Macro and Close-up Photography

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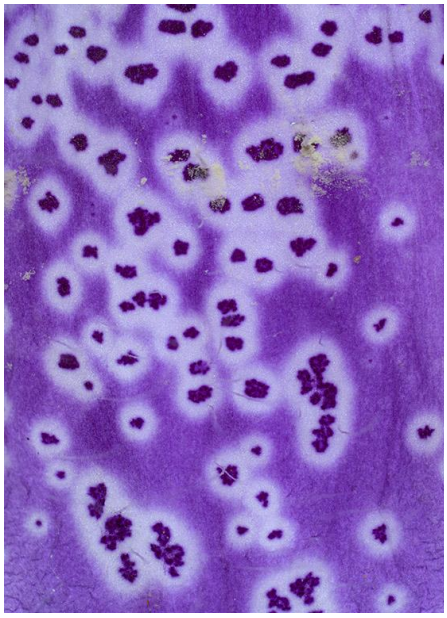
What is Macro Photography?

Effectively, all “Macro” means is getting a bit closer than normal. It is a way of looking closely at the detail of something. It can mean entering a new world of things you may never have seen before.



Inside a Foxglove flower

A few decades ago things were defined this way:

- close-up — up to life size on the sensor (a few centimetres)
- macro — up to 10 times life size on the sensor (a few millimetres)
- photomicrography — closer than 10 times... …using a microscope!

Today things are rather less well defined. It just means getting a bit closer. Think of anything smaller than a credit card.

(There is also a slightly cynical view which says that “Close Up is what you can do with your existing equipment... Macro is what you can do by spending more money on more equipment!)

Inside a tulip

Detail of a Pocket Watch

The Technical Bit!

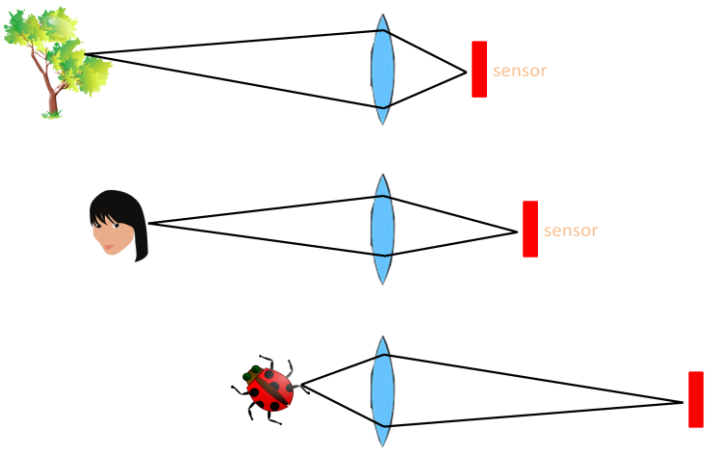
As you focus on things which are closer, the sensor has to move further away.

To focus on things a long way off, the distance from the lens to the sensor is one focal length. By the time you are focussing on something which is at life size, the distance from the lens to the sensor has doubled to two focal lengths.

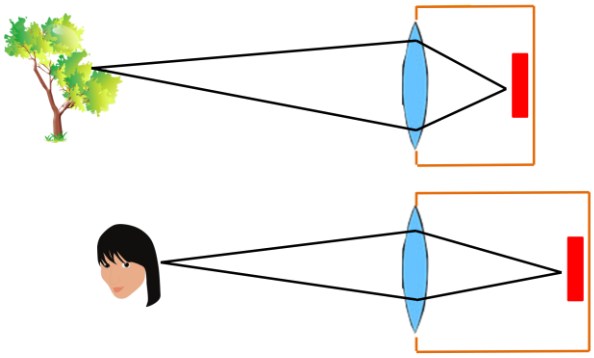
This change is distance has to be accommodated by the focussing arrangements built into the camera and lens.

The problem is that there are limits to any camera and lens design. If you want to get very close, then you may be trying to do something which the camera and lens designers had not allowed for.

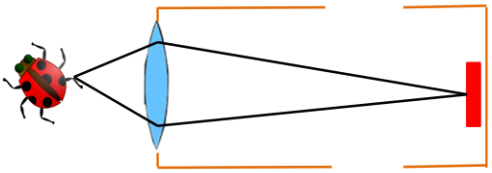
In this case you have to take over.



As you focus closer the sensor moves further away



The focusing in the camera can take things so Far



Eventually the camera focusing can't cope

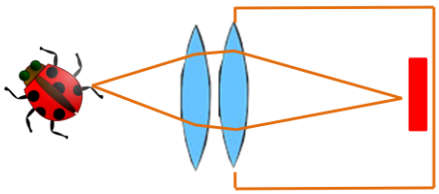
When you say you are getting closer, what you really mean is the magnification is becoming greater. Magnification in macro photography depends on two things:

- the focal length of the lens;
- the distance between the lens and the sensor.

