Macrophotography
by
Robert Berdan
How to achieve Magnification

1. Normal camera lenses about 0.1 to 0.5X
2. Close-up Filters 0.2 to 2.0X
3. Teleconverters 1.0 to 2.0X the lens magnification
4. Extension tubes 0.5 to 5.0X
5. Bellows Extension up to 10X
6. Macro-lenses 0.5 to 5.0X
7. Stereomicroscope 1 to 50X
8. Light microscope 5 to 1000X
9. Scanning electron microscope 5 to 500,000X
Normal 35-50 mm lens

Close-up Filters
Closeup Filters

Focal Length & Diopters

The focal length of the lens is defined as the distance from the middle of the lens to its focal point.

Dioptr = \frac{1000 \text{ mm}}{\text{Focal length in mm}}

E.g. +2 Dioptr = \frac{1000 \text{ mm}}{500 \text{ mm}}

+4 Dioptr = \frac{1000 \text{ mm}}{250 \text{ mm}}

Can combine +1 and +2 to get a +3 Dioptr

Dual Element Lens
$150-$200 each

Single Element Filters
Set of 3 $75-$100
Determining Magnification with Close-up Filters

\[
\text{Magnification} = \frac{\text{Focal length of camera lens}}{\text{Focal length of close-up filter}}
\]

E.g. \[
\frac{50 \text{ mm Normal Lens}}{250 \text{ mm (+4 Diopter Close-up)}} = 0.25 \times
\]
\[
\frac{200 \text{ mm Telephoto lens}}{500 \text{ mm (+2 Diopter Close-up)}} = 0.4 \times
\]
Teleconverters/Extenders

Nikon 1.7 X loses 1.5 F-stops
Nikon 2.0X loses 2 F-stops
Canon 1.4X loses 1 F-stop
Canon 2X loses 2 F-stops
Extension Tubes
Magnification Achieved by Extension (Tubes or Bellows)

Magnification = \frac{\text{Extension distance in mm}}{\text{Focal length of lens in mm}}

E.g. \frac{50 \text{ mm Extension tube}}{50 \text{ mm Normal lens}} = 1.0 \times \text{Magnification}

\frac{50 \text{ mm Extension tube}}{200 \text{ mm Telephoto lens}} = 0.25 \times \text{Magnification}

The more extension the greater the magnification achieved, however longer focal length lenses require more extension to achieve the same magnification.
There are a few macro-zoom lenses (e.g. 70~180mm f/4.5~5.6s ED), the longer the focal length the greater working distance you have from your subject. Also keep in mind the actual focal length will vary depending on whether you are using a full frame camera or digital camera with 1.5-1.6X sensor.
Macro Lenses have built in Extension

Note some macro lenses the extension occurs internally e.g Canon 100 mm, Also you can add an extension tube for even more magnification.
Canon MP-E 65 mm 1-5X Macro Lens

Primarily for Studio work - requires flash or very bright lights also requires macro focusing stage to move the lens back and forth.
Use Extension tube & Telephoto lens

75-150 Zoom, T-32 Flash & Variable extension
Achieving Very High Magnification

Stereo Microscope

Magnification 1-50 X

Light Microscope

Magnification 5-1000X
Stereo Microscope

Tiger Beetle 10X

Light Microscope

Dog Flea 50X
Lighting for Macrophotography

Natural Light
Soft overcast light - especially after rainfall is often the best for flowers

Flash
Vary the Depth of Field when you take Macro Photos

60 mm Macro lens at F2.8

60 mm Macro lens at F22
Mist & Dew

If there is no natural dew on the web or flower you can add it with a spray bottle
Simplify the Background

Flash only - background is distracting

Flash and black card used
Tripod that goes flat to the ground or use Bean Bag

Also to reduce vibration use your self timer or electronic cable release
Summary

1. You can take close-up shots with a normal & telephoto lens, to get even closer attach closeup filters, a teleconverter, extension tubes, bellows or use a macro lens.

2. Macro-photography requires a good support - a tripod, bean bag and use a cable release or self timer to get the sharpest pictures. If you hand hold - use flash.

3. Macro shots are always available - just get low to the ground or up close to rocks and vegetation and explore the scene through your viewfinder.

4. Soft light is best for flowers and subdued subjects while side light is best for emphasizing texture.

5. If there is nothing else to shoot you can almost always find something interesting to capture with a macro-lens.