What lens do I need?

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What do you want to photograph?

If you have just one lens, whether it be a 50mm prime lens or a 28-70mm zoom lens or something else then obviously you have to use that lens for whatever it is that you photograph - landscapes, portraits, sports, nature, and so on. That's what happens if you photograph with a camera that has a fixed lens (such as a 'compact' camera). You challenge is then to learn how to use that lens most effectively for the different subjects that you will photograph.

If you have an inter-changeable lens camera (such as a DSLR or a mirrorless camera) that gives you much more flexibility. However, it also forces you to decide what lenses you will use and under what circumstances. If you are considering purchasing a new lens or you are trying to decide what lens to take with yo on a trip then you should ask yourself at least the following questions:

- What do I want to photograph?
- Under what circumstances will I be using this lens?
- Do I want the flexibility of a zoom lens of would I prefer to have several prime (fixed focal length) lenses?
- What type and quality of lens will be capable of giving me the results that I want?
- How much can I afford to spend?

One good lens is better than a bag full of poor lenses.

The most important of these questions are the first two. You cannot possibly make a sensible decision about what lens to buy/use unless you first think about what you want to photograph with it and under what circumstances you will be using it. Whilst you can obviously photograph most subjects with any lens, an inappropriate choice will not give you satisfactory results. For example, it should be obvious that a wide-angle lens (such as 24mm) is of limited use for photographing small birds in the wild and a 600mm lens is of limited use for photographing most things indoors.

To explore these ideas further, I will discuss some of the factors to take into account when choosing a lens for photographing specific categories of subject - landscapes, portraits, nature, and so on. I will also consider some of the other issues such as prime versus zoom lenses and full-frame versus crop sensor cameras. But first it is important to clarify some basic terminology that is used to describe lenses.

LENS BASICS

If you look at the technical specifications of a lens on the manufacturer's website or at a detailed technical review of the lens it can be quite confusing because it will mention many factors that, for most practical purposes, you do not really need to be concerned about when using the lens. However, you need at least a basic

understanding of the following characteristics of lenses in order to make sensible choices about what lens to buy or what lens to use in particular circumstances.

The first thing to consider is whether or not a particular lens is designed to be used on the camera body that you have. If you have a DSLR then it will have either a 'full-frame' sensor or a so-called 'cropped sensor'. Full-frame sensors are about the same size as a frame of 35mm film (that is, 36x24mm). Lenses designed for use with such cameras will produce an image across the full dimensions of the sensor. Cameras with full-frame sensors are usually at the top-end of the range of cameras produced by each manufacturer and, therefore, tend to be expensive.

Most DSLRs and most other interchangeable-lens digital cameras have sensors that are considerably smaller than full-frame. Consequently, a smaller area of the image projected by the lens is captured by the sensor - hence that are called 'cropped' sensors. This does make a difference to what lens you should choose because using the same lens at the same distance from the subject, a cropped sensor camera will capture a narrower angle of view than a full-frame camera. This gives the impression that the image is being magnified or that the focal length of the lens has increased. In fact, nothing about the lens changes, it's just that it is capturing a smaller section of the scene. The amount by which the focal length of a lens *appears* to change when it is put on a cropped sensor camera is referred to as the *crop factor* of the camera. For Nikon camera DSLRs the crop factor is 1.5 and for Cannon DSLRs the crop factor is 1.6. The size of the cropped sensors in DSLRs is usually referred to as APS-C.

I will come back to this a bit later, but for now you simply need to remember that lenses designed for full-frame cameras will work on cropped sensor cameras but the reverse is not true. Lens designed for cropped sensor cameras will produce an image on a full-frame camera but it will occupy just a small section of the sensor.

FOCAL LENGTH

The focal length of a lens is the distance in millimetres from the optical centre of a lens to the imaging sensor when the lens is focused at infinity.

Lenses come in a great variety of focal lengths and they are often described as follows:

- Fish-eye: 4-14mm
- Ultra wide-angle: 14-24mm
- Wide-angle: 24-35mm
- Normal or Standard: 35-60mm
- Short-telephoto: 70-135mm
- Telephoto: 200-400mm
- Super-telephoto: 600mm and longer.