This suggests that there are two ways to tackle the problem: modify the lens or modify the focusing.

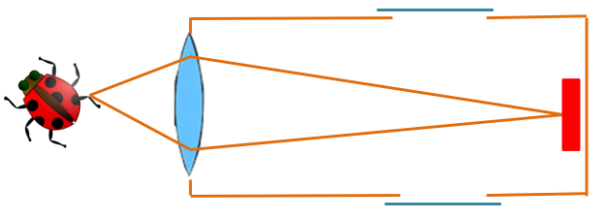
The first option is to add a close up lens. This is like looking through a magnifying glass to make things look bigger.

Technically, the combination of the original lens and the close up lens reduces the overall focal length. This increases the magnification without having to alter the focusing arrangements.



Close-Up Lens

The second option is to tackle the limitation on focusing by adding something between the land and the sensor. This something is a "tube" it is simply a spacer to extend the focussing. It has no lens and does not affect the optics. This spacer could be extension tubes or bellows for a little more flexibility at the expense of convenience.



Extension Tubes or Bellows

Equipment

Having got this far, what are the options for spending that money which is burning a hole in your pocket?

Close Up Lenses

These extra lenses simply screw into the filter thread on your existing lens. They usually come as a set with different strengths. The strengths are given in dioptres. Dioptres are effectively an inverse focal length; the more dioptres the shorter the focal length. In practical terms, a high dioptre lens gives more magnification.

Close Up Lenses

For comparison, a 50mm lens has a strength of 20 dioptres.

They are lightweight and all camera automation is preserved. They are fairly cheap at about £25 for a set but lens quality may be an issue.

Companies such as "Raynox" produce close up lenses with a reputation for quality at a price. They cost £50 to £100 for a single lens.

Extension Tubes

These are lightweight additions to the camera's focussing mechanism. They fit between the camera and the lens to increase the distance between the lens and the sensor. This means, of course, that the camera needs to be able to take interchangeable lenses.

Extension Tubes

The come as set, usually of three in different lengths which can be used singly or in combination to produce different magnifications.

They can be auto or manual versions. Manual tubes are cheaper but, with no links between the lens and the camera, lose all automation. Auto tubes, on the other hand preserve all connections between the lens and camera.

Sets of Manual tubes can be had for as little as £20. Auto tubes start at about £50.

Bellows

Like extension tubes, bellows fit between then lens and the camera. They provide more adjustment than extension tubes and greater magnification is possible. On the other hand, they are larger and heavier, and are less easy to use.

Bellows

You may also need a focussing rack (more cost) to move the camera, bellows and lens assembly backwards and forwards to achieve focus.

In some case it may be easier to put the subject on the focussing rack rather than the camera.

Manual bellows cost in the range £20 and £70. At the other end of the scale, automatic bellows from Novoflex cost around £800.

Dedicated Macro Lens

These are lenses designed for the job – at a price. The optics is optimised for close subjects and will focus closer than a conventional lens. On the other hand, they may only go to half life size. In this case you may need extension tubes as well. All automation is preserved.

Macro Lens

if you can afford it, this is the best way forward

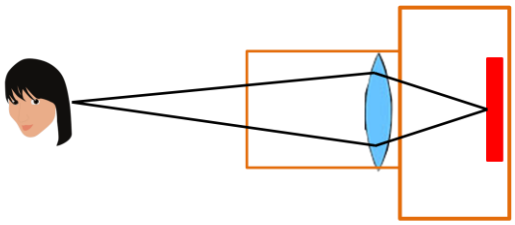
Depending on the make and mount this is going to cost several hundred pounds.

Reversing Ring

This device puts the lens on the camera backwards! It screws into the filter thread and then mounts onto the camera body. It is fairly cheap at £10-£15 but loses all automation.

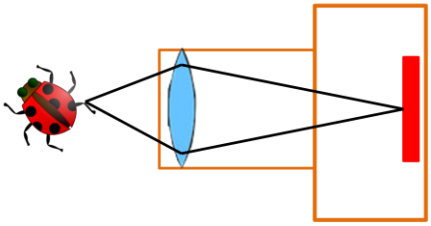
You may ask why anyone would want to mount a lens backwards.

There is space between the rear element of the lens and the sensor. This is particularly the case with a DSLR where there needs to be space for the mirror. This means that the effective lens position has to be well back inside the physical glassware. This is particularly extreme in the case of a wide angle lens as, when focused on the far distance the effective lens position must be one focal length in front of the sensor.



