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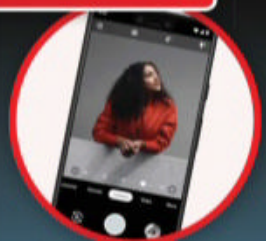

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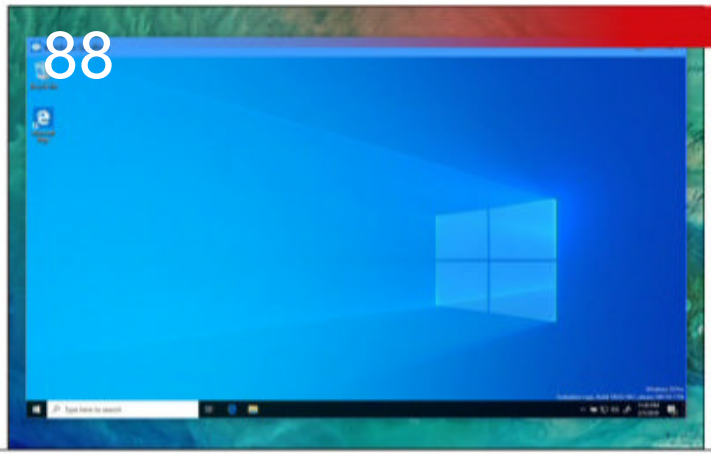


HOW TO

Asus ZenBook S13

Price: £1,499 from **fave.co/2x8ujeL** ★★★★½

Asus is further cementing its position as one of the most interesting laptop manufacturers on the market, proving that it's not afraid to take risks and try out new form factors.

Take the ZenBook S13. The almost bezel-less design makes it look extremely clean and tight, and the inclusion of the 'reverse notch' places the webcam in a space where it doesn't increase the size of the top bezel. It's one of the more interesting designs we saw at CES 2019 – where the device launched.

After using the laptop intensively for two weeks, including putting it through its paces as my main device

while covering E3, I'm happy to confirm that this is a laptop that's as powerful as it is portable and should meet most users' needs – as long as you can afford it.

Design

When looking at the device for the first time, the biggest impression comes from the screen. The bezels are almost non-existent on the sides and also on the top, making the viewing experience extremely slick as the display almost touches the edges of the laptop. This design allows for a staggering 97 percent screen/body ratio on the 13.9in display, which is only FHD but very pretty to look at none-the-less.

A maximum brightness of 400 nits puts it at the upper end of most laptops we've tested, and contrast and colour reproduction have impressed, too. The only real downside is the glossy finish, which means that even with that brightness it can still be a slight struggle to use outside or in other bright, glare-filled conditions.

It's what's above the screen that matters more, though. The webcam is held within a notch that protrudes from the centre of the top bezel – an inverse of what you're probably used to seeing cutting into the displays of most modern phones. It's small enough to still fit within the design and works very well thanks to the gently curved edge – it also provides a little lip that you can use to open the lid too, which is more useful than you may imagine in a time of extremely slim design and small form factors.

There are a couple of little design details that make the S13 feel very tailored and premium. The diagonally brushed aluminium on the keyboard deck and the cut

A fingerprint sensor has been built into the top-right corner

line above the function keys make it stand out just that little bit more from the vast array of laptops on the market these days, though I'll admit that the silver finish on the lid is a little too shiny and garish for my tastes – your mileage may vary.

Like most of the modern Asus laptop line it also boasts the company's ErgoLift hinge – a slightly odd-looking design that I nonetheless love, as it gently lifts the keyboard up to a comfortable typing angle while clearing space below the body, improving both cooling and audio performance.

The keyboard is comfortable and responsive, with a surprisingly deep travel, and it sits somewhere in the middle of the clicky-mushy spectrum. The wide trackpad is a little more of a let down though – it works well, but there's a slight drag to the finish, a friction every time you slide your finger across.

The tapered design means that Asus hasn't had to compromise on ports

There's also a fingerprint sensor built into the top-right corner. This is quick and reliable, though we would prefer it built into the power button or elsewhere on the body, rather than taking up trackpad space.

The S13 is also absolutely tiny: at 316x129x19.5mm and weighing just 1.1kg this is about as portable a laptop as you're going to get with what is almost a 14in display – essentially it's a 14in laptop in the body of a (small) 13in one, which is a major achievement.

