Warmup

Choose a team name.

Kids: go to art table and make super awesome team name tags!

Parents: time to set up our Arduino Workbench.

The Arduino Workbench

Install this! 1

http://arduino.cc/en/main/software

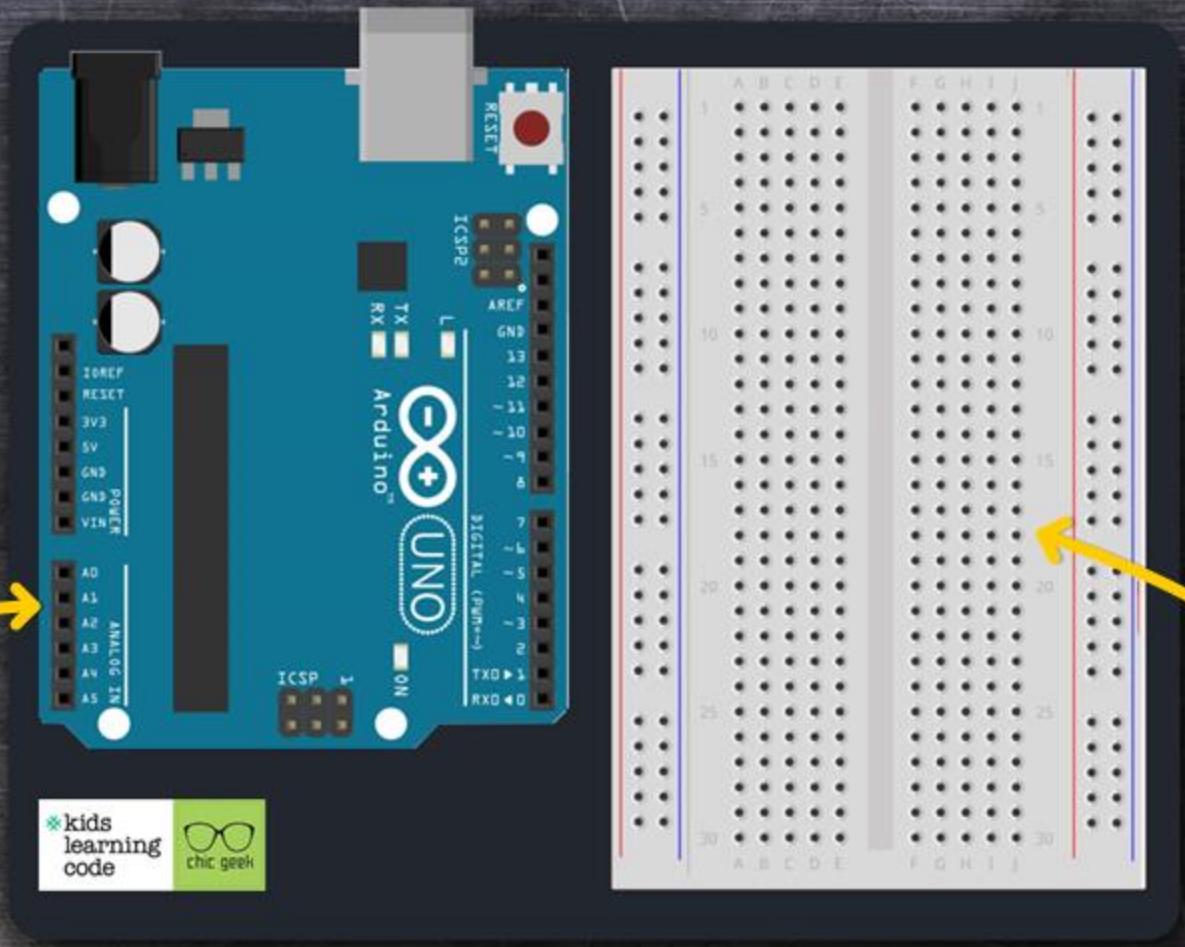
2 Do this!

Connect your Arduino to your computer

Load and run this! 3

File -> Examples -> Basics -> Blink

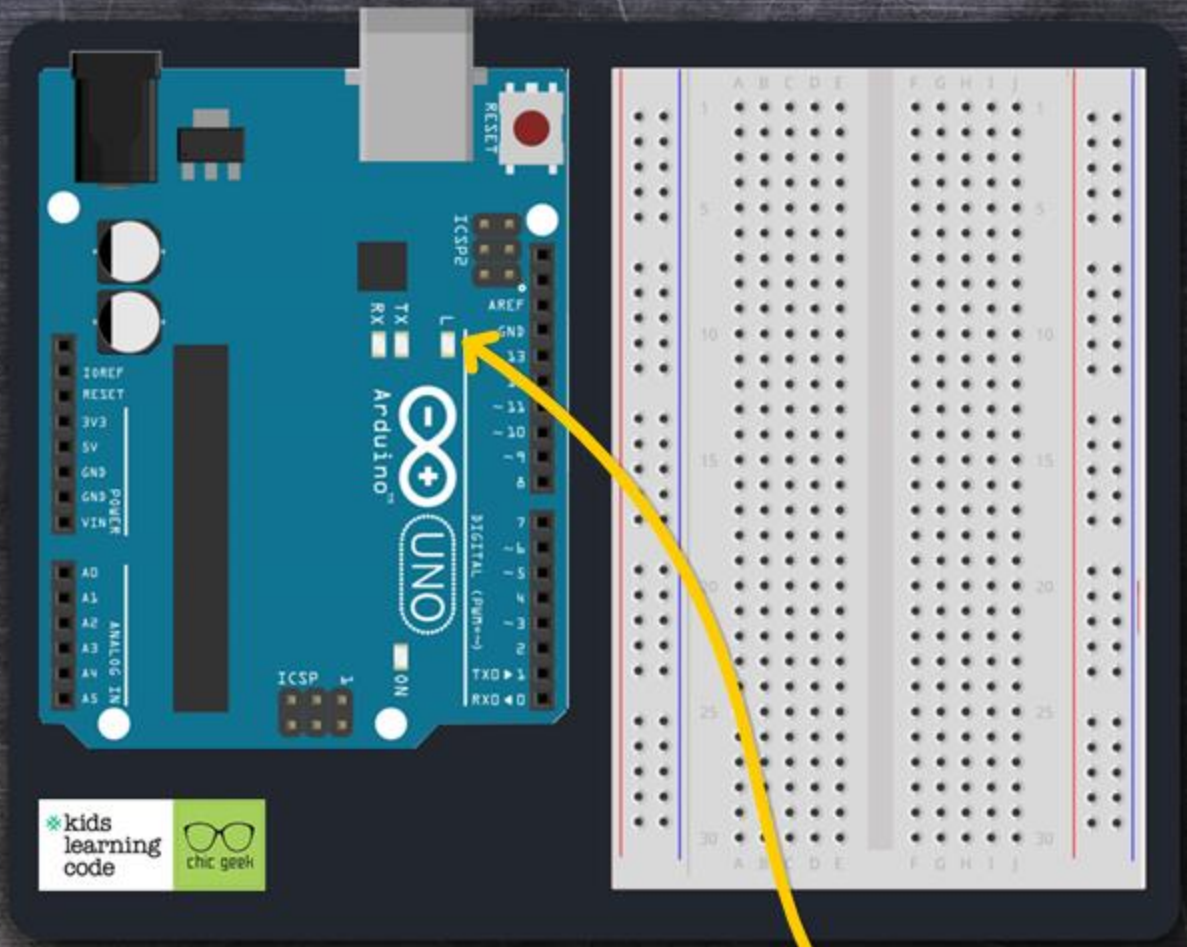
Your Arduino



These funny-looking holes are **connectors**. You use them to connect things to your Arduino.

This white play area is called a **breadboard**. You can build super awesome things here!

Can You Find The Light?



Let's teach our Arduino to blink its little light.

