week 07 LENSES

Different lenses can bring radically different perspectives to an image, but they can also dominate a scene if used without care. Before you start, you should consider what you are trying to achieve with your photo. This will help you in deciding what lenses to use in any given situation.

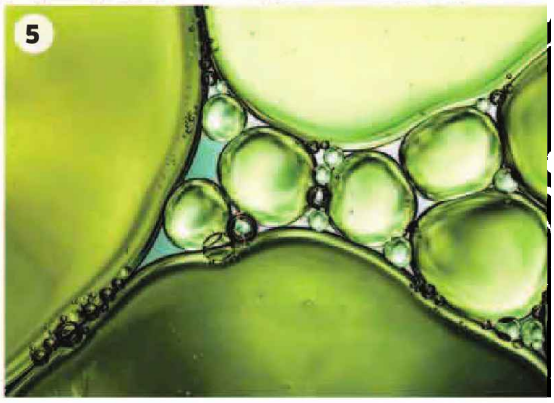
In this module, you will:

- **see how the lens you use** affects the visual character of the photographs you make;
- **examine what the focal length** of a lens describes and the differences between prime and zoom lenses;
- **follow a step-by-step guide** to see how perspective shifts as you change lenses;
- **experiment with using lenses** to create different images;
- **review your photographs** and learn how to use your lenses to their full advantage;
- **correct lens distortions**, such as vignetting, in post-production;
- **test your knowledge** of different lenses and how you can use them to get the most from different situations.

Let's begin...

TEST YOUR KNOWLEDGE

Which lens should you use?



Changing your lens changes your perspective on the world, depending on whether you use a wide-angle, standard, telephoto, or even a specialty lens like a fisheye or a tilt-shift. See if you can work out which lens has been used in these shots.

A Standard lens: The field of view of a standard lens is closest to that of the human eye.

B Wide-angle moderate: A mid-range wide-angle lens has no distortion, but allows you to work close to the subject.

C Extreme wide-angle: Super wide-angle lenses get a lot into the frame but can cause distortion and converging verticals.

D Fisheye: A fisheye lens creates a lot of distortion at the edges.

E Short telephoto: A short telephoto is great for portraits.

F Telephoto: A telephoto zoom is perfect for capturing fast action.

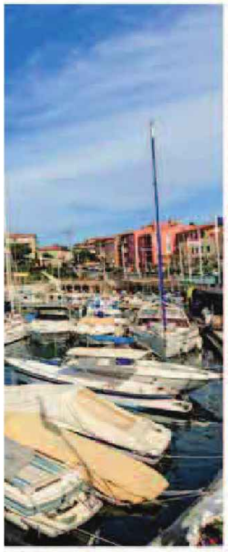
G Extreme telephoto: Super telephotos can bring distant objects into close framing.

H Macro: A macro lens can make objects larger than life.

I Tilt-shift lens: These create special effects, making a scene look like a model.

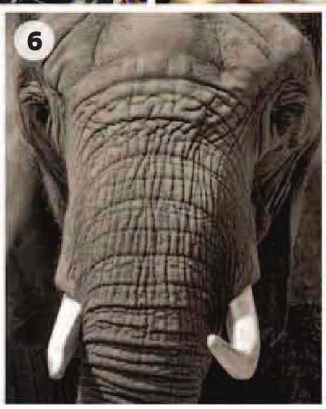
ANSWERS

A/ 1: Old car in Havana, Cuba
B/ 8: Moorland in Northumbria, UK
C/ 4: Boats in a marina, Saint-Jean-Cap-Ferrat, France
D/ 3: Manhattan skyline
E/ 9: Portrait of a young woman
F/ 2: Kids playing soccer
G/ 6: Face-to-face with an elephant
H/ 5: Oil droplets on water
I/ 7: View over Florence, Italy



7

9



6

8

NEED TO KNOW

- Each lens has a different field of view, from very wide to very narrow.
- Lenses can have either a fixed focal length (see pp.124–125), called a prime lens, or one with a range of focal lengths, called a zoom lens.
- A fixed focal length lens tends to be faster, lighter, and of better optical quality than an equivalent zoom lens.
- Extreme lenses will distort the world in ways that the human eye does not. For example, a fisheye lens will make a subject appear to “bulge” toward the edges, while a tilt-shift lens can make a cityscape look like a toy.

Review these points and see how they relate to other photos in this module

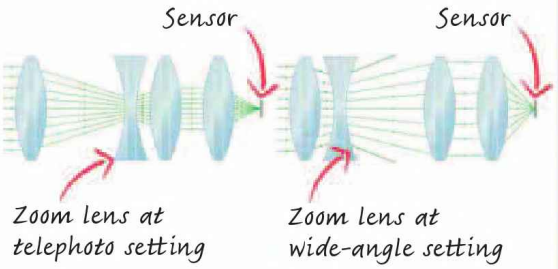
UNDERSTAND THE THEORY

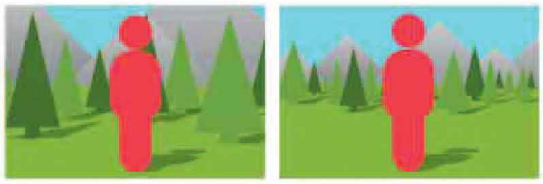
Primes versus zooms

Lenses are available in a range of focal lengths. The focal length determines how much of a scene is captured by the lens. It also determines more subtle factors, such as the depth of field available at each particular aperture. In order to create satisfying photos you want to learn to "see" like a camera, and understanding how lenses work is an important part of this process.

FOCAL LENGTH

The focal length of a lens is the measurement in millimeters of the distance from the optical center of the lens to the focal plane when the lens is focused on infinity. Prime lenses have a fixed focal length; zoom lenses have a variable focal length.