There's not even any real compromise on ports to achieve that, in part thanks to a tapered design. That means that the thick end of the wedge includes two USB-C ports (one of which is used for charging) along with microSD, USB-A, and a 3.5mm audio jack. If that's not quite enough for you, Asus throws in a USB-C dongle that adds in an extra USB-A port and HDMI, though sadly there's no Ethernet included.

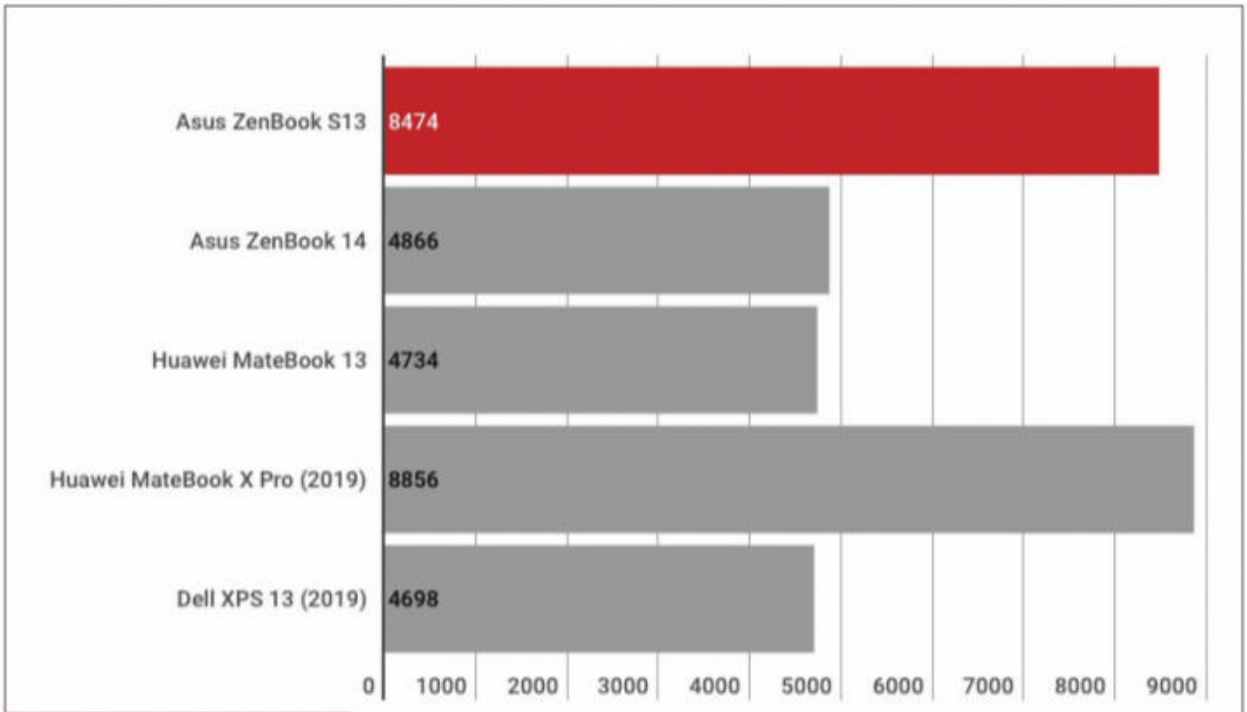
Performance

Something this small and pretty surely can't have impressive specs under the hood too, right?

