PHOTOGRAPHY BASICS

- CAMERAS | LENSES | ACCESSORIES
- SHOOTING TECHNIQUES
- TIPS FOR IMAGE COMPOSITION

Canon Academy

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ISO, APERTURE AND SHUTTER SPEED

Exposure

Exposure determines the brightness of a photo. Two factors control the amount of light entering the camera: the aperture and the shutter speed. The ISO value defines the light sensitivity of the sensor.

EXPOSURE: 3 IMPORTANT PARAMETERS

The exposure of a photograph is determined by three factors:

1. the length of the exposure time

2. the aperture of the lens

3. the camera‘s ISO sensitivity

More light hits the camera's image sensor

- the longer the exposure time

- the larger the aperture of the lens.

Increasing the ISO sensitivity, on the other hand, does not "capture more light", but rather intensifies the existing light falling on the image sensor.

The interaction between the image sensor and image processor in the camera ensures that the best possible image quality is achieved even at high ISO settings.

Correctly assessing lighting conditions

Thanks to the dilation of the pupil, our eyes can still detect a sufficiently bright environment even when the camera is already exposed to light levels that could result in blurred, out of focus or underexposed images.

You can practice correctly estimating lighting conditions. Simply estimate the shutter speed required to get a correct exposure at a given aperture (e.g. f/4) and ISO sensitivity (e.g. ISO 800), and then compare it with the camera‘s exposure reading.

EXPOSURE TIME

When you press the shutter button on your camera to take a picture, the exposure starts. Exposure time is the amount of time that the mechanical or electronic shutter of the camera or image sensor is open, allowing light to pass through the lens and onto the sensor.

Exposure times range from a fraction of a second to several seconds. The longer the shutter is open, the more light falls on the sensor. In daylight, a shorter exposure time is sufficient to allow the same amount of light to fall on the sensor as in the evening when there is little daylight.

The image on the left is too dark, or underexposed. The image on the right, on the other hand, is too bright and is overexposed. The large image above shows the correctly exposed subject. Both the dark and light areas are clearly discernible.

SHUTTER SPEED: FREEZE IN ACTION

The aperture and shutter speed settings are adapted not only to the lighting conditions, but also to the subject or shooting situation. For example, with fast-moving subjects such as sports, a short exposure time is used to 'freeze' the movement, and the aperture is opened up accordingly to 'capture' enough light despite the short exposure time.

Shutter speed (in seconds)

1/4s | 1/8s | 1/15s | 1/30s | 1/60s | 1/125s | 1/250s | 1/500s | 1/1000s

Long exposure time:
▶ more motion blur

Short exposure time:
▶ less motion blur

APERTURE: AMOUNT OF LIGHT AND DEPTH OF FIELD

The iris diaphragm in the camera lens has two functions: It controls exposure and depth of field.

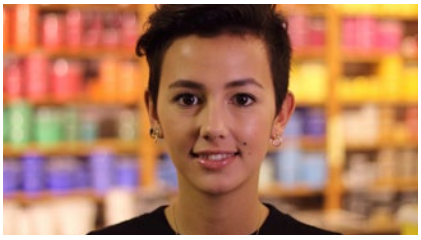
The size of the iris opening controls the amount of light that passes through the lens onto the sensor. The aperture is set on the camera or lens. A small aperture lets in less light, while a large aperture lets in more light. The size of the aperture is described by the f-number. But be careful: small aperture numbers such as "2.8" mean a large opening of the aperture, large num-bers such as "22" mean a small opening.

However, the aperture not only determines the amount of light, but also the area in focus in the image: the smaller the aperture, the larger the area in focus in front of and behind the point on which you have focused.

Aperture value and depth of field

F16

F5.6



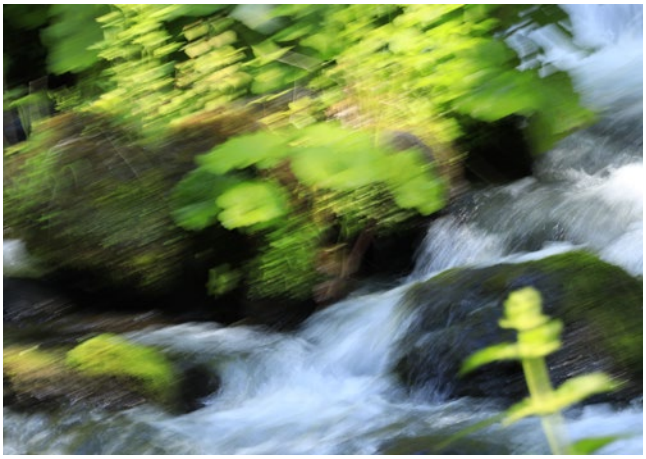
F2

Large aperture value F
- small aperture
- high depth of field

Small aperture value F
- wide aperture
- shallow depth of field

CAMERA SHAKE AND MOTION BLUR

You have focused on the spot and your picture is still not sharp? The exposure time was probably too long. Blurred images can also be caused by "camera shake" or rapid movement of the subject. Fast movement is sharply captured by a short shutter speed, while the image stabilisation in the camera and lens works to counteract camera shake.