Telephoto A concave element in a zoom lens causes light to diverge. When moved to the front of the lens, only the most central rays of light reach the sensor, magnifying the image.

Wide angle A convex front element in a lens causes light to converge, reducing magnification, creating a greater angle of view of the scene to be projected onto the sensor.

PRIME OR ZOOM?

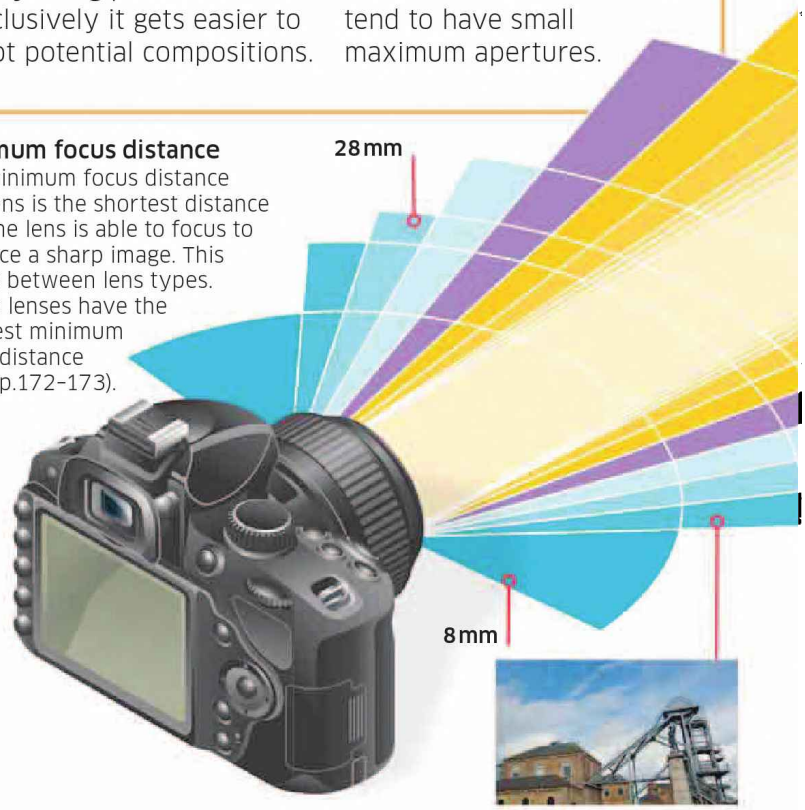
Prime lenses

- **A prime lens** is one that has a fixed focal length, such as a 24 mm, 50 mm, or 135 mm. This means that you need several lenses for common shooting situations rather than just one or two.
- **Prime lenses** are typically lighter, smaller, and have larger maximum apertures than equivalent zoom lenses. Optical quality in terms of sharpness and reduction of chromatic aberration or distortion (see pp.126–127) is often higher.
- **By using** prime lenses exclusively it gets easier to spot potential compositions.

Zoom lenses

- **A zoom lens** combines a range of focal lengths all in one. Common combinations are wide-angle zooms in the 17–35 mm range, mid-range zooms such as 24–105 mm, and telephoto zooms such as 70–200 mm.
- **Zooms** with a very large focal length range—16–300 mm, for example—are known as superzooms. They're convenient because you only need one lens; the downside is a compromise in image quality.
- **Zooms** sold as kit lenses tend to have small maximum apertures.

Minimum focus distance
The minimum focus distance of a lens is the shortest distance that the lens is able to focus to produce a sharp image. This varies between lens types. Macro lenses have the shortest minimum focus distance (see pp.172–173).



Pro tip: You'll find that you begin to naturally see composition possibilities that suit the prime lenses you own once you're familiar with their particular angle of view.

Pro tip: A zoom lens can make you a lazy photographer, as composition can be easily altered by turning the zoom ring. Exploring a scene by moving around it will offer more possibilities for creating interesting compositions.

85mm

135mm

350mm

500mm

250mm

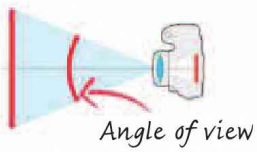
1000mm

35mm

50mm

ANGLE OF VIEW

The angle of view is the measurement in degrees of the amount of a scene captured by the lens; this can be measured horizontally, vertically, or diagonally. It is affected by the focal length of a lens and sensor size.

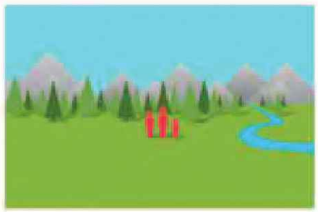


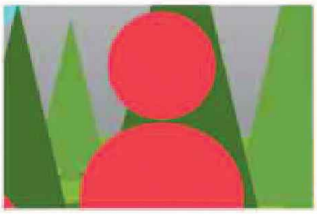
Angle of view

A wide-angle lens is so called because the angle of view is large. A fisheye lens is the most extreme type of wide-angle lens, with an angle of view of 180°.

A standard lens has a focal length that matches the diagonal measurement of the sensor. This produces images that closely match how we see the world.

Super telephoto lenses have extremely narrow angles of view. The longer the focal length of a lens, the narrower this is, so only a small section of a scene can be captured.





UNDERSTAND THE THEORY

Lens distortions

Almost every type of lens has some minor imperfections or faults that can degrade the image quality. In practical terms, these are normally so small as to be irrelevant, but they can be an issue under certain circumstances and when you're working at large print sizes. Fortunately, these issues can often be fixed either in-camera or in post-production. Knowing the potential problems of your lenses makes you better able to anticipate and fix them.