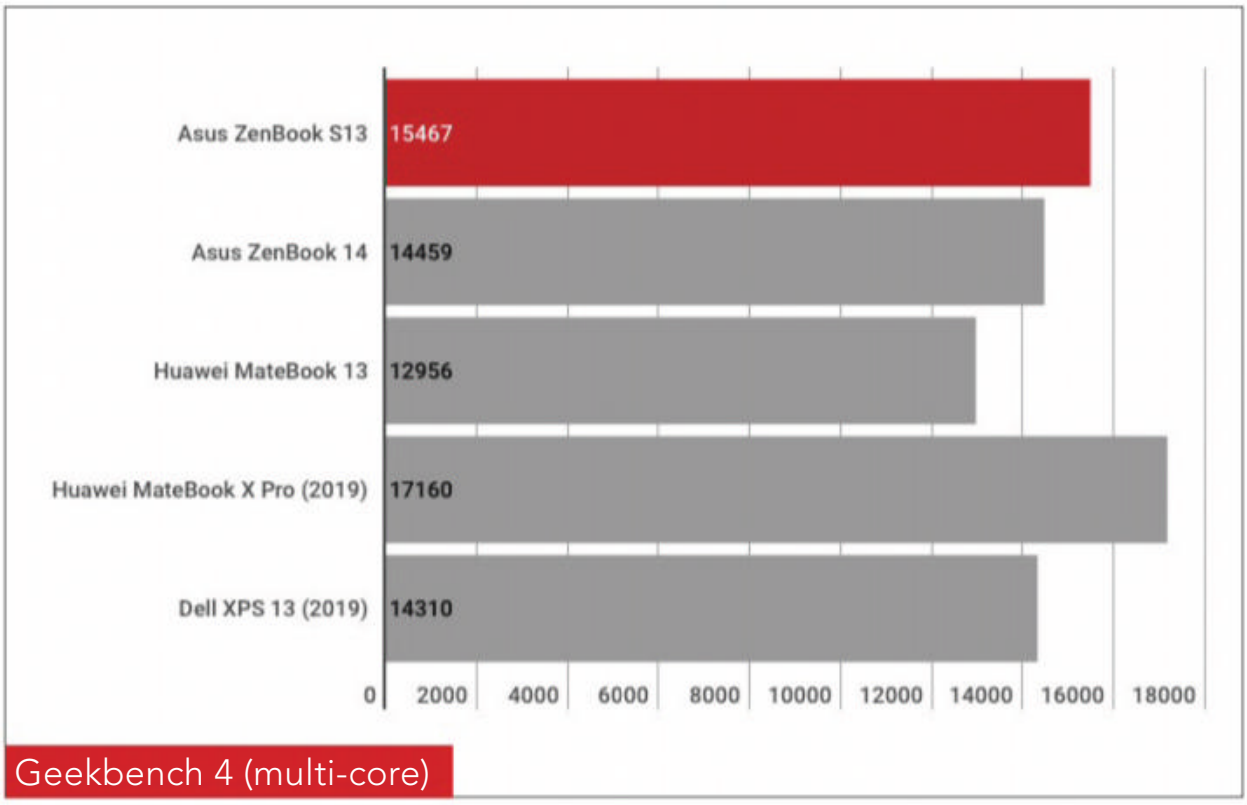
Asus have made sure the ZenBook S13 is well equipped with an Intel Core i7-8565U processor, backed up by a discrete Nvidia GeForce MX150 graphics card – a rarity in this sort of form factor. It won't be enough to compete with a proper gaming PC, but it will make the S13 perfectly capable of basic gaming and creative tasks – I used it for audio, photo, and video editing on the road with no complaints.

The processor and graphics are supported by a 512GB SSD and 16GB of RAM.

