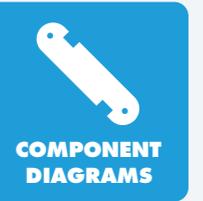


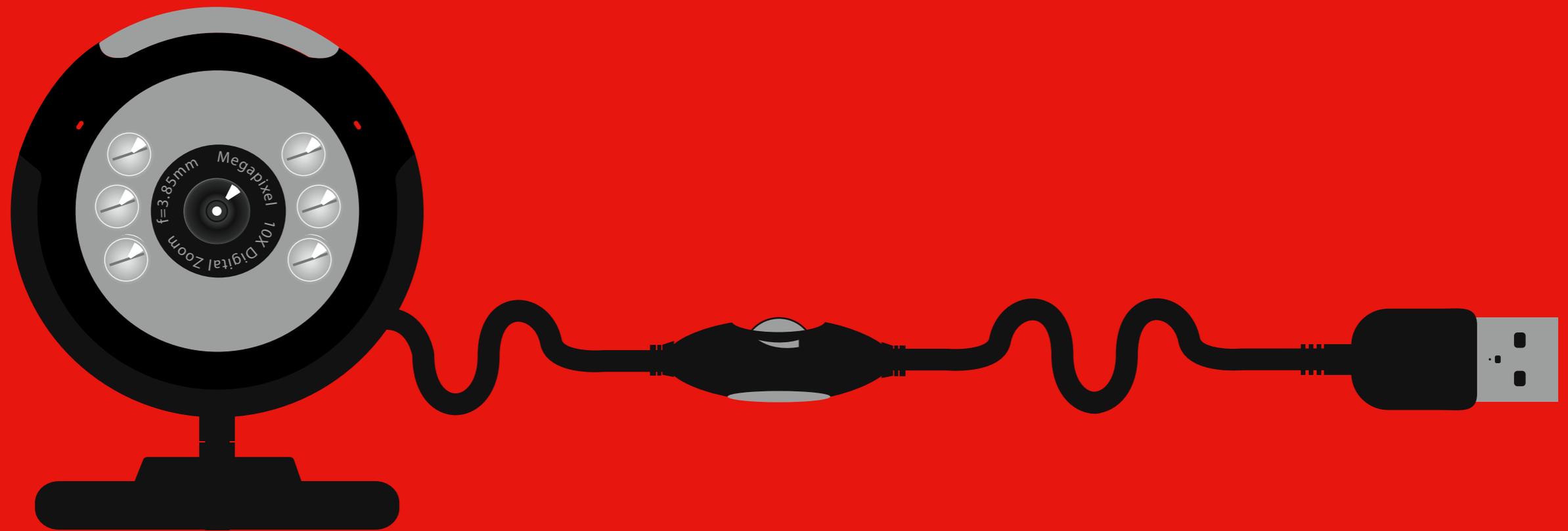
# MAKE YOUR OWN MICROSCOPE

Copyright © Makerversity



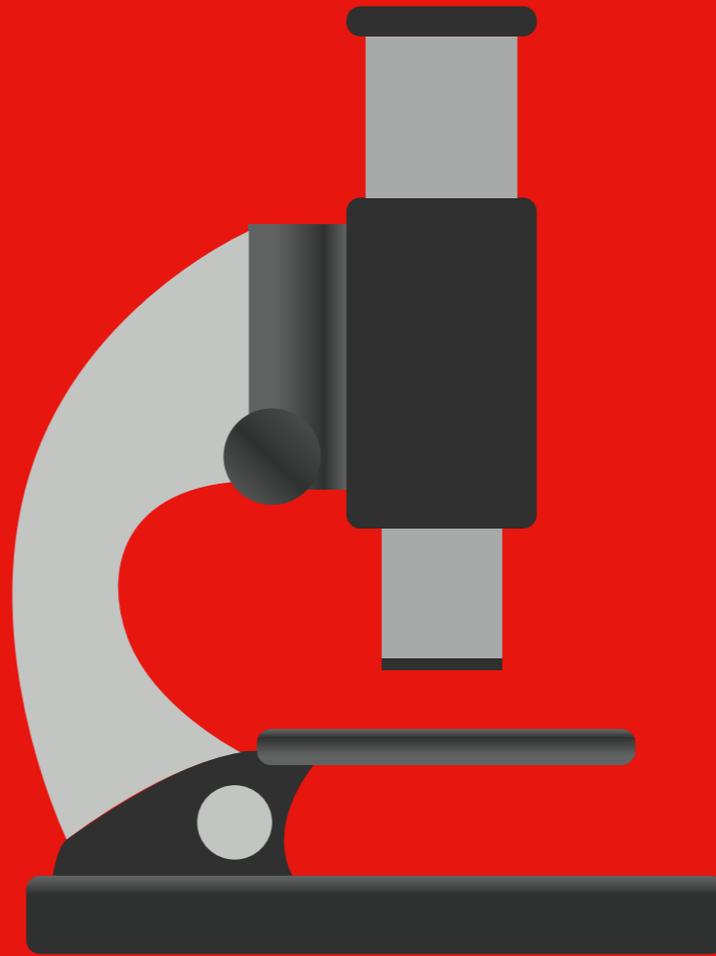
**MAKERVERSITY DIY**

**HACK.**



## **MEET YOUR WEBCAM**

Did you know that the first webcam was inspired by the 'Trojan Room Coffee pot' in a computer lab at the University of Cambridge in 1991? A camera was placed in front of the coffee pot so that people working in other parts of the building could always see how much coffee was left.



## **...SOON TO BECOME A MICROSCOPE!**

What are microscopes used for? Who uses them?

The first microscopes were known as 'flea glasses' because they were used to observe small insects. Today, the most powerful lens allows us to see an object as small as 500 nanometres - one centimetre is ten million nanometres!

## **(WALT) WE ARE LEARNING TO...**

- ...understand that objects are made up of a sum of components.
- ...identify these different components, learn what they do and where else they are used.

At the end of the session, we'll have turned a webcam into a digital microscope that you can actually use!

## **(WILF) WHAT I'M LOOKING FOR...**

...you to identify different components and recognise them in different products and devices.

...you to learn how to use common tools correctly and safely.

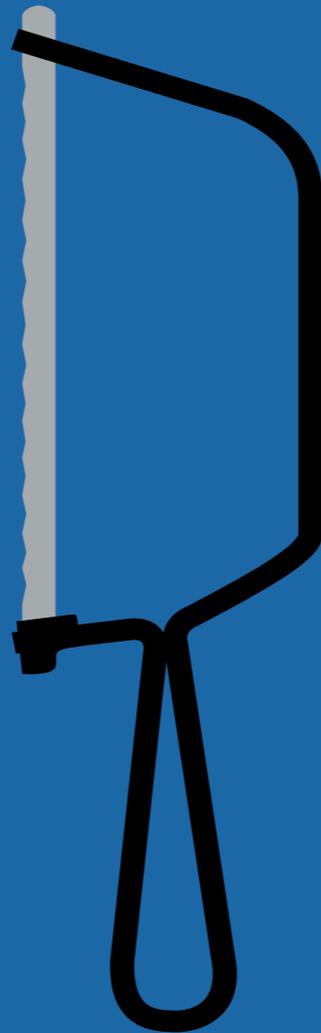
## YOUR TOOL KIT

- 1 precision screwdriver
- 2 junior hacksaw
- 3 cutting mat
- 4 small G-clamp
- 5 computer/tablet with USB port
- 6 scalpal
- 7 steel rule
- 8 vernier calipers (if available)

