



MIRRORLESS CAMERA GUIDE

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Introduction to the 2016 Guide to Mirrorless Cameras

Hi, and welcome to my 2016 Guide to Mirrorless Cameras!

Mirrorless cameras have only been around a little over 10 years, but they have really only been a major force in the photography world for a few years. In that short period of time, they have initiated something of a revolution in digital photography. You now have many photographers ditching their DSLRs and "going mirrorless."

Since these cameras are very new, you may not be that familiar with them. Further, what information is out there is usually on specific models. Hence this guide.

So let me start off by telling you what I want to do in this guide. There are basically three purposes for this guide, which are to:

- Give you an introduction to mirrorless cameras, if you are not yet familiar with them;
- Compare mirrorless cameras to other kinds of cameras you might be considering, such as a compact camera or a DSLR;
- Compare the various models available to help you choose a specific model of mirrorless camera.

The first few chapters will cover goals 1 and 2, and the remainder of the book will compare the models. Once we get into comparing the specific models, much of this guide will consist of charts. I spend a lot of time comparing the different models.



This guide is actually an update of a prior mirrorless camera guide I made in the fall of 2014. If you happened to see the original guide, you'll see that not only is this guide bigger and more in-depth, but it is fundamentally different in the approach. I want to take a second

to explain that - not because the changes to the guide matter to you that much - but because it says a lot about what is happening in the world of mirrorless cameras.

First, as you might expect, I have covered all the new models that have come out since the original guide. Although the original guide was published only a year and a half ago, it is already hopelessly out of date. Almost every model has been updated or replaced. Many of the models covered in the prior guide are no longer even available. This fast pace of change is a testimonial to the innovation going on right now in mirrorless.

Compare the rate of change to mirrorless during this time to the changes in the DSLR market and you will see a huge difference. DSLRs are changing relatively slowly. Eighteen months ago, for example, the top cameras in the DSLR world were the Nikon D810 and the Canon 5D mark iii. Today, the D810 is still the top camera from Nikon. Arguably the Canon 5D mark iii is still the top of the line (Canon has introduced the 5DS, but apparently this was not an update of the 5D mark iii and we can expect a 5D mark iv at some point). In any case, the 5D mark iii is still being marketed and sold as a flagship product by Canon.

The information available on camera results continues to improve as well. Therefore, the second major change to this guide is the inclusion of a lot more information about the cameras themselves. I have added some additional comparisons of features and specifications along with ratings from DP Review. In addition, I am including testing results from DXO Mark on mirrorless cameras.

We'll talk more about DXO Mark and its scoring later, but they test the dynamic range, low-light performance, and color depth of camera sensors and they create scores that allow you to compare cameras. It provides some great information about these cameras and allows us to make much more informed choices about them.

Thirdly, I have revised how I categorized the mirrorless cameras for comparison purposes. This is more important than might appear to you on first blush. You need to be careful about which cameras you compare. If you compare a cheaper camera with a small sensor to an expensive camera with a large sensor, that doesn't do anything for anyone.

In the past, it always seemed logical to have three categories: (1) beginner, (2) intermediate, and (3) advanced. However, the longer I've done this the more it seems as though that isn't really how the camera market works. Instead, there are basically four categories, which, in the DSLR world, are as follows:

- Entry-Level: Base model cameras with APS-C sensors (e.g. Canon T6i and Nikon D5500)
- Mid-Range: Upgraded cameras with APS-C sensors (e.g. Canon 7D mark ii and Nikon D7200)
- Advanced: Cameras with full-frame sensors (e.g. Canon 6D and Nikon D750)
- Expensive: Full frame cameras with the highest specs and best features (e.g. Canon 5D mark iii and Nikon D810).

It works similarly in the mirrorless world, although the situation is more confused because of the use of Micro Four Thirds sensors and also because full frame is so new to the mirrorless market. We'll get into it more later, but for now I just wanted to point out the difference.

Finally, I have shifted the focus of this guide more toward providing you with information to make your own decisions about mirrorless cameras as opposed to my recommendations. That's not to say that I won't give my opinion - I will, and I won't be coy about it. But the idea is simply to give you the tools for making your own decisions.

Part of the reason I focus more on information rather than opinion is that I don't think I'm really qualified to say which cameras are best. I perform no independent testing of these cameras. I simply assemble and rely on the information that is already out there. In addition, the camera manufacturers thus far have not seen fit to send me models to test (sniff). Therefore, while I have rented some of these cameras, and I do own a couple of mirrorless cameras, much of my "hands on" experience consists largely of me playing with them at camera stores.

In any case, camera recommendations are often useless since what is important to one photographer is often not important to another. For example, camera criteria to a portrait shooter are fundamentally different from those of a landscape photographer. Look and feel play big roles. One size doesn't fit all.

Anyway, you should find all the information you want about mirrorless cameras here. As part of the preparation of this guide, I have scoured the internet for information about them and, based on that, I believe there is more information in this guide about mirrorless cameras than there is anywhere else. Hopefully this information helps you decide if a mirrorless camera is right for you. If so, it should also help you choose the right one.

Chapter 1: What Makes a Camera Mirrorless?

If you aren't familiar with camera technology, then this talk of "mirrorless" cameras might be confusing. After all, what do mirrors have to do with anything in the first place? Let's start this guide by explaining what mirrorless cameras are.



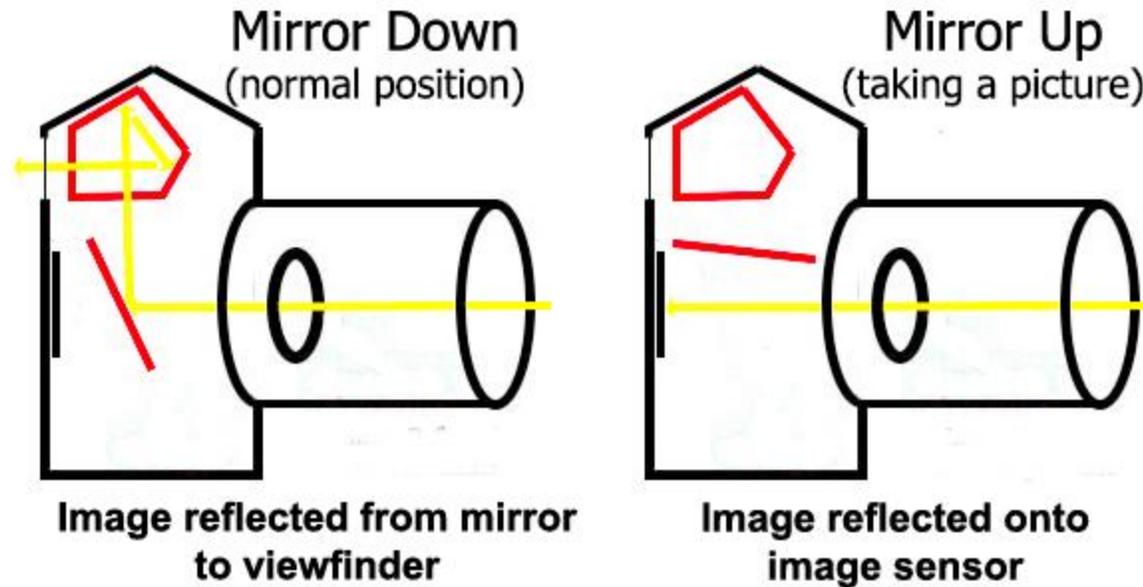
The reason mirrorless cameras are called "mirrorless" is that they are typically compared with DSLRs, which have mirrors inside them. Therefore, to explain mirrorless cameras, I first need to take a step back and explain DSLRs.

A DSLR is a "digital single lens reflex" camera (they were just called "SLRs" before the digital era, and they just added the D for digital). For over 50 years, the SLR has reigned supreme among cameras because they solved a problem for camera manufacturers. That problem that SLRs solved was how to allow the photographer to see exactly what the camera was seeing. Prior to SLRs, cameras either used a viewfinder that was just an *approximation* of what the

camera would be photographing or else the camera would have two lenses with identical views (called twin reflex cameras), with one for the photographer to view the scene and the other for taking the actual picture.

The SLR solved that problem by using a mirror and a prism inside the camera that reflects the image coming through the lens up to the viewfinder. When the shutter release button is pressed, the mirror flips out of the way allowing the light onto the image sensor. Check out this diagram, which shows you how it works:

How DSLRs Work



The DSLR was a great improvement in camera technology because allowed the photographer to see the exact image they were taking with only one lens. Once it was developed, it became more or less ubiquitous in the camera world, and even after the transfer to digital it was the dominant type of camera.

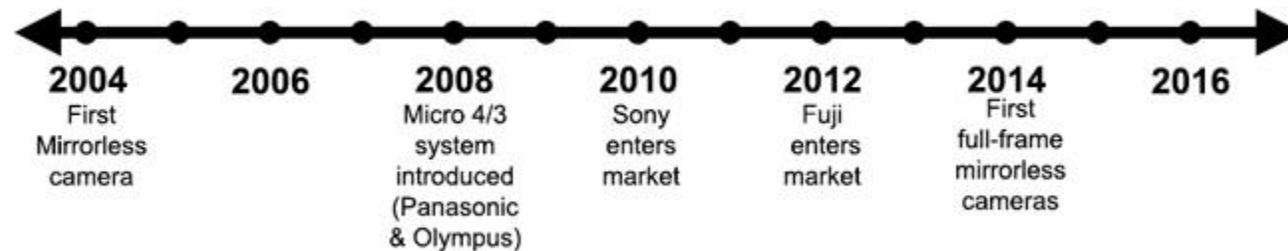
The only downside to SLRs is that the mechanism is bulky and there are extra costs involved due to the mirror and prism. There are also a lot of moving parts, which means things can go wrong. As a result, camera manufacturers have long sought another way.

