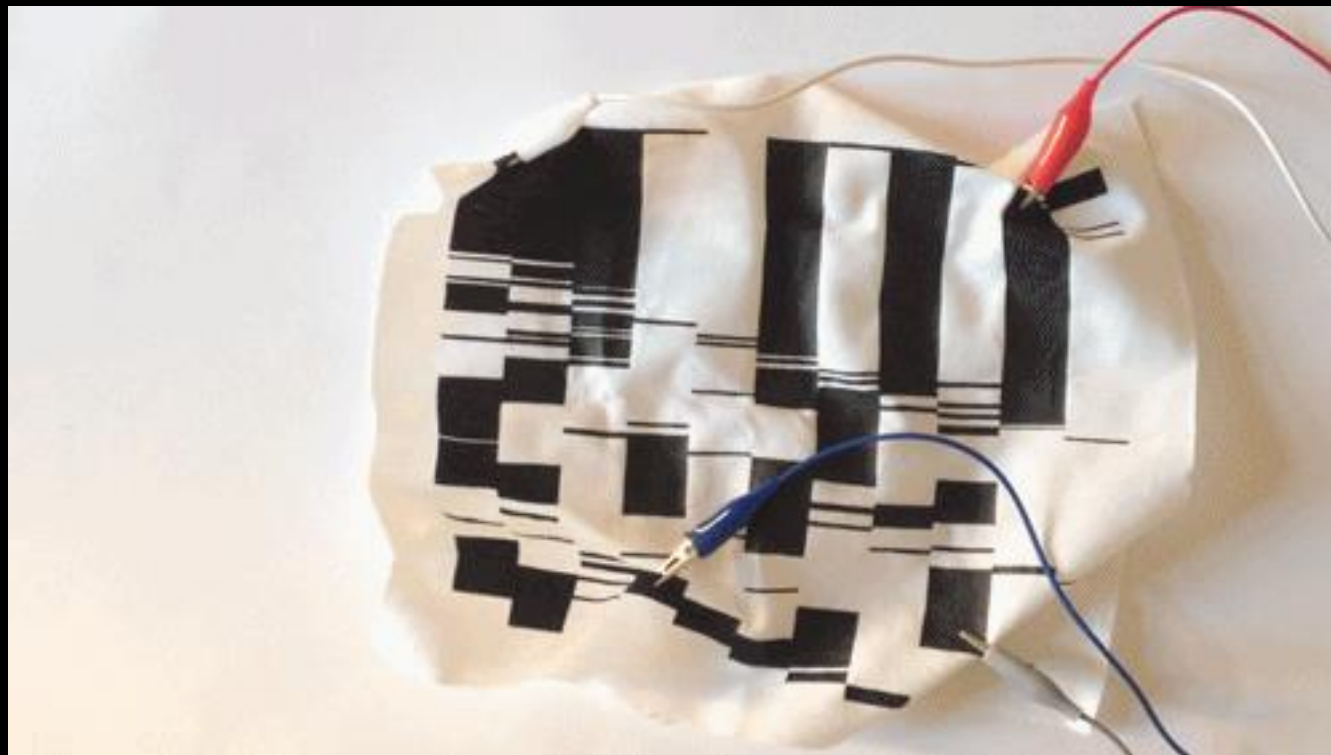

ir

light

sonar (proximity)

sound

touch

bend

mostly they change
resistance in some way

THE LDR

A variable resistor

Some examples of sensors in the world

https://vimeo.com/105146759

Interaction breakdown:

When the dancer bends her arm,
trigger a motor to hit the instrument with a mallet.
https://www.youtube.com/watch?v=OtKf9C0s6p8#t=30

1. A motor for each mallet hooked up to a circuit and your Arduino
2. A bend sensor MAPPED to trigger the mallet using the code in the Arduino IDE
3. input is mapped to output

What is a
multimeter?

SERIAL DATA

This is kind of line `println()` in processing in that it lets you print out values

But totally different in that it's actually a data sending protocol. Things happen one bit at a time. More detail here: http://www.ladyada.net/learn/arduino/lesson4.html

I like to think of it like shipping. It ships data to a port on your computer other applications can go to and there they can receive that data.

You call `Serial.begin(baudrate)` in `setup()` and the you can can `Serial.write(value)` in the `loop()`

SERIAL DATA

You'll always want to check to see if you have any data available *BEFORE* you start reading it or you can crash your computer