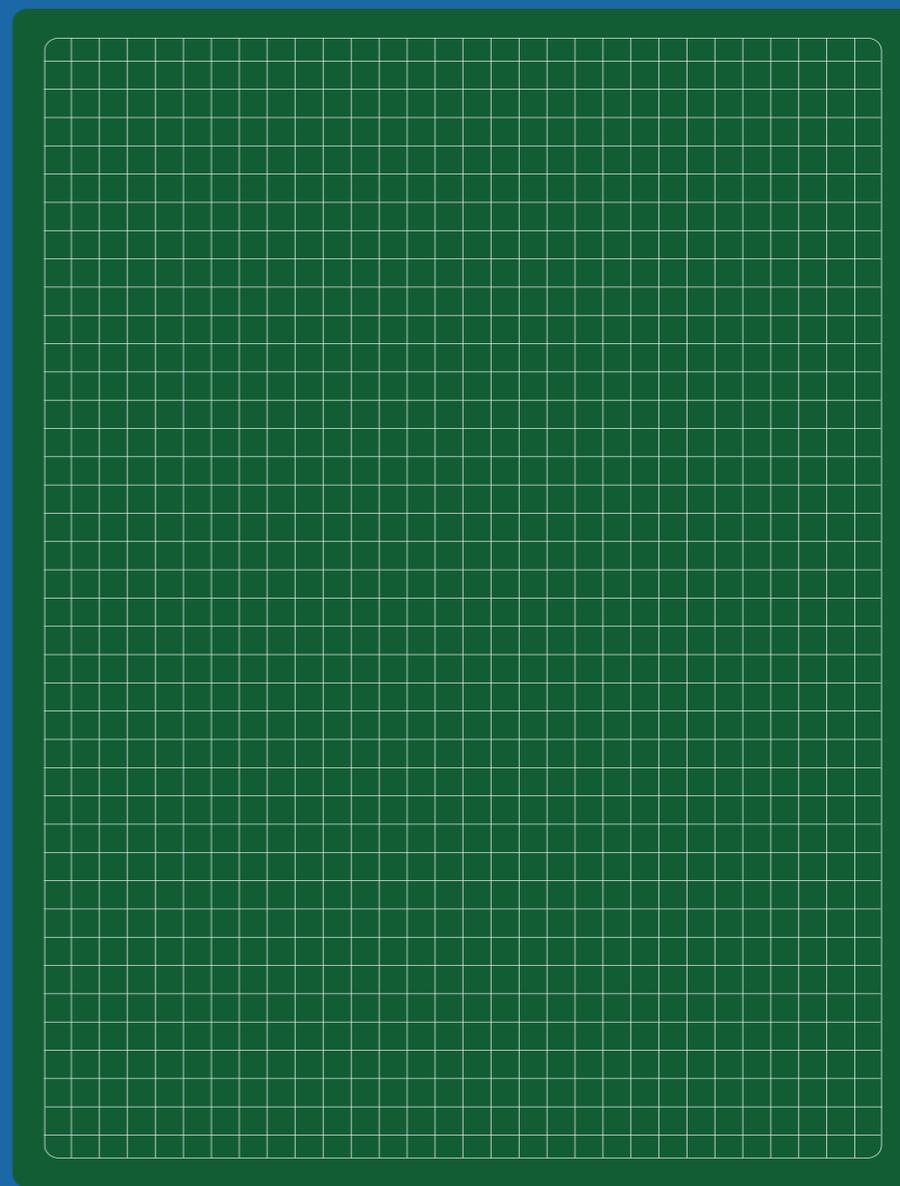
1



2



3



4



5



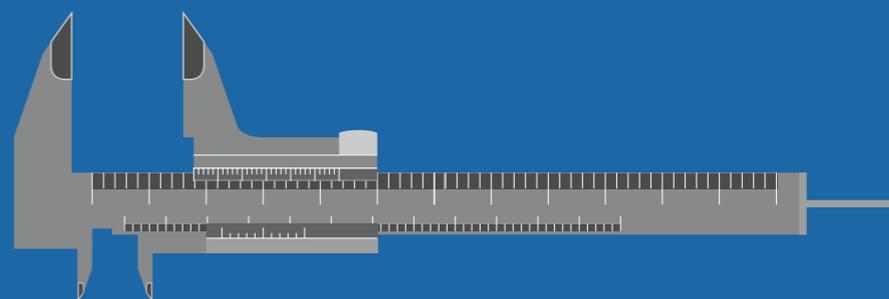
6

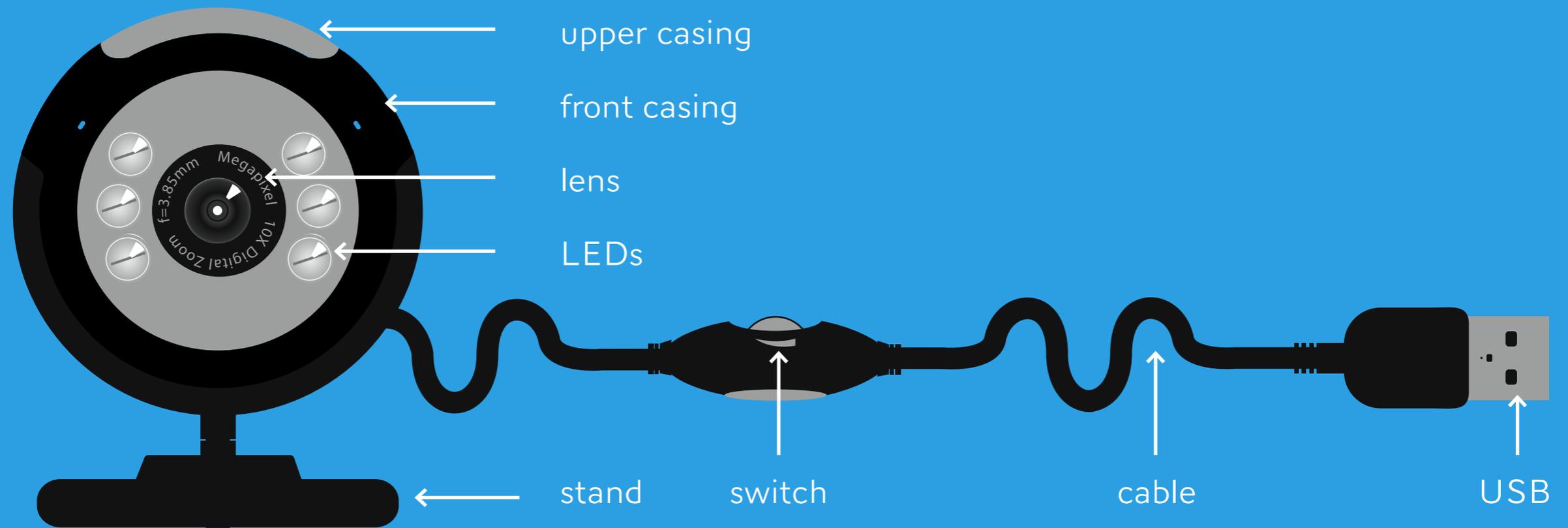


7



8





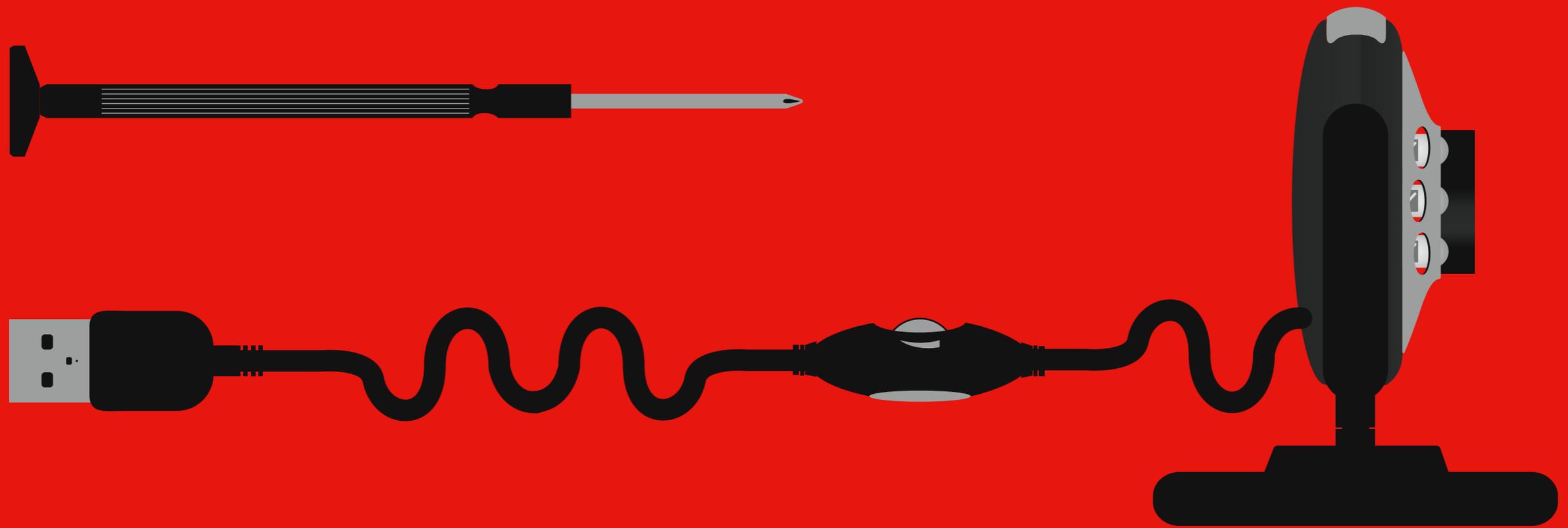
## WHAT IS A WEBCAM MADE UP OF?

Can you identify the component parts of your webcam?  
Find out what each part does and think about what they are for.

# **FORM AND FUNCTION**

All of the components you can see have been designed as objects in their own right. Each is made to meet a specific need or perform a specific task (its function) and then styled to look a certain way (its form).

Think of all of the components in your webcam: what do they do? Why do you think they look and feel the way they do?