In recent years, the camera manufacturers have created cameras that have an electronic read-out of what the sensor is seeing, rather than looking through the lens as you would with a DSLR. The electronic display not only shows exactly what you are about to photograph, it also provides exposure and focus data about the shot you are about to take. This change resulted in smaller cameras with fewer moving parts. Because these cameras were able to accomplish all this electronically (without the use of the mirror and the prism), these cameras were initially called "mirrorless" cameras.

The first mirrorless cameras came on the market in 2004. Initially, they were viewed as a bridge between cheaper compacts and more expensive DSLRs. Since then, the technology has advanced, and the manufacturers have also begun using larger and larger sensors and

otherwise increasing image quality. The Micro 4/3 system was introduced in 2008. In 2014, the first “full frame” mirrorless cameras were introduced. At that point, mirrorless cameras have been just as capable as DSLRs in most respects.

Development of Mirrorless Cameras



Let's be clear on what is and is not a “mirrorless” camera. There have been cameras on the market that operate without using mirrors for a long time. These are typically inferior cameras referred to as “compacts” or “point-and-shoots.” They have smaller image sensors and are therefore inferior cameras for casual use. Another key characteristic of what we call “mirrorless” cameras is that they have interchangeable lenses, and compacts and point-and-shoots have only fixed lenses. When one refers to “mirrorless” cameras, they typically do not mean these compact cameras.

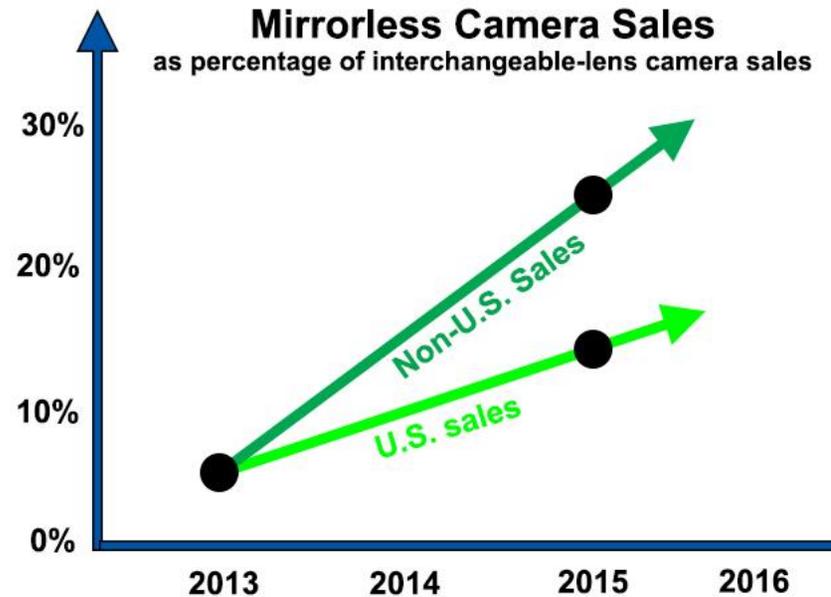
What I am calling “mirrorless” cameras have a lot of other names as well. They are also sometimes called electronic viewfinder with interchangeable lens (EVIL) cameras, mirrorless system cameras (MSC) or digital single lens mirrorless (DSLM). I'm just making you aware of these names in case you see them elsewhere, and here I'll call these cameras “mirrorless.”

Where Mirrorless Fits In

Although the entire mirrorless market is only 12 years old, a lot has changed in recent years. One might question where mirrorless cameras belong in the current camera market.

To start with, there has been pressure from the bottom created by the rise in smartphone cameras. The iPhone has only been around since 2007, followed by the Samsung Galaxy in 2009, but they have been decimating the lower end of the camera market ever since. In fact, in the time period between 2010 and 2015, total camera sales have *decreased* by 30%. Casual photographers no longer even need a camera, they just use their phones. As a result, the need for lower-end mirrorless cameras is evaporating. Mirrorless cameras have needed to improve just to have a market.

Mirrorless cameras have intruded upon what was once the exclusive province of the DSLR - the serious amateur and pro market. And they have been making a lot of headway. In 2013, mirrorless cameras were only 5% of cameras sold. Just two years later, in 2015, mirrorless cameras constituted 16% of all interchangeable-lens cameras sold in the U.S. and 26% of cameras sold outside the U.S.



There is no need to worry about the demise of the DSLR just yet. They still constitute 77% of the interchangeable-lens camera market, with mirrorless picking up the other 23%. But the rise of mirrorless is startling, and shows no signs of abating. In fact, while DSLR sales have been lagging, mirrorless sales have picked up. Recent stats show that DSLR sales are falling an average of 16% a year while mirrorless sales are increasing at 17% a year.

Recent Camera Sales



You and I are not in the camera business, so we do not really care who sells what kind of camera. I present these figures only so you can have a sense of mirrorless's place in the photography world. It is reasonable to wonder whether this is just a flash in the pan. Based on what we are seeing, it certainly seems that mirrorless cameras will be here for the foreseeable future, and could become dominant in short order.

At the same time, it is not inevitable that mirrorless cameras take over and DSLRs disappear. It is true that most of the innovation in the camera market has come in the mirrorless space. Some of this is the result of the tendency of manufacturers to resist change to DSLRs - especially high-end DSLRs - which have long been viewed as the province of the "serious photographer," who is uninterested and possibly offended by the addition of "bells and whistles" to these cameras. Only after items are accepted on lower-end cameras do they work their way up to higher-end DSLRs (for example, Wifi, a

standard feature on mirrorless cameras, is only now being added to DSLRs and still isn't present on some of them). There is no telling whether the innovation will continue to be in the mirrorless space and to what extent the DSLR manufacturers will pick up the pace. Predicting the rate of innovation or its path is a dicey business.

Where are Canon and Nikon?

We haven't talked about specific cameras yet, but one of the things that always strikes those that are used to the DSLR market is the absence of Canon and Nikon from the mirrorless space. So let's address that now.

Canon and Nikon absolutely dominate the DSLR market. While I do not have specific figures, I believe their combined sales to exceed 95% of the DSLR market. When you come over to the mirrorless space, however, Canon and Nikon are, for all intents and purposes, non-existent. Sure, they have a few token, low-end models, but they are not serious players by any stretch. So when are they coming to the party?

Everyone has been asking themselves that question for several years now. In 2013, it was well-known that their coming was imminent. In 2014 we were perplexed that they were letting Sony get such a head-start on the high-end mirrorless cameras. In 2015 we were bewildered that they hadn't made an appearance. In 2016, well . . . there are no signs they are coming and it looks like they might never.

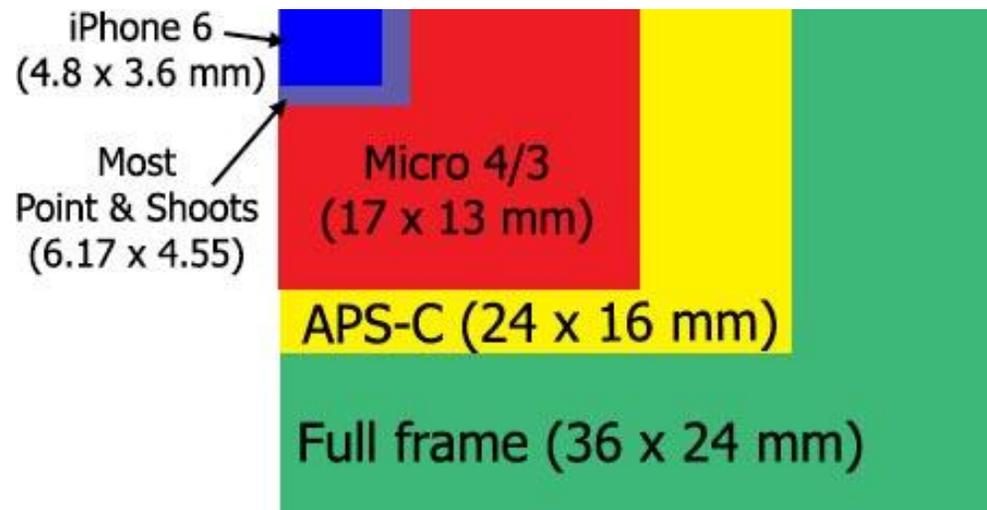
Why bring this up? Because this issue has held up a lot of photographers from making the switch to mirrorless. Many photographers own a lot of Canon and Nikon lenses that have been thinking they could port over once Canon or Nikon enter the mirrorless market. This is a dubious strategy to begin with because the use of larger DSLR lenses largely defeats the purpose of going with the smaller mirrorless camera. In any case, however, it doesn't appear they are coming to the party anytime soon. Therefore, if you are considering a switch, you'll probably need to decide the issue on its own merits without waiting around for Canon or Nikon.

Chapter 2: Mirrorless Camera or Smartphone?

As mentioned previously, a lot of casual photographers are eschewing the separate camera entirely and just using their smartphones. After all, the phone is nearly always on you and it makes it ridiculously easy to share your pictures. In addition, these cameras have improved markedly in recent years, and the current models from Apple and Samsung offer 8 and 16 megapixel pictures, respectively. So should you rely on your phone as a camera?

In a word, no. I'm not going to make a pretence here of a side by side comparison because there is none. For those that are not at all familiar with how cameras work, let me explain why.

The most important feature of a digital camera is the digital sensor, or more specifically the size of the digital sensor. This is the piece that actually captures the image. The bigger the digital sensor, the better. Here is how the sensor sizes of smartphones compare with those used in mirrorless cameras:



Smartphones use sensors the size of the rectangle on the top left hand corner. Mirrorless cameras use either Micro 4/3 (shaded red), APS-C (shaded yellow), or full frame sensors (shaded green). As you can see, the digital sensors in mirrorless cameras are way bigger than those use in phones and compact cameras.

Why is a larger sensor better? Part of it has to do with resolution. When you create a picture, the original camera pixels get spread out over the paper or computer monitor to create an image. The larger

the starting point, the less you have to spread out the pixels. It leads to better final quality.