What causes camera shake?

"Camera shake" occurs when the exposure time is too long, causing unwanted camera movement when taking handheld photos. The result is a blurred picture.

Tip: Avoid unintentional camera movement when taking handheld photos. For example, you can "clamp" the camera between your head and hands and rest your elbows on your torso, or by placing the camera on a solid surface or tripod.

What causes motion blur?

Motion blur occurs when the shutter speed is so long that fast objects in the scene move in the frame during the exposure. The static parts of the image may still be in focus.

Tip: Achieve a shorter exposure time by setting a larger aperture or higher ISO sensitivity.

Image stabilisation in lens and camera

Lenses with an optical image stabiliser (IS system) allow you to use longer shutter speeds without blurring. For example, you can take sharp pictures at 1/15 second instead of 1/125 second. The EOS R1, R3, R5, R5 Mark II, R6 and EOS R6 Mark II mirrorless cameras also feature in-camera image stabilisation ("IBIS"). Together with the image stabilisation of the RF lenses, this allows exposure times to be increased by up to 8.5 f-stops without the risk of camera shake. In this example, two seconds would be possible instead of 1/125th of a second.

Atmospheric landscape scenes require a high ISO sensitivity setting in order to achieve short shutter speed times and avoid shake and motion blur. The image on the right simulates the increase in noise at high ISO settings.

ISO SENSITIVITY IN PRACTICE

The ISO value set on the camera is a measure of how sensitive the sensor is to the amount of light falling on it; at high ISO values, the camera needs less light to correctly reproduce the brightness of the subject. Shorter exposure times or smaller apertures can be used.

Unwanted noise occurs at extremely high ISO sensitivities. Images will appear grainy and less detailed than at lower ISO settings.

Tip: With current EOS R cameras, this effect only occurs at very high ISO settings.

The "Auto ISO" setting allows you to set an up-per limit for your camera's ISO sensitivity, such as ISO 3,200 or ISO 12,800. This allows you to decide how much loss of quality is acceptable for your subject.

Aperture: 1.8 | **Exposure time:** 1/200s | **ISO:** 100

Aperture: 4 | **Exposure time:** 1/400s | **ISO:** 400

ISO SENSITIVITY IN PRACTICE

For **snapshots**, use the shortest exposure time possible, such as 1/250th of a second, to "freeze" motion. Longer exposure times will result in motion blur if people or objects are moving in the scene. Depending on the brightness, select a medium to high ISO sensitivity, such as ISO 800 to ISO 6400.

For **landscape photography**, the ISO sensitivity can be set to a low value, such as ISO 100. A small aperture, such as f/8 to f/16, provides a large depth of field. The exposure time is correspondingly longer. A tripod and the lens's image stabiliser help prevent blur caused by camera shake. Canon lenses with an optical Image Stabiliser are identified by the abbreviation "IS".

Aperture: 2,8 | **Exposure time:** 1/500s | **ISO:** 400

Aperture: 4 | **Exposure time:** 1/1.000s | **ISO:** 1.600

Situations involving **fast-moving subjects**, such as sports, children or animals, require a very short exposure time. If the exposure time is too long, motion blur will occur, which is not always intended. A short exposure time freezes the movement. To achieve this, first select the shortest possible value of 1/250 sec, or even shorter.

Important: The longer the focal length of the lens used, the shorter the exposure time should be. The aperture can be set to an average value between 4 and 8. All lenses work best in this range. The ISO sensitivity is then adjusted according to these two values for correct exposure.

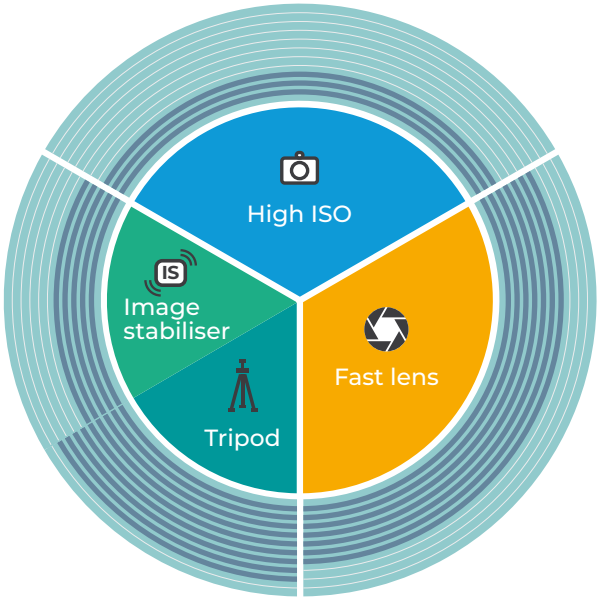
LOWLIGHT PHOTOGRAPHY

When taking photos in low light, high ISO settings on the camera, fast lenses, image stabilisation or a tripod can be used, depending on the subject.