You will often come across the terms "effective focal length" and "35mm equivalent focal length" as ways of describing the focal length of different lens/

camera combinations. The effective focal length for a particular camera/lens is an indication of what focal length lens you would need on a full-frame DSLR to get the same angle of view. If you put a 50mm lens on a Nikon cropped-sensor DSLR it will have the same angle of view as a 75mm lens on a full-frame sensor camera. So we way that the 50mm lens has an effective focal length of 75mm when put on the cropped-sensor camera - it will appear to produce a magnified image if compared to the same lens on a full-frame camera being used to photograph the same subject at the same distance. However, it is important to remember that no physical changes occur when you swap the lens from one camera to another, the perspective is the same, the focal length is the same, the image magnification is the same - all that is changing is the field of view.

Camera manufacturers take advantage of the 'apparent magnification' that you get from cropped sensors and produce lenses specifically for cameras with the smaller sensor sizes. They are often referred to as "digital lenses". If such a lens is labelled as a 200mm lens (for example) its focal length will be 200mm but its effective focal length will be 300mm. However, because it only needs to produce an image to cover the smaller sized sensor its lens elements do not have to be as large as that needed for a full-frame camera, so the lens can be made smaller and lighter. It will probably also be cheaper than an equivalent quality 300mm lens for a full-frame camera. But, if you have a cropped sensor camera, it may be a good idea to buy good quality full-frame compatible lenses in case you ever decide to trade up to a full-frame camera.

Full-frame lenses are designated as Nikon FX, Canon EF, Sigma DG and Tokina FX. The lenses designed for APS-C size sensors are designated Nikon DX, Canon EF-S, Sigma SC and Tokina DX.

PRIME OR TELEPHOTO

Lenses that have a fixed focal length are called prime lenses. Lenses with variable focal lengths are called zoom lenses. Factors to consider when trying to decide whether to purchase prime lenses of zoom lenses include the following:

Zoom lenses are more versatile than prime lenses. Depending on what subject matter you typically photography, a single lens of say 28-200mm might cover all the focal lengths you need.

Good quality zoom lenses can perform very well but they may not give the same sharpness, clarity, low distortion and lack of vignetting that you could get with similar quality prime lenses. You may find that the lens, rather than the camera becomes the limiting factor in the quality of the images yo can capture.

Unless you purchase 'professional' quality zoom lenses their widest possible aperture will change as you zoom and the quality of your images may not be as good at either end of the zoom range as it is around the middle.

Prime lenses generally have a larger maximum aperture than similar quality zoom lenses and this can be important if you need to use very fast shutter speeds or

take images in very low light. A larger aperture is also useful if you want to minimise the depth of field and blur the background.

ANGLE OF VIEW

The angle of view of a lens indicates the amount of a scene that a lens can take in, measured in degrees. Angle of view is closely related to focal length - the longer the focal length the narrower the angle of view. Here are some examples (for lenses on a full-frame camera).

14mm

600mm

In the above images the edge of the ice was the same distance from the camera in each case (about 25m). The wide-angle lens tends to exaggerate perspective, making the foreground and background appear further apart. On the other hand, the telephoto lens appears to flatten the image, bringing the foreground and background subjects closer together.

APERTURE

One of the key specifications of a lens is its largest aperture. Good quality short focal length prime lenses will have large maximum apertures of perhaps f/1.4 or f/1.8. Similar quality longer focal length prime lenses will probably have maximum apertures of f/2.8 or f/4. Zoom lenses tend to have smaller maximum apertures and unless they are very good quality lenses the maximum aperture will not be constant across the zoom range.; for example, it might vary from f/3.5 to f/5.6.

There are two advantages in having a lens with a large maximum aperture – it will be easier to focus in low light, it will enable you to use relatively fast shutter speeds in low light (if used at maximum aperture and it will allow you to choose a narrow depth of field to throw the background out of focus. However, if you are comparing two lens of similar quality - say a 300mm f/2.8 lens with a 300mm f/4 lens you will find that the f/2.8 lens is probably heavier and more expensive.

Most lenses have a minimum aperture of f/22, although for some lenses it will f/16 and for others (mainly specialised macro lenses) it might be smaller (perhaps f/32). When choosing a lens, the smallest aperture is less important that the largest aperture because you will probably not use the lens at this setting very often. You might want to use the smallest possible aperture if maximising depth of field is critical, but this can result in a slight softening of the image. This is caused by diffraction, a slight bending of the light rays that are closest to the edges of the hole in the shutter. For good quality lenses this is not usually a major problem.