The issue actually goes much further than just resolution though. You can cram 50 megapixels on a tiny digital sensor like those used in smartphones, but the result is poor image quality. The small sensor will result in images with lots of digital noise and a very limited range of tones. You will also not be able to create any background blur in your photos either.

There are a host of other benefits of mirrorless cameras as well. Here are a few of the key advantages:

- **Focal length:** Obviously, you can change lenses and get whatever focal length you want with a mirrorless camera. With a phone you are stuck with one focal length.
- **Speed:** There is no comparing the speed of a dedicated mirrorless camera with that of a phone. The cameras in phones are slow, while the cameras in mirrorless cameras take between 5 and 40 shots per second.
- **Focus:** You have a great ability to control the focus on a mirrorless camera, but almost none in the camera in your phone. As mentioned previously, you can control the depth of field
- **Manual Control:** If you want to control the exposure settings of your photos, you can do so with a mirrorless camera but not with a phone. This goes well beyond getting a "correct" exposure. There are a lot of effects you can achieve through exposure settings. For example, if you want to slow down the shutter speed to capture flowing water, you can do so with a mirrorless camera, but are out of luck if you just have your phone.
- **Raw Data:** Mirrorless cameras give you access to RAW files, which contain much more data. RAW files capture more colors and preserve much more detail in the highlights and shadows. If you are going to edit your photo at all, you should be starting with a RAW file. You can do this with any mirrorless camera, but not with a smartphone or most compacts.

If you have any interest in photography beyond party pics and photos of your food, you need a dedicated camera. But don't worry - now that mirrorless cameras are here, you don't have to lug a big camera around. In fact, mirrorless cameras aren't that much bigger than your phone. In fact, here is a front view comparison:



iPhone and Mirrorless - side by side.

We'll get into the specifics of the various models of mirrorless camera in a moment, but first let's go to the opposite end of the spectrum, and compare mirrorless cameras to DSLRs.

Chapter 3: Mirrorless or DSLR?

Most people considering a mirrorless camera will struggle with the choice between a mirrorless system and a DSLR. There is no easy choice and I'm not going to be able to make the answer altogether clear for you.

We'll get into comparisons of models in a moment, but let's first compare them in a general sense.

Comparison of Mirrorless and DSLR Features

<u>Characteristic</u>	<u>Advantage to:</u>
Size and Weight	Mirrorless
Image Quality	Tie
Lenses	DSLR
Focus	Tie
View	DSLR
Video	Mirrorless
Speed	Mirrorless
Price	Mirrorless

Size

Obviously, mirrorless cameras are much smaller and lighter than DSLRs. Therefore, as between the two, mirrorless cameras clearly win on the issue of size. Everyone wants a smaller camera.



Let's add a little perspective to this subject though. The size advantage of mirrorless cameras, while very real, is often somewhat overstated. It is not like you can fold up a mirrorless camera and put it in your shirt pocket. You are still carrying around a camera and lens, just a little bit smaller one. DSLRs weigh just a few pounds, and it is not like we are lugging around 8x10 view cameras with glass

plates like the photographers of old. I understand that the lenses and tripods are smaller too, but we still have it pretty good with modern DSLRs.

I know people that are serious hikers and others that are getting up in years, and I recommend mirrorless cameras for them every time. The small size and light weight is a big deal for them. For most

people, however, it isn't the game changer some claim. In fact, upon purchasing a DSLR, many photographers immediately attach a battery grip to the bottom of the camera, thereby adding about 50% to its size. If we were that concerned about the size and weight, seems like we could start by just taking off the battery grips.

That said, smaller is better. No question. I am not arguing that point. I'm only trying to keep it in perspective.

Lenses

One of the reasons for the popularity of Canon and Nikon DSLRs is their lens lineups. Even if you found a better DSLR than a Canon or a Nikon (and I'm not sure you could), you would probably still be better off sticking with Canon or Nikon because of the high quality of their lenses. At this point in time, the lens lineups of both Canon and Nikon are better than anything offered in the mirrorless world. Therefore, lens quality is still an advantage of DSLRs.

As we did with the last point, however, let's put this in perspective. First of all, the lens lineups of the mirrorless camera systems get better every year. At this point, they are good to very good. The advantage of the DSLR is slight, it looks like it might disappear entirely soon.

Secondly, we have to consider lens compatibility. With DSLRs, you have never been able to use the lens of one brand with the camera of another brand. Canon lenses don't work on Nikons, and vice versa. In the mirrorless world, this is changing. Obviously, it is changing as it relates to Micro Four Thirds cameras, where you have

multiple manufacturers combining to create one format. But it is also changing because of the prevalence of adapters for mirrorless cameras. You can buy adapters allowing you to use most lenses on different mirrorless cameras. The downside is that functions such as autofocus don't always work, but it is nice to have a world of different lenses opened up to you.

Focus

Focusing speed and accuracy has historically been an advantage of DSLRs. Mirrorless cameras focused by using contrast detection, which was slower. Now, however, this issue has been resolved in the mirrorless world. As you will see when we get to specific models, mirrorless cameras have contrast detection and phase detection systems (the same as DSLRs) and many autofocus points. They are just as fast as DSLRs. In fact, many experts say this will soon be an advantage of mirrorless cameras.

In addition, mirrorless cameras allow *focus peaking*, which is where the parts of the picture that are in focus light up in the LCD. While virtually any digital camera will show you where your focus is set and will light up focus points for parts of the picture that are in focus, in the case of focus peaking the image itself lights up, rather than the focus points. Many photographers find focus peaking useful to get the correct focus.

Viewfinder

Because the display of mirrorless cameras relies entirely on digital components, there is no optical viewfinder in mirrorless cameras. Some will find this slightly disconcerting, especially if you have been

shooting with a DSLR for a long time. For others, it will not be an issue. In any case, you should be aware that the view of a mirrorless camera will be entirely digital. It will look like what you see now with Live View on your DSLR, even when you look through the eyepiece.

Video

Pretty much all cameras shoot video these days. The quality of video is slightly better in mirrorless cameras right now. Whereas the newest DSLRs have HD video (1920 x 1080), the newest mirrorless cameras have Ultra HD video (3840 x 2160) or 4K video (4096 x 2160).

Mirror Lock Up

When a DSLR takes a picture, the mirror inside flips out of the way. This causes tiny vibrations in the camera, and can slightly impact your image quality. As a result, most DSLRs have a "mirror lockup" setting, which causes the mirror to flip up when you press the

shutter button the first time, then exposes the picture when you press the shutter button again.

Mirrorless cameras - obviously having no mirror - have no need of such a function. It is just one less thing the photographer needs to worry about.

Speed

Mirrorless cameras now shoot a little faster on average. Not that much faster, and you will find DSLRs that shoot faster than some mirrorless cameras. Still, on the whole, mirrorless cameras are slightly faster. This may become a major advantage of mirrorless cameras in the future, as mirrorless cameras are not limited by the same frame speed limitations that DSLRs face.

Price

You can find cheap and expensive cameras of both type, but on the whole mirrorless cameras are cheaper. How much cheaper? About 35% at present. Here is how it breaks down by camera type:

	Type of Camera			
	<u>Entry Level</u>	<u>Mid Range</u>	<u>Advanced</u>	<u>Expensive</u>
Average Price of DSLRs	\$ 823	\$ 1,098	\$ 1,698	\$ 3,165
Average Price of Mirrorless Cameras	\$ 464	\$ 699	\$ 1,184	\$ 2,138
Percentage Cheaper for Mirrorless	44%	36%	30%	32%

Which to Pick?

This comparison leads to the ultimate question of "should I buy a mirrorless camera or DSLR?" As stated in the beginning of the book, my goal here isn't so much to push you in one direction or the other, but rather to give you the information to make the best choice possible for you. And, to be sure, I don't think there is a right answer here.

At the same time, I do not want to appear coy and I want to try to answer the question. The answer is going to depend on your situation. If you are starting from scratch, I'd probably go with a mirrorless camera. If you already have a DSLR and are wondering whether to convert to mirrorless, for the most part I would hold onto the DSLR. But I will cover strategies for transitioning later in the guide.

Of course, there is more to it than these short answers. The answer will actually be much different for you depending on what type of photography you do. Different camera features and attributes are more important for some photographers than others. With that in mind, and let's try to take this a notch deeper and look at it depending on what type of photography you do.

Landscape and Seascape Photographers: I think DSLRs and mirrorless cameras are pretty equal for landscape photography. You can get high resolution and great image quality with either. Mirrorless costs less and is easier to carry, but the lens selection is greater for DSLRs. This one is a toss-up. I revert to the suggestion of going mirrorless if starting from scratch, otherwise sticking with your DSLR. Of course, if you do a lot of hiking, that changes things and I'd go mirrorless.

Wildlife and Nature: I would choose a DSLR if you plan to shoot a lot of wildlife. The limited selection of quality of lenses in the mirrorless world would hold you back right now. Long lenses are just way better for this type of photography.

Street Photography: I would go mirrorless if you plan to shoot street photography. The smaller camera makes you more unobtrusive, which is paramount. In addition, having their picture taken by a big camera just tends to make some people nervous.

Family and Vacation: I would go mirrorless if you just plan on taking general family and vacation pictures. The small size would make it much easier to carry around without interfering with other activities.

Sports: This is another tossup. Just a few years ago, mirrorless cameras had issues with focusing and speed. Now they are

probably faster than DSLRs on average. On the other hand, the small size probably isn't going to matter as much, especially with a big lens on the camera.

Macro: I would lean toward DSLRs for macro photography. There are more and better macro lenses available.

These considerations will further depend on the particular model(s) we are talking about. And speaking of that, let's dive into them now.

Chapter 4: Entry-Level Mirrorless Cameras

We will now take a look at particular camera models, and we'll start with the cheapest cameras available, which I call "entry-level." This category is defined as those cameras that cost \$500 or less without a lens. Where the camera is only sold as a kit (with the lens), I went up to \$799 to account for the cost of the lens.