Landscape

What matters in the picture:
Details and large depth of field

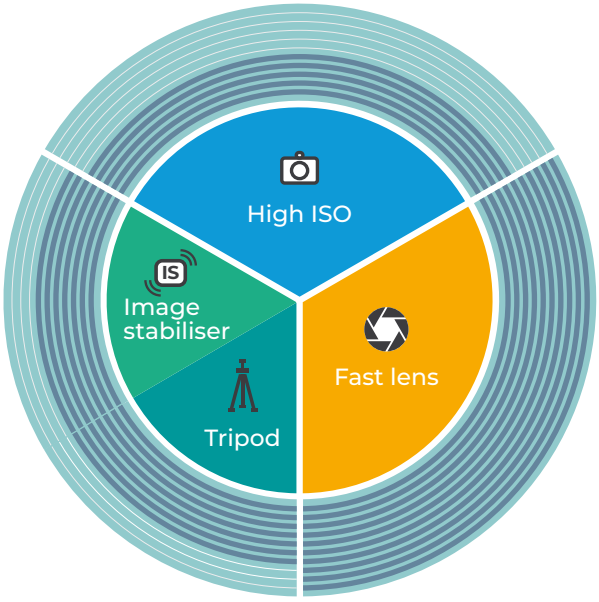
Priority for exposure:
Small aperture



Portrait

What matters in the picture:
Selective focus, nice bokeh

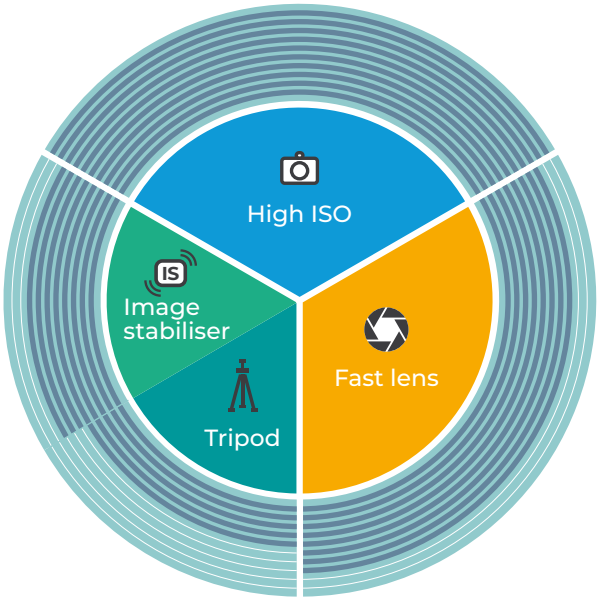
Priority for exposure:
Large aperture



News

What matters in the picture:
Sharpness and large depth of field

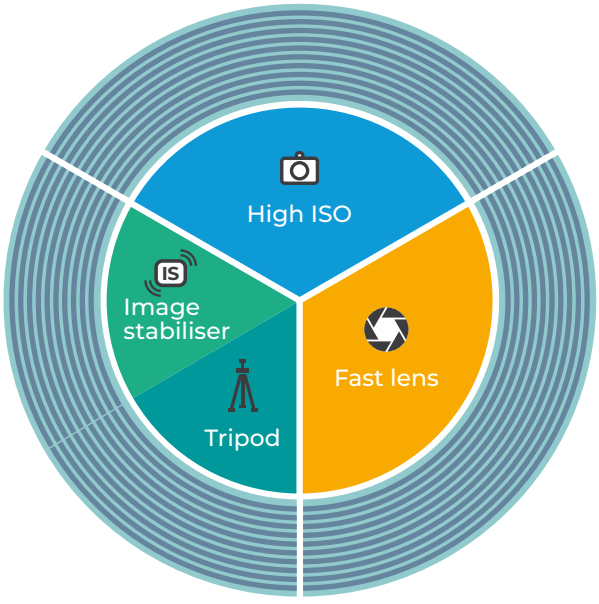
Priority for exposure:
Short exposure times



Sports

What matters in the picture:
Sharpness, selective focus

Priority for exposure:
Short exposure times



SHOOTING MODES FOR EVERY SCENE

Exposure

EOS cameras can be set up to use a variety of scene modes. Your choice of scene depends on the subject and the way you want to frame it.