VIGNETTING

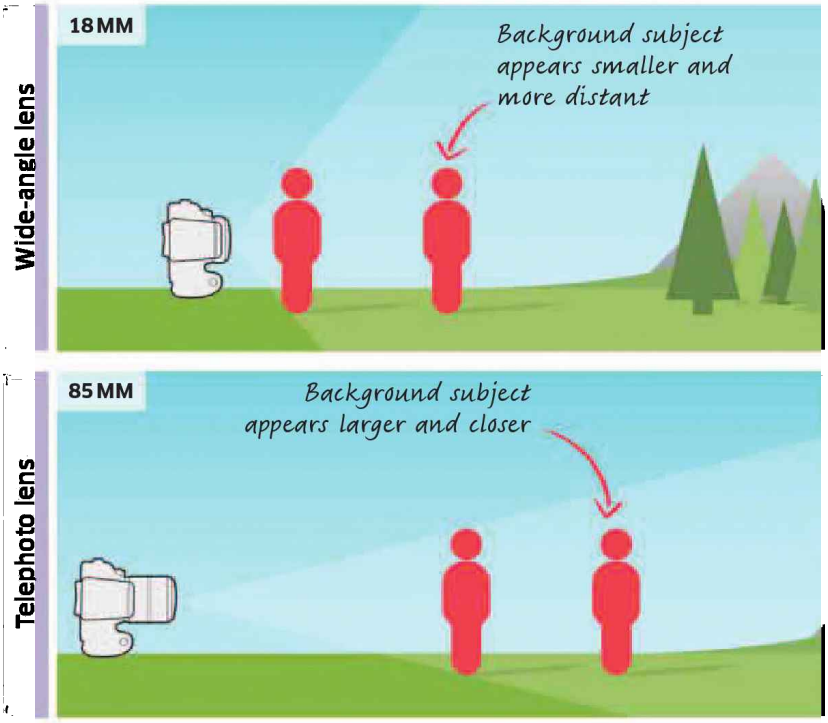
Vignetting describes the effect seen when the corners of a photo are darker than the center. The most common type of vignetting is caused when a lens is used at maximum aperture. Making the aperture smaller reduces this type of vignetting.

Mechanical vignetting is caused when the edges of filters or lens hoods protrude into a shot. Mechanical vignetting is most common when using wide-angle lenses.

We tend to look at brighter areas of a photo more readily than darker areas. Deliberate vignetting can help to emphasize a central subject.

PERSPECTIVE

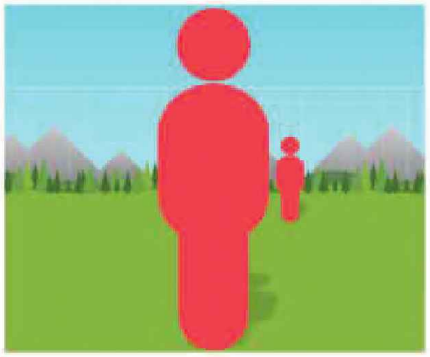
Perspective is the visual effect that makes objects appear smaller as their distance from the viewer increases. You can exaggerate or reduce the effect by changing your position and by altering the focal length of the lens.



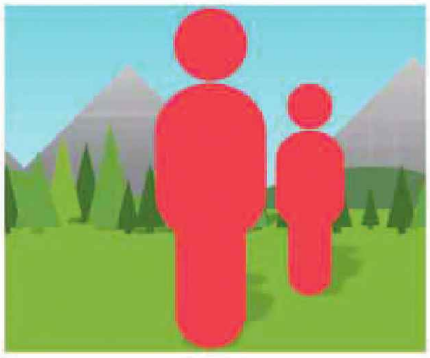
CHROMATIC ABERRATION

Chromatic aberration (CA) appears as visible color fringes around sharp edges in a photo. CA is caused by the inability of a lens to bring all the wavelengths of color into precise focus on the sensor. More expensive lenses often have special glass elements to reduce CA.

Axial (or transverse) CA is seen as a colored halo around high-contrast detail. It occurs most often when using a lens at maximum aperture; it disappears when smaller apertures are used.



Wide-angle lenses have wide angles of view, increasing the difference in the apparent sizes of objects that are at different distances from the camera. Nearby objects will appear to be larger and distant objects smaller (see pp.140–141).

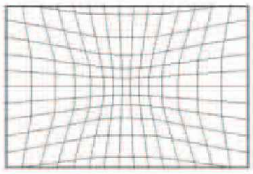


Telephoto lenses have small angles of view, decreasing the difference in the apparent sizes of objects that are at different distances from the camera (see pp.156–157).

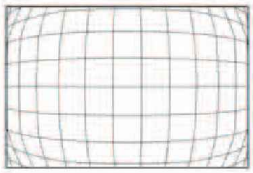
Lateral CA is seen as color fringing—often cyan and magenta—usually in the corners of an image. Not affected by the aperture size, it can be corrected in-camera or in post-production.

Sensor blooming occurs when a highlight blows out (for example, tree branches against a light sky), and is usually uncorrectable. This problem is caused by the sensor.

DISTORTION



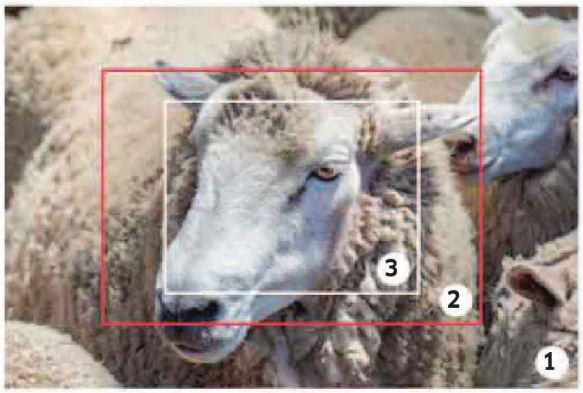
Pincushion distortion is when straight lines curve inward. This distortion is commonly seen in telephoto lenses (see week 9).