THE SWEET SPOT

You will probably find that most lenses do not produce the best quality images when used close to their minimum aperture or close to their maximum aperture. The aperture at which a particular lens produces its sharpest images is often called its 'sweet spot' and for most lenses it will probably be at an aperture somewhere between f/8 and f/11. You can determine the sweet spot of a lens as follows:

- Mount your camera on a solid tripod.
- Attach a sheet of newspaper with fine print to a wall at a distance that will allow you to fill the frame with a section of the fine print. Make sure the paper is in good light but not harsh direct sunlight.
- Make sure the lens is pointing directly at the paper, not at an angle either vertically or horizontally.
- Focus on the print as carefully as you can - using manual focus and live view if you are not confident that the autofocus is 'spot on'.

- Set you r camera to aperture priority mode and take a series of photographs at each of the available aperture settings, for example, f/2.8, f4, f/5.6, f/8, f/11, f/16 and f/22.
- Download the images to your computer, open then in Photoshop, zoom in to at leat 100% and compare the images - take particular notice of variations in clarity and contrast between the images. The image that is the clearest is the one take at the 'sweet spot' of the lens.

AUTO/MANUAL FOCUS

Most modern lenses will allow you to switch between manual and autofocus. A manual setting can be important for situations where the autofocus will not operate correctly. Two things are important with autofocus - the accuracy of the focus and the speed at which the focus will lock. The most challenging conditions for any autofocus system are low light and low contrast scenes.

Regardless of how well the autofocus system on your lens can operate, to get the best results you need to consider the autofocus settings on your camera body. You can get basic information about this from my notes on *Camera Craft*.

BUILD

The major lens manufacturers (Nikon, Canon, Sony, etc) will often have two lenses with similar focal lengths (or zoom ranges) but very different price tags. The difference is probably that the cheaper lens comes from the manufacturer's 'consumer' range and the dearer lens comes from the 'professional' range. The professional lenses are usually built more solidly, have better weather seals, and better optics. If you can afford it, always buy the best quality lenses.

SHARPNESS

Put simply, sharpness is a function of the amount of fine detail in an image and the amount of contrast between adjacent pixels with different tonal values. Whilst it is possible to enhance apparent sharpness with various image processing techniques, the basic sharpness of your "from camera" images will depend on:

- Your camera - the quality of its sensor and the way in which the image is processed by the camera.
- The resolving power of the lens.
- Shutter speed
- The steadiness of the camera when the image was taken - in particular whether the camera was on a tripod or hand-held.
- Whether or not vibration reduction (image stabilisation) was used.
- Whether the camera was used in single-shot or burst mode.

Although there are some exceptions, the general rule is that high quality lenses (the more expensive ones) produce sharper images than low quality lenses.

OPTICAL STABILISATION

Vibration reduction (VR for Nikon lenses) or Image stabilisation (IS for Canon lenses) is an electronically controlled mechanical system build into the lens to reduce the effect of minor lens vibrations. Some Sony cameras (and others) have this system built into the camera body rather than the lens.

As a basic rule-of-thumb, when you hand-hold a camera the shutter speed should always be faster than the reciprocal of the focal length. For example, the shutter speed should be faster than 1/200 sec for a 200mm lens. Lens manufactures claim that vibration reduction can extend this by a factor of 2 to 4 times allowing, for example, a 200mm lens to be hand-held at perhaps 1/30 sec. Of course, other factors such as the weight of the lens and the steadiness of your hand need to be considered but generally speaking VR is a good feature to have on lenses above 70mm.

Different lens manufactures (and sometimes different lenses from the same manufacture) will have several VR 'modes' such as *standard*, *sport* or *tripod*. You need to check the lens/camera handbook to see which mode is recommended for the type of shooting you are doing - then you need to experiment to see what works best for you.

MINIMUM FOCUS DISTANCE

For every lens there is some minimum distance between the subject and the lens below which the lens will not focus. In broad terms, the longer the focal length of the lens the greater the minimum focus distance. For long focal length lenses this is generally not a problem because you are using the lens in situations where the subject is not very close - that's why you bought the long lens! However, it can be a problem if you are trying to get close to very small subjects in order to fill the frame or if the thing you are photographing decides to come close to you. Minimum focus distance is also very important for macro lenses and that will be discussed in a later tutorial.

