**How to: make a microscope from a webcam**

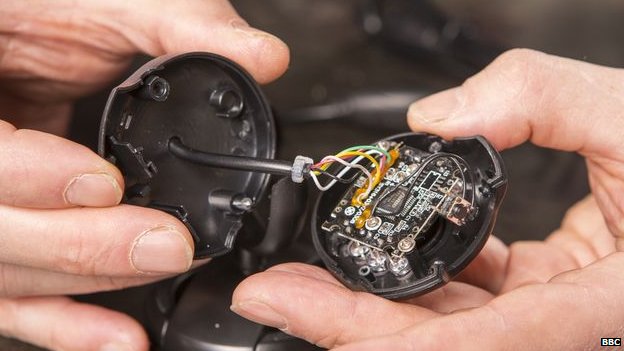
**http://www.bbc.co.uk/science/0/22600308**

Mark Miodownik, presenter from Dara O Briain's Science Club on BBC Two, reveals how you can perform simple science experiments at home. Try some DIY science and see the microscopic world up close by turning a webcam inside out...

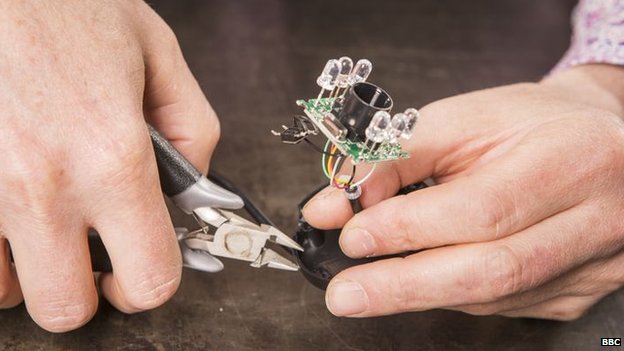
Create a high-powered microscope from a cheap webcam by following Mark's simple step-by-step instructions. Because your microscope is connected to your computer, you can save and [share your images](https://twitter.com/BBCScienceClub) easily.

Find items you'd like to examine close-up - from flower petals to a strand of hair.

Check the webcam works by connecting it to your computer. Then remove the screws from the casing.

Carefully prise off the webcam cover to expose the electronics inside.

The optical lens part is partially glued to the front of the webcam but it can be detached by twisting firmly. Once the lens (the part on the right) is detached, pop the outer ring off.

Now carefully cut away the casing around the remaining electronics with a plastic cutter or small scissors

Take the optical lens part, now without its outer ring, and turn it around so that the small lens is now facing upwards.

Stick the optical lens part back on to the electronics using electrical tape.

Connect the modified webcam to your computer and point it at the screen. You should be able to see individual pixels.

Stick the webcam in the centre of a rectangular base - plastic is shown here but thick cardboard will work. Make three holes in a triangular pattern near the edges of the base and slot through three long screws. Each screw should have two nuts, one at the base and the other twisted half way up. Connect the webcam to your computer.

Cut a platform the same size as the base with three holes in the same positions. Cut out a smaller central square to allow your lens to be visible. Slot the platform on to the screws. Twisting the nuts will accurately raise or lower it. Now put your glass slide on the device and backlight it using a torch.

1/10

**Things you'll need:**

* An old webcam
* Something to look at - ie. petals, strands of hair, grains of sand etc
* A small screwdriver
* Plastic cutters or small nail scissors
* Thick cardboard
* Three long machine screws
* Six nuts which fit on the machine screws
* Glass or acrylic slide
* Electrical tape
* A torch (with a filament bulb)

**How to do it:**

**You may need to download webcam software before you start if your computer doesn't automatically install the webcam. Make sure the webcam works before starting and that whoever owns it is happy for you to modify it.**

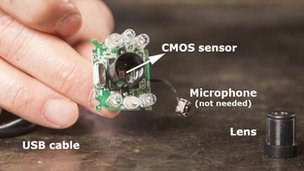
**1.**

Gather together some items you'd like to examine close-up. Flower petals, a strand of hair or grains of sand are all good options.

Before you start modifying the webcam, check it works by connecting it to your computer.

**2.**

**How does it work?**



A webcam is a compact digital camera with software that grabs a still image at pre-set intervals.

**How can a webcam become a microscope?**

The webcam's digital camera works by capturing light through a small lens on to a CMOS or CCD image sensor.

The sensor converts the picture into a digital format that is transmitted to the computer usually via a USB cable.

The lens on the camera is designed to take a wide-angle view and focus it on to the small sensor.

But if you flip the lens around, this process is reversed and the very small image appears magnified instead.

This way a basic webcam should be able to achieve 200x magnification.

Start to dismantle the webcam by removing the screws from the outer casing. Some screws may be covered up by plastic caps or stickers. Now prise off the cover to expose the electronics inside.

**3.**

You will need to remove the lens, which is partially glued on to the front of the case. Twist it firmly to unscrew it from the casing.

**4.**

You won't need the optical lens' outer ring, so remove this by popping it off using firm pressure.

**5.**

Taking off the lens will have exposed a grid of light-detectors known as a charge-coupled device (CCD) connected to a USB cable. Now carefully cut away the remaining casing around the electronics with a plastic cutter or small nail scissors.

**6.**

Take the lens, now without its outer ring and flip it over.

**7.**

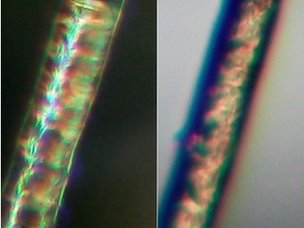
Stick the reversed lens back on to the electronics using electrical tape.

**8.**

Re-connect the modified webcam back to the computer and point it at the screen. You should now be able to see a close-up of some pixels.

**9.**

You will need to build a case for the modified webcam as very small objects need to be completely stable to obtain clear images.

Two views of a strand of hair under a webcam microscope

Stick the webcam to the centre of a rectangular base measuring approximately 15cm x 10cm - a piece of plastic works well but thick cardboard can also be used.

Make three holes in the base in a triangular pattern and slot in the three machine screws - these need to be at least 40mm long. Each screw should have two nuts, one twisted down to the base to keep it stable and the other one half way up.

Cut out a platform the same size as the base with three holes in the same positions. Also cut out a small central rectangle around 4cm x 3cm, for the lens to be visible through. Slot the platform on to the screws and gently guide it down to the level of the nuts.

**10.**

Place a glass or clear acrylic slide over the central hole. Place a petal or another object on the slide and plug in the webcam. Turn on the torch to backlight your object. You can also use a bright desk lamp, just make sure it has a filament bulb as a bulb with an LED will give you a flickering image.

There should now be an image on the computer's webcam viewer software. The microscope's focus can be changed by raising or lowering the upper platform a few millimetres by twisting the upper three nuts upwards or downwards.

Press the 'Print Screen' button on your keyboard if you want to capture the image and 'paste' it in to a document.

Send the microscopic images you create to , and we'll retweet our favourites.

[Dara O Briain's Science Club](http://www.bbc.co.uk/programmes/b037ml9p) is at 8pm, Thursdays throughout August 2013 on BBC Two