Barrel distortion is when straight lines curve outward. It is typically caused by wide-angle lenses (see Week 8).

IMAGE SENSOR SIZE

The image formed by a lens is circular. The size of the sensor determines how much of this circle is used to create a photo. This is why a lens's angle of view is determined by both its focal length and the sensor size. The standard sensor size used for comparison is the full-frame (36 x 24 mm) sensor. Lenses on cameras that have a smaller sensor will capture a smaller angle of view. Two other common sensor sizes are 4/3s (17 x 13 mm) and APS-C (24 x 16 mm).



This photo was shot with a 180 mm lens on a full-frame camera **(1)**. On an APS-C camera the angle of view would be reduced **(2)**, and for a 4/3s camera the angle of view would be smaller still **(3).**

LEARN THE SKILLS

Changing perspective

Perspective is the visual effect that makes objects look smaller as their distance from the viewer increases. This effect can be controlled by changing the lens's focal length: a wide-angle setting exaggerates distance by increasing the apparent space between the elements in a scene; a telephoto setting has the opposite effect, appearing to compress space.

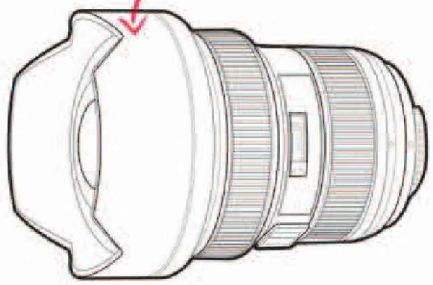
1 Find the right scene

Look for a location where you have some objects in the background and the middle distance. You will need plenty of space behind you to move away from your model.

A woodland setting gives you lots of options for background and midground objects.

2 Attach a mid-range zoom lens

Set up your camera on a tripod with a mid-range zoom lens. The tripod will allow you to be more accurate and consistent.

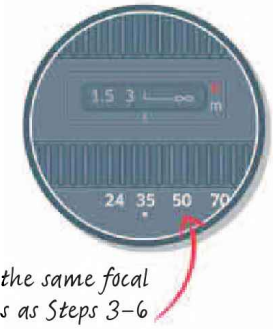


6 Repeat the process

Now repeat the process over a series of focal lengths. Each time check that you have kept the framing of the model constant.

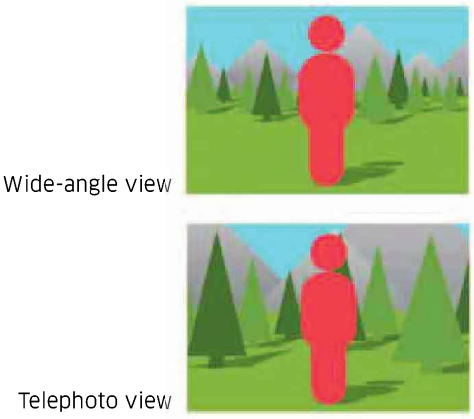
7 Change the focal length from one spot

Move back through the range of focal lengths you have used so far, taking a photo at each one, this time without moving your position.



8 Assess the results

Scan through the images in sequence to see how the relationship between foreground, midground, and background changes with the focal length.



Where to start: You will need a model and a mid-range zoom lens, such as a 28–70 mm or 24–105 mm, and a tripod.

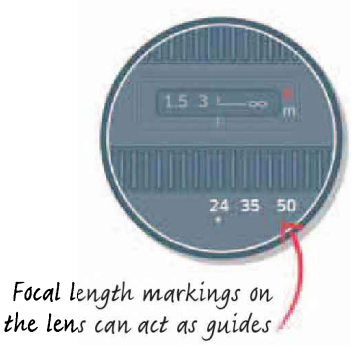
You will learn: How the relationship between foreground and background elements changes with different focal lengths on a zoom lens.

3 Compose your image

Set the lens to the widest setting. Position your model so that they are framed from the waist up, with the top of their head just below the top of the frame. Take a photograph at that setting.

4 Move to the next focal length

Now reset the lens to the next focal length you want to use. Move backward from your subject until you have them framed in the same way as in the first image.



5 Check your composition

Take a photo at the new setting. Toggle back and forth from the new image to the first image and make sure that the model appears to be the same size in the frame.

At a telephoto setting, foreground and background appear closer together.

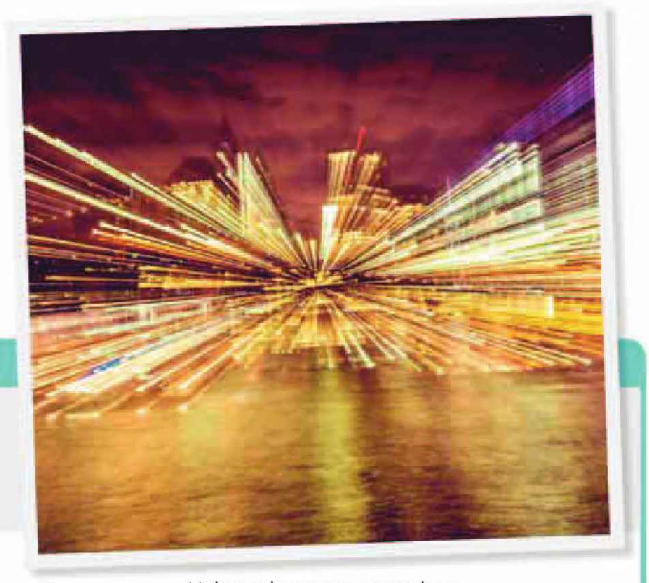
WHAT HAVE YOU LEARNED?