Without further ado, let's get into the current models of entry-level mirrorless cameras. I will first list all the current models in a chart to show you how they compare based on specifications.

I recognize these charts may sometimes be hard to read, depending on what device you are using to read this guide. Therefore, under each chart, you will see a link to a larger PDF of that chart. Just click on that link if you are having trouble seeing it here. In addition, [here is a webpage](#) that links to all of the charts in this book, so you can flip through them next time you are at a computer.

Comparison of Specifications

Entry-Level Mirrorless Cameras

	<u>Canon</u> <u>EOS-M10</u>	<u>Olympus</u> <u>E-PL7</u>	<u>Fujifilm</u> <u>X-A2</u>	<u>Canon</u> <u>EOS-M3</u>	<u>Panasonic</u> <u>G7</u>	<u>Samsung</u> <u>NX500</u>
<u>Core</u>						
Sensor	APS-C	Micro 4/3	APS-C	APS-C	Micro 4/3	APS-C
Pixels	5184 x 3456	4608 x 3456	4896 x 3264	6000x4000	4592 x 3448	6480 x 4320
Mega-Pixels	18	16	16	24	16	28
Bit Depth	14	12	-	14	-	14
<u>Shooting</u>						
Frames per Second	4.6	8	5.6	4.2	40	30
Highest ISO	12,800	25,600	6,400	12,800	25,600	25,600
Fast Shutter Speed	1/4000	1/4000	1/4000	1/4000	1/4000	1/6000
<u>Focus</u>						
AF Detection	Hybrid	Contrast	-	Contrast	Contrast	Contrast & Phase
AF Points	49	81	-	31	49	209 & 205
<u>Size</u>						
Dimensions	108x67x35	114x66x38	117x66x40	111x68x44	125x86x77	120x64x43
Weight	301g*	309g	350g*	366g	415g*	287g
<u>Display</u>						
Viewfinder	-	-	-	-	Electronic	None
LCD	3" tilting touch.	3" tilting touch.	3" tilting touch.	3" tilting touch.	3" swivel touch.	3" tilting touch.
<u>Other Features</u>						
Video	HD	HD	HD	HD	Ultra HD	4K
Max Resolution	1920 x 1080	1920 x 1080	1920 x 1080	1920 x 1080	3840 x 2160	4096 x 2160
Built-In Flash	Yes	No	Yes	Yes	Yes	Yes
Wireless Capability	Yes	Yes	Yes	Yes	Yes	Yes
<u>Kit Lens</u>						
Focal Length	15-45 mm	-	16 - 50 mm	18 - 55 mm	14 - 42 mm	16 - 50 mm
Aperture	f/3.5 - 6.3	-	f/3.5 - 5.6	f/3.5-5.6	f/3.5 - 5.6	f/3.5 - 5.6
<u>Price</u>						
Body Only	-	\$449	-	\$479	-	-
w/ Kit Lens	\$499	-	\$549	\$599	\$798	\$799

*with battery & card

(To see the full-sized PDF version of this chart, [click here](#))

Are There Other Models That Were Excluded?

Before we talk about the cameras listed, I should mention that there are a few cameras omitted from this list that are, strictly speaking, interchangeable-lens mirrorless cameras. The omitted models are made by Nikon and Pentax, and they were excluded because they have very small digital sensors. As noted previously, the size of the digital sensor of a camera is of particular importance to image quality. That applies not just to resolution, but to low-light performance and dynamic range. I do not believe these cameras would have been competitive. I drew the line for consideration at cameras with Micro Four Thirds sized sensors.

Comparing the Specifications of Entry-Level Mirrorless Cameras

We'll talk about this category in a second, but first let's pause and consider what you get as an entry-level camera these days. You can expect to get a camera in the 16-24 megapixel range with 3" moveable touchscreen LCDs with ISOs in the 12,800 - 25,600 range, shooting at least 4 frames a second, and with HD video at a bare minimum, all for about \$500. That's pretty incredible. It is becoming cliché, but this is a great time to be a photographer.

You will get a pretty serviceable camera in this range. The sensors are split between Micro 4/3 and APS-C sizes. You will get reasonable resolution, certainly large enough for displaying on a monitor or digital device or making mid-sized prints. The ISO ranges are more than adequate.

There are a few features that are common to these cameras that are pretty interesting. The first is that they all have a 3-inch tilting touchscreen LCD (except the Panasonic, which swivels as well). Oddly, both the tilting feature and the touchscreen aspect become less common as you pay more for the camera. Secondly, they all have high-quality video. HD-quality video is now a bare minimum, and we are starting to see Ultra HD and 4K video being added to these models.

The most capable cameras in terms of specifications appear to be the Panasonic G7 and Samsung NX500, which is to be expected since they cost the most. The key differences of the Panasonic model are the Ultra HD video and the super-fast shooting speed (40 frames per second!). The Samsung has the highest resolution of the group at 28 megapixels, a very fast shooting speed (30 frames per second, a great focusing system, and is the only one of the group to offer 4K video.

Let's Consider Superseded Models That Are Still Available

In this entry-level category, we are offered another buying opportunity, which is to buy superseded cameras. This price range contains a number of cameras that, while they have been replaced by newer models, are still available. These aren't used or refurbished cameras - they are new cameras sold from Amazon, B&H, or Adarama. When the manufacturers come out with newer models, they discount the price of the old model.

These cameras used to be much more expensive, and they stack up well against the current entry-level models. As an example, in my prior mirrorless guide, I considered the Sony a6000 to be the best mid-range camera available. At that time, it sold for \$650. It is now being replaced by the Sony a6300, and Sony has dumped the price of the a6000 to \$498. Therefore, although it was a mid-level camera then (and a good one at that), the price reduction now qualifies it as an entry-level camera. That's just one example of this phenomena, and we see similar things happening with Olympus and Fujifilm models as well.

Here are mirrorless camera models that, while they have been replaced by new models, are still available and now cost less than \$500:

Comparison of Specifications

Entry-Level Mirrorless Cameras (Superceded Cameras)

	Olympus E-PL6	Olympus OM-D E-M5	Olympus OM-D E-M10	Sony a5000	Sony a6000	Fujifilm XPro1
Superceded By:	E-PL7	E-M5 mk. II	E-M10 mk. II	a6300	a6300	XPro2
Core						
Sensor	Micro 4/3	Micro 4/3	Micro 4/3	APS-C	APS-C	APS-C
Pixels	4608 x 3456	4608x3456	4608 x 3456	5456x3632	6000x4000	6000x4000
Mega-Pixels	16	16	16	20	24	24
Bit Depth	12	12	12	14	14	-
Shooting						
Frames per Second	8	9	8	3.5	11	6
Highest ISO	25,600	25,600	25,600	16,000	25,600	6,400
Fast Shutter Speed	1/4000	1/4000	1/4000	1/4000	1/4000	1/4000
Focus						
AF Detection	Contrast	Contrast	Contrast	Contrast	Contrast & Phase	Contrast
A.F Points	35	35	81	25	25 & 179	49
Size						
Dimensions	111x64x38	122x89x43	119x82x46	110x63x36	120x67x45	140x81x43
Weight	325g	430g	396*	269g*	344g*	451g
Display						
Viewfinder	-	Electronic	Electronic	Electronic	Electronic	Optical & Electronic
LCD	3" tilting touch.	3" tilting touch.	3" tilting touch.	3" tilting	3" tilting	-
Other Features						
Video	HD	HD	HD	HD	HD	HD
Max Resolution	1920 x 1080	1920 x 1080	1920 x 1080	1920 x 1080	1920 x 1080	1920 x 1080
Built-In Flash	No	No	Yes	Yes	Yes	No
Wireless Capability	Yes	Yes	Yes	Yes	Yes	Yes
Kit Lens						
Focal Length	14 - 42 mm	14 - 42 mm	14 - 42 mm	16 - 50 mm	16 - 50 mm	-
Aperture	f/3.5 - 5.6	f/3.5 - 5.6	f/3.5 - 5.6	f/3.5-5.6	f/3.5 - 5.6	-
Price						
Body Only	-	\$379	-	-	\$498	\$499
w/ Kit Lens	\$299	\$449	\$499	\$448	\$648	-

*with battery & card

(To see the full-sized PDF version of this chart, [click here](#))

The specifications of these models are actually very similar to the cameras we just looked at. The resolution is about the same, the speed is about the same, the ISO range is the same, and most of them even have 3" tilting touchscreen LCDs like the newer models. They all have HD video as well, which is still the standard among the newer models. It seems to me there are some real values here.

If you are just starting out, it is a very viable strategy to pick up one of these cameras for a lot less than you might otherwise spend, and then use the money you saved to start working on your collection of lenses.

Testing Results for Entry-Level Cameras

In any case, it is one thing to compare specifications, but what about picture quality? Let's take a look at the testing results available for the cameras in this range. Here are the testing results from a company called DXO Mark, and I will explain this testing further below.

DXO Mark Testing Results								
Entry-Level Mirrorless Cameras								
	<u>Sony a5000</u>	<u>Olympus M5</u>	<u>Canon M10</u>	<u>Olympus M10</u>	<u>Olympus PL7</u>	<u>Canon M3</u>	<u>Sony a6000</u>	<u>Samsung NX500</u>
Sensor Size	APS-C	Micro 4/3	APS-C	Micro 4/3	Micro 4/3	APS-C	APS-C	APS-C
Mega-Pixels	20	16	18	16	16	24	24	28
Price	\$448*	\$379	499*	\$499*	\$449	\$479	\$498	\$799*
Overall Score	79	71	65	72	72	72	82	87
Portrait Score	23.8	22.8	22.2	22.8	22.7	22.8	24.1	24.8
Landscape Score	13	12.3	11.4	12.3	12.4	11.8	13.1	13.9
Sports Score	1089	826	753	884	873	1169	1347	1379

No data for Olympus E-PL6, Fujifilm XPro1, Fujifilm X-A2, or Panasonic G7

*Price includes kit lens

(To see the full-sized PDF version of this chart, [click here](#))

What is This DXO Mark Testing?