SHOOTING MODES

Program mode P

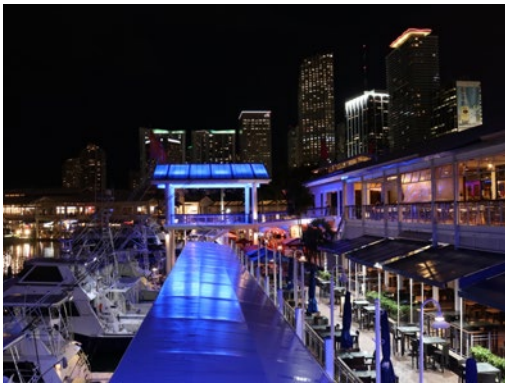
The camera automatically selects a combination of aperture and shutter speed to match the metered exposure. Program mode is useful when the light changes quickly and you want to concentrate on the subject rather than the exposure. This mode is ideal for beginners.

Shutter priority mode Tv

With this automatic mode, the photographer sets the desired exposure time and the camera's electronics determine the correct aperture based on the exposure reading. This allows you to decide whether to freeze or allow movement in the image. Sports photography is a typical application for Shutter priority mode.

Aperture priority mode Av

When the desired aperture is preselected, the camera's electronics select the shutter speed according to the light meter reading. For subjects that require a shallow depth of field, aperture priority selects a large aperture, i.e. a small f-number. The camera does the rest. Portrait photography is a typical example.



Scene modes SCN

Canon EOS cameras offer scene modes for typical subjects such as portraits, landscapes or night scenes. When you select a scene mode, the camera automatically determines the appropriate aperture, shutter speed and ISO sensitivity for the subject.

Manual exposure mode M

The aperture and shutter speed are set manually. When in manual exposure mode, the viewfinder of any EOS camera displays a "light scale". The aperture, shutter speed and ISO sensitivity are set so that the index mark on the light scale is exactly in the centre of the scale, meaning that the exposure is "balanced". Targeted overexposure and underexposure are also possible.

Manual exposure control is used in the studio, for example when photographing with a flash. The photographer has full control over the exposure by setting all the values manually. It is also used for long exposures, such as night shots.

Manual exposure compensation

Manual exposure compensation can be used to manually influence the exposure value measured by the camera. Typical exposure errors (snow, backlighting) can be compensated for. On the camera, the exposure is shifted towards "plus" (brighter) or "minus" (darker) using the appropriate function. In a backlit situation, a camera reading will usually produce an image that is too dark. In this case, the correction will be in the brighter direction. In the automatic aperture programme, this will result in a larger aperture, i.e. a smaller f-number.

Tip: In the case of a back-lit subject, the exposure should be at least a full f-stop brighter than the measured exposure (e.g. the measured f-stop of 11 is corrected to f-stop 8).

Two levels brighter | One lever brighter | One level darker | Two levels darker

AUTOMATIC EXPOSURE BRACKETING

Another way to get the best exposure in difficult lighting conditions is to use exposure bracketing. This involves taking a series of shots with different exposures. The bracketing function of EOS cameras allows you to create these series of exposures automatically, without having to adjust the aperture or shutter speed manually. Firstly, you specify the "distance" from the measured exposure at which further exposures are to be taken automatically, e.g. in full, half or one-third increments. Exposures are always taken in both directions. Usually three shots are available, but depending on the model, two, five or seven shots may be possible. Three to five shots are usually sufficient to determine a perfect exposure with automatic exposure bracketing.

What happens during bracketing in the shooting programme?

Shutter priority (TV)
With Shutter priority, the aperture changes during bracketing, the exposure time remains constant as preselected.

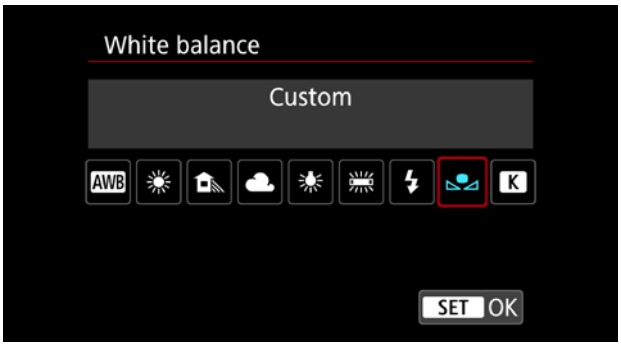
Aperture priority (Av)
In Aperture priority mode, the shutter speed changes during the exposure, but the aperture remains fixed. This also applies to the Program mode.

Program mode (P)
The exposure time changes during bracketing, but the aperture remains constant as measured in program mode.

Manual mode (M)
In manual control, automatic bracketing changes the exposure time, but the aperture remains constant.