- Using a tripod will help you be more consistent with your framing and composition.
- Wide-angle lenses—and settings—have short focal lengths. The shorter the focal length you use, the more distant the background will seem relative to anything in the foreground.
- Telephoto's longer focal lengths appear to compress distance, so that the elements in a scene appear far closer together spatially.

PRACTICE AND EXPERIMENT

Testing out lenses

These three assignments will help you to explore the extremes of individual lenses and their effects on an image. They can be completed using the widest angle and telephoto extremes on a standard zoom lens. However, try getting hold of specialty wide-angle and telephoto lenses and seeing the effects they have on a photo.



Using a long exposure has created this zoom burst effect.

TAKE A ZOOM BURST IMAGE

EASY | **OUTDOORS**
2–4 HOURS | **POINT LIGHT SOURCES**
BASIC + tripod, wide-angle or standard zoom lens

This technique works well in situations where you have lower light levels and point light sources, such as in a cityscape.

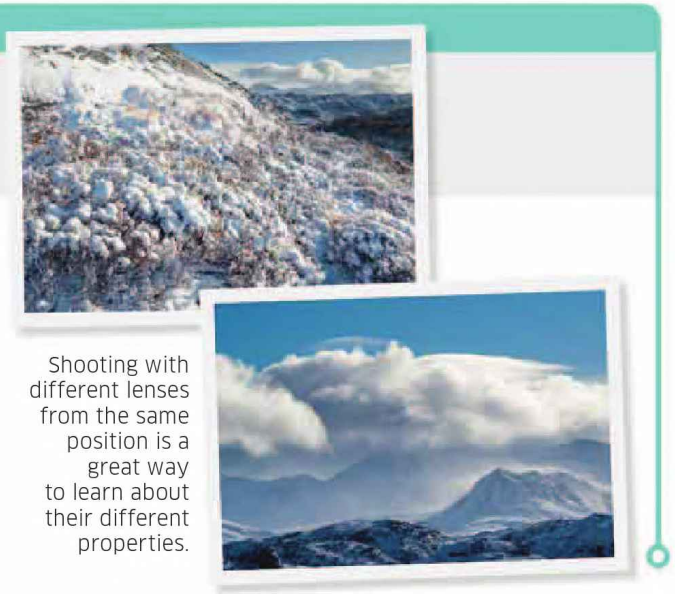
- **Position** your camera on a tripod and compose your image at the widest setting of the lens you are using.
- **Set** your shutter speed to 1/4 sec at the corresponding aperture, using either Manual or Aperture Priority modes.
- **Press** the shutter and, as you do so, quickly turn the zoom ring toward the longest focal length.
- **Try** zooming in the opposite direction, from the longest setting to the widest.

SHOOT AT EXTREMES

MEDIUM | **OUTDOORS**
2–4 HOURS | **LANDSCAPE SUBJECT**
BASIC + tripod, wide-angle or standard zoom lens

Choose a scene that has objects close to the camera and far in the distance; a landscape is ideal.

- **Set** up your camera on a tripod and compose your photograph with a wide-angle lens. Take the picture.
- **Attach** a telephoto lens and shoot the same scene, picking out a detail from the far distance.
- **Look** at the two images on your computer afterward. Find the same area on the wide-angle photograph that you shot with the telephoto, and zoom in until it covers the same view. How do they differ?



Shooting with different lenses from the same position is a great way to learn about their different properties.

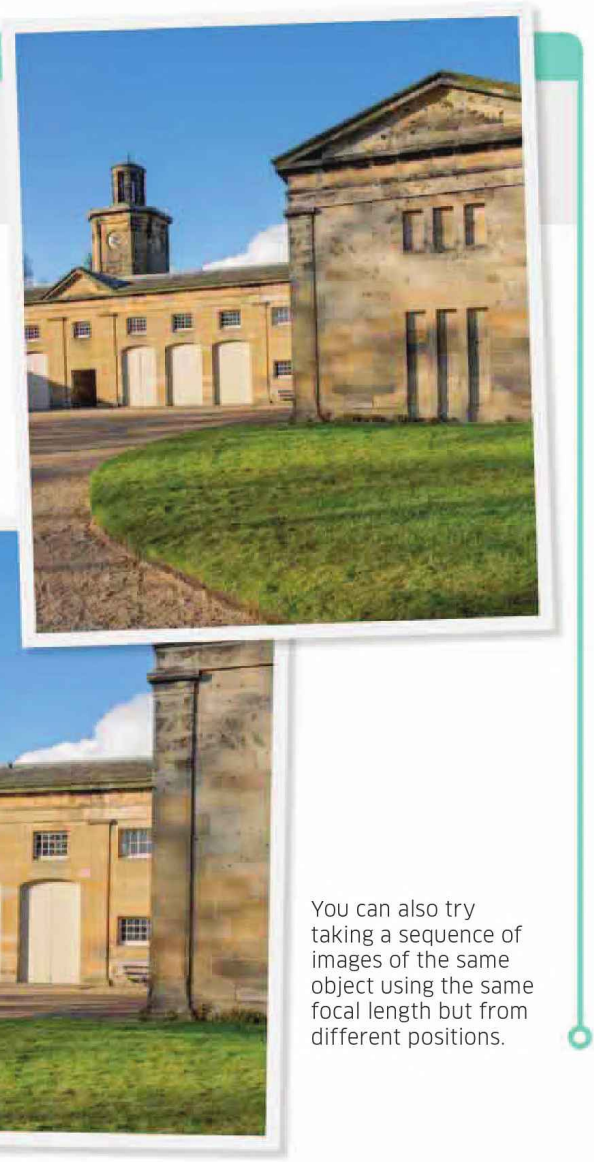
Pro tip: A piece of gaffer tape will hold a zoom lens at a set focal length once you have set it up.