There are a lot of people and groups that test cameras and lenses. The problem with all such groups is that they don't report their results in a way that allows us to compare many different cameras. That is, they don't create a score for performance aspects of cameras.

- **Color Sensitivity (Portrait Score)**: This rating indicates the degree to which colors can be distinguished from each other. Essentially, they measure the number of colors that the camera's sensor is able to distinguish. The higher the color sensitivity, the more color nuances that can be distinguished. They refer to the result as the Portrait Score.
- **Dynamic Range (Landscape Score)**: This measures the degree to which the camera can capture tones between pure white and pure black. The larger the range, the better. It is measured in stops of light. Because of the importance of this metric to landscape photographers, who often face very bright skies and dark shadows in the same picture, it is referred to as the Landscape Score.
- **Low-Light Performance (Sports Score)**: This is the maximum useable ISO value of the camera. In other words, it is the highest ISO you can use for a picture and not have it overwhelmed by digital noise. Because high ISO levels are important to sports photographers who need to use very fast shutter speeds, DXO Mark calls this the Sports Score.

These are the scores you saw in the chart above. They are the scores we'll use to compare all the cameras in this guide. They are a great way to compare cameras. You can go to their website and see more about their testing [here](#).

As handy as these tests are, they are not perfect. First of all, DXO Mark does not test every camera. You may have noticed that the Panasonic G-7, which has impressive specifications, has no testing results from DXO Mark. In addition, as you will see in future comparisons, *none* of the Fujifilm cameras have been tested. This leads to incomplete data.

A company called [DXO Mark](#) does this though. They test three very important aspects of digital cameras, and here is how they report the results:

In addition, you might also question the results based on how certain brands are treated. In particular, the scores for Canon cameras are always very low. I have addressed this previously in my [article comparing low-light performance of cameras](#). That won't impact things too much here, where we are comparing mirrorless cameras and Canon is not much of a player, but it will matter when we compare mirrorless cameras to DSLRs, where Canon is a major

player. It also causes some questions about the validity of the testing in general.

All that said, the DXO Mark testing is a great tool for comparing cameras. I always look at the scores when I am considering different cameras. It is what we will primarily use to compare image quality in this guide.

Ratings from DP Review

There is another scoring measure we will use as well. A website called [Digital Photography Review](#) (or DP Review) tests cameras and gives them a rating. If you aren't already familiar with DP Review, it is an invaluable resource for information about cameras and lenses. I recommend checking it anytime you are considering buying anything.

DP Review's rating doesn't just cover sensor performance, like the scores from DXO Mark. Rather, DP Review's rating is an overall

score judging the quality of the camera. The score does include aspects tested by DXO Mark like image quality and low-light performance, but it also includes other things like build quality, ergonomics, features, and value. It is more of a holistic measure of the camera, rather than a measure of discrete tests.

This holistic approach is either good news or bad news, depending on how you look at it. On the one hand, it is important to look at other aspects of a camera other than strict color, dynamic range, and noise data. There is more to cameras than just these three things, and the DP Review Score acknowledges that. On the other hand, the more things you include in one score the less that score means. As a result, the DP Review rating system seems fuzzier and more subjective. In any case, more information and another opinion is a good thing to have, and we will use it for all the cameras in this guide (at least the ones they rate, since like DXO Mark they don't rate every camera).

The scores from DP Review are on a 0-100 scale. Per DP Review, here is what the scores mean:

- 0-40 Totally unacceptable. Run away.
- 41-50 Poor to below average. Avoid.
- 51-60 At best average. Treat with caution.
- 61-70 Average to good.
- 71-80 Good to Excellent.
- 81-100 Outstanding.

The good news for us is that every single mirrorless camera in this guide for which there is a DP Review Rating is at least a 79, which is in the high end of the "good to excellent" category, and over 90% are in the "outstanding" category.

With that said, here are the DP Review ratings for the entry-level mirrorless cameras:

DP Review Scores - Entry-Level Mirrorless Cameras						
	<u>Fujifilm XPro1</u>	<u>Olympus M5</u>	<u>Olympus M10</u>	<u>Panasonic G7</u>	<u>Samsung NX500</u>	<u>Sony a6000</u>
Sensor Size	APS-C	Micro 4/3	Micro 4/3	Micro 4/3	APS-C	APS-C
Mega-Pixels	24	16	16	16	28	24
Price	\$499	\$379	\$499*	\$798*	\$799*	\$498
DP Review Score	79	80	80	80	81	80

No DP Review Scores for Canon EOS-M3, Canon EOS M-M10, Fujifilm X-A2, Olympus E-PL6, Olympus E-PL7, or Sony a5000.

* price includes kit lens

(To see the full-sized PDF version of this chart, [click here](#))

Testing Results

You will likely notice a theme in the DXO Mark testing results, which applies to the cameras at all levels, and it is that the smaller the sensor, the worse the low-light performance, and consequently the worse the overall DXO Mark score. In this case, the Micro 4/3 cameras all scored worse than the APS-C cameras. The Portrait Scores and Landscape Scores are not that far off. Most of the difference is in the Sports Score, which measures low-light performance. As a result, the Olympus cameras suffered.

The best DXO Mark Scores went to the Samsung NX500 and the Sony a6000. A high score for the Samsung NX 500 is not surprising - almost expected - in a sense because this camera is the most expensive in the category (\$799 with a kit lens). Still, this camera has impressive features, specifications, and testing results. The Sony a6000 is interesting because, as mentioned previously, it has been replaced by the a6300, but is still available at a discounted price and compares well to others in this class.

The DP Review Scores for the cameras at this level are remarkably similar. Using their 100 point scale, there is only 2 points of difference between all the cameras. Again, the Samsung NX500 comes out slightly on top. There are 4 cameras tied at 80, including the Sony a6000.

Mirrorless versus DSLR Models

Ok, we've now compared mirrorless cameras to other mirrorless cameras for those that are trying to decide which model they want. But what about those who are still torn between the mirrorless

camera and the DSLR? Let's compare mirrorless cameras and DSLRs now.

As mentioned earlier, Canon and Nikon dominate the DSLR market, so I will use models from those two companies in each of the categories we went through with the mirrorless cameras. The prices won't line up perfectly because mirrorless cameras are generally cheaper. But they will be close.

The two entry level DSLRs are the Canon Rebel T6i (or 760D outside the U.S.) and the Nikon D5500. I'll compare them to the top mirrorless candidates for this category, the Samsung NX500 and the Sony a6000. Here is how they shape up, with the specifications at the top, the size and price in the middle, and the testing results and ratings at the bottom:

Mirrorless vs. DSLR: Entry-Level Cameras

	Mirrorless		DSLR	
	<u>Sony a6000</u>	<u>Samsung NX500</u>	<u>Canon t6i</u>	<u>Nikon D5500</u>
<u>Specs</u>				
Sensor Size	APS-C	APS-C	APS-C	APS-C
Mega-Pixels	24	28	24	24
Frames per Second	11	30	5	5
Highest ISO	25,600	25,600	12,800	25,600
LCD	3" tilting	3" tilting touch.	3" Pivoting Touch.	3.2" Swivel Touch.
Video	HD	4K	HD	HD
AF Detection	Contrast & Phase	Contrast & Phase	Phase	Phase
AF Points	25 & 179	209 & 205	19 (cross type)	39 (9 cross type)
<u>Size</u>				
Dimensions	120x67x45	120x64x43	132x101x78	124x97x70
Weight	344g*	287g	555g	420g
<u>Price</u>	\$498	\$799 (w/ lens)	\$749	\$897
<u>DXO Overall Score</u>	82	87	71	84
Portrait Score	24.1	24.8	22.7	24.1
Landscape Score	13.1	13.9	12	14
Sports Score	1347	1379	919	1438
<u>DP Review Rating</u>	80	81	75	79

(To see the full-sized PDF version of this chart, [click here](#))

At this level, mirrorless cameras seem to stack up well against their DSLR counterparts. The mirrorless specifications are at least as good as those of the DSLRs, they cost less, and the test results and ratings are a little better.

Final Takeaway for Entry-Level Mirrorless Cameras

We've taken a look at the specs of the mirrorless cameras. We've compared the DXO Mark testing results and the DP Review ratings. We've also looked at them next to comparable DSLRs. So what is the final takeaway?

As with so many things in photography, it depends. It can go in a lot of different directions depending on your situation. Let's take a look at a few of them.

If you are just looking for the best mirrorless camera in this category, and you are not worried about future upgrades or anything else, you should give some thought to the Samsung NX500. It costs the most of any camera in the category, so it had better be good, but it appears that it is. It has the highest resolution of any camera in this category, the best focusing, and it is the only one that shoots 4K video. It has also received the highest scores from both DXO Mark and DP Review.

You might just be thinking of buying a mirrorless camera at this level as an entry point into the mirrorless world, with the idea that you will upgrade later if you like it. If that is the case, consider the Sony a6000. It has been replaced by the Sony a6300, but that actually

works to your benefit because Sony has marked down the a6000. The upgrades to the a6300 were modest, as we will see later. You can now get the a6000 for under \$500, and it works well. Its specs match up well against every other camera in this category and it gets great scores from DXO Mark and DP Review. What's more, as we will see later in this guide, Sony dominates the high-end mirrorless market, so when it is time to upgrade, you can remain in the same system.

All this said, I would not try to scare you away from any of the cameras in this category. I like the Olympus models, and everyone loves the new Fujifilm mirrorless cameras. We live in a great time when even entry-level cameras will get you great results.