## **LET'S LOOK INSIDE**

The casing of your webcam is designed to protect the delicate components inside that make it work. Have a look at the casing of your webcam and figure out how it is held together. Using your screwdriver, carefully remove the screws and pull the casing apart to reveal the circuitboard inside.

## TOOL TIP!

**MOST SCREWS AND BOLTS HAVE A RIGHTHANDED THREAD, SO TO TIGHTEN OR LOOSEN, IT MIGHT HELP YOU TO REMEMBER:**



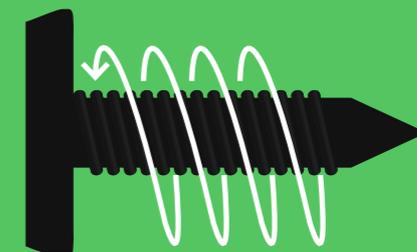
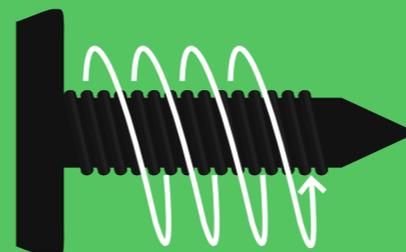
To tighten, turn clockwise. Look at the head of the screw, it looks like you are turning it to the right.

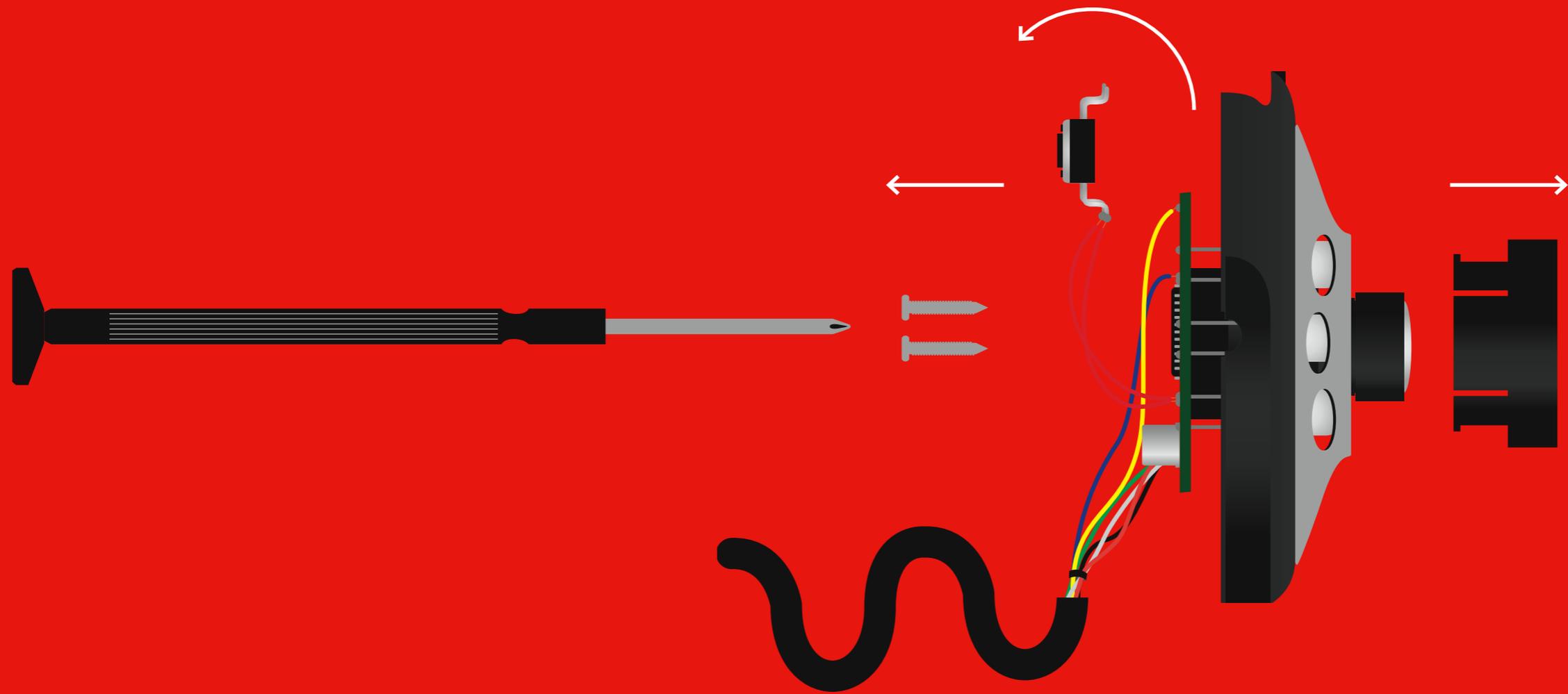


To loosen, turn anti-clockwise. Look at the head of the screw, it looks like you are turning it to the left.