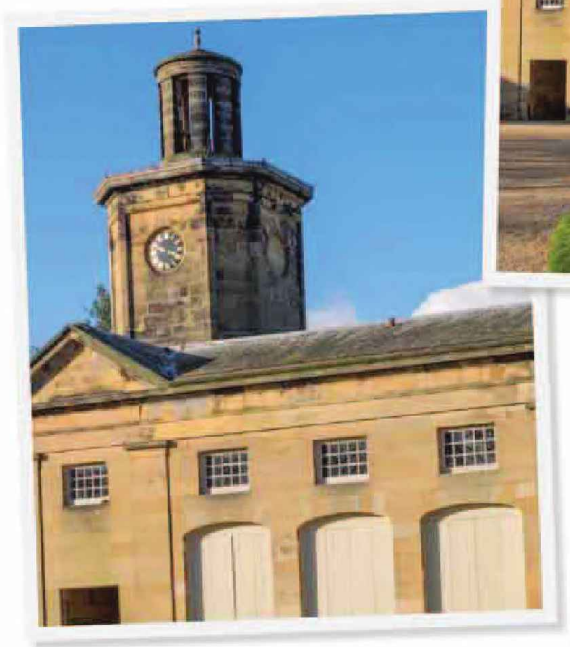
SINGLE FOCAL LENGTH

MEDIUM | **INDOORS OR OUTDOORS**
2–4 HOURS | **AS MANY SUBJECTS AS POSSIBLE**
BASIC + prime lens (or zoom lens set to one focal length)

This is a great way to learn the specific characteristics of a certain lens.

- **Choose** a prime lens in the 28–50 mm range, or set your zoom lens to 28, 35, or 50 mm.
- **Go out** and shoot using only that lens. Hold the lens up to your eye and scan the scene, and try to memorize the angle of view it gives you. Then look at a new scene, try to estimate the coverage of the lens, and then bring the camera up to your eye and see how close you are to being correct.
- **Bracket** your photographs using a range of apertures to see how the depth of field changes.
- **Try** this exercise for a range of different lenses until you are confident you know what each one will do.





You can also try taking a sequence of images of the same object using the same focal length but from different positions.

WHAT HAVE YOU LEARNED?

- As you change lenses, the perspective stays the same, but the field of view changes.
- Zoom effects can give dynamism and energy to a shot, especially at night.

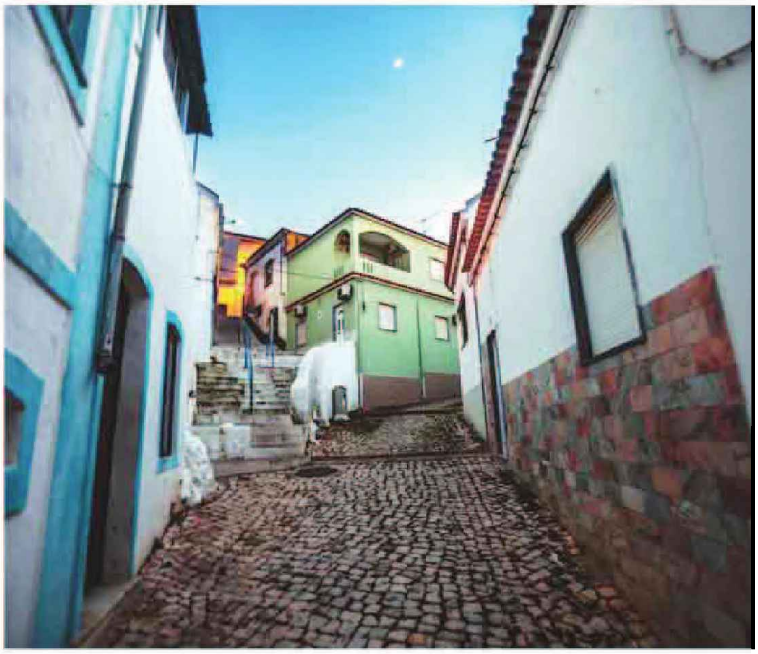
ASSESS YOUR RESULTS

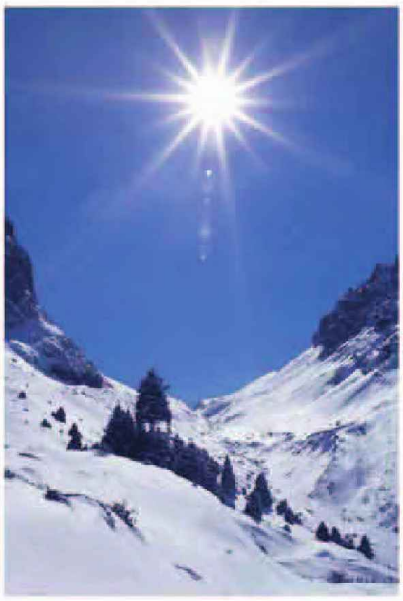
Reviewing your shots

Once you've completed the assignments, review your images and choose the ones you're happiest with. Then go through the checklist here to see if any of them could be improved.

Is there distortion near the corners of your image?
When taking shots of buildings using wide-angle lenses, take care to keep the verticals straight to avoid distortion, especially at the edges of the frame.

Are your verticals true?
When you tilt a camera up or down while using a wide-angle lens, it can create a lot of distortion and converging verticals. Do you think the converging verticals in this image work or not?