Our first Arduino program

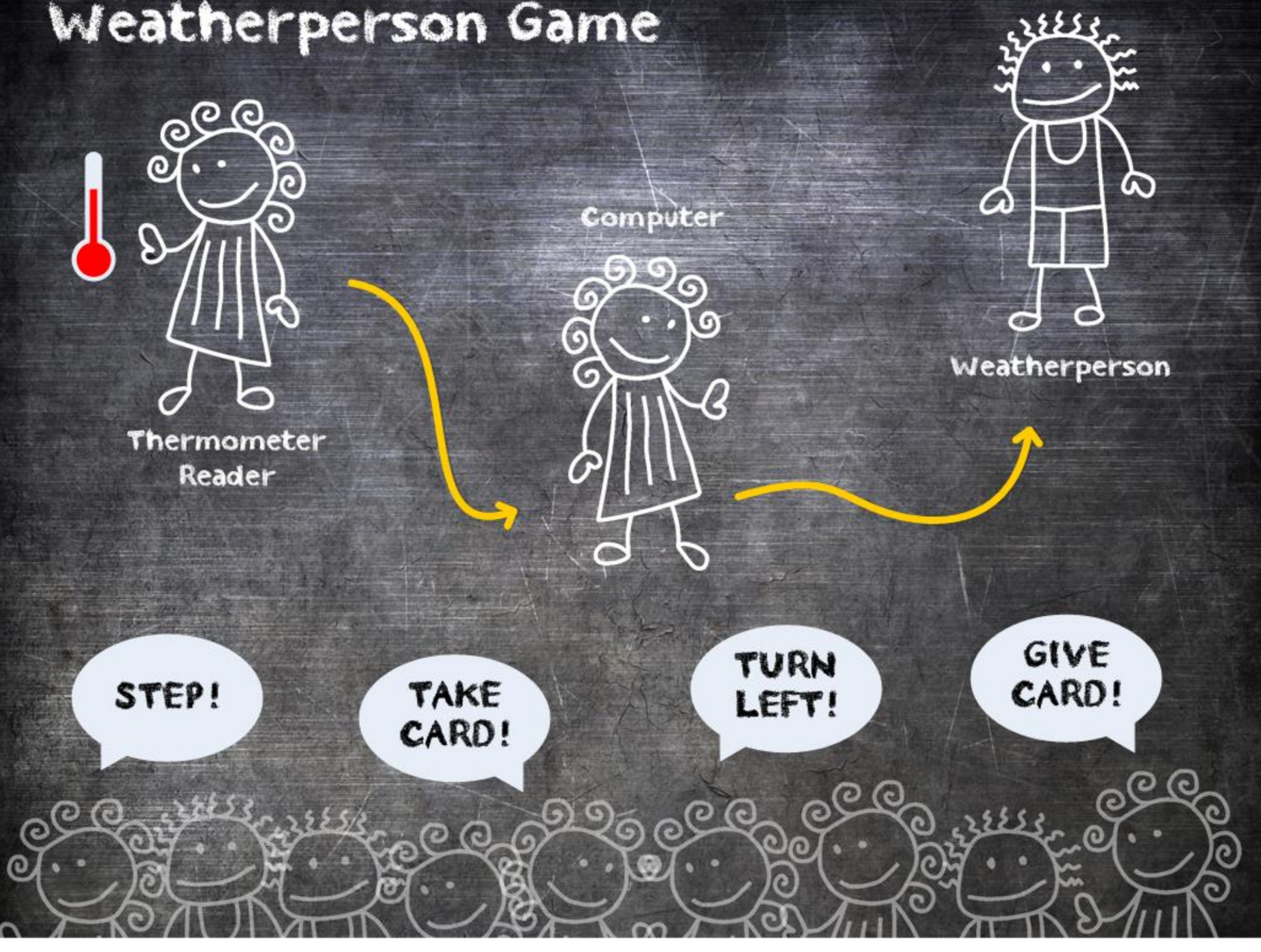
We write programs using **INSTRUCTIONS**

1. Do something
2. Do something else
3. Now keep doing it over and over!

Our Arduino does each instruction, over and over, very quickly

Computer programs are called "software".

Weatherperson Game



Parts of an Arduino program

1. setup

Your Arduino does this once, like waking up in the morning

2. loop

then it keeps doing this forever, like a cat chasing its tail!

remember ->

setup then loop loop loop loop loop loop...

Make me blink!

<- remember we do this once

```
void setup() {
  pinMode(13, OUTPUT);
}
```

hey arduino! use connector number 13 as a digital control!!

```
void loop() {
  digitalWrite(13, HIGH);
  delay(1000);
  digitalWrite(13, LOW);
  delay(1000);
}
```

turn it on (light up the light)

turn it off now

<- then we keep doing this forever

Make me blink!

Blink_Done | Arduino 1.0.1

File Edit Sketch Tools Help

Blink_Done

```
void setup() {
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH);
  delay(1000);
  digitalWrite(13, LOW);
  delay(1000);
}
```

type in this program, then click the arrow to start your Arduino

Blink!

1/ How can you make your light blink faster or slower?

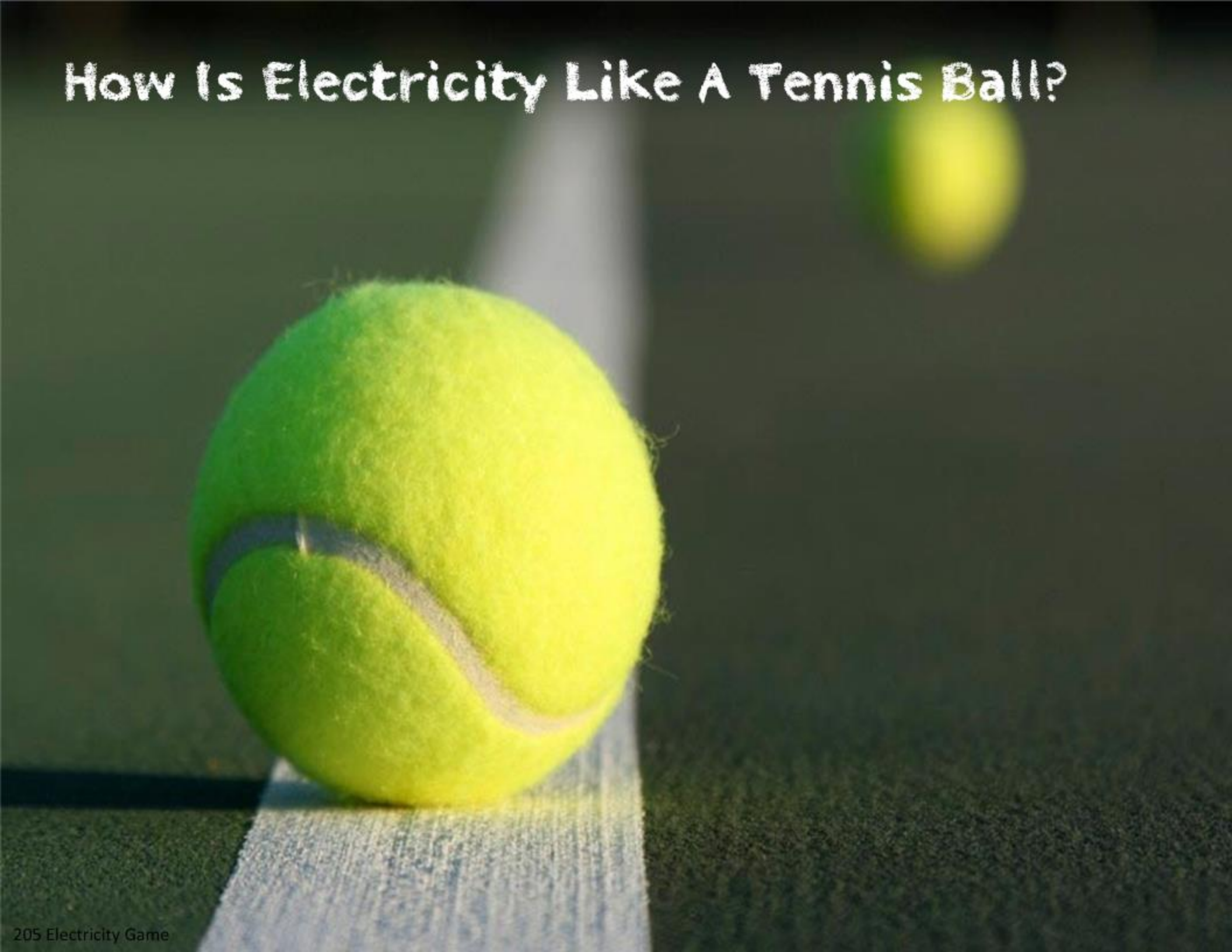
2/ Why is time in thousands?

3/ How often does your Arduino do the SETUP part?

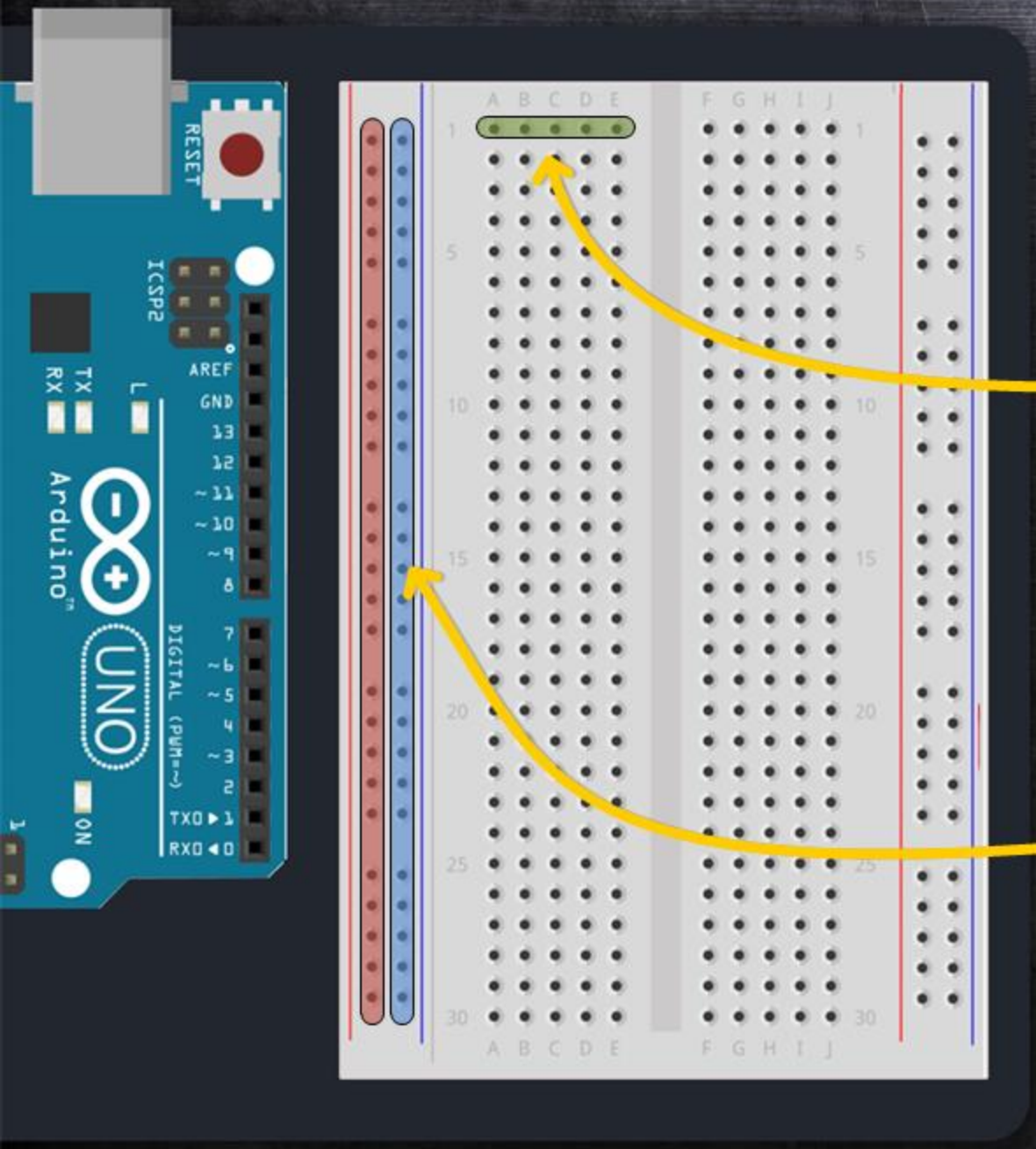
4/ How often does your Arduino do the LOOP part?