WHITE BALANCE: THE COLOUR OF LIGHT

The camera's white balance is used to adjust the camera to the colour of the light. The aim is to reproduce colours as accurately as possible - as the human eye sees them - and in daylight and most mixed lighting situations, the automatic white balance ("AWB") will usually provide accurate results.



If you want to further optimise your images by taking into account the light and colour conditions, you can alternatively select pre-defined profiles for different lighting situations (cloud-less sky, shade, closed cloud cover, incandescent light or flash) in the camera menu (see above).

The two manual white balance settings are for more specific situations.

If you use one of the presets, remember to read just the white balance when the subject or location changes. Automatic white balance is usually a safe choice.

TIP: With RAW files, the white balance can be changed later, for example in Canon Digital Photo Professional (DPP). For subjects with "critical" white balance, it is best to set the RAW option in the red camera menu.

Manual white balance

For the most accurate results, use manual white balance: with a white sheet of paper (or better still, a grey card) in front of the lens, you can calibrate the camera exactly to the available light. Grey cards for photography are colour neutral and are often used in fashion and product photography where accurate colour reproduction is important.

WHICH CAMERA?

The great strength of all EOS system cameras is their versatility. By choosing the right lens, photographers can optimise their camera for almost any shooting situation. We explain which camera features are useful for specific applications.

COMPARISON OF APS-C AND FULL FRAME

The size and resolution of the image sensor determine the quality and impact of your photos: A high megapixel resolution provides a detailed image. A large sensor size gives you more creative control over sharpness and blur.

Full frame: EOS R1 and EOS R5 Mark II

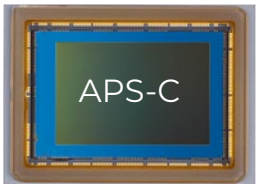
APS-C sensor: EOS 90D and EOS R7

Full frame: 36 mm x 24 mm
Corresponds to 35mm film format,
Lens crop factor: 1

Cameras: EOS R1, R3, R5, R5 Mark II, R6, R6 Mark II, R8, R, RP

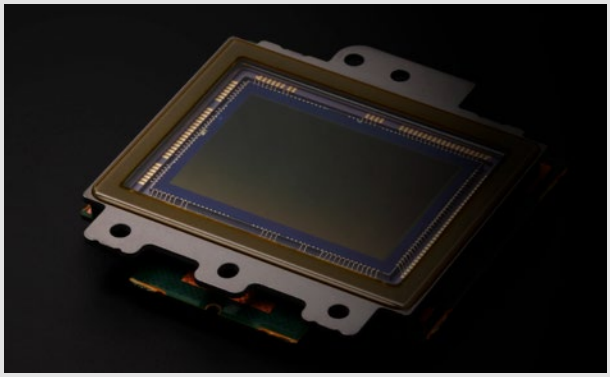
APS-C: 22,3 mm x 14,9 mm
Area about 40% of the full frame sensor,
Lens crop factor: approx. 1.6

Cameras: EOS R7, R10, R50



What role does sensor size play?

Compared to the APS sensor, full frame sensors offer greater design freedom and extended high ISO capabilities. An APS-C sensor allows compact camera bodies to be built; the 1.6 crop factor is appreciated by wildlife and sports photographers and Canon's **Dual Pixel CMOS AF II** technology is used for sensor-based focusing in both still and video images with both sensor sizes.



HOW IT WORKS: SLR AND MIRRORLESS

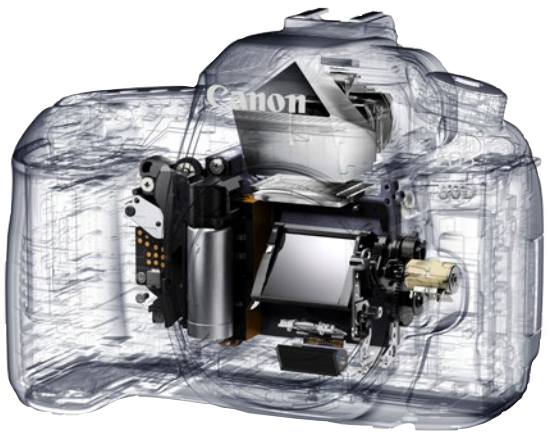
As the name suggests, "mirrorless" system cameras do not use the optical mirror prism system of a DSLR. The image from the sensor is displayed directly on the screen or in the electronic viewfinder (EVF).