Chapter 5: Mid-Range Mirrorless Cameras

Comparison of Specifications					
Mid-Range Mirrorless Cameras					
	Fujifilm <u>X-T10</u>	Fujifilm <u>X-E2S</u>	Olympus <u>OM-E E-M10 mk ii</u>	Olympus <u>OM-D E-M5 mk ii</u>	Panasonic <u>GH3</u>
<u>Core</u>					
Sensor	APS-C	APS-C	Micro 4/3	Micro 4/3	Micro 4/3
Pixels	4896 x 3264	4896 x 3264	4608 x 3456	4608 x 3456	4608 x 3456
Mega-Pixels	16	16	16	16	16
Bit Depth	-	-	12	12	-
<u>Shooting</u>					
Frames per Second	8	7	8.5	10	20
Highest ISO	6,400	6,400	25,600	25,600	12,800
Fast Shutter Speed	1/4000	1/4000	1/4000	1/8000	1/4000
<u>Focus</u>					
AF Detection	Contrast & Phase	Contrast & Phase	Contrast	Contrast	Contrast
AF Points	77 & 15	77 & 15	81	81	-
<u>Size</u>					
Dimensions	118x83x41	129x75x37	120x83x47	124x84x46	132x94x81
Weight	381g*	349g*	390*	410g	550g*
<u>Display</u>					
Viewfinder	Electronic	Electronic	Electronic	Electronic	Electronic
LCD	3" tilting	3"	3" tilting touch.	3" swivel touch.	3" swivel touch.
<u>Other Features</u>					
Video	HD	HD	HD	HD	HD
Max Resolution	1920 x 1080	1920 x 1080	1920 x 1080	1920 x 1080	1920 x 1080
Built-In Flash	Yes	Yes	Yes	No	Yes
Wireless Capability	Yes	Yes	Yes	Yes	Yes
<u>Kit Lens</u>					
Focal Length	18-55 mm	18 - 55 mm	-	-	-
Aperture	f/2.8 - 4.0	f/2.8 - 4.0	-	-	-
<u>Price</u>					
Body Only	\$649	\$699	\$699	\$899	\$548
w/ Kit Lens	\$949	\$999	-	-	-

*with battery & card

(To see the full-sized PDF version of this chart, [click here](#))

Let's take a look now at the current models of mid-level mirrorless cameras (see the chart above). This category is defined as those where the camera body costs \$500 - \$900, or up to \$1,000 with a lens included. As with the previous section, there is a superseded camera that is still available (the Panasonic GH3). Since there was only one such camera in this category, I just included it with the others rather than consider it separately.

This group of cameras contains some upgrades of some of the models we saw in the prior section, along with some new models. It is a mix of APS-C sensor cameras from Fujifilm along with some Micro 4/3 cameras from Olympus and Panasonic. They are all pretty similar in that they all:

- Have a resolution of 16 megapixels;
- Shoot very fast (between 7 and 20 frames per second);
- Have 3-inch tilting or swivel touchscreens (except the Fujifilm X-E2S);
- Shoot HD Video.

Testing Results for Mid-Range Mirrorless Cameras

Now let's take a look at the testing results of the cameras in the mid-level category. DXO Mark published testing results for 3 of the 5 cameras in this category. Here are the results:

DXO Mark Testing Results			
Mid-Range Mirrorless Cameras			
	<u>Olympus M10 mk ii</u>	<u>Olympus M5 mk ii</u>	<u>Panasonic GH3</u>
Sensor	Micro 4/3	Micro 4/3	Micro 4/3
Mega-Pixels	16	16	16
Price	\$699	\$899	\$548
Overall Score	73	73	71
Portrait Score	23.1	23	22.7
Landscape Score	12.5	12.4	12.4
Sports	842	896	812

No data for Fujifilm X-T10 or Fujifilm X-E2S.

(To see the full-sized PDF version of this chart, [click here](#))

The results for these cameras are all very consistent, in the range of 71-73 total scores. These scores are somewhat disappointing in that they are really no better than the results for the entry-level cameras. However, the two Fujifilm entries are missing. This makes it difficult to draw any meaningful conclusions about this category based on the DXO testing results.

Therefore, let's move on and take a look at the DP Review scores for cameras in this range. DP Review has ratings for 4 of the 5 cameras in this category, as follows:

DP Review Scores - Mid-Range Mirrorless Cameras				
	<u>Fujifilm X-T10</u>	<u>Olympus M10 mk ii</u>	<u>Olympus M5 mk ii</u>	<u>Panasonic GH3</u>
Sensor Size	APS-C	Micro 4/3	Micro 4/3	Micro 4/3
Mega-Pixels	16	16	16	16
Price	\$649	\$699	\$899	\$548
DP Review Score	80	80	81	79

(To see the full-sized PDF version of this chart, [click here](#))

There is not much difference in these scores. The good news is that there are no cameras that are rated as being really bad cameras. On the other hand, none of them really stands out. The top rated camera is the Olympus O-MD M5 mark ii, which is also the most expensive camera in the category.

Mirrorless vs. DSLRs (Mid-Range)

As the final step in our comparison of mid-range cameras, here is the comparison of mid-range mirrorless cameras with their DSLR counterparts. For the DSLRs, I chose models with APS-C sensors but with more features and stronger specs (and more expensive) than the entry-level cameras. For Canon that was the 70D and for Nikon it was the D7200.

Mirrorless vs. DSLR: Mid-Range Cameras

	Mirrorless		DSLR	
	<u>Fujifilm X-T10</u>	<u>Panasonic GH3</u>	<u>Canon 70D</u>	<u>Nikon D7200</u>
<u>Specs</u>				
Sensor Size	APS-C	Micro 4/3	APS-C	APS-C
Mega-Pixels	16	16	20	24
Frames per Second	8	20	7	6
Highest ISO	6,400	12,800	12,800	25,600
LCD	3" tilting	3" swivel touch.	3" 'Swivel Touch.	3.2"
Video	HD	HD	HD	HD
AF Detection	Contrast & Phase	Contrast	Phase	Phase
AF Points	77 & 15	-	19 (cross type)	51 (15 cross type)
<u>Size</u>				
Dimensions	118x83x41	132x94x81	139x104x79	136x107x76
Weight	381g*	550g*	755g*	675g
<u>Price</u>	\$649	\$548	\$999	\$1,197
<u>DXO Overall Score</u>	-	71	68	87
Portrait Score	-	22.7	22.5	24.5
Landscape Score	-	12.4	11.6	14.6
Sports Score	-	812	926	1333
<u>DP Review Rating</u>	80	79	83	84

(To see the full-sized PDF version of this chart, [click here](#))

The mirrorless models are a little faster and considerably cheaper. The DSLRs have higher resolution and better low-light performance. Testing results are mixed. As a result, the cameras in this category are pretty comparable.

Final Takeaway for Mid-Range Mirrorless Cameras

It does not appear that any of these cameras particularly stands out. The specifications are very similar. The testing results and ratings from DXO Mark and DP Review are almost the same for each camera. As a result, when it comes to choosing a camera in this category, to me it is pretty much a tossup. Your decision should be made more by look and feel.

If I am going to be brutally honest about these cameras though (and I am), I don't really see the case for any of them. I think I would just save my money and buy one of the cameras in the entry-level category. The upgrades in terms of specifications at this level are very slight. The testing results are no better. Why spend the extra money?

If you are determined to get a better camera than any offered in the entry-level category, my thought is to consider holding on until you can get one in the Advanced category. That is where the cameras start looking much more impressive.

At the same time, there is nothing wrong with any of these cameras. Resolution, image quality, and features are all more than adequate.

Chapter 6: Advanced Mirrorless Cameras

Comparison of Specifications

Advanced Mirrorless Cameras

	<u>Fujifilm X-T1</u>	<u>Hasselblad Lunar</u>	<u>Olympus OM-D E-M1</u>	<u>Olympus PEN-F</u>	<u>Panasonic GH4</u>	<u>Samsung Galaxy NX1</u>	<u>Sony a6300</u>	<u>Sony a7</u>
Core								
Sensor	APS-C	APS-C	Micro 4/3	Micro 4/3	Micro 4/3	APS-C	APS-C	Full-frame
Pixels	4896 x 3264	6000x4000	4608 x 3456	5184 x 3888	4608 x 3456	6480 x 4320	6000x4000	6000 x 4000
Mega-Pixels	16	24	16	20	16	28	24	24
Bit Depth	-	-	12	12	-	14	14	14
Shooting								
Frames per Second	8	10	10		40	15	11	5
Highest ISO	6,400	16,000	25,600	25,600	25,600	25,600	25,600	25,600
Fast Shutter Speed	1/4000	1/4000	1/8000	1/8000	1/8000	1/8000	1/4000	1/8000
Focus								
AF Detection	Contrast	Contrast	Contrast & Phase	Contrast	Contrast	Contrast & Phase	Contrast & Phase	Contrast & Phase
AF Points	49	25	37 & 81	81	49	209 & 205	169 & 425	25 & 117
Size								
Dimensions	129x90x47	142x82x70	130x94x63	125x72x37	133x93x84	140x102x66	120x67x49	127x94x48
Weight	440g*	570g*	497g	427*	560g	550g*	404g	416g
Display								
Viewfinder	Electronic	Electronic	Electronic	Electronic	Electronic	Electronic	Electronic	Electronic
LCD	3" tilting	3" tilting	3" tilting	3" swivel touch.	3" swivel touch.	3" tilting touch.	3" tilting	3" tilting
Other Features								
Video	HD	HD	HD	HD	4K	4K	Ultra HD	HD
Max Resolution	1920 x 1080	1920 x 1080	1920 x 1080	1920 x 1080	4096 x 2160	4096 x 2160	3840 x 2160	1920 x 1080
Built-In Flash	No	Yes	No	No	Yes	Yes	Yes	No
Wireless Capability	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Kit Lens								
Focal Length	18-55 mm	18-55 mm	-	-	-	16 - 50 mm	16 - 50 mm	28 - 70 mm
Aperture	f/2.8 - 4.0	f/3.5 - 5.6	-	-	-	f/3.5 - 5.6	f/3.5 - 5.6	f/3.5 - 5.6
Price								
Body Only	\$999	-	\$999	\$1,199	\$1,497	\$1,499	\$998	\$1,098
w/ Kit Lens	\$1,399	\$1,199	-	-	-	\$1,699	\$1,148	-

*with battery & card

(To see the full-sized PDF version of this chart, [click here](#))

The entries costing between \$1,000 and \$1,500 have been grouped into the Advanced category. As with the other categories, there is one camera included that has been replaced by a newer model. It is the Sony a7 (replaced by the a7 ii), but it is still available.