Electricity and Wiring

How Is Electricity Like A Tennis Ball?



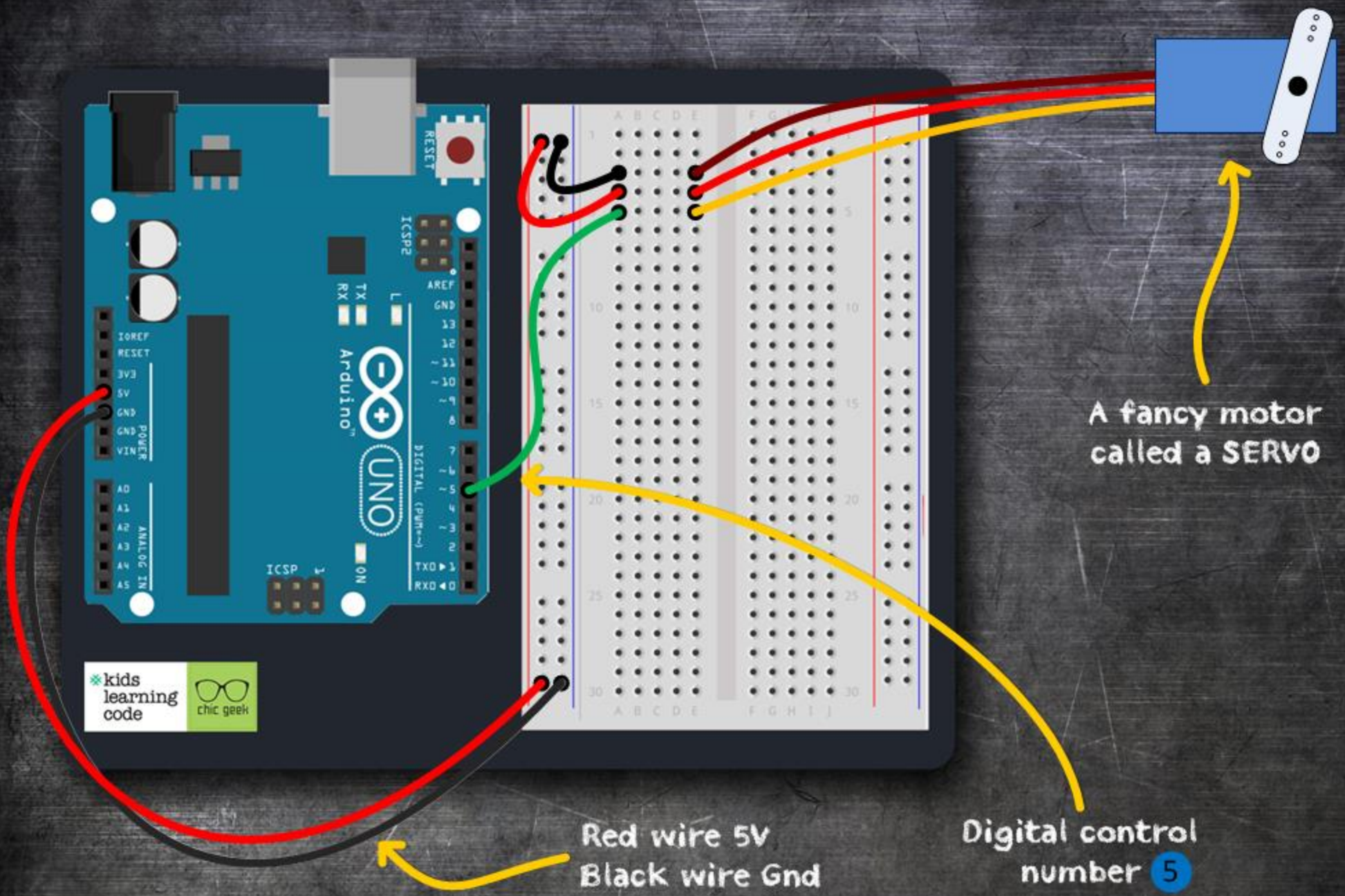
Wiring On The Arduino Breadboard



These five holes are connected inside the breadboard so you can use them to hook parts together

These holes carry power to your circuit. The red ones are all + and the blue ones are all -

Lights Are Fun But Motors Are way Cooler!



Make my motor spin!

```
#include <Servo.h>

Servo MyServoMotor;

void setup() {
  MyServoMotor.attach(5);
}
```

use a helper file so we can control servos

create an object in software to be our blue servo

tell our servo that it is wired up to digital control number 5 on our Arduino

But wait! There's more...

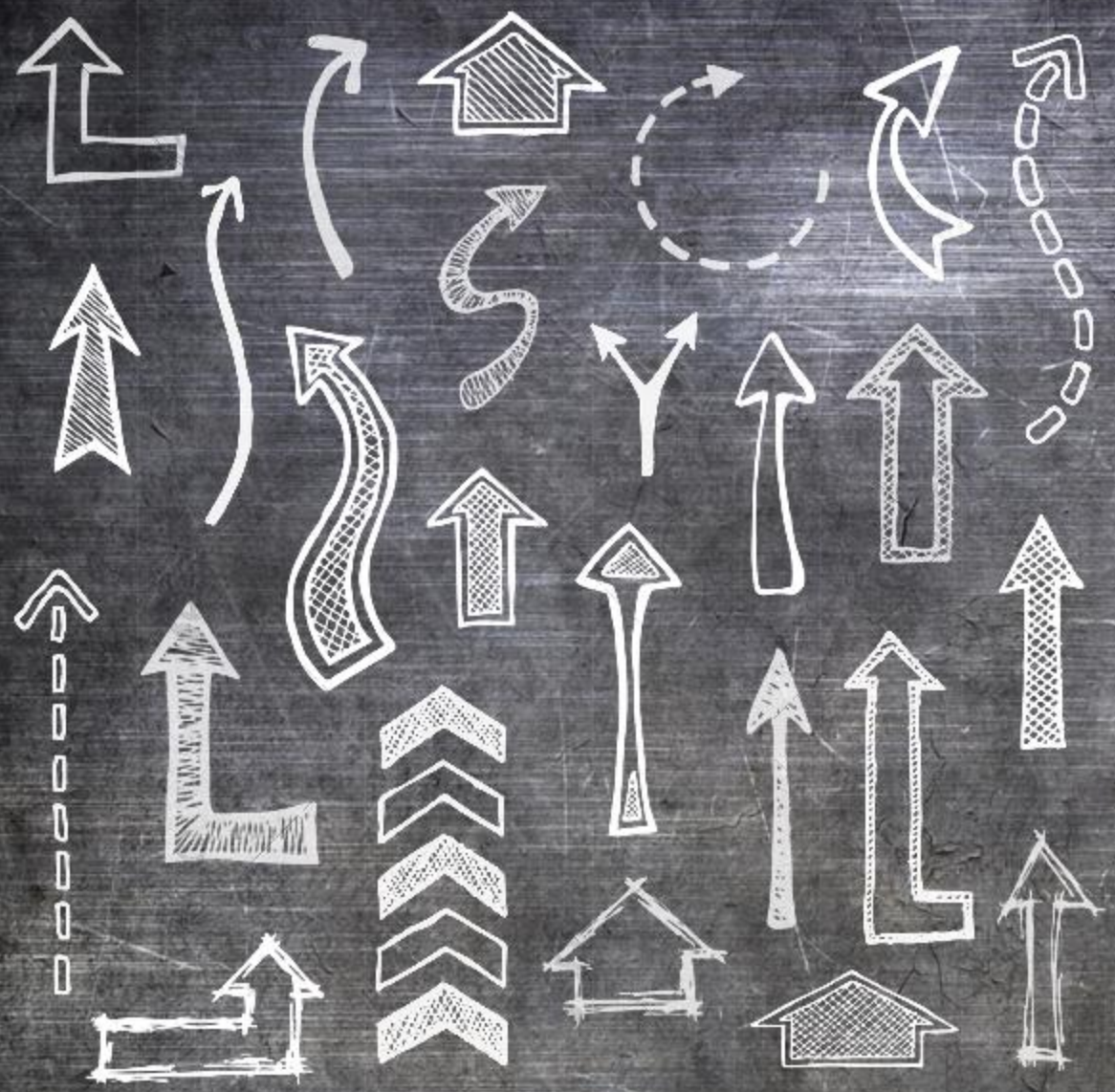
Make my motor spin!

```
void loop()
{
  for(int A = 0; A < 180; A += 10)
  {
    MyServoMotor.write(A);
    delay(15);
  }
  for(int A = 180; A >= 1; A -= 1)
  {
    MyServoMotor.write(A);
    delay(15);
  }
}
```

Spin the motor forward

Then spin the motor backward

Pointers



Go to art table.