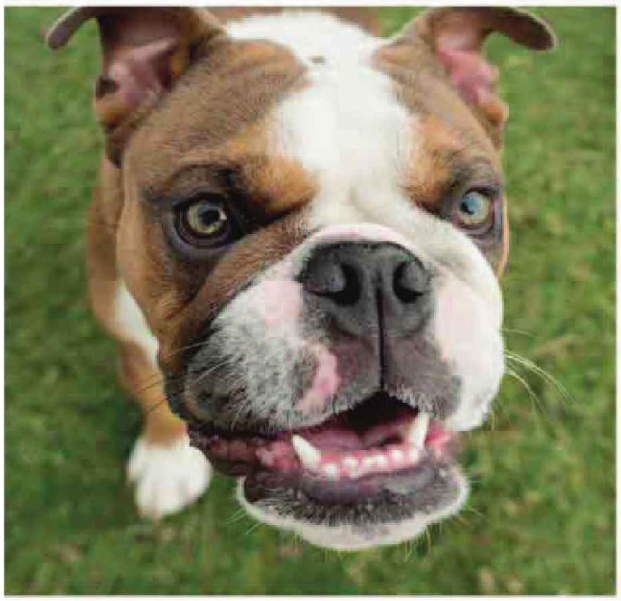


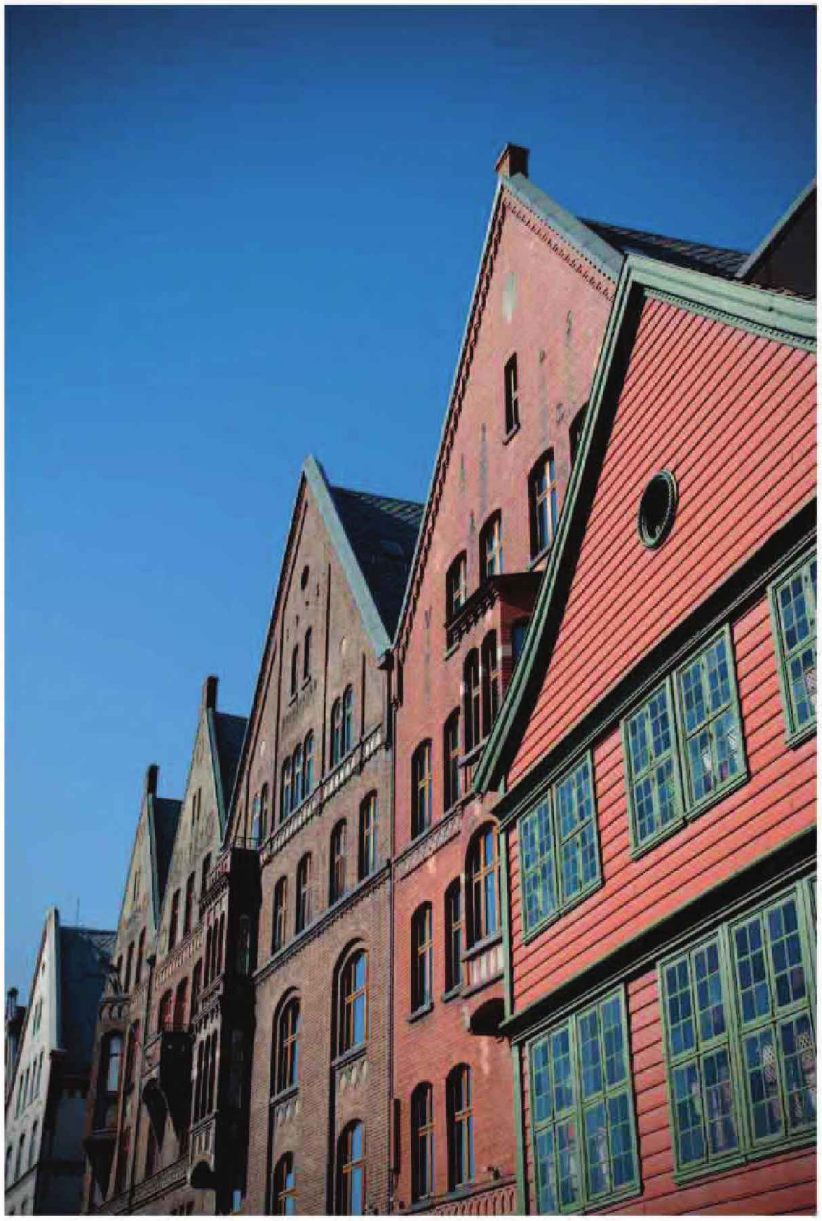
Is lens flare visible?
Lens flare is caused by light from a point light source, such as the sun, reflecting inside the lens and recreating the shape of the aperture, as shown here. You can avoid this by using a lens hood or by shading the light source, using your hand or a piece of paper.

Have you avoided camera shake?
You need to make sure you set a shutter speed high enough to avoid camera shake. To keep these birds sharp, you would need to set a higher shutter speed than the focal length of the lens.

> The **heart and mind** are the true lens of the **camera.**
>
> YOUSUF KARSH

Does your image have the right focus?
With long lenses you need to be very careful with your focusing, as depth of field will be minimal. In this case, you should focus on the dancers' feet.