## SCREW THREAD

A screw thread is the ridge that runs in a spiral around the length of a screw. Take a look at the top of a bottled drink and at the inside of its lid to see how internal and external threads fit.





## LET'S TAKE A CLOSER LOOK

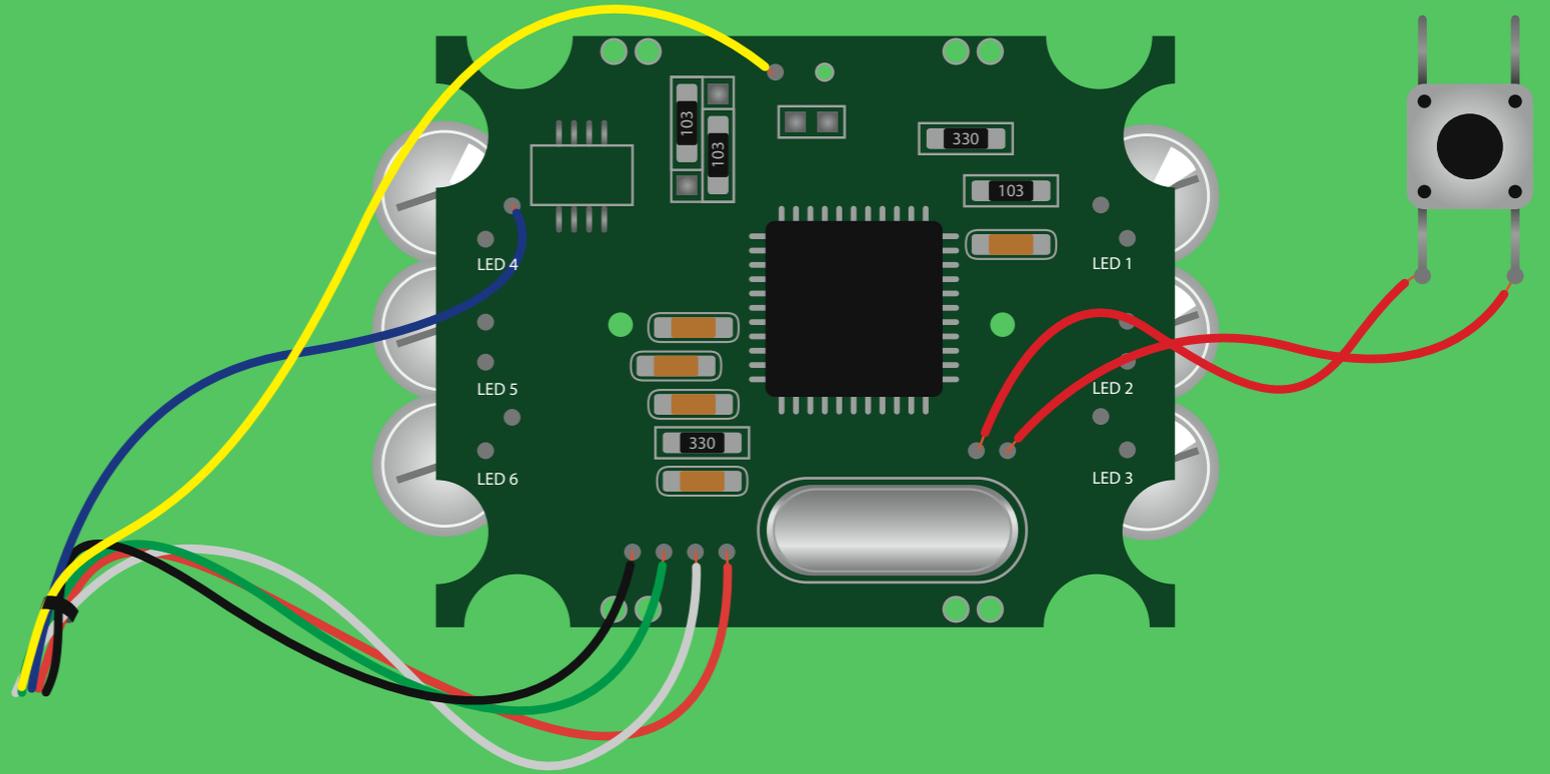
Your circuit board is still attached to the front casing, twist the outer lens cover until it pops out and carefully unscrew the circuitboard from the front casing. does your webcam look broken? notice that your camera is still working.

## **WATCH OUT!**

Be careful not to damage the circuitboard, LEDs or the lens when you remove the casing!