Make a pointer for your motor.

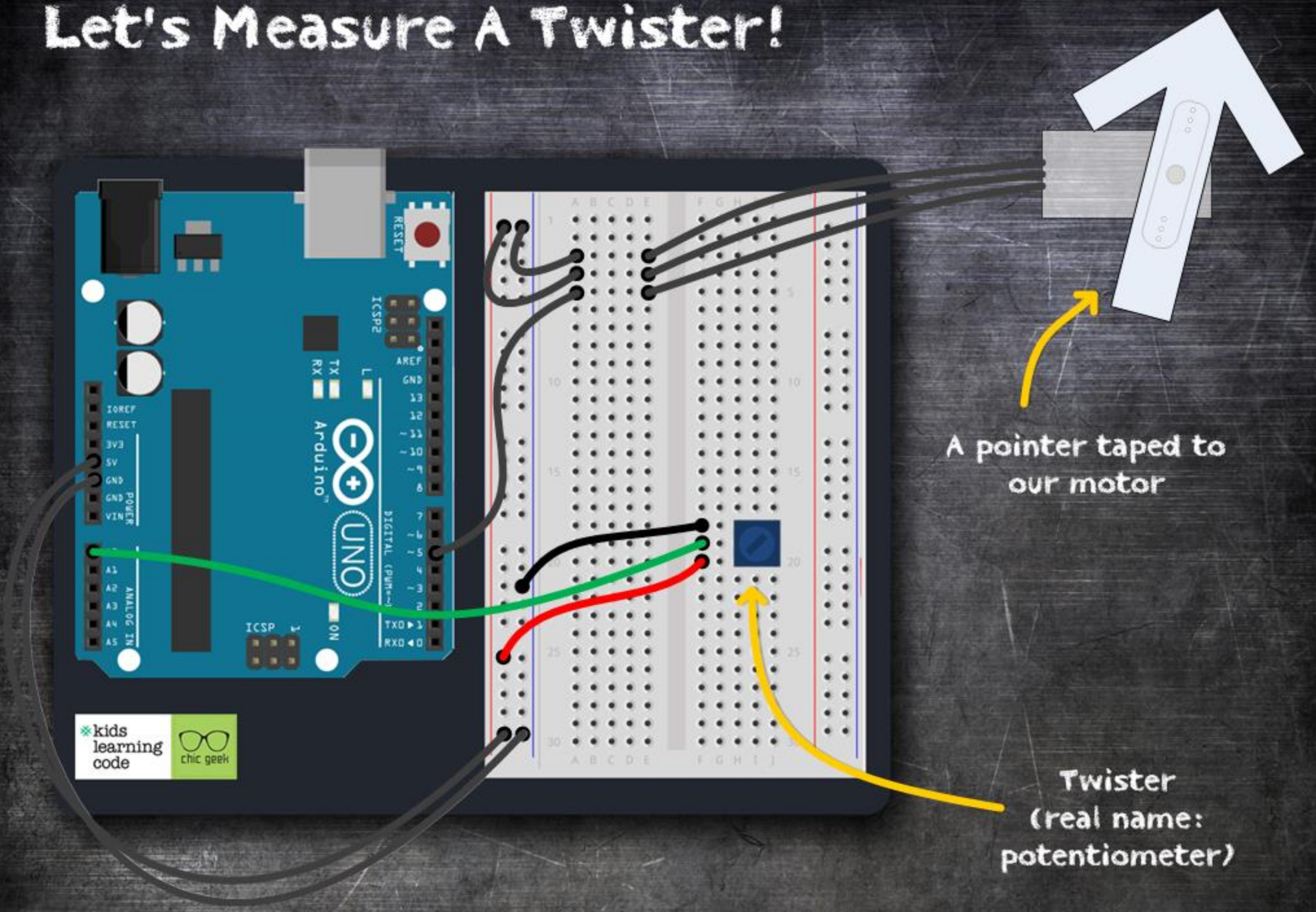
Don't make it too skinny.

Decorate it.

Tape it to your servo.

The Twister!

Let's Measure A Twister!



Make my pointer point!

```
#include <Servo.h>

Servo MyServoMotor;

void setup() {
  MyServoMotor.attach(5);
}
```

still need a helper file so we can control servos

create an object in software to be our blue servo

tell our servo that it is wired up to digital control number 5 on our Arduino

But wait! There's more...

Make my pointer point!

```
void loop()
{

  int TwisterPosition = analogRead(0);
  int ServoPosition = map(TwisterPosition, 0, 1023, 179, 0);
  MyServoMotor.write(ServoPosition);
  delay(200);

}
```

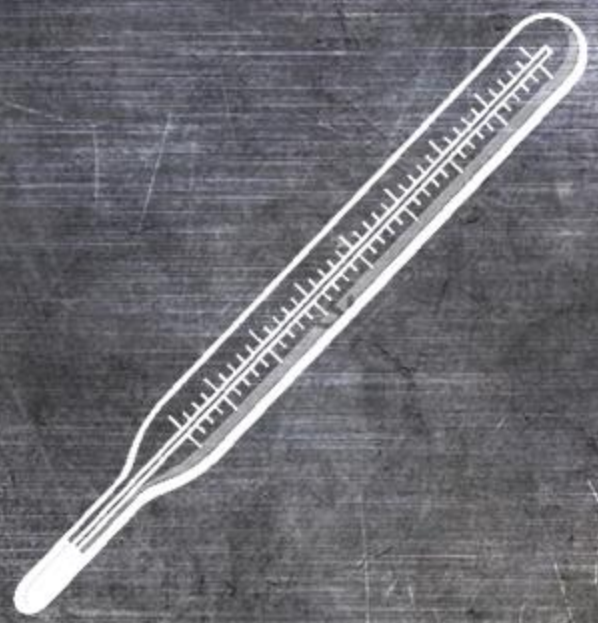
measure the twister that is wired up to analog sensor 0

convert to motor position

send new position to servo

How COOL was that??

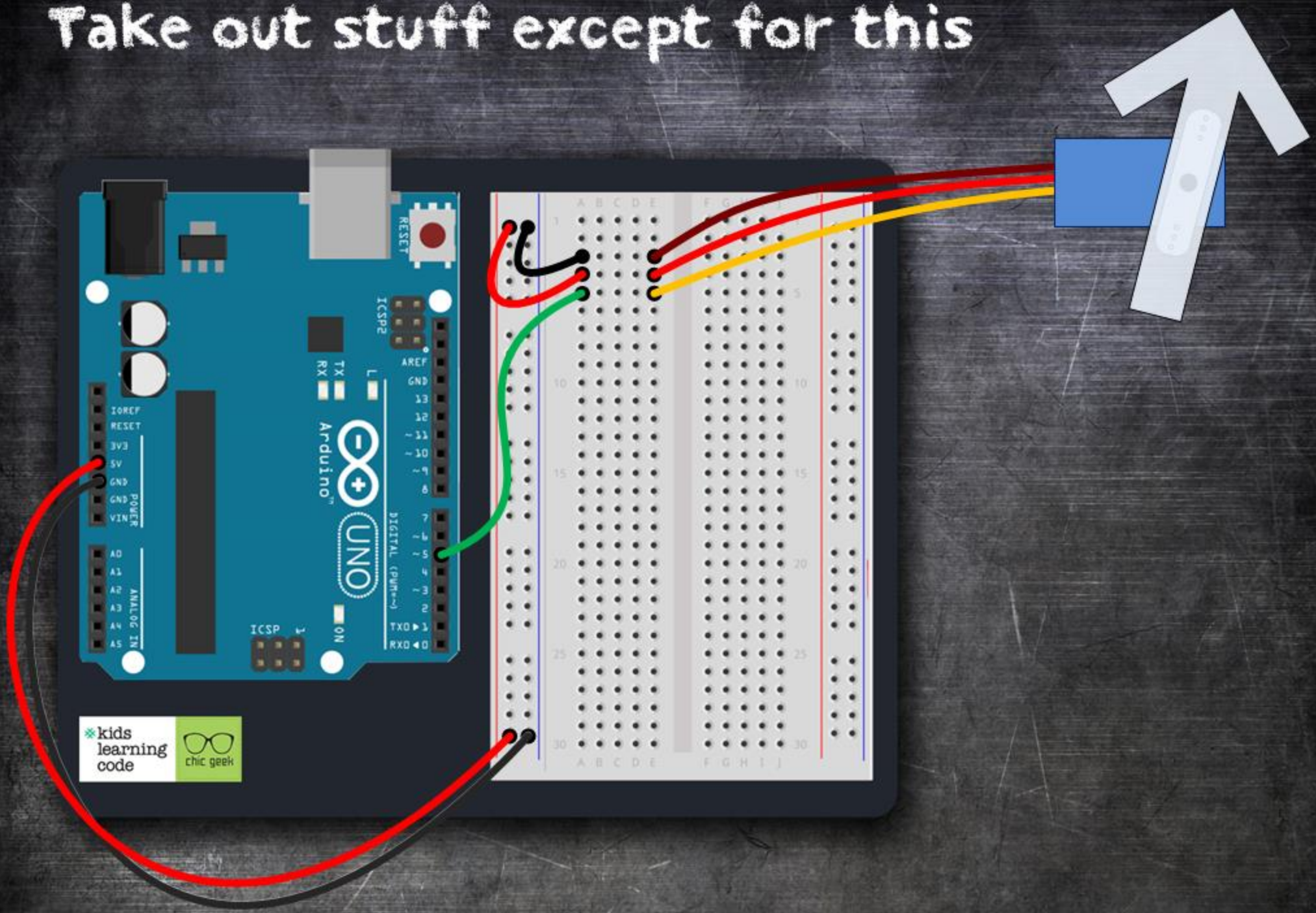
Analog things and digital things



Thermometer

Light Switch

Take out stuff except for this



Sensing Things

Your Arduino can measure things in the world around it.
This is called sensing. What do you want to measure?