We have a wide range of specs and features in this category. It starts with the sensor size. There are Micro 4/3 sensors, APS-C sized

sensors, and even one full-frame sensor. Resolution ranges from 16 megapixels to 28 megapixels. Speed ranges from 5 to 40 frames per second. Video ranges from HD to 4K. There is quite a disparity here.

Testing Results for Advanced Cameras

Here are the DXO Mark testing results for these models:

DXO Mark Testing Results Advanced Mirrorless Cameras				
	<u>Olympus M1</u>	<u>Panasonic GH4</u>	<u>Samsung NX1</u>	<u>Sony a7</u>
Sensor Size	Micro 4/3	Micro 4/3	APS-C	Full-frame
Mega-Pixels	16	16	28	24
Price	\$999	\$1,497	\$1,499	\$1,098
Overall Score	73	74	83	90
Portrait Score	23	23.2	24.2	24.8
Landscape Score	12.7	12.8	13.2	14.2
Sports Score	757	791	1363	2248

No data for Fujifilm X-T1, Hasselbad Lunar, Olympus PEN-F, or Sony a6300.

(To see the full-sized PDF version of this chart, [click here](#))

Unfortunately, we only have DXO testing results for about half the models available. In the case of the Sony a6300, that is totally understandable since the camera isn't even out yet.

One thing we see here, and we see this virtually every time, is that DXO Mark scores cameras with Micro 4/3 sensors very low. The problem is always low-light performance. Per the DXO Mark testing, noise sets in at very low levels (under ISO 800) in cameras with

Micro 4/3 sensors. It results in the Sports Score being very low for every Micro 4/3 camera, which then pulls the overall score down quite a bit. If low-light performance is important to you, then - at least per DXO Mark - you might want to consider a camera with at least an APS-C sized sensor.

Moving on to the DP Review ratings, we have ratings almost all of these cameras. Here they are:

DP Review Scores - Advanced Mirrorless Cameras						
	<u>Fujifilm X-T1</u>	<u>Olympus E-M1</u>	<u>Olympus PEN-F</u>	<u>Panasonic GH4</u>	<u>Samsung NX1</u>	<u>Sony a7</u>
Sensor Size	APS-C	Micro 4/3	Micro 4/3	Micro 4/3	APS-C	Full-frame
Mega-Pixels	16	16	20	16	28	24
Price	\$999	\$999	\$1,199	\$1,497	\$1,499	\$1,098
DP Review Score	84	84	82	85	87	80

No DP Review Scores for Hasselblad Lunar or Sony a6300.

(To see the full-sized PDF version of this chart, [click here](#))

All of these scores are excellent. Some of them, particularly the Samsung NX1 and the Panasonic GH4, are outstanding.

Mirrorless vs. DSLRs (Advanced)

Finally, let's compare the advanced mirrorless camera models against their DSLR counterparts. In the DSLR world, this category is

characterized by the jump to full frame. Therefore, I used the low-end full frame cameras offered by Canon and Nikon here. For Canon that is the 6D and for Nikon it is the D750.

Mirrorless vs. DSLR: Advanced Cameras

	Mirrorless			DSLR	
	<u>Samsung NX1</u>	<u>Sony a6300</u>	<u>Sony a7</u>	<u>Canon 6D</u>	<u>Nikon D750</u>
<u>Specs</u>					
Sensor Size	APS-C	APS-C	Full-frame	Full-Frame	Full Frame
Mega-Pixels	28	24	24	20.2	24.1
Frames per Second	15	11	5	4.5	6.5
Highest ISO	25,600	25,600	25,600	25,600	12,800
LCD	3" tilting touch.	3" tilting	3" tilting	3"	3.2" Tilting Touch.
Video	4K	Ultra HD	HD	HD	HD
AF Detection	Contrast & Phase	Contrast & Phase	Contrast & Phase	Phase	Phase
AF Points	209 & 205	169 & 425	25 & 117	11 (1 cross type)	51 (15 cross type)
<u>Size</u>					
Dimensions	140x102x66	120x67x49	127x94x48	145x112x71	141x113x78
Weight	550g*	404g	416g	770g	750g
<u>Price</u>	\$1,499	\$998	\$1,098	\$1,399	\$1,997
<u>DXO Overall Score</u>	83	82 **	90	93	93
Portrait Score	24.2	24.1 **	24.8	24.8	24.8
Landscape Score	13.2	13.1 **	14.2	14.5	14.5
Sports Score	1363	1347 **	2248	2956	2956
<u>DP Review Rating</u>	87	-	80	83	90

** a6000 data

(To see the full-sized PDF version of this chart, [click here](#))

I should point out that the Canon 6D has been on the market for a very long time, and as a result its price is quite a bit lower. When it was introduced, the 6D cost about \$2,000, now it costs only \$1,399. In a sense, that skews the results, since it makes the 6D look more favorable than it would look at its full introductory price. Still, we are comparing current prices for all models, and we are using reduced pricing for mirrorless models as well, so what's good for the goose is good for the gander.

For comparison purposes, I had to pick the 3 best mirrorless cameras. It seems to me that the three best cameras in terms of specifications are the Samsung Galaxy NX1, the Sony a6300, and the Sony a7, so I have included all three. Again, the Sony a7 has been replaced by the Sony a7 ii, but the original model is still being sold so I have included it here. As to the Sony a6300, it has only recently been announced and no testing data is available. Rather than leave it blank, I made an assumption. My assumption is that the testing results will be at least as good for the a6300 as they were for the a6000. I simply used the testing results from the a6000. I noted it on the chart, but wanted to make this very clear, as it could appear squirrely.

Final Takeaway for Advanced Mirrorless Cameras

The advanced camera market leaves us with no clear winner, but with a lot of options.

First of all, you cannot overlook the Samsung NX500. Its specs are probably the best in the category, its testing scores are near the

top, and DP Review rates it the highest of any of these cameras. It is not cheap, but this one may be the best.

You also have the option of going full frame in this category. Due to a price mark-down of the Sony a7, you can get it for only about \$1,100. The full-frame sensor will perform really well, particularly in low light, as shown by its testing results, which are the best of any in this category.

Finally, speaking of testing results, don't let them scare you away from the Micro 4/3 cameras if you are otherwise inclined to go that way. In particular, the Panasonic GH4 is pretty amazing. It shoots the fastest of any camera in this category (at 40 frames per second), and has impressive specs, including 4K video.

Chapter 7: Expensive Mirrorless Cameras

Comparison of Specifications					
Expensive Mirrorless Cameras					
	Fujifilm <u>XPro2</u>	Panasonic <u>GX8</u>	Sony <u>a7 II</u>	Sony <u>a7S II</u>	Sony <u>a7R II</u>
<u>Core</u>					
Sensor	APS-C	Micro 4/3	Full-frame	Full Frame	Full-frame
Pixels	6000 x 4000	5184 x 3888	6000 x 4000	4240 x 2832	7952 x 5304
Mega-Pixels	24	20	24	12.4	42
Bit Depth	14	-	14	14	14
<u>Shooting</u>					
Frames per Second	8	10	5	5	5
Highest ISO	12,800	25,600	25,600	102,400	25,600
Fast Shutter Speed	1/8000	1/8000	1/8000	1/8000	1/8000
<u>Focus</u>					
AF Detection	Contrast & Phase	Contrast	Contrast & Phase	Contrast	Contrast & Phase
AF Points	196 & 77	49	25 & 117	169	25 & 399
<u>Size</u>					
Dimensions	141x83x46	133x78x63	127x96x60	117x69x38	127x96x60
Weight	445g	487g*	556g	627*	625*
<u>Display</u>					
Viewfinder	Optical & Electronic	Electronic	Electronic	Electronic	Electronic
LCD	3"	3" swivel touch.	3" tilting	3"	3" tilting
<u>Other Features</u>					
Video	HD	Ultra HD	HD	Ultra HD	Ultra HD
Max Resolution	1920 x 1080	3840 x 2160	1920 x 1080	3840 x 2160	3840 x 2160
Built-In Flash	No	No	No	No	No
Wireless Capability	Yes	Yes	Yes	Yes	Yes
<u>Price</u>					
Body Only	\$1,700	\$1,798	\$1,698	\$2,298	\$3,198

*with battery & card

(To see the full-sized PDF version of this chart, [click here](#))

The final category of mirrorless camera is those costing more than \$1,500 for the camera body. However, there are really two classes of camera within this category. The first is those that hover around the \$1,700 price point (the Fujifilm XPro2, the Panasonic GX8, and the Sony a7ii). After that, the price jumps up dramatically for the Sony a7Sii and especially for the a7R ii. We should keep that in mind as we compare them.

Testing Results for Expensive Mirrorless Cameras

Here are the DXO Mark testing results:

DXO Mark Testing Results Expensive Mirrorless Cameras				
	<u>Panasonic GX8</u>	<u>Sony a7 II</u>	<u>Sony a7S II</u>	<u>Sony a7R II</u>
Sensor Size	Micro 4/3	Full-frame	Full Frame	Full-frame
Mega-Pixels	20	24	12.4	42
Price	\$1,798	\$1,698	\$2,298	\$3,198
Overall Score	75	90	85	98
Portrait Score	23.5	24.9	23.6	26
Landscape Score	12.6	13.6	13.3	13.9
Sports Score	806	2449	2993	3434

No data for Fujifilm XPro2

(To see the full-sized PDF version of this chart, [click here](#))

From the testing, we can see that the smaller sensor cannot hang with the larger sensors. It performs significantly lower than the other cameras in all areas; particularly in the area of low-light performance (sports score). While the Fujifilm XPro2 has not been tested, with its APS-C sensor my guess is that its testing scores will

exceed those of the Micro 4/3 camera, but will not be quite as the full-frame models.