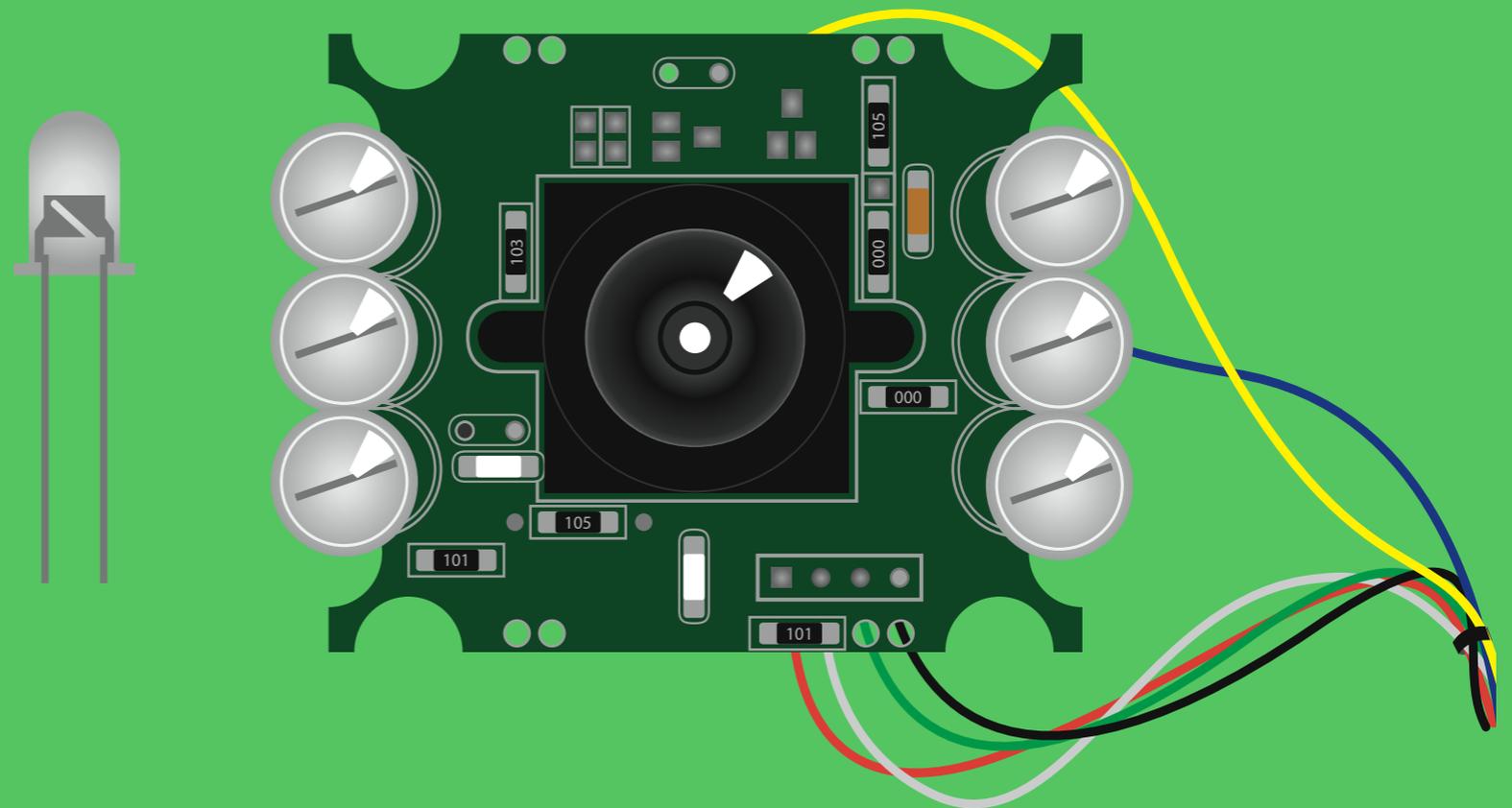
## CIRCUIT BOARD

A circuit board is found in most of your household electronics. It connects and controls the components attached to it, like the LEDs, using conductive tracks in copper sheet.



## LED

Light Emitting Diodes (LEDs) are efficient light sources which glow when electricity passes through. These little lights can be found in alarm clocks, TV displays and even traffic lights!

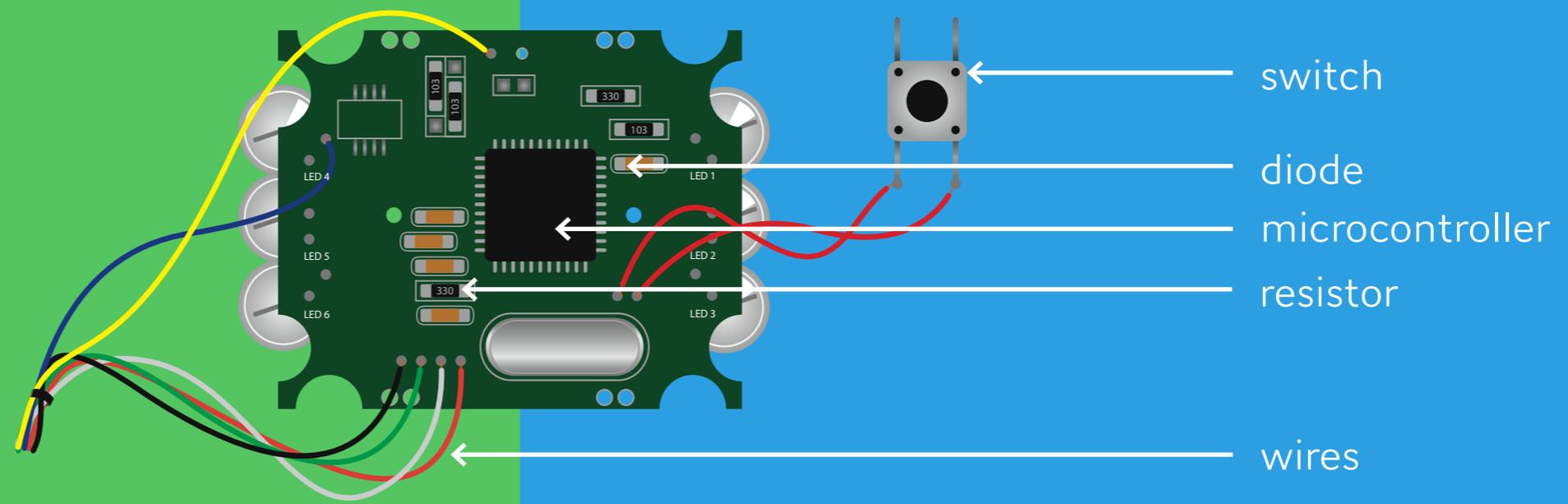


# **SOLDERING**

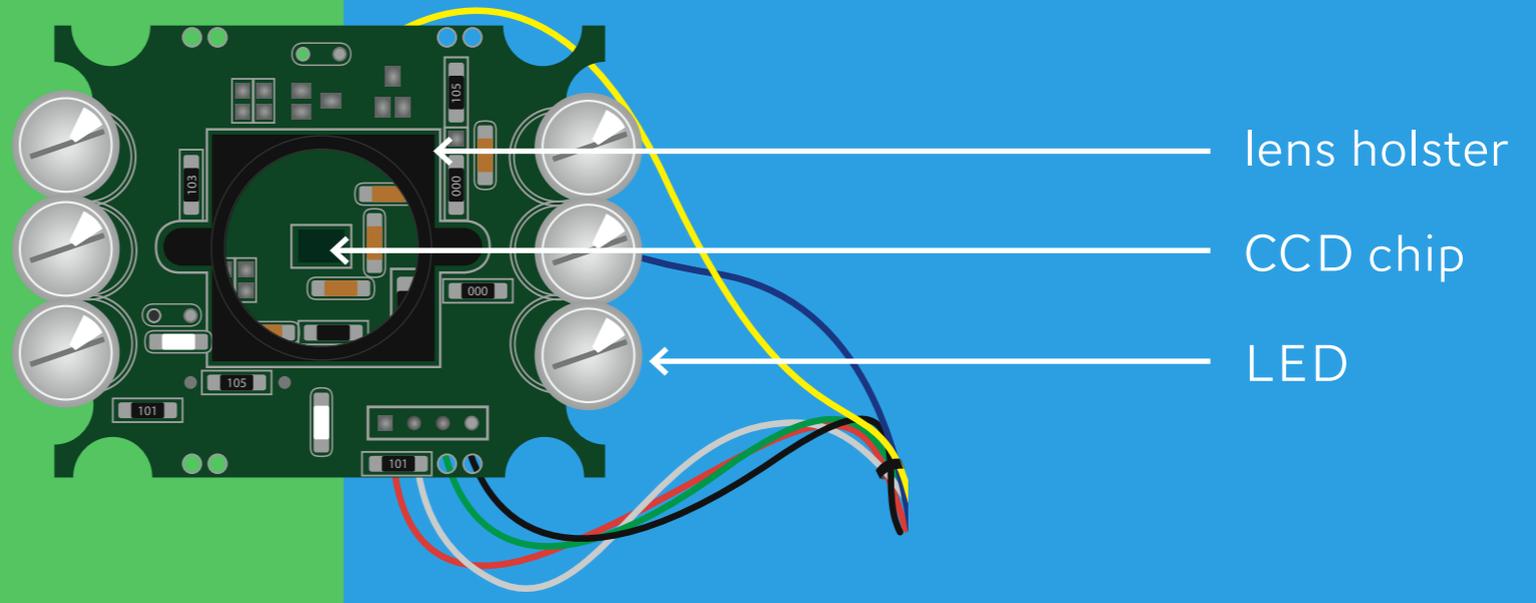
Components are attached to the circuit board using a process called 'soldering'. Soldering is one way to join pieces of metal. It does this by melting a filler metal, called solder, into the joint.