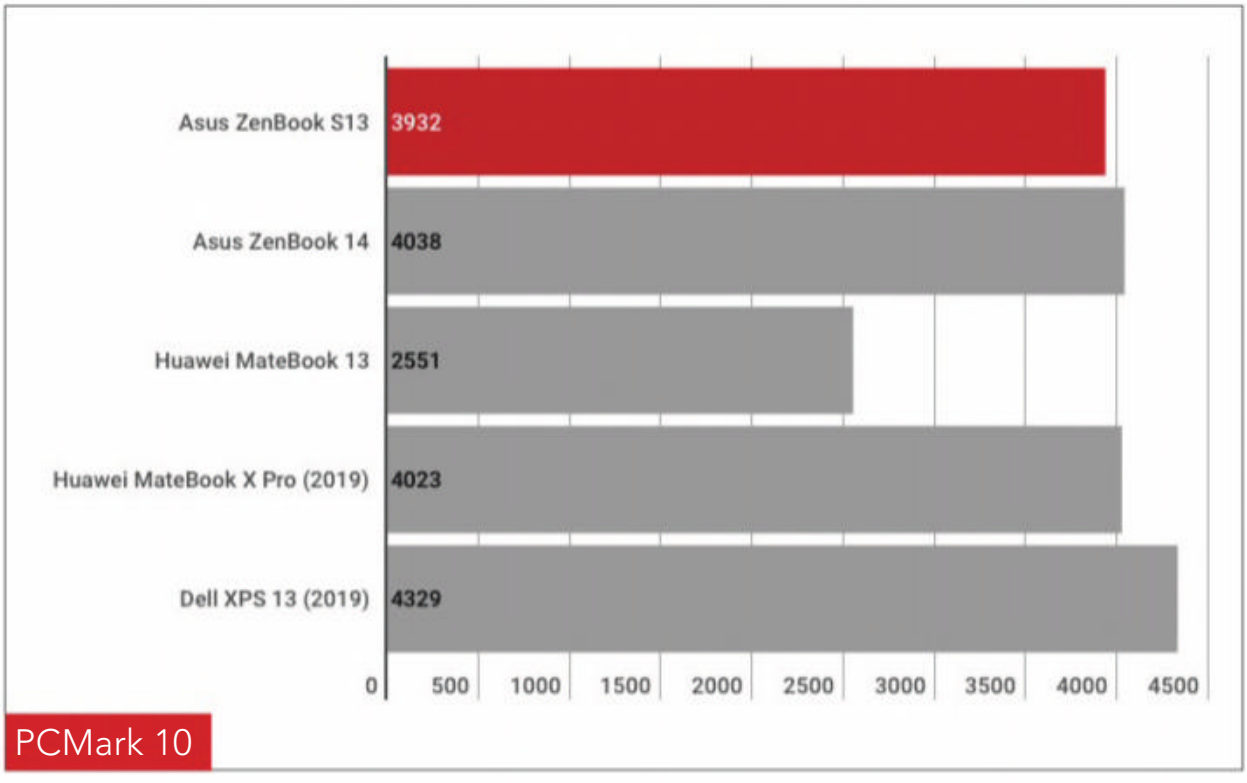
In terms of actual use, that converts to seriously solid benchmarking performance (using our 16GB RAM model). Geekbench's CPU test and PCMark's



3DMark (Sky Diver)



Geekbench 4 (multi-core)



PCMark 10

multitasking test both put the S13 up with just about every comparable ultrabook, while on the 3D Mark graphics test it and the MateBook X Pro leave everything else in the dust – that's the impact of the MX150 GPU. As a reminder though, at comparable specs this is cheaper than all of these rivals except the ZenBook 14.

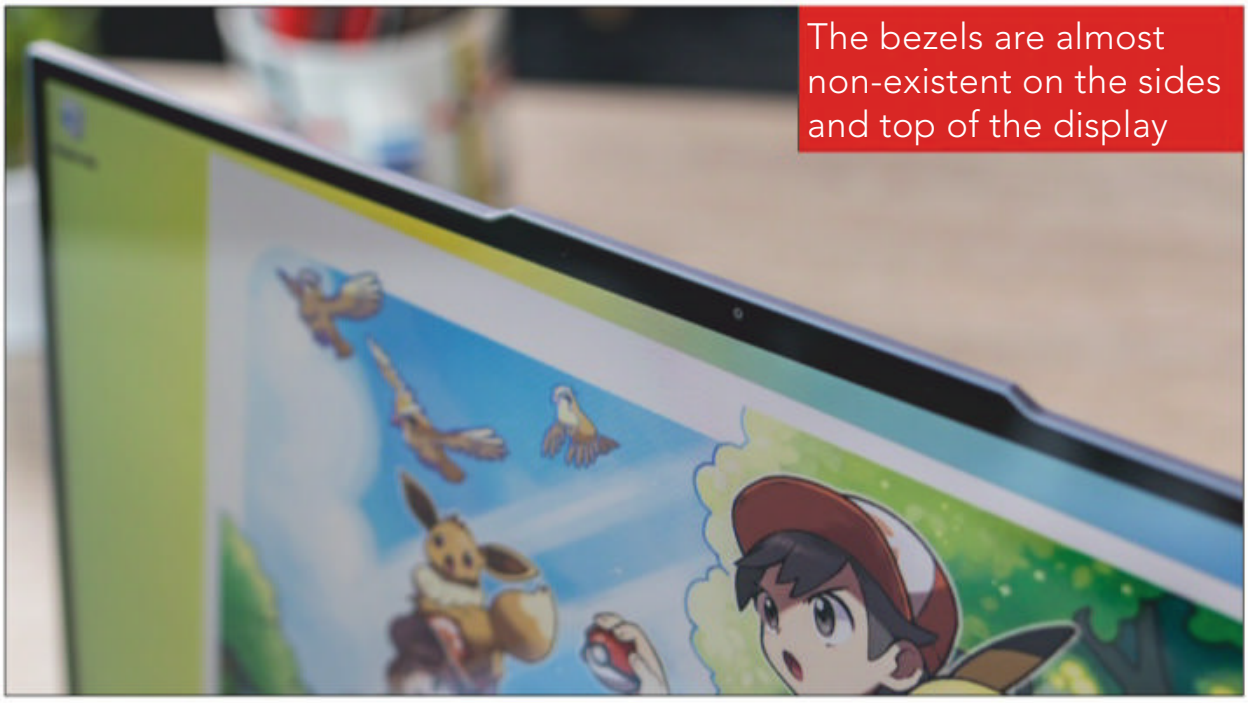
Despite all that internal oomph, battery power is solid too – the S13 delivered just under 13 hours of continuous video in our battery test, in line with last year's ZenBook and ahead of the XPS 13. Once again the MateBook X Pro just edged it, but that's a much bigger and pricier device.