Let's now check out the DP Review scores, and see how their more holistic approach treats these cameras:

DP Review Scores - Expensive Mirrorless Cameras			
	<u>Panasonic GX8</u>	<u>Sony a7 ii</u>	<u>Sony a7R ii</u>
Sensor Size	Micro 4/3	Full-frame	Full-frame
Mega-Pixels	20	24	42
Price	\$1,798	\$1,698	\$3,198
DP Review Score	82	82	90

No DP Review Scores for Fujifilm XPro2 or Sony A7S ii

Our data here is incomplete because DP Review only has scores for 3 of the 5 cameras in this category. Still, we can see that the cameras that are clustered around the \$1,700 price point get comparable results (actually exactly the same, at 82) and the super-expensive camera is in its own league at 90.

Mirrorless vs. DSLRs (Expensive)

Finally, here are the top of the line cameras in each space. For the mirrorless contenders, I chose the Fujifilm XPro2 because of its impressive specs, the Sony a7ii because of its great specs and test

scores, and the Sony a7R ii because it is the top camera in almost every way.

For the DSLR candidates, I chose the top Canon and Nikons. For Nikon, that was easy. It is the D810. Canon has split up the 5D line though, so I used both the 5D mark iii and the new 5DS R.

Mirrorless vs. DSLR: Expensive Cameras

	Mirrorless			DSLR		
	<u>Fujifilm XPro2</u>	<u>Sony a7 II</u>	<u>Sony a7R II</u>	<u>Canon 5D mk iii</u>	<u>Canon 5DS R</u>	<u>NikonD810</u>
<u>Specs</u>						
Sensor Size	APS-C	Full-frame	Full-frame	Full Frame	Full Frame	Full Frame
Mega-Pixels	24	24	42	22.3	50.3	36.3
Frames per Second	8	5	5	6	5	5
Highest ISO	12,800	25,600	25,600	25,600	6,400	12,800
LCD	3"	3" tilting	3" tilting	3.2"	3.2"	3.2"
Video	HD	HD	Ultra HD	HD	HD	HD
AF Detection	Contrast & Phase	Contrast & Phase	Contrast & Phase	Phase	Phase	Phase
AF Points	196 & 77	25 & 117	25 & 399	61	61 (41 cross type)	51 (15 cross type)
<u>Size</u>						
Dimensions	141x83x46	127x96x60	127x96x60	152x117x76	152x117x76	146x123x82
Weight	445g	556g	625*	860g*	845g	880g
<u>Price</u>	\$1,700	\$1,698	\$3,198	\$2,799	\$3,899	\$2,797
<u>DXO Overall Score</u>	-	90	98	81	86	97
Portrait Score	-	24.9	26	24	24.6	25.7
Landscape Score	-	13.6	13.9	11.7	12.4	14.8
Sports Score	-	2449	3434	2293	2308	2853
<u>DP Review Rating</u>	-	82	90	82	83	82

(To see the full-sized PDF version of this chart, [click here](#))

The mirrorless cameras stack up really well against their DSLR counterparts in this category. Even the Sony a7 ii, which costs significantly less than the other cameras, has similar specs and better testing results than the DSLRs that cost a lot more. Once you jump up to the cameras costing roughly \$3,000, the Sony a7R ii dominates.

Final Takeaway for Expensive Mirrorless Cameras

Remember that this category splits between those cameras at the \$1,700 price point and the more pricey cameras. Let's look at them separately first.

At the \$1,700 price point, we have the Fujifilm XPro2, the Panasonic GX8, and the Sony a7ii. The full frame of the Sony model seems to give it a sizeable advantage over the others. This is almost entirely due to low-light performance, so consider how important a consideration that is for you before discounting Micro 4/3 cameras (and how much stock you place in these testing results anyway).

There are two higher priced cameras, both by Sony. The first is the a7Sii. Keep in mind that this camera has only 12 megapixels. It is designed for video and extreme low light performance. As such, it is sort of a specialty item. If you are still photographer looking to do the normal sorts of things that still photographers do, this camera probably isn't the best idea.

That leaves the Sony a7R ii. Obviously, this camera is a beast. It is full frame, 42 megapixels, and tests off the charts. It has by far the highest DXO Mark testing results and the highest DP Review score.

But it will cost you an extra \$1,500. Is it worth it to spend the extra \$1,500? I suspect the answer to that question is just going to depend a lot on your financial situation.

Chapter 8: Strategies for Entering the World of Mirrorless Cameras

By now you understand all about mirrorless cameras, and even know about the particular models. Maybe you are thinking about moving into mirrorless. If you don't already have a camera or don't have much invested in a current system, the path is easy. Just buy the one that is best for you.

But what if you have been shooting Canon or Nikon for years? What if you have a lot invested in lenses and other gear wrapped around those systems? How should you go about things? In this chapter, I will walk you through a few strategies for making the transition.

Strategy 1: Stick with DSLRs

First of all, let me state that it is not my intent to talk anyone into buying into the mirrorless system or to choose any particular camera. You will do fine with a DSLR. There is virtually nothing you can do with a mirrorless camera that you cannot do with a DSLR. Yes, they are smaller, and yes they have a few different features you don't commonly find on DSLRs, but it isn't like there is suddenly a whole new world opened up to you. You are still exposing pictures the same as you always have. And recall from Chapter 3 that DSLRs are actually better suited for some sorts of photography.

Therefore, it is still a viable strategy to ignore the entire mirrorless market entirely and stick with your DSLR. Don't forget that, for all the hoopla surrounding mirrorless cameras these days, DSLRs still

account for the vast majority of interchangeable-lens cameras being sold today. That said, since you have picked up this guide and worked your way through it, I am guessing you have an interest in mirrorless cameras. This strategy may not be for you, but it must be said.

Strategy 2: Sell Everything and Change Over

The most common strategy for entering the mirrorless market is to sell all your old gear and buy a mirrorless system. This is also the most time consuming and potentially the most expensive way as well. There are, however, some mitigating points:

- Your lenses held their value. It is not uncommon to hear of people selling their lenses for very close to what they originally paid for them. Sometimes people will actually get what they paid for the lens, or even a little more. Therefore, there is no reason you should take a bath when you sell your lenses. Since people often have the most money tied up in lenses, this is very good news.
- Selling used gear is now much easier because of the internet. Previously, if you wanted to sell camera gear you could spread the word through a camera club or something, and your potential market was pretty limited. Now, you can use Craigslist to sell the item to anyone in your community.

If that doesn't work, you can pay a little bit to sell your item on EBay and get access to a world-wide market.

As to the camera, how this goes will depend where you are in the life-cycle of your camera. If your camera is newer or more expensive, you will almost certainly want to sell it. In that case, once again I would start with Craigslist and then move on to EBay. But if your camera is old and/or not worth much, you might just keep it around as a backup. Of course, if you sold all your lenses it will be of limited utility. I usually keep my old cameras, but candidly they usually end up as bookends.

Strategy 3: Change the Camera Only (Use Your Old Lenses)

Keep in mind that mirrorless cameras are much better about allowing the use of lenses from other systems than are DSLRs. You can buy an adapter for virtually any system of lenses so that you can use your old lenses on your new mirrorless camera. Therefore, another strategy for changing over to a mirrorless system is to just buy a mirrorless camera and lens adapter. That way you can use all your old lenses, without the need to sell them all and buy mirrorless lenses.

The downside of this approach is that you would be using large lenses with a smaller camera. That will negate part of the benefit of the mirrorless system. However, if you kept your old DSLR, you could use the same lenses on both your old DSLR and your new mirrorless system (with the adapter). You would have lenses for both systems. Over time, you could add mirrorless lenses to your

collection, and slowly transition to the mirrorless system. That would allow you to spread the financial impact over time.

Strategy 4: Mirrorless Backup

A final strategy is to keep all your old DSLR gear and just add a mirrorless camera as a backup or walking-around camera. This amounts to dipping your toe into the mirrorless water and seeing how you like it.

Using this strategy, you will probably want to start out with a more inexpensive model of mirrorless camera. You can buy the camera and a lens for now and as time goes on, if you find you like the mirrorless system, add another lens or two. When it is time to upgrade your main camera (the DSLR), you can make the switch. At that point, you will have a stable of lenses ready to go.

I have actually been employing this strategy myself. I have bought a couple of phased-out Sony mirrorless cameras over the last few years (I'm currently using the a6000, which was just replaced by the a6300). Since the camera didn't cost nearly as much as my main DSLR (and it is smaller), I keep it in my car so I always have a camera with me. Meanwhile, I have bought a few lenses for the mirrorless camera and may add one or two more. When it comes time to upgrade my DSLR, I will be well-positioned to switch to mirrorless, assuming that is what I decide to do at that time.

But that is just me. The point for you is that you can buy an inexpensive mirrorless camera and just keep it around. It may result in a full transition, or it may remain just a handy backup.

Chapter 9: Conclusion

There is just no question that mirrorless cameras are now every bit as capable as DSLRs. They are amazing devices. But is one right for you? Hopefully the information in here helped you decide that. And I also hope that this helps you pick one out if you decide to go that route.

But my real hope is that you will not get bogged down in camera details for too long. It can be interesting and fun to pick out your new camera. I enjoy doing it myself, and I enjoy diving into the info for this guide. But let's not live in the land of camera specs forever. There is a lot more to photography than that. You can have a great camera and be a terrible photographer, and you can take great pictures with a cheap camera. Just get the camera, and then let's start having fun with it.