If any of the connections break on your circuitboard, you can fix them with this process.

# CAN YOU FIND OUT WHAT EACH COMPONENT DOES?



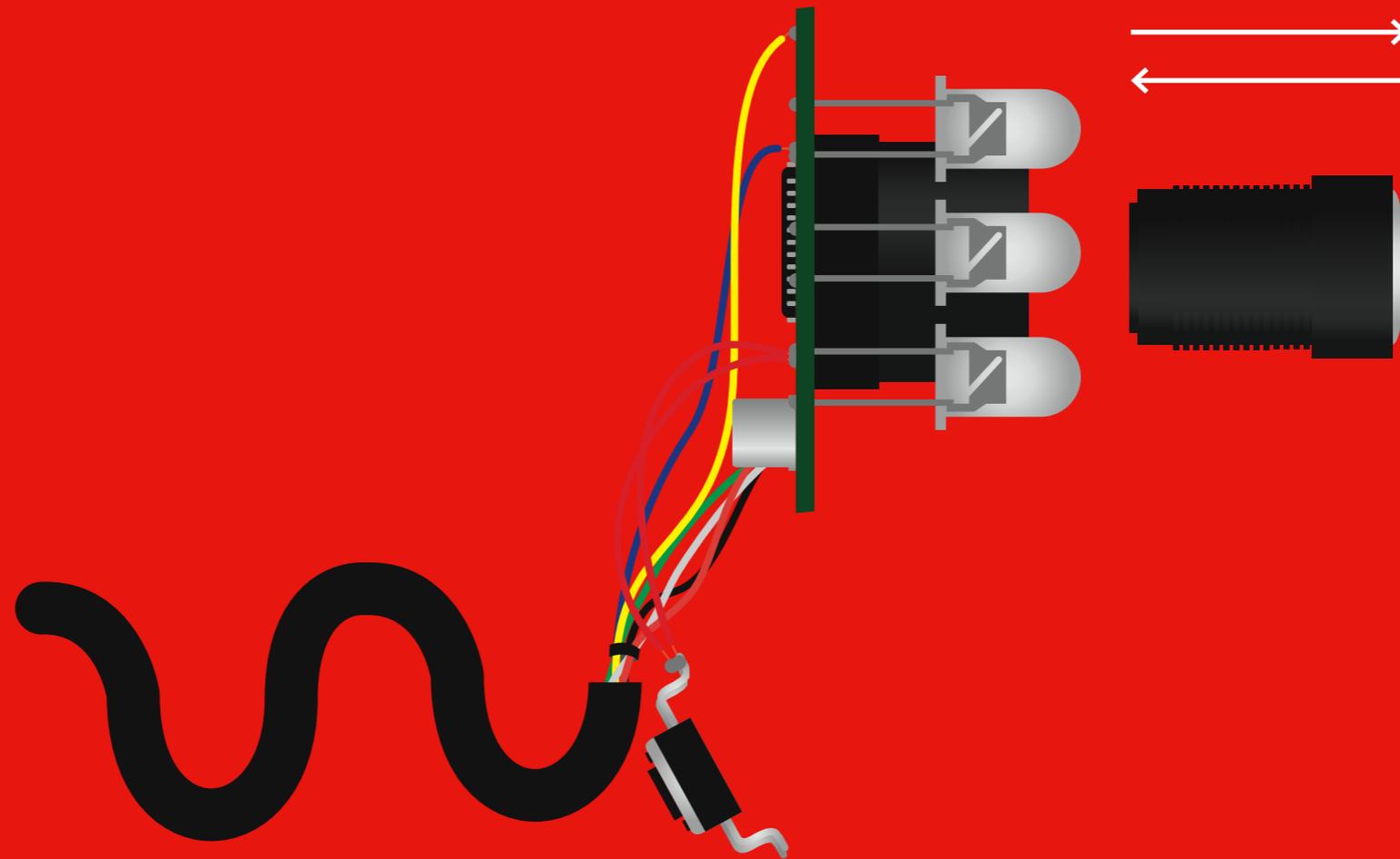
**BACK**



**FRONT**

## CCD CHIP

A light sensitive chip which converts light into electrons which are read as pixels. It is the eye of the webcam. The size of the sensor dictates the image quality. All digital cameras have one.



## LET'S HAVE A LOOK AT THE LENS

Try to twist out the lens a little, bringing it away from the circuit board.

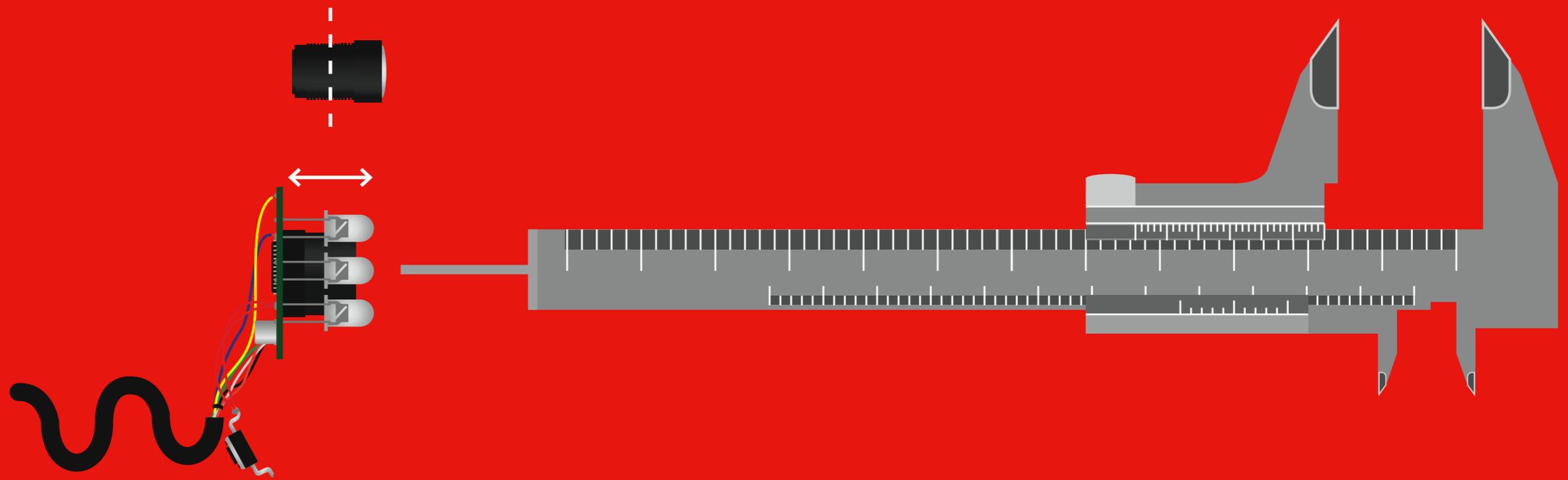
Do you remember which way to turn it to loosen it?

What is happening to the image on your screen?

Unscrew your lens fully and take a look at what is beneath it.