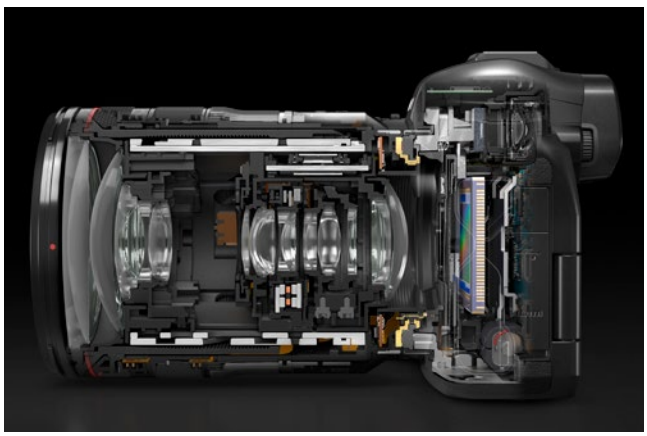
How a DSLR works

In a digital single lens reflex camera (DSLR), the image is first deflected 90 degrees by a mirror, then rotated by a prism and finally displayed in the optical viewfinder. When the photographer presses the shutter button, the mirror flips up and the mechanical shutter opens, sending the image from the lens directly onto the sensor.

How a mirrorless camera works

With a mirrorless camera, the image passes through the lens directly onto the sensor and is displayed electronically on the camera's rear screen or, depending on the model, in the electronic viewfinder. This is also known as the electronic viewfinder (EVF).





COMPARISON OF OPTICAL AND ELECTRONIC VIEWFINDERS

A key difference between mirrorless and DSLR cameras is the viewfinder: with DSLRs, light entering through the lens is deflected by an optical system. With a mirrorless camera, the image signal from the sensor is used for the viewfinder display.

The **electronic viewfinder** on a mirrorless system camera (DSLM) displays an electronic image of the subject. An advantage of the electronic viewfinder over the optical viewfinder is that the effects of white balance, image styles, creative effects or exposure corrections can be assessed directly in the live image of the viewfinder. Additional information and aids (e.g. grid, spirit level) can also be displayed.

In the **optical viewfinder** of an EOS DSLR camera, the subject is deflected by a mirror through the lens and then into the prism viewfinder. When the shutter is released, the mirror flips up and the viewfinder goes dark for the duration of the exposure. In Live View mode, on the other hand, a DSLR works much like a mirrorless camera: the rear display acts as an electronic viewfinder.

All cameras in the EOS R system and many DSLR models have a **rotating and tilting screen**. This ability to adjust the screen makes it possible to shoot from difficult positions, such as overhead or high in the grass, without losing the view of the screen. It can also be swivelled and rotated all the way to the front for taking a selfie or recording yourself for a video podcast.

	EOS R System	EOS DSLR
Optical viewfinder	no	yes
Electronic viewfinder (EVF)	yes	no
Clip-on EVF	no	no
Rotate and tilt display	yes (except EOS R100)	EOS 250D, 850D,77D, 90D, 6D Mark II
Viewfinder image display	yes	no
Camera menu in viewfinder	yes	no
Image effects in the viewfinder	yes	no

LENSES: ZOOM OR FIXED FOCAL LENGTH?

Both concepts have their strengths. Zoom lenses such as the RF 24-240mm F4-6.3 IS USM or the RF-S 55-210mm F5.0-7.1 IS STM, designed for EOS R cameras with APS-C sensors, have a wide focal length range. This means they cover a broad range of subjects and save weight.

On the other hand, there are the advantages of fixed focal lengths: they offer high image quality and have a larger initial aperture, i.e. they are faster than zoom lenses.

TIP: Many photographers use an "always-on" zoom lens, e.g. 24-105mm (for full-frame cameras), and also have a fast fixed focal length in their camera bag for their favourite subjects.

LENSES: CHOICE OF FOCAL LENGTH

Which focal length is the right one? The answer depends on the available light and the subject.

Wide-angle lenses are usually the lens of choice for **landscape and architectural photography**. They capture a wide angle of view and make distant objects appear further away, emphasising the vastness of the landscape.

For cameras with an APS-C sensor, the wide angle range starts at around 18 mm; for full-frame cameras, 24 mm is considered a true wide-angle.

For street and reportage photography, lenses between 28mm and 50mm are considered the ultimate for cameras with a full-frame sensor: you are close enough to the action, but still have a good overview. For APS-C cameras, this corresponds to a focal length of around 18-28mm.

Portrait shots are particularly impressive at tele-photo focal lengths. The professional L-series RF 135mm F1.8 L IS USM and the more affordable RF 85mm F2 Macro IS STM are ideal for this genre: thanks to their longer focal length and high speed, they produce a pronounced bokeh effect (face in focus, background blurred). At the same time, they reproduce the proportions of the face in a way that is natural and free of unwanted distortion.

For EOS cameras with an APS-C sensor, the RF 50mm F1.8 STM is an inexpensive way to "upgrade" to a fast portrait focal length with a crop factor of 1.6.

Wildlife and sports shots are best captured at long focal lengths - for example with the professional RF 100-500mm F4.5-7.1 L IS USM or the affordable RF 100-400mm F5.6 IS USM.