Verdict

Asus has been making dependable laptops for years without earning the hype of Dell or Apple's latest, but the ZenBook S13 is a sign that this is an under-appreciated company operating at the top of its game.

Right now you cannot find an ultrabook that crams specs like this into a body this small, and the S13 does it all while undercutting most of the market on price. That's not even mentioning the reverse notch – what could have been a design gimmick but in fact keeps the bezels slim, while providing an unexpectedly handy lip for opening the laptop.

The silver finish might be a bit bling and the trackpad isn't the best, but those are minor complaints in the grand scheme of things. If you can afford to drop a grand and a half and want discrete graphics in an ultra-portable package, the S13 is a very easy recommendation. Dominic Preston



The bezels are almost non-existent on the sides and top of the display

Specifications

- 13.9in (1,920x1,080, 200ppi) LED-backlit IPS Full HD display
- Windows 10 Home
- 8th-gen Intel Core i7-8565U processor
- Nvidia GeForce MX150 GPU
- 8GB/16GB 2133MHz LPDDR3 on-board RAM
- 512GB PCIe SSD
- 802.11ac Wi-Fi
- 2x USB 3.1 Gen 2 Type-C (support fast charging, data transfers and display connectivity)
- USB 3.1 Gen 2 Type-A
- MicroSD card reader
- 3.5mm headphone jack
- Bluetooth 5.0
- Asus SonicMaster stereo audio system
- Full-size backlit keyboard

If you want discrete graphics in an ultra-portable package, the S13 is a very easy recommendation

- Touchpad with fingerprint reader
- HD webcam
- 50Wh 3-cell lithium-polymer battery
- 316x195x12.9mm
- 1.1kg

LG gram 17

Price: £tbc ★★★★½

There was a time when a 17in laptop was a desktop replacement device, but that's no longer the case. The LG gram 17 is a great laptop for those wanting loads of real estate in a chassis you can actually take around with you.

These days a 17in laptop is going to be of the gaming variety, focused on power and not portability. With the gram 17 though, LG proves that a large laptop doesn't have to be thick and heavy. In fact, it's lighter than many laptops with a smaller screen. It's also no slouch when it comes to performance and there are plenty of good features on offer here.

Price and availability

The gram 17 is currently available for $1,699 in the US, though at the time of writing no UK price had been announced. LG has told us it will go on sale over here in July.

Design

If this was a boxer, it would be a featherweight – and that's despite it's size being inappropriate for the category. At just 1.34kg this is the lightest 17in laptop on the market. That's seriously impressive and it's a pleasant surprise picking up the LG for the first time. Your wrist and arm is prepared for a certain level of effort based on the size of it, and it's not needed.