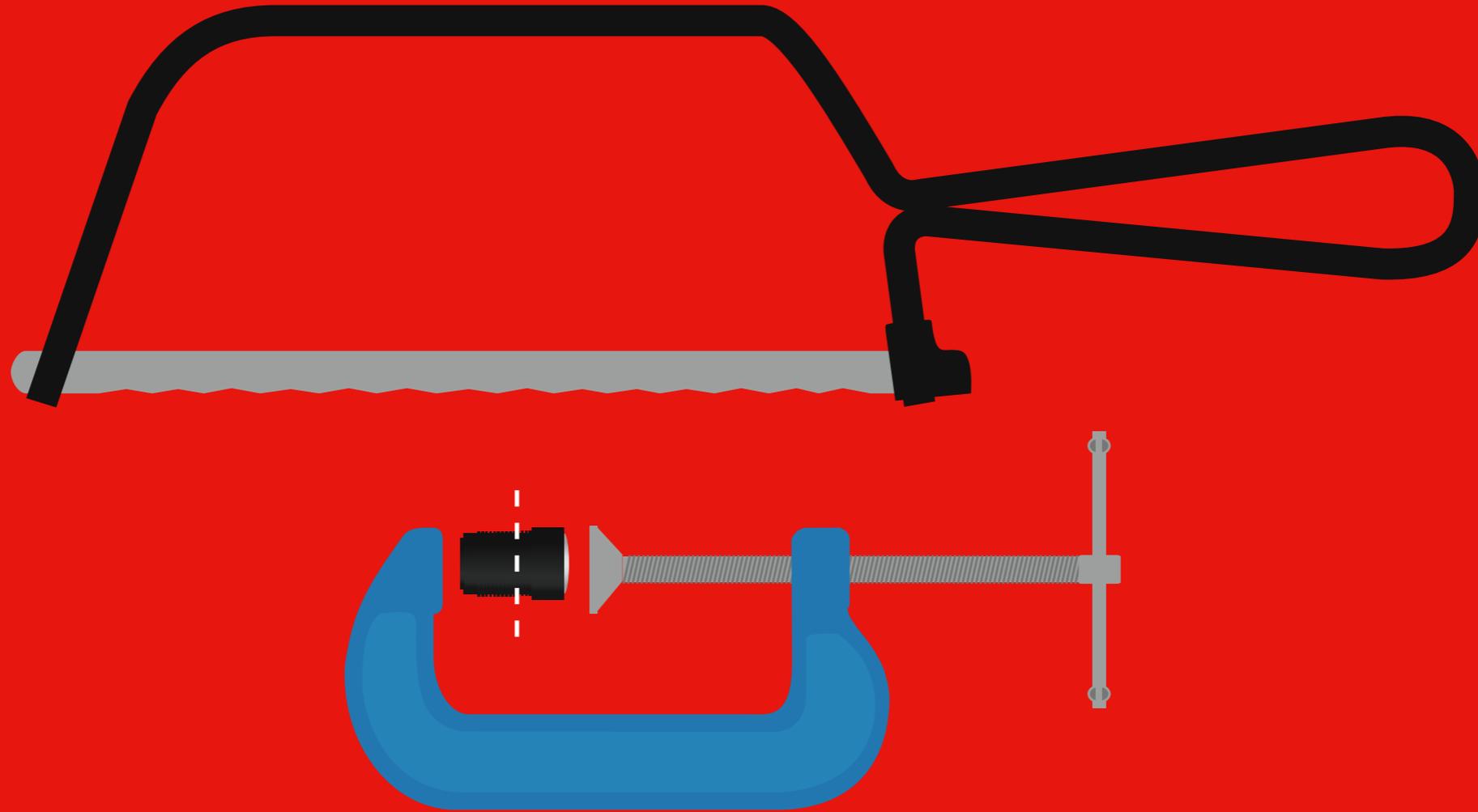
## **STILL WORKING?**

Notice that even though we're taking it apart,  
you can still see an image on your screen?



## MEASURE

Measure the depth of the lens holder and mark it out on the barrell of the lens itself, this should be about half way down.  
You might want to use the depth probe of a set of calipers if you have one, or use a strip of card or dowel to mark out the internal depth.



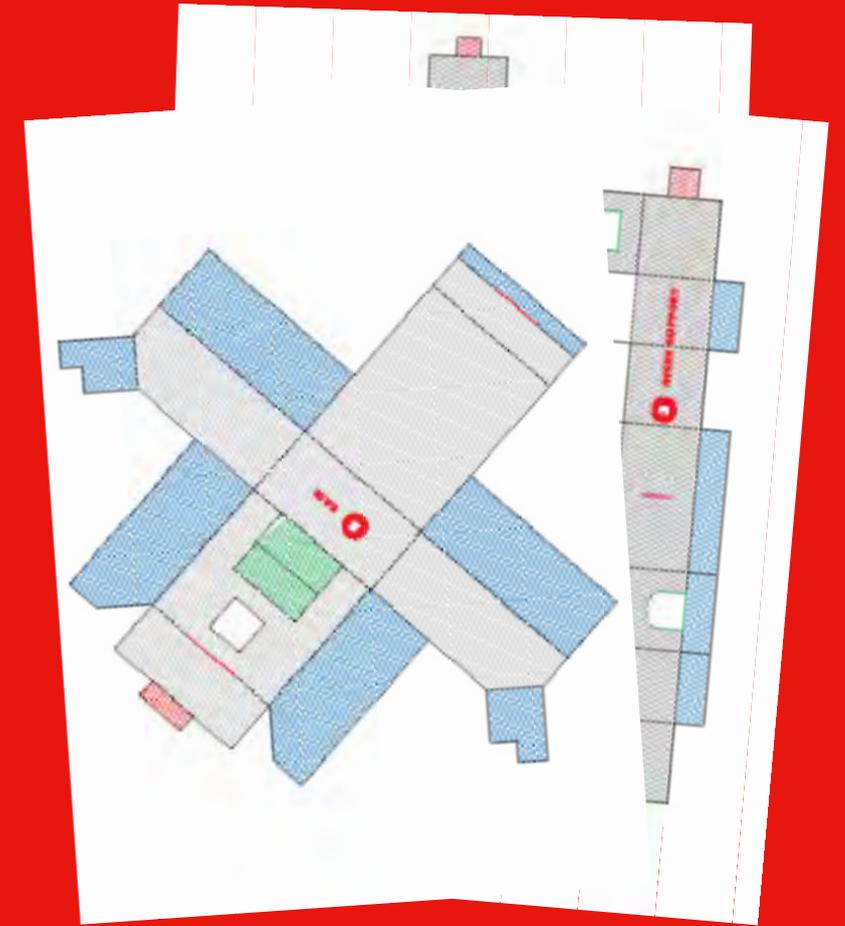
## **CUT DOWN YOUR LENS**

Holding the lens in the small g-clamp from end to end,  
saw through the centre of the barrell.

Slow strong strokes with the saw will be much  
more accurate and controlled than really fast sawing.