L-SERIES LENSES

There are over 40 RF lenses available for EOS R cameras. The range covers focal lengths from 5.2mm to 1,200mm.

The L lenses stand out within this range. These professional lenses are designed for photographers who value performance and robustness.

They can be identified by the red ring at the front of the barrel. The fastest lenses within a "focal length family" are always the L variants. They are elaborately constructed with special lens designs and materials to achieve very high image quality.

They are also more heavily sealed against external elements such as water and dust than lenses without the red ring.

BOKEH: BEAUTIFUL BLUR

In photography, the Japanese term "bokeh" refers to the quality of blur in an image.

A subject in a photograph appears out of focus if the corresponding optical scattering circle created by the lens exceeds a certain size.

The appearance of such a blurred circle in the image also determines the effect of the overall blur; the outer shape, which is determined by the shape of the aperture in the lens and the edge area, which is determined by aberrations.

The ideal shape of a blurred circle would be perfectly round with no coloured edges.

The Japanese term "bokeh" describes a harmonious background blur, which is also important as a design element in portraits with an open aperture.

Rounding is achieved with a large number of aperture blades. The RF 85mm F1.2 L USM, for example, has nine blades instead of the usual six or seven.

The edges of the scattering circle are subject to the aberrations of the lens. They usually have a colouration due to chromatic aberration. This colouration decreases as the optical quality of a lens increases. Especially fast lenses for portraits have a very nice bokeh.

Object shots benefit from the selective sharpness distribution.

ACCESSORIES: SPEEDLITE FLASH

The sun in your bag

Creative flash photography is no longer rocket science, thanks to intelligent technologies such as Canon's E-TTL II metering, which uses a pre-flash through the lens to determine the amount of flash required, even taking into account the distance to the subject.

Cameras such as the Canon EOS R10, R50 or R100 have a built-in flash. When a higher output than the built-in flash is required, or when the camera does not have a built-in flash, external flashes such as the Canon Speedlite EL-5 are needed: despite its compact size, this mid-range flash offers enough power for a wide range of outdoor scenes and larger rooms.

The Speedlite EL-5 also offers remote flash functionality. This means that one or more flash units can be placed anywhere in the room to individually illuminate a subject.

The latest EOS R system cameras have built-in flash control, allowing remote flash firing from up to ten metres away. Using the Canon Speedlite Transmitter ST-E3-RT or ST-E10, distances of up to 30 metres can be covered by wireless remote control.

ACCESSORIES: TRIPOD FOR STABLE SHOTS

A tripod is a good option for night shots and long exposures - or when flash is not an option for creative or technical reasons. The type of tripod required depends on the exposure time, focal length of the lens and total weight of the equipment.

For full-frame cameras with large lenses, long focal lengths and long exposure times, the classic tripod enables blur-free shots. For smaller setups or shorter focal lengths, a more compact and lighter monopod is also sufficient as a "holding aid".

CREATIVE EXPOSURE: BLUR AND UNDEREXPOSURE

Basically, a subject is "correctly" exposed when it is sufficiently bright and neither blurred nor motion blurred.

Depending on the subject or creative intent, motion blur may be desirable. This effect can be used to make movement "visible", making the image appear more dynamic. The easiest way to achieve this effect is to use the automatic aperture control.

For example, you can set the shutter speed to 1/2 sec. to make people walking across a square "disappear" in the blur.

When the camera is on a tripod, the rest of the scene - buildings, traffic signs, etc, will be in focus.

Deliberate underexposure of the subject can also be attractive. Particularly in black and white photography, the "low-key effect", in which dark tones predominate, can give subjects a special appeal. The easiest way to achieve this style is to reduce the exposure using exposure compensation or manual exposure.