WEIGHT

The weight of a lens, particularly a long telephoto lens can be important for two reasons. Heavy lenses are more difficult to hand hold and heavy lenses can be a problem when travelling by air. As lens manufacturing technology has improved, the weight of good quality lenses has been coming down.

CHROMATIC ABERRATION

Chromatic aberration shows up in images as 'colour fringing', usually red/cyan, blue/yellow or green/magenta fringing along high contrast edges. It is the result of the lens focusing different wavelengths of light at slightly different points on the sensor. Good quality lens are designed to minimise chromatic aberration and, if you shoot in RAW, you will find controls for removing it in programs such as Lightroom and Adobe Camera Raw.

TELECONVERTERS

A teleconverter is an attachment that fits between the lens and the camera body to increase the effective focal length of the lens. It will contain several lens elements and be designed to provide a fixed amount of 'magnification', usually 1.4X, or 2X. If you use a 1.4X teleconverter it will do this:

- Increase the effective focal length by a factor of 1.4 (e.g. a 200mm lens will become a 280mm lens).
- Reduce the maximum aperture by 1 stop (e.g., from f/2.8 to f/4).
- Make your autofocus system work slower.
- Reduce the sharpness of your images to some extent.

Teleconverters seem appealing if you have, say, a 300mm f/4 prime lens and you want a cheap option for getting a 600mm lens. However, it will become a 600mm f/8 lens and that may not be particularly useful. You can expect less than desirable result if you put a teleconverter on a zoom lens that is not f/2.8.

CHOOSING A LENS FOR LANDSCAPE PHOTOGRAPHY

Ultra wide-angle and wide-angle lenses will certain allow you to fit a lot into a landscape image but most of the features will be very small in the frame. For interesting results you can try getting very close to something in the foreground and still include a large amount of background - as in this example:

23mm, f/22, 1/200 sec, ISO 200

One of the big advantages of short focal length lenses is that they give greater depth of field at any given aperture than longer focal length lenses. The perspective of a wide-angle lens also adds a sense of depth to an image as it tends to make the horizon look further way than it actually is, as in this image:

24mm, f/22, 1/160 sec, ISO 400

Normal and short-telephoto lenses have a more restricted field of view but they allow you to concentrate more on special features rather than the broad landscape, as in this example.

50mm, f/7.6, 1/250 sec,ISO 200

This trend continues as you move into the medium- and long-telephoto lenses - allowing you to highlight specific features of the landscape. However, it is important

to note that haze and heat distortion can limit the usefulness of long-telephoto lenses in landscape photography.

180mm

300mm

It is worth keeping in mind that if the lens you have is not wide enough to include the full landscape you want to capture you may be able to take a series of images and stitch them together in Lightroom or Photoshop.

9 images taken with 105mm lens and stitched in Lightroom

When photographing landscapes you will usually want to use a small aperture to maximise the depth of field (unless you are specifically trying to isolate a feature by

using a shallow depth of field). Therefore, the widest aperture of the lens is less important than its ability to resolve fine detail.

Most landscape subjects will be motionless so fast autofocus is not usually an important feature for landscape lenses. You may even find that manual focus gives you the best results, particularly if you have your camera mounted on a tripod.

Vibration reduction (image stabilisation) can be a benefit on a landscape lens if you are shooting hand-held, or it's windy, or you are using a polarising or ND filter (which will reduce the light entering the camera).

CHOOSING A LENS FOR NATURE PHOTOGRAPHY

The subject matter for nature photography includes at least the following:

Landscapes
Animals - large and small
Birds - large and small
Insects - large and small
Plant life - large and small

You should not expect one lens to meet all your nature photography needs.

The message here is simple; the typical subject matter that you will photograph and the circumstances in which you photograph those subjects should be first consideration when selecting a lens for nature photography. It should be obvious that if you are photographing large animals at close distances you will be able to fill the frame with a relatively short focal length lens. For example, the following image was taken at a distance of approximately 20m with a 100mm lens.

To fill the frame with a smaller subject, in this case the baby elephant, you will need a longer focal length lens.