Temperature

Light

Motion

Sound

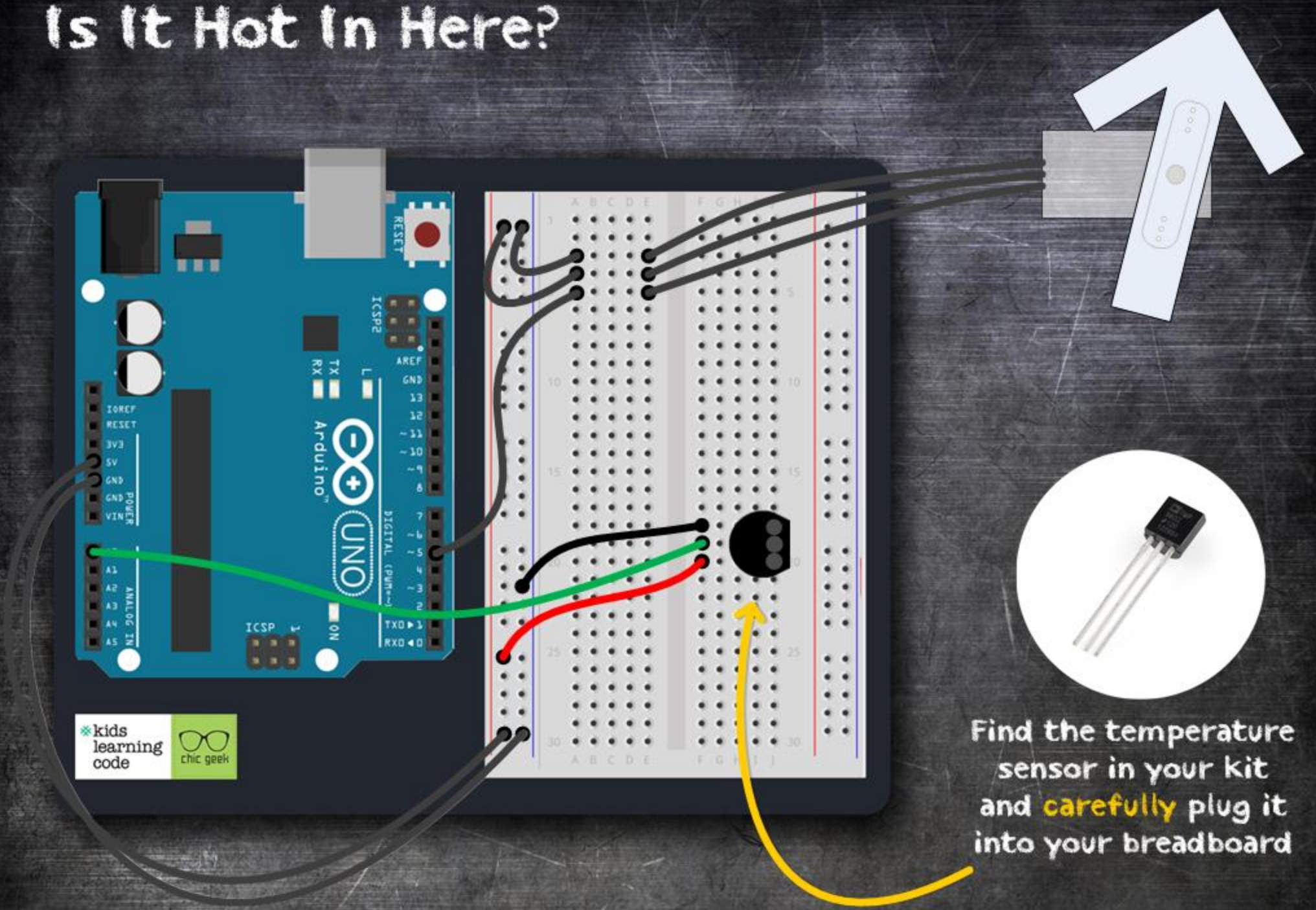
Distance

Heartbeat

Force

Orientation

Is It Hot In Here?



Find the temperature sensor in your kit and carefully plug it into your breadboard

Is It Hot In Here?

```
#include <Servo.h>

Servo MyServoMotor;

void setup()
{
 MyServoMotor.attach(5);
}

void loop()
{
 int CurrentTemperature = analogRead(0);
 int ServoPosition = map(CurrentTemperature, 130, 160, 179, 0);
 MyServoMotor.write(ServoPosition);
 delay(500);
}
```

measure the temperature

convert to motor position

send it to the motor

Is It Hot In Here?

1/ How can you make your temperature sensor warm up?

Hint: reach out and touch something.

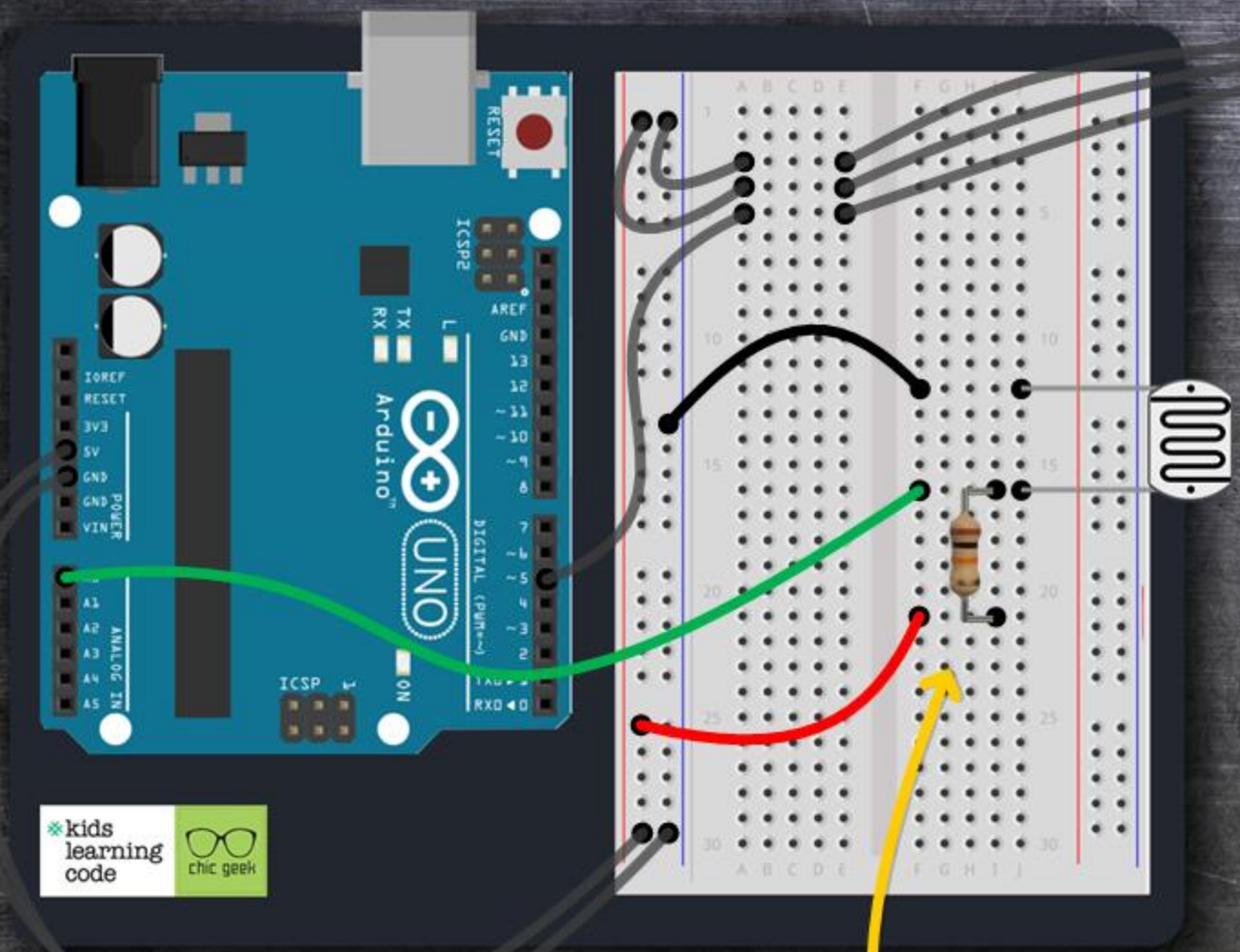
2/ How can you make your temperature sensor cool off?