LG has achieved this by using a nano-carbon magnesium alloy, which has passed seven US Military durability tests. It doesn't feel like metal to the touch, nor does it look like it. Think more along the lines of plastic with a nice spray paint coating. The laptop doesn't feel cheap, though the display is bend. The base is much more rigid.

Thanks to thin bezels around the screen, the gram 17 is smaller than most 17in laptops. In fact, we managed to fit it into a bag designed for a 15in model. Despite the small bezel, LG has added a webcam above the screen.

There's plenty of room for a keyboard and trackpad here, along with space to rest your arms. The LG's trackpad is a decent size and works smoothly, but while the backlit keyboard provides a pleasant typing experience – the keys have good travel and a crisp enough response – it could be a little better.

There's plenty of room for a keyboard and trackpad

It's good to see a dedicated number pad here, though it's a little squashed on the end and a few keys are smaller than we'd like, namely the Enter and arrow keys. We're being a little picky here because there's so much space available. On the plus side, there's a dedicated function row at the top and the power button has a built-in fingerprint scanner.

Display

The screen is arguably the main reason to buy the LG gram 17. After all, you can get plenty of equally powerful laptops for a lower price with a smaller display. This is going to appeal to anyone, who even on a 14- or 15in laptop still doesn't feel like they have the space to do things properly.

LG has gone with an IPS LCD display here, and although it's not 4K, the 2,560x1,600 resolution is

decent and has a solid pixel density of 177ppi. It uses an unusual 16:10 aspect ratio, as opposed to 16:9 or something like 3:2 on the Microsoft Surface Laptop 2. LG claims this is better for tasks such as editing photos and typing Word documents. We're not totally convinced, especially when the main selling point here is the laptop's 17in size. More real estate is better than the aspect ratio if you ask us.

The display also has a good 89 percent sRGB and Delta E average of 1.54. Add decent viewing angles, contrast and brightness (maximum 370cd/m^2) and you've got a laptop display good for almost any task.

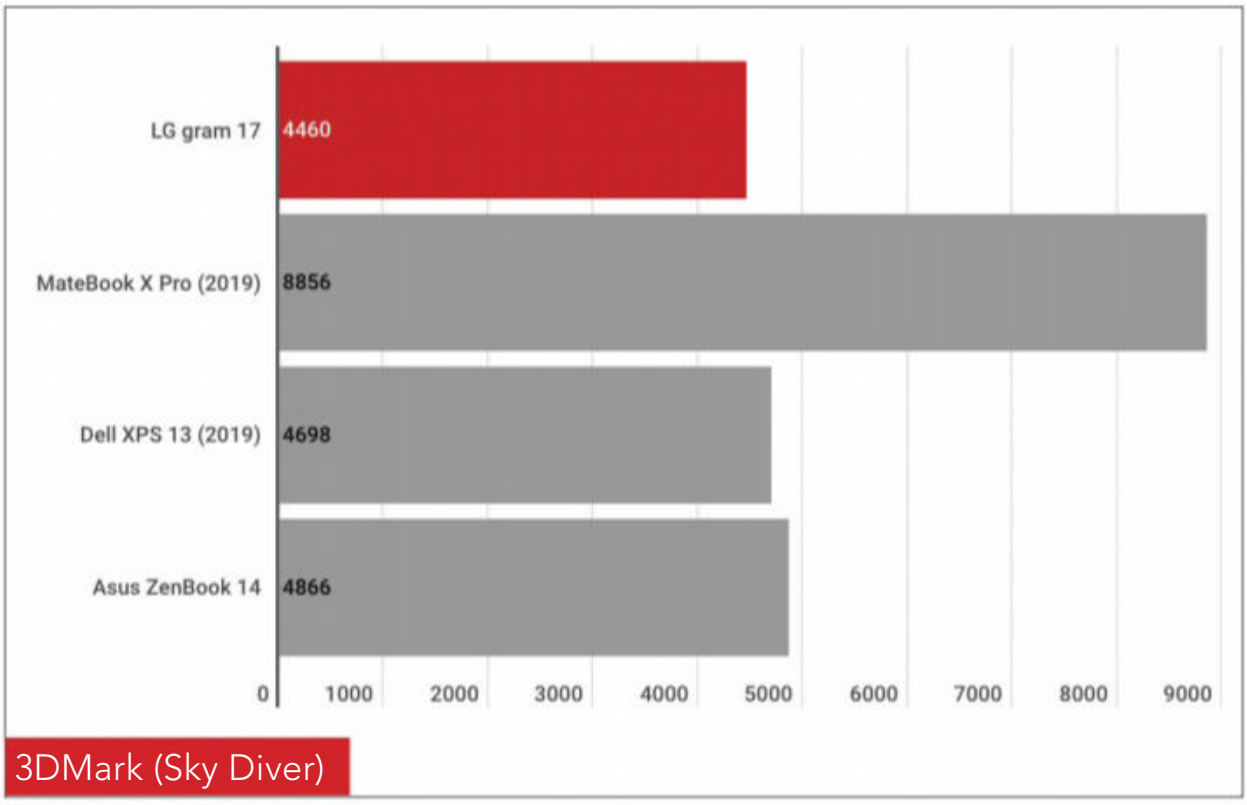
It's worth noting that this isn't a touchscreen like previous LG gram models.