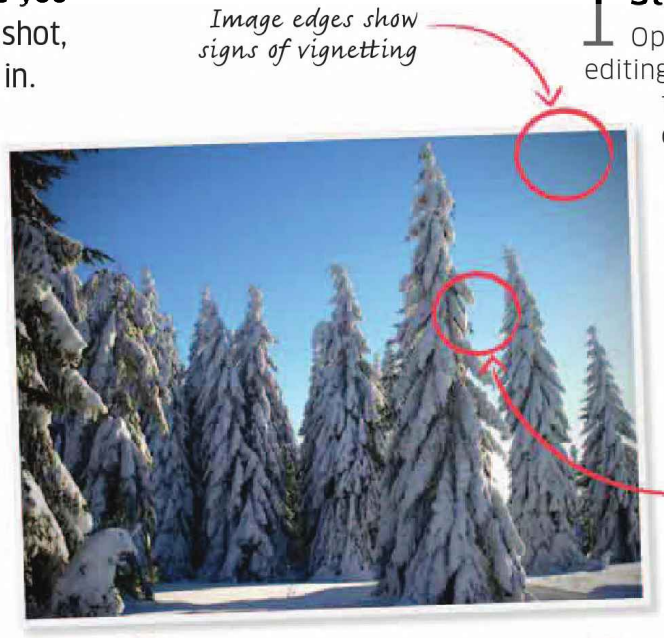


Did you get too close to your subject?
If you use a standard lens to shoot a portrait, try not to get too close to the subject or you will distort their features, especially the nose.

Does your image have vignetting?
Vignetting, as shown in this image, can be a problem with fast lenses used wide open, or when an accessory mounted in front of the lens is too small.

Correcting lens problems

No matter how much care you take in setting up a great shot, distortions can still creep in. Fortunately, there are software correction tools that will handle the unwanted variables and distortions created by your lenses.

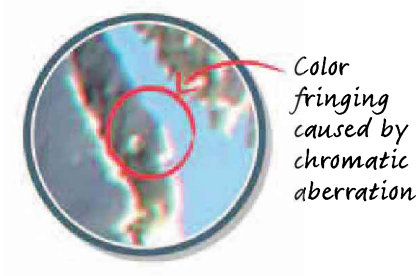


1 Study your image

Open your photo in image-editing software and look closely for any signs of distortions caused by the lens. These include distortions to perspective, vignetting, and chromatic aberrations. In this wide-angle shot of a forest, the verticals of the trees look natural, so perspective distortion is not an issue.

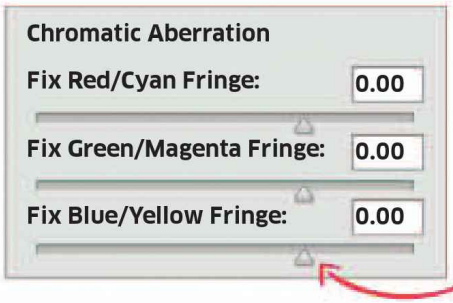
4 Check for aberrations

Look closely at the edges of objects in your image, especially where there is a high level of contrast between the object and the background, and look for signs of chromatic aberrations. These may take the form of hazy lines of color.



5 Use the sliders

Enlarge the area you want to correct by up to 400 percent so you can gauge how effective your adjustments will be. In the Lens Correction box, three sliders deal with colored fringes: each slider adds or reduces a particular color to reduce lateral chromatic aberration (see pp.126–127).



6 Perform one final check

View the whole image on screen by selecting Fit on Screen from the magnification menu. Click on OK if you're happy with the corrections you've made.

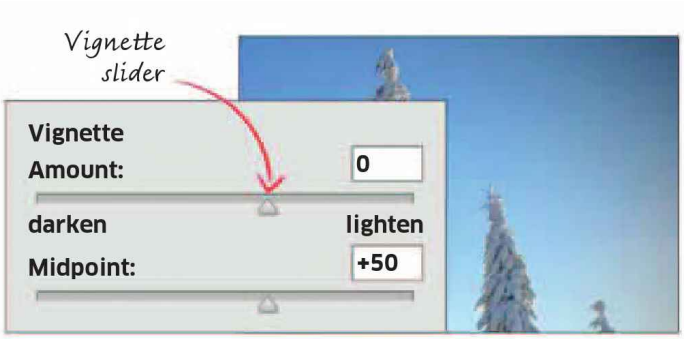
Pro tip: Before you start correcting a set of problems, think about the best order in which to tackle them. Noise reduction is generally more effective prior to working on chromatic aberrations, while sharpening should be performed afterward.

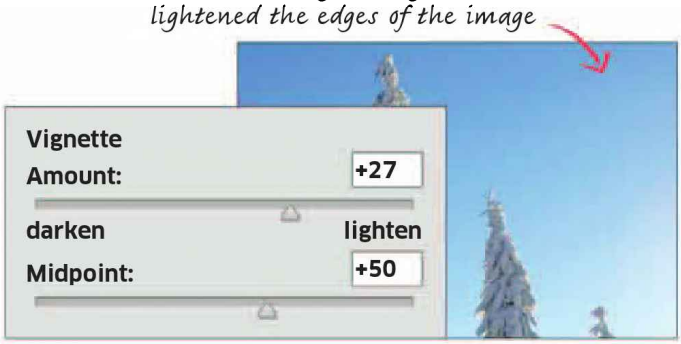
2 Open the Lens Correction box

Click on Filter and then on Lens Correction. Click on the Custom tab once the Lens Correction dialog box is displayed. The Vignette slider allows you to lighten or darken the edges of the image. Remember, you can add or increase an image's vignetting effect to draw attention to the central subject if you want to.

3 Adjust the vignette

Move the Vignette slider back and forth to take away vignetting or add it for effect. Note that correction will increase image noise toward the corners, because digitally brightening an image amplifies both image detail and noise equally.





Corrected image with vignetting lightened and chromatic aberrations reduced.

LENS PROFILES

Many image-editing software programs now have automated lens correction. This is based on preset parameters for most common lenses. You can load these presets and the software will use a precalibrated profile to remove distortions and aberrations typical to that particular lens.