Hint: is it getting windy in here?

3/ Can you make your program respond faster?

4/ What does the "map" instruction do in your program?

Let's Make A Light Sensor!



the colours are brown - black - orange - gold

Find the light sensor and 10K resistor in your kit and wire them up like this.

How Much Light Is There?

```
#include <Servo.h>

Servo MyServoMotor;

void setup()
{
 MyServoMotor.attach(5);
}

void loop()
{
 int HowMuchLight = analogRead(0);
 int ServoPosition = map(HowMuchLight, 0, 1000, 179, 0);
 MyServoMotor.write(ServoPosition);
}
```

measure the light reaching the light sensor wired to analog input 0

convert to motor position

send it to the motor

How Much Light Is There?

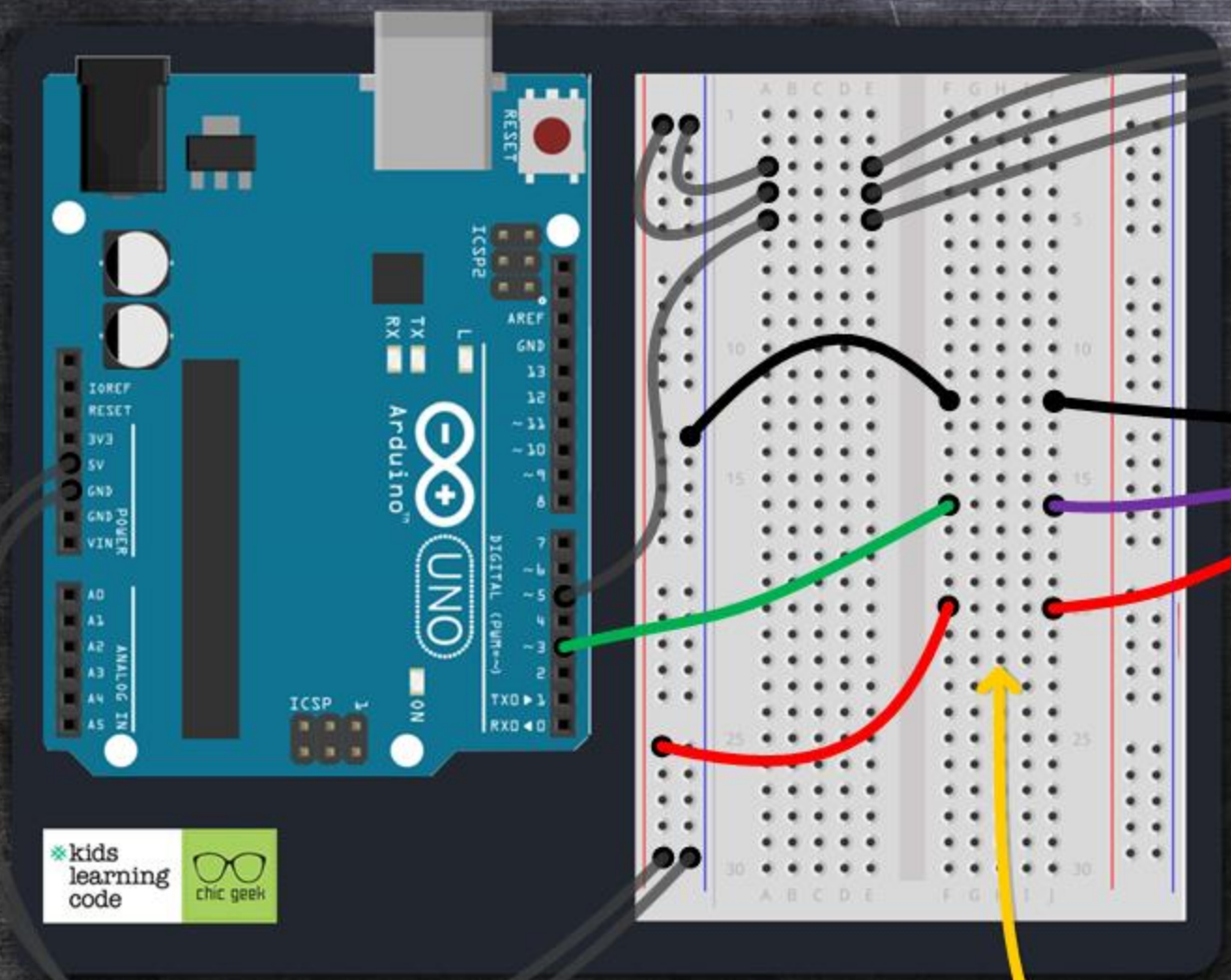
1/ How can you shine more light on your light sensor?

2/ How can you make it darker for your light sensor?

3/ Is your Arduino REALLY measuring light?

4/ What does the "map" instruction do in your program?

Can an Arduino sense motion?



Get the motion sensor from your mentors and wire up your circuit like this

Can an Arduino sense motion?

```
#include <Servo.h>

Servo MyServoMotor;

void setup()
{
 MyServoMotor.attach(5);
 pinMode(3, INPUT);
 pinMode(13, OUTPUT);
}

void loop()
{
 int IsThereMotion = digitalRead(3);

 if (IsThereMotion == 1)
 {
  digitalWrite(13, HIGH);
  MyServoMotor.write(0);
 }
 else
 {
  digitalWrite(13, LOW);
  MyServoMotor.write(179);
 }
 delay(3000);
}
```

teach the Arduino what inputs and outputs to use

ask the sensor if there is motion

if there is motion, move the pointer and turn ON a light

but if there is no motion, move the pointer back and turn OFF the light

Can an Arduino sense motion?

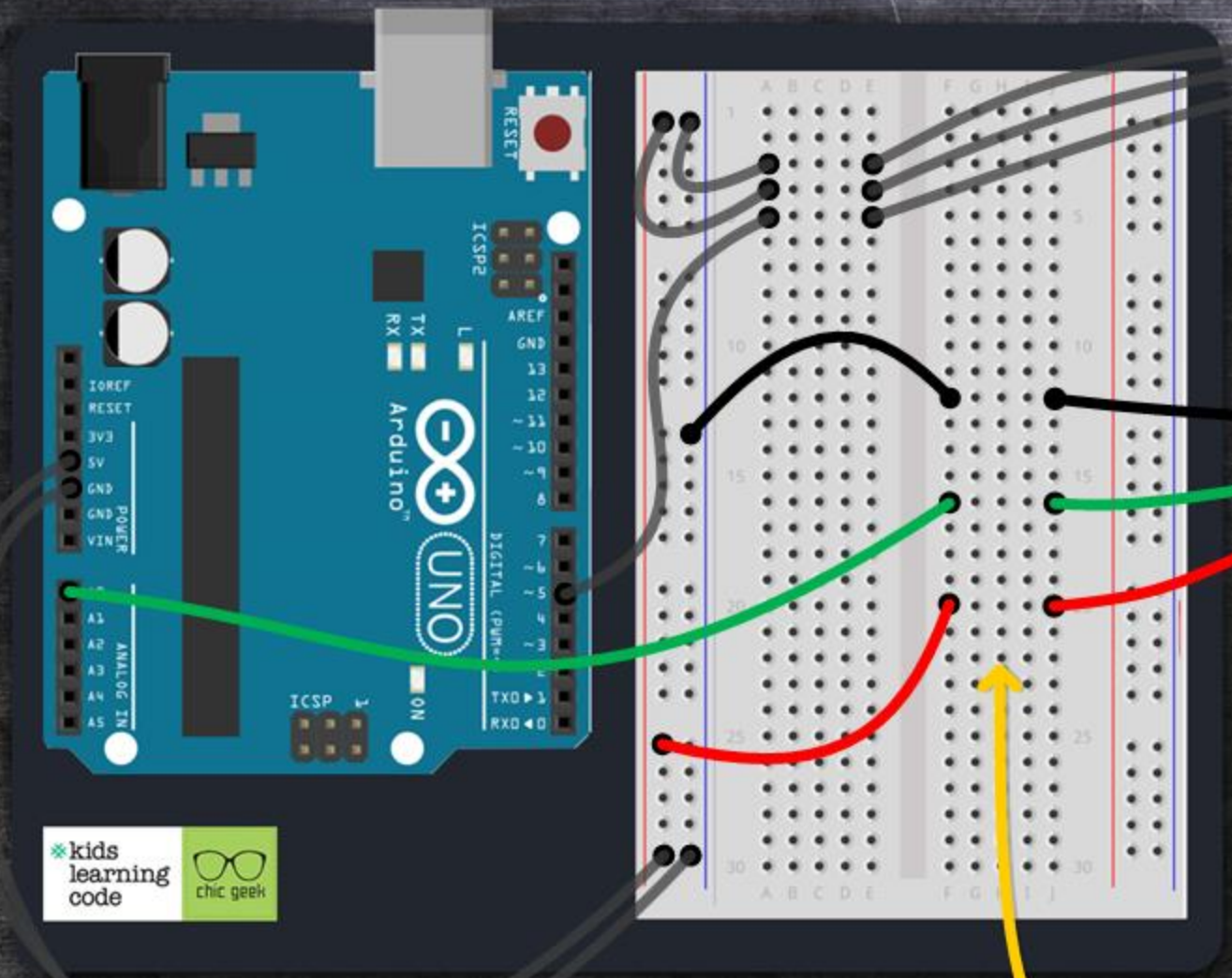
1/ How sensitive is your motion sensor?

2/ Can you sneak up on it if you move slowly?

3/ How is it sensing you?