Effective Lens Position

If the lens is reverses, the effective lens position moves forwards. It is as if the lens has been fitted with extension tubes.



Lens Reversed

Coupling Ring

Another cheap option at £10-£15. In this case one lens is mounted in front of another lens – reversed. Usually the reversed lens has a focal length shorter than the lens mounted on the camera.

Automation is preserved for the lens mounted on the camera. Effectively the reversed lens is acting as a powerful close up lens.

Compact Camera

Compact Cameras will often focus down to a couple of centimetres at the wide end of their zoom lens.

Digital Microscope

A true digital microscope will cost many hundreds, if not thousands, of pounds. However, at the cheap end of the market there are devices addressing what you might call the toy market.

They are cheap (£30 - £40) and claim high magnification with a cheap plastic lens. They give a resolution of about 2Mpx.

They require a USB connection into a PC. You should check your hardware compatibility before buying.

Problems

Problem 1 – Running Out of Light

As he distance between the lens and camera increases less light gets to the sensor. Effectively this means that the "f" number you thought you were using is no longer correct.

The effective "f" number increases as the distance between the lens and the sensor increases. At life size, the marked "f" number is doubled.

To counter this, you need:

- longer shutter speed
- higher ISO

The effect of this is more camera shake. In addition, the autofocus may not work.

Flash may help, but this will change the overall character of the lighting. If you are photographing an insect, the flash may scare it away.

Problem 2 – Camera Shake

When you magnify the image you also magnify camera shake. All the normal techniques for countering camera shake apply. Support the camera:

- tripod or monopod
- tabletop tripod
- beanbag
- camera bag

If your camera system has good image stabilization this will help.

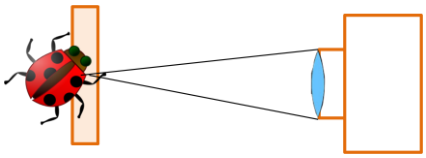
Problem 3 – Lighting

If the lens is very close to the subject it will cast a shadow over the subject. You can get round this by using a longer lens. However, this means more camera shake.

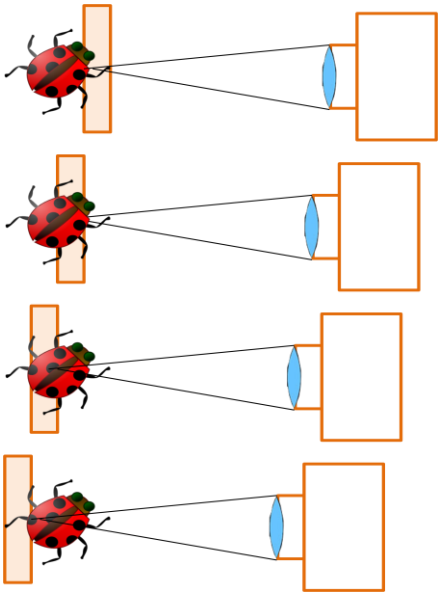
On a positive note, using a longer lens means that you are further from the subject. If this is an insect, you are less likely to frighten it.

Problem 4 – Depth of Field

The closer you get, the less the depth of field. When you get really close you may not be able to find a precise focus because everything seems to be out of focus.



Limited Depth of Field



Several Exposures at Different Distances

Combined image created from the sharpest parts of each exposure

In order to be increase the depth of field you need a smaller aperture. This means more light or you may have to raise the ISO.

One technique which is increasingly popular is Focus Stacking.

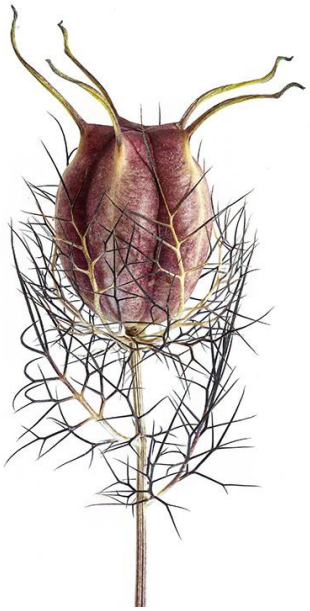
This involves taking several exposures at different distances – each focuses on a different part of the subject.

Traditionally this was done by putting the camera and lens on a focusing rack and moving the whole assembly by a few millimeters between exposures. Alternatively the position of the camera can be fixed and the focusing mechanism in the camera used to move the plane of focus.

Today the technique may be automated and built into the camera automation.

Finally create a composite image from the sharpest part of each exposure. While in principle it is possible to create this composite image by hand, in practice dedicated software is needed. Photoshop has the facilities to do the job. Alternatively there is specialist software such as Helicon Focus.

A Few Pictures



Nigella Seed Head

Crocosmia

Lily of the Valley

Forget Me Not