Performance

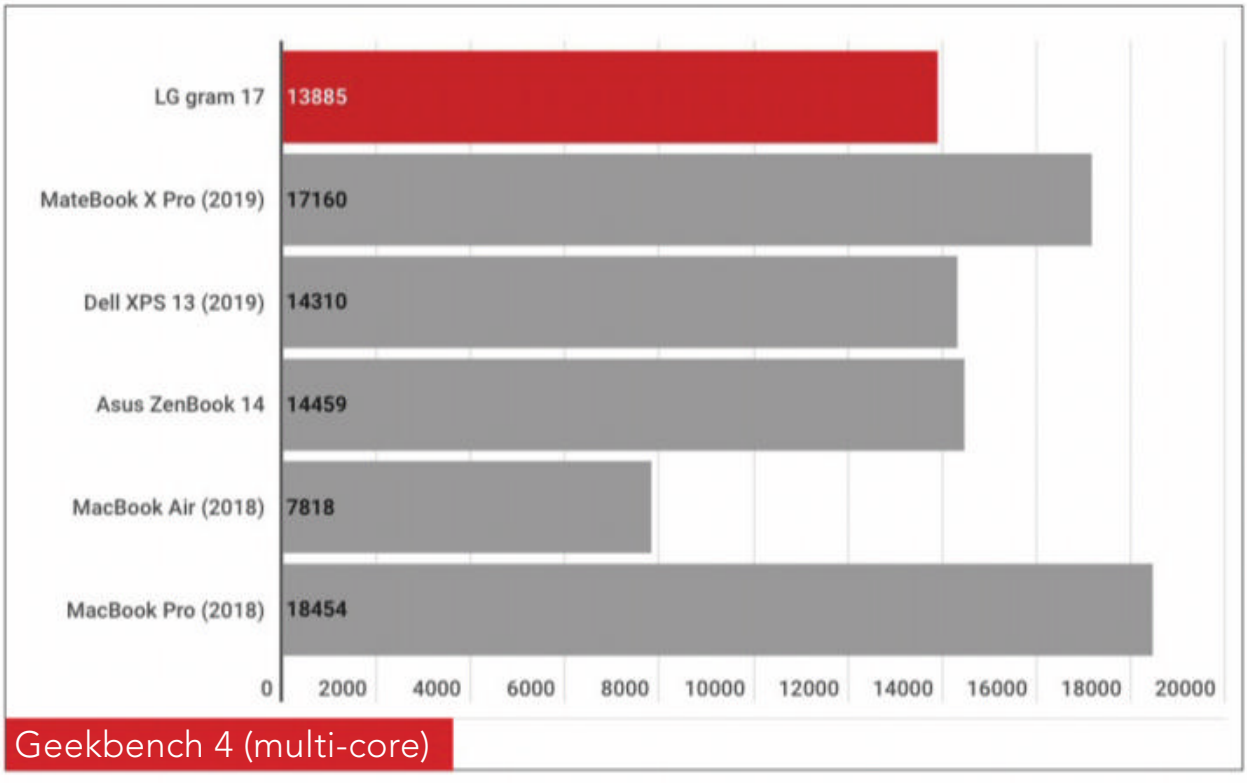
The