4/ Should your parents put one by the cookie jar?

How far away are you?



Get the distance sensor from your mentors and wire up your circuit like this

How far away are you?

```
#include <Servo.h>

Servo MyServoMotor;
int SampleCounter = 0;
int DistanceToObject = 0;

void setup()
{
 MyServoMotor.attach(5);
}

void loop()
{
 DistanceToObject += analogRead(0);
 SampleCounter = SampleCounter + 1;
 if (SampleCounter == 100) {
  DistanceToObject = DistanceToObject / 100;
  int ServoPosition = map(DistanceToObject, 0, 110, 0, 179);
  MyServoMotor.write(ServoPosition);
  DistanceToObject = 0;
  SampleCounter = 0;
 }
 delay(10);
}
```

we need to remember how many samples we've taken

take a sample and ADD it to a bucket

once we have a full bucket of samples, we take an average of all of them

move the motor to the average sample value

How far away are you?

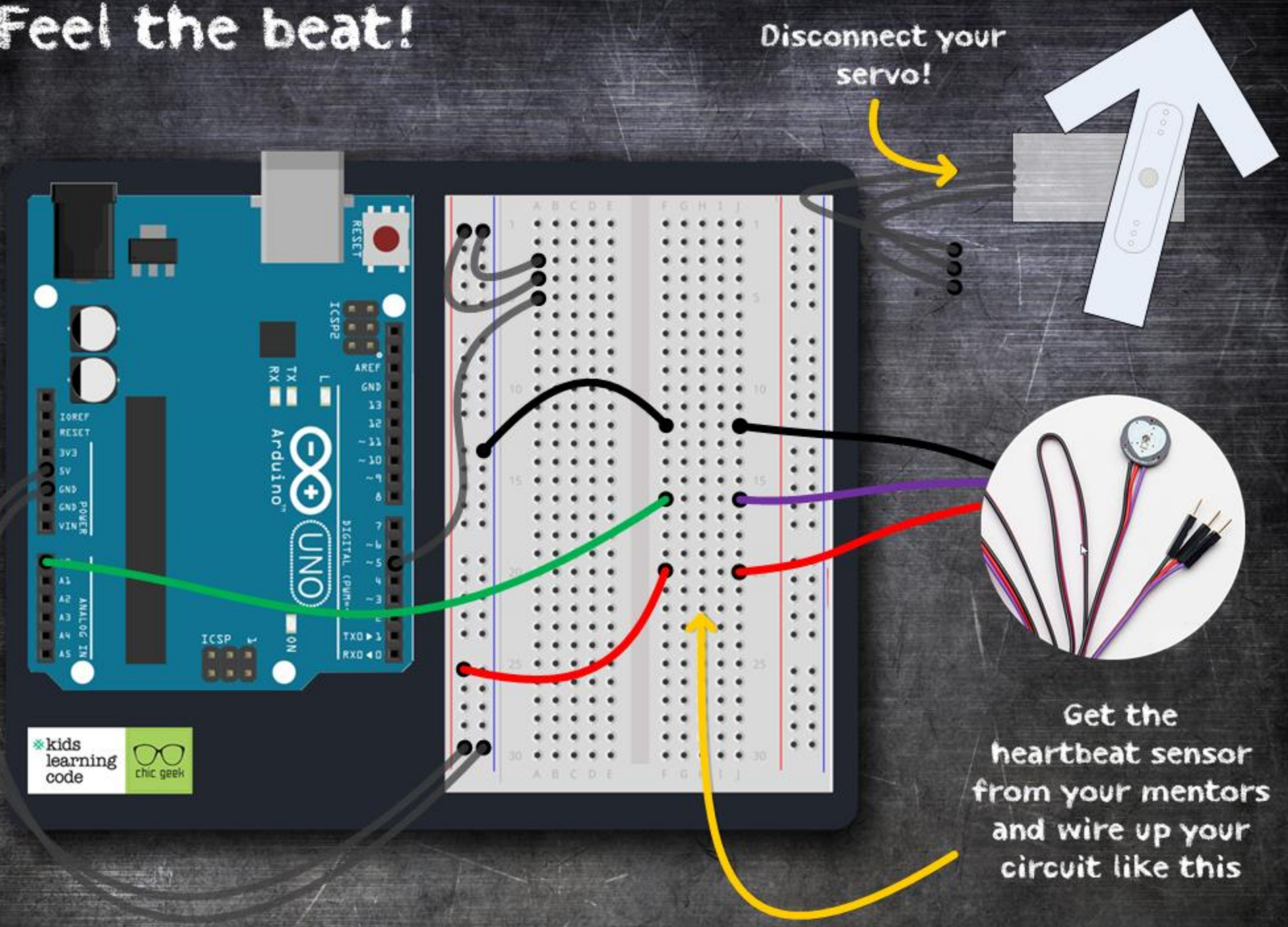
1/ How sensitive is your distance sensor?

2/ What is the furthest you can measure?

3/ How is it measuring distance?

4/ Should your parents put one by the cookie jar?

Feel the beat!

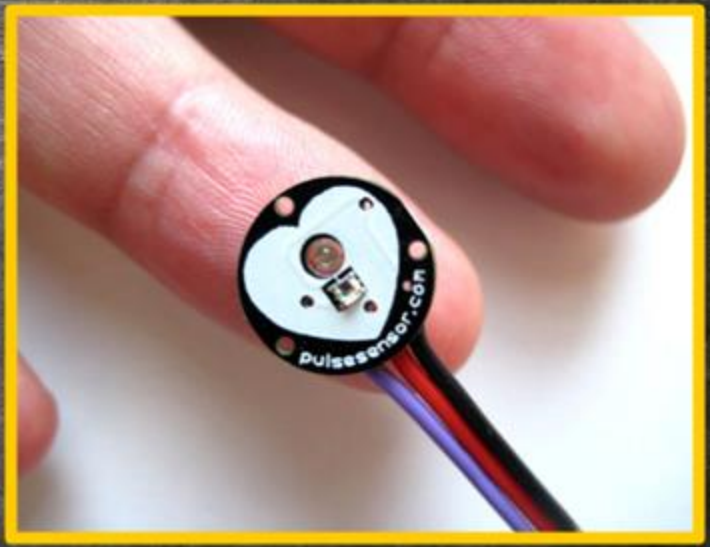


Feel the beat!

You can load the code for the heartrate sensor from L08_Heartrate in the lab files.

It's a bit complex so we won't go through it today, but it's still fun to watch the Arduino measure your heart rate!

Place the sensor against your fingertip and watch the little light on the Arduino board.



Feel the beat!

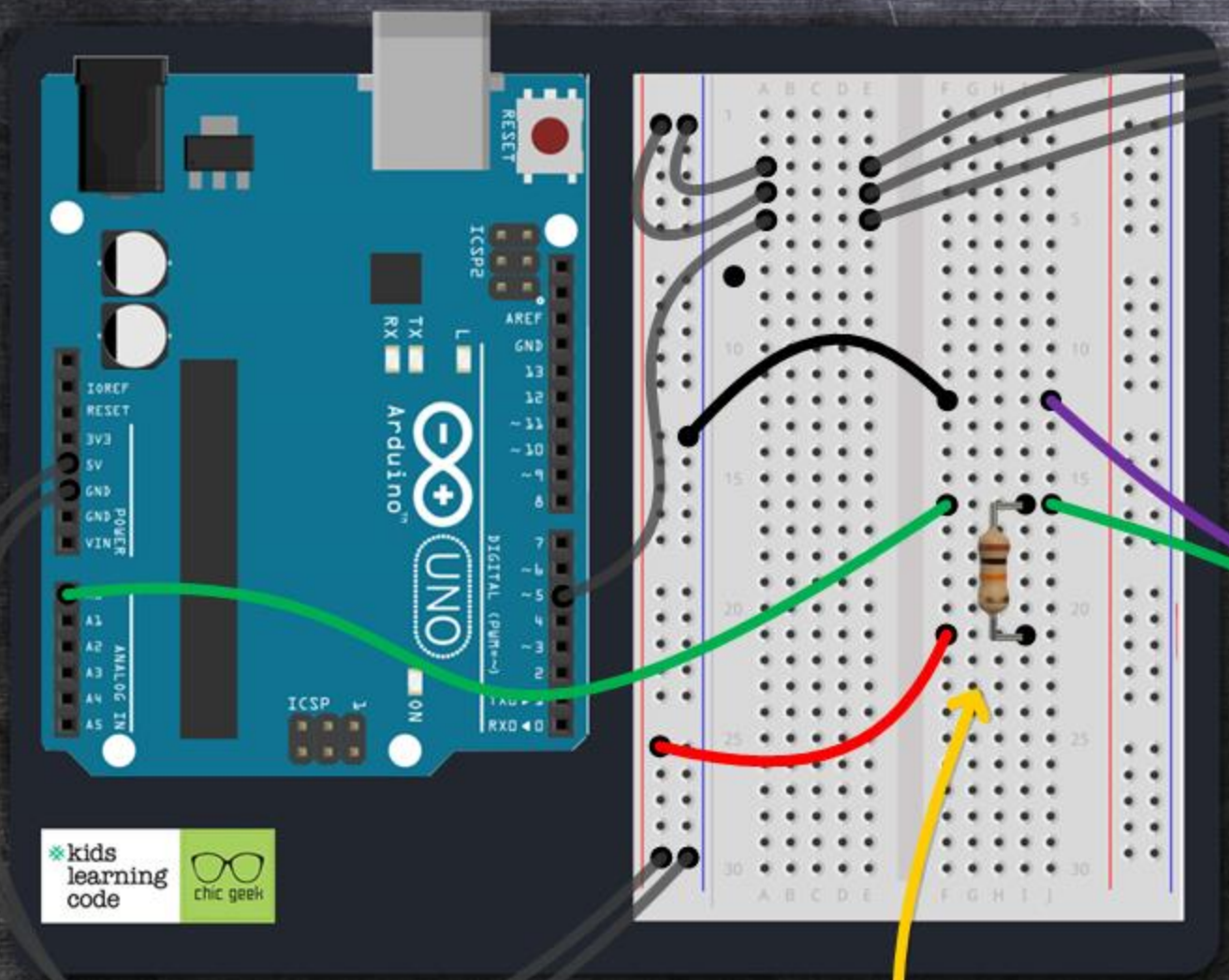
1/ How sensitive is your heart rate sensor?