200mm

300mm

400mm

The challenge of “filling the frame” becomes even greater when the creature you are photographing is small - a typical challenge for bird photographers. Very occasionally you can get close to wild birds and photograph them with a wide-angle lens, such as this image taken with a 14mm lens at a distance of about 50cm (That’s my excuse for the crooked horizon!):

However, a more typical situation might be this one where the magpie was photographed with a 200mm lens at a distance of about 5m.

To get some idea of what size creature you need to "fill the frame" at a particular distance you have to consider the angle of view of the lens you are using. The following table might help. A 200mm lens (on a full-frame camera) has a horizontal angle of view of approximately 10.3 degrees. So, to fill the frame horizontally at various distances you would need subjects of the following sizes:

Distance	Object Size
2m	36cm
10m	1.8m
50m	9m
100m	18m

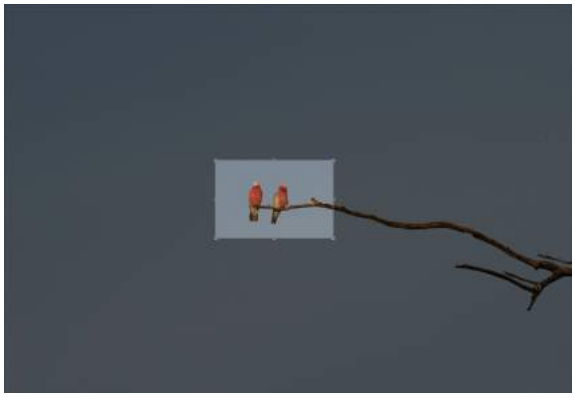
In all cases, the vertical size of the subject needed to fill the frame is 2/3 the object sizes given above.

To get an idea of how close you might need to be to a creature to "fill the frame" consider this image which was taken with a 600mm lens at a distance of about 65m:

To capture an equivalent image with a 200mm lens you would need to be about 20m from the kangaroo.

The challenge is much greater when photographing birds. The following image was taken with a 600mm lens with the birds about 5m from the camera.

With the birds further away or with a shorter focal length lens you simply have to be content with the birds being smaller in the frame. However, don't overlook the fact that if you have a reasonable quality camera and lens combination you can always crop your images, as in the following example where the birds were about 80m away:



Obviously, if you have to crop the images heavily you will loose quality and the images will probably not be suitable for prints. Whatever camera/lens you are using you need to experiment to determine their practical limits so that you do not waste time photographing creatures that are simply too far away to allow you to produce images of worthwhile quality. A useful rule of thumb is to try to capture images that will allow you to retain at least half of the capture area when they are cropped, as in this example:

CHOOSING A LENS FOR PORTRAIT PHOTOGRAPHY

Wide-angle lenses can be useful for environmental portraits where you are not too close to the subject and you want to include information about their surroundings. However, if you get too close to the subject you will get noticeable (and probably very undesirable) distortion.

Normal focal length lenses (around 50mm on a full-frame camera) can give good results if you are not too close and include the subject from at least the waste up. Again, if you get too close you will get distortion.

Short tel-photo lenses (85-135mm) are often referred to as 'portrait' lenses because they give undistorted natural looking portraits from comfortable working distances (2-5m).

Telephoto lenses (up to about 300mm) can be very useful for portraits as they allow you to work at greater distances from the subject and isolate the subject from the background. The slight compression effect they produce can be flattering.

Whatever focal length lens you use, a wide aperture will help to blur the background. If you want to buy a lens specifically for portraits, an 85mm f/1.8 prime lens or a 135mm f/1.8 prime lens could be a good choice.

Of course, you will frequently find that cropping is a very valuable tool when constructing a portrait.

70mm lens

Cropped

Summary

Before buying a lens, think carefully about what you want to use it for, and do not expect that a single lens will satisfy all your needs if you intend to photograph a range of different subjects (nature, landscape, portraits, etc.).

Zoom lenses, particularly those with a wide zoom range (such as 18-300mm) might seem like a good way to avoid buying several lenses. However, try before you buy because you may be disappointed with the quality of images taken near the two ends of the zoom range.

A good quality lens on an average quality camera will produce the best images that your camera is capable of producing. A poor quality lens on a good quality camera is a waste of money.

If you want to point out any errors in these notes or suggest ways in which they could be improved please send me an email.

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