## **WHEN USING YOUR HACKSAW**

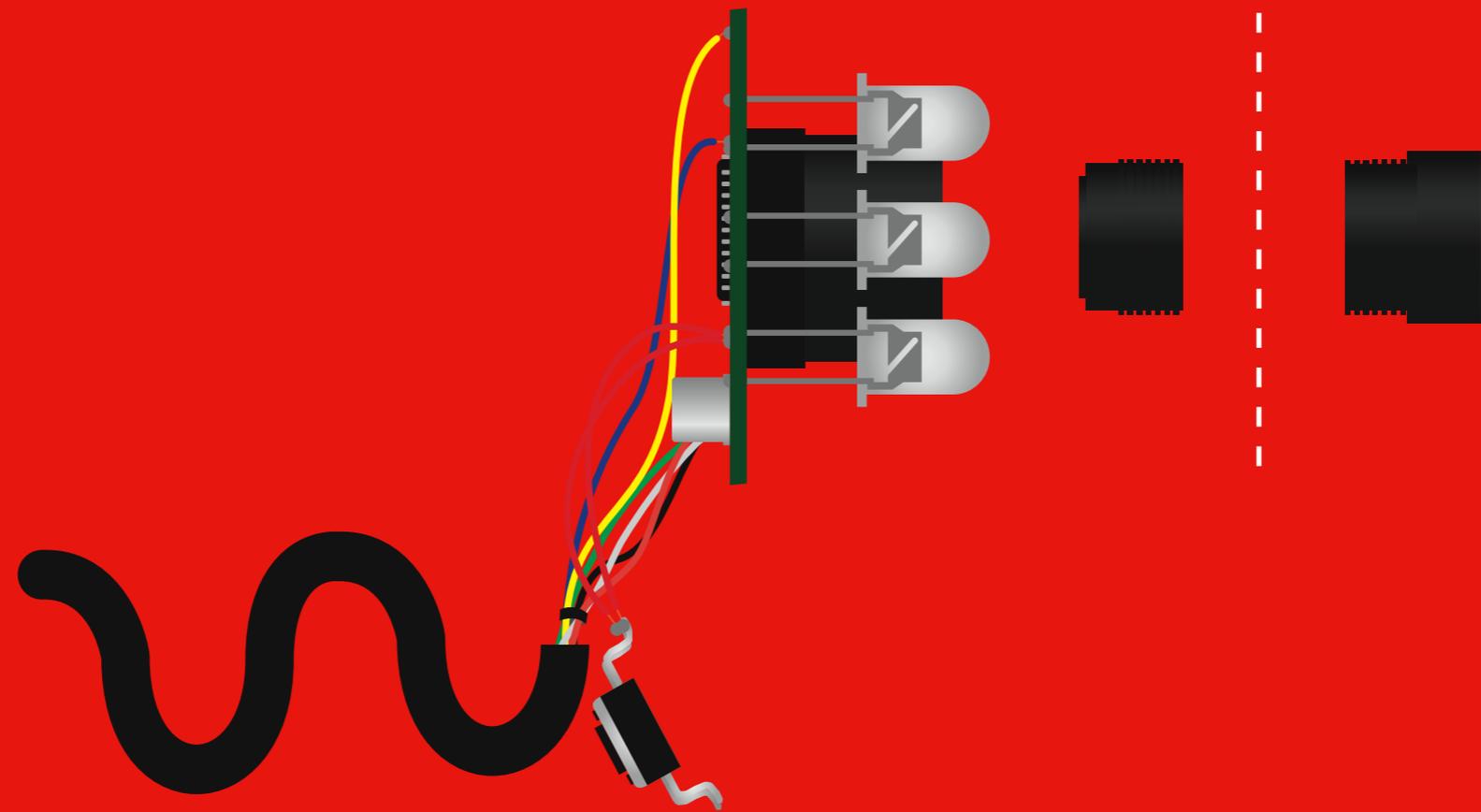
Make sure your lens is clamped securely and that any loose hair or clothing is kept out of the way.



## WHILST YOU'RE WAITING...

Whilst your partners are sawing, how about you have a go at building a new stand for your microscope?

Take a look through the steps and colour coding on your instruction sheet and carefully cut around the net of each component piece.

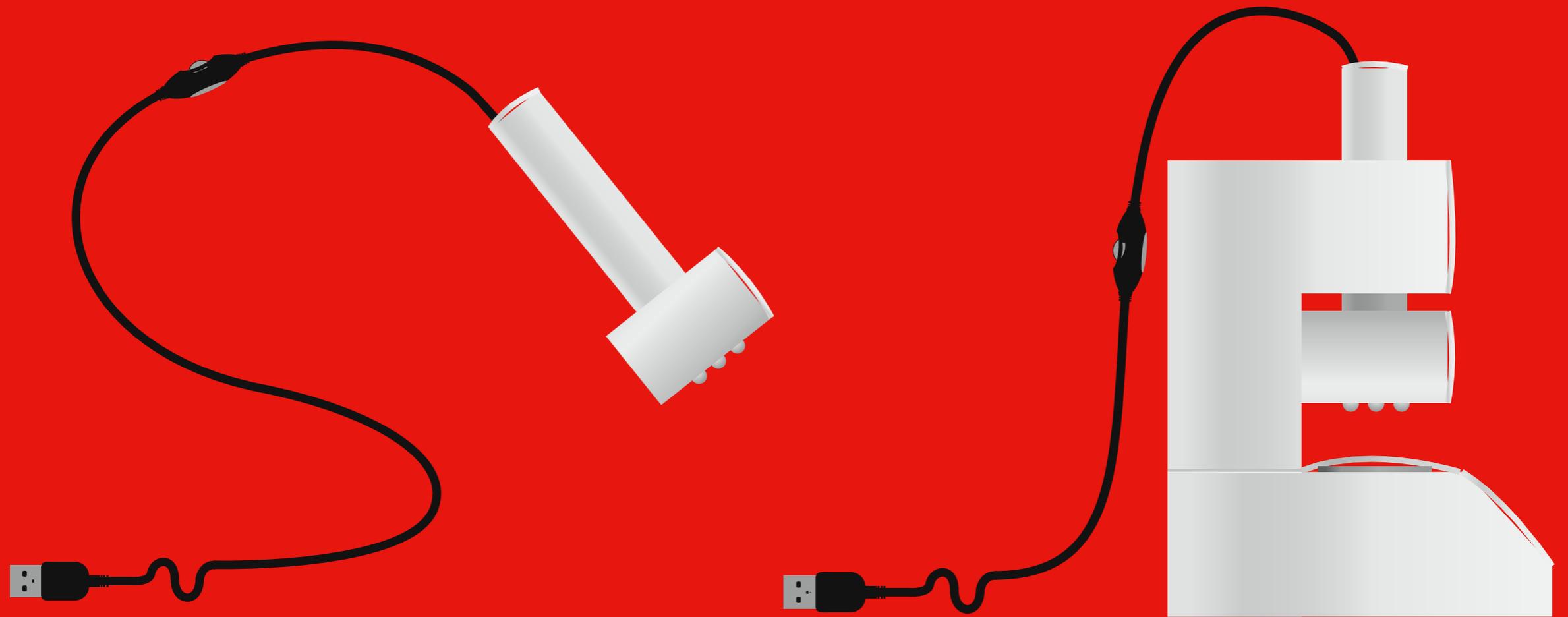


## REASSEMBLE YOUR COMPONENTS

Carefully twist the shortened lens back into the holder on your circuitboard.  
Keep an eye on your screen! How close can you get to an object to see it clearly?  
How much detail can you see?

## **REMEMBER!**

Of the two halves of your lens, make sure to choose the half with the sensor on the back!



## **NOW PLAY!**

Build your net around the circuitboard and lens.  
You can use it as a wand or a freestanding microscope!  
What can you find in your classroom to explore?

## **WHAT CAN YOU SEE?**

On your exercise sheet, record some of the most interesting things you observe through your microscope.  
What else do you think you could use a webcam for?