2/ What is your heart rate?

3/ How is it measuring heart rate?

4/ How fast can you make it go?

Light as a feather!



the colours are brown - black - orange - gold

Use the force sensor from your mentors and 10K resistor in your kit and wire them up like this.

Light as a feather!

```
#include <Servo.h>

Servo MyServoMotor;

void setup()
{
 MyServoMotor.attach(5);
}

void loop()
{
 int HowMuchForce = analogRead(0);
 int ServoPosition = map(HowMuchForce, 0, 1023, 0, 179);
 MyServoMotor.write(ServoPosition);
}
```

ask the sensor how much force it is sensing

convert it to a motor position and send it to the motor

Light as a feather!

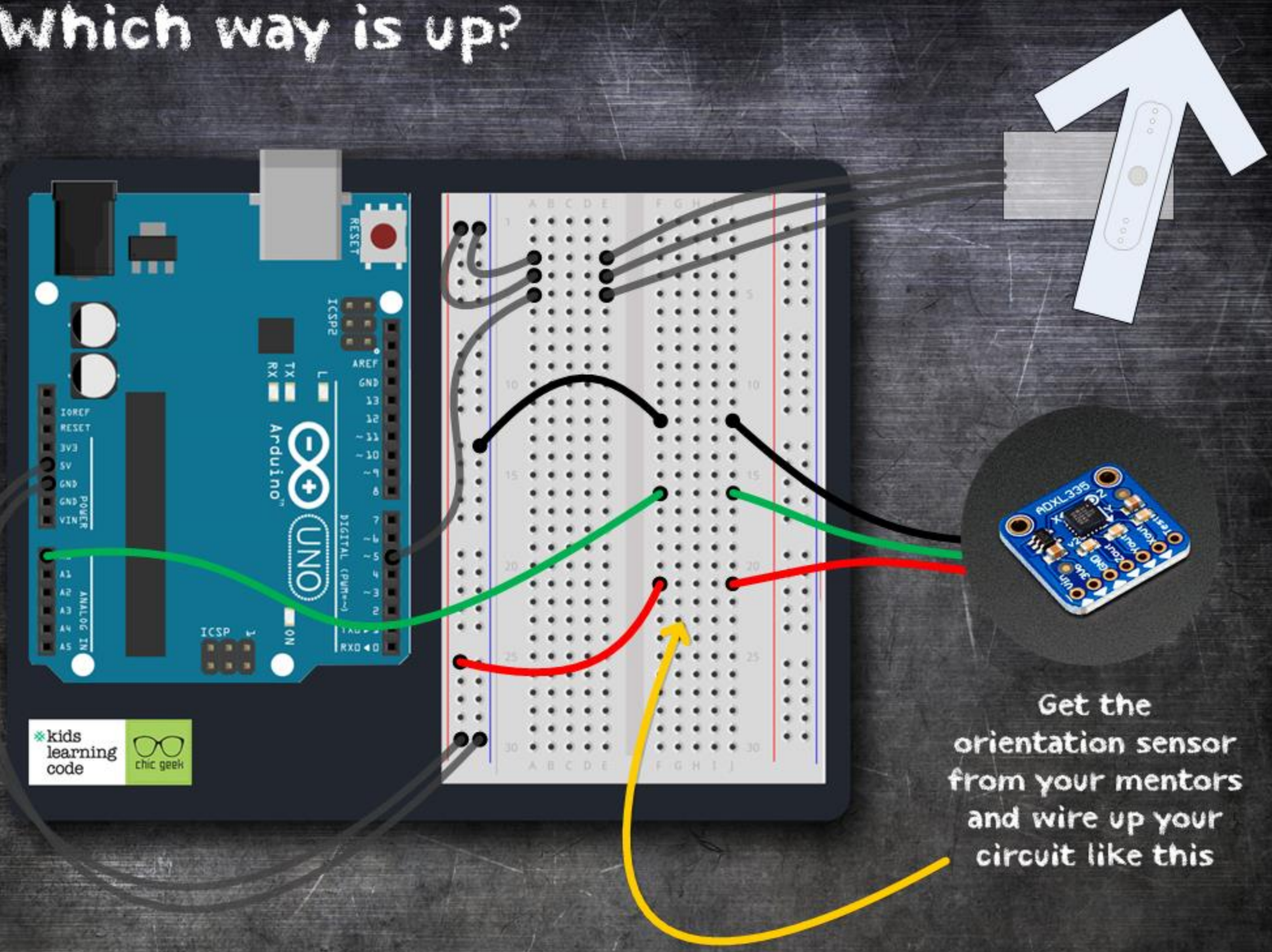
1/ How sensitive is your force sensor?

2/ What common household object could you build with this?

3/ How is it measuring force?

4/ Shall we use it to weigh mom or dad?

Which way is up?



Get the orientation sensor from your mentors and wire up your circuit like this

Which way is up?

```
#include <Servo.h>

Servo MyServoMotor;

void setup()
{
 MyServoMotor.attach(5);
}

void loop()
{
 int Orientation = analogRead(0);
 int ServoPosition = map(Orientation, 200, 450, 179, 0);
 MyServoMotor.write(ServoPosition);
 delay(100);
}
```

read the current orientation

convert it to a motor position

move the motor to this position

Which way is up?

1/ How sensitive is your orientation sensor?

2/ Is an orientation sensor part of any games you have?

3/ What could you build with this?

4/ What would happen if we attached it to your pet?

TEAM PRESENTATIONS

Temperature

Light

Motion

Sound

Distance

Heartbeat

Force

Orientation

Where Do You Use Arduinos?

In the real world, Arduinos (and other microcontrollers) are all around you.

Where do you think you use them?

Challenges

You have all the parts you need to build these projects. Ask your mentors for help if you need it. Give it a try!

1/ Build a traffic light

Hint: there is a three-colour light in your kit. You can turn on one colour at a time using your Arduino.

2/ Build a high-temperature alarm

Use your temperature sensor make the light on the Arduino light up if the temperature gets too high.

3/ Build a beeper

Use the "piezoelectric buzzer" in your kit to make a beep.

Group Challenge

Remember our cannon? Who wants to fire it again???

To fire the cannon you need to answer all of the following challenge questions. Each correct answer gets you one step closer to...

BOOM!!!

The Arduino is a simple

a) digital control

b) microcontroller

c) sensor

d) program

The Arduino is a simple

a) digital control

b) microcontroller

c) sensor

d) program

Computer programs are called

a) hardware

b) SETUP and LOOP

c) software

d) connectors

Computer programs are called

a) hardware

b) SETUP and LOOP

c) software

d) connectors

You can measure things in the real world using analog and digital

a) sensors

b) software

c) programs

d) breadboards

You can measure things in the real world using analog and digital

a) sensors

b) software

c) programs

d) breadboards

What is this instruction doing?

```
Value = analogRead(0);
```

a) resetting the analog signal to zero

b) telling the Arduino that signal zero is analog

c) measuring the value on analog signal number zero

d) reading digital control zero

What is this instruction doing?

```
Value = analogRead(0);
```

a) resetting the analog signal to zero

b) telling the Arduino that signal zero is analog

c) measuring the value on analog signal number zero

d) reading digital control zero

Is this question about a digital or analog thing --

Did it rain more than 25mm today?

a) neither

b) it depends if it is still raining

c) analog

d) digital

Is this question about a digital or analog thing --

Did it rain more than 25mm today?

a) neither

b) it depends if it is still raining

c) analog

d) digital

Which of these is the best description of electricity?

a) a kind of force made up of tiny tennis balls

b) a form of energy that flows through conductors

c) a type of power that Arduinos can generate

d) a form of analog energy

Which of these is the best description of electricity?

a) a kind of force made up of tiny tennis balls

b) a form of energy that flows through conductors

c) a type of power that Arduinos can generate

d) a form of analog energy

Which of these is true?

a) the Arduino does SETUP and LOOP once

b) analog things only have two possible answers

c) only positive electricity can flow in a red wire

d) the Arduino starts over when you push "reset"

Which of these is true?

a) the Arduino does SETUP and LOOP once

b) analog things only have two possible answers

c) only positive electricity can flow in a red wire

d) the Arduino starts over when you push "reset"

I REALLY WANT TO FIRE THE CANNON!

a) yes

b) yes

c) yes

d) all of the above!!!!!!

I REALLY WANT TO FIRE THE CANNON!

a) yes

b) yes

c) yes

d) all of the above!!!!!!

From your instructors, mentors, and organizers...

YAY YOU!

Nice job! You just learned the basics of Arduino and how to program microcontrollers! TOTALLY AWESOME!

Thanks for attending!

kids learning code

chic geek