Tokyo night scene

PERSPECTIVE, FOCAL LENGTH, POINT OF VIEW, IMAGE COMPOSITION

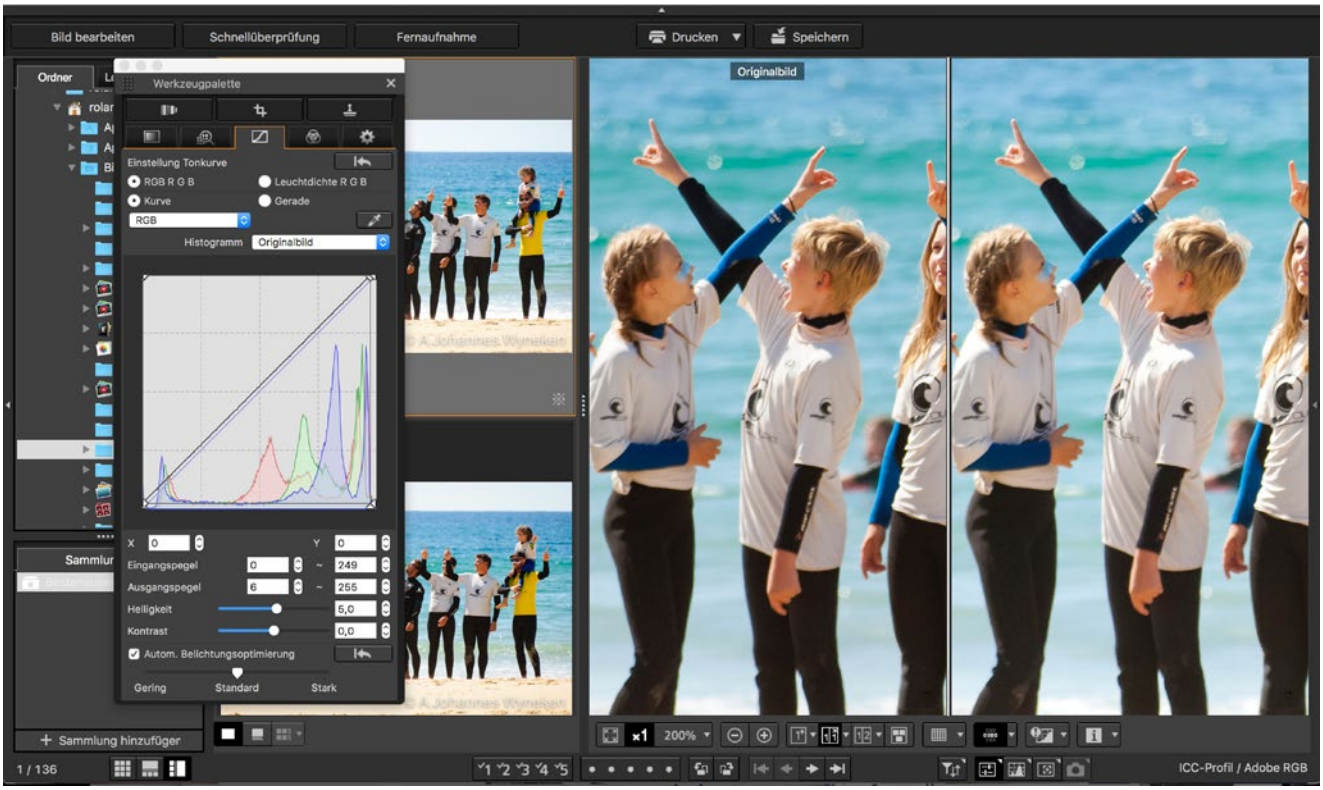
If you want your pictures to stand out from the crowd, you should familiarise yourself with the local conditions and alternative angles before taking them. This is all the more important for frequently photographed subjects, such as a famous building. An elevated shooting position - this could be a bollard or a pedestrian bridge - creates a sense of scale and perspective.

The frog's-eye view makes buildings or natural elevations appear more imposing.

A deliberately chosen foreground, such as a person or plant, lends depth to urban landscapes and adds a visual layer to the composition.

The lens also has a significant impact on the effect of the image. Telephoto lenses condense space and ensure that the main subject stands out vividly against a blurred background when the aperture is open. Wide-angle shots, on the other hand, emphasise the vastness of urban and natural spaces, providing consistent sharpness and allowing the viewer‘s eye to 'breathe'.

Tip: The rule of thirds provides a guide to successful image composition. This image division, which most people find particularly harmonious, can be found relatively easily by displaying corresponding grid line patterns in the viewfinder or on the display of Canon EOS or PowerShot cameras.



RAW DEVELOPMENT AND RETOUCHING

For maximum flexibility in image processing, shoot in RAW format. Although this will take up more space on your memory card, the improved image quality and greater ability to manipulate the data at a later stage without loss will more than compensate for this. Even exposure errors can be corrected to a certain extent.

Every Canon EOS camera comes with Canon Digital Photo Professional (DPP). This software is ideal for processing RAW data. Subsequent control over exposure, white balance, image style, sharpness and contrast is easy and the results can be optimised with just a few controls.

In the case of a series of corrected images, these can then be converted into the desired format for display on a monitor or for printing "in one go".

RAW workflow tools not only optimise and creatively edit RAW files, but also organise large numbers of images, as is often the case with portrait photography. Popular tools include Adobe Lightroom and CaptureOne Pro from Phase One.

If you want to delve deeper into image processing, you can use an image editing programme. The possibilities for retouching images or combining multiple images into a composite are almost limitless with these specialised applications.

The top retouching software is Adobe Photoshop. An alternative is Affinity Photo from Serif.

MORE OF THIS?

Want to learn more about exposure? At the Canon Academy workshops, our trainers will teach you step-by-step how to get the perfect exposure for any subject, but the Canon Academy has much more in store for you.

Check the Canon Academy website for the latest workshop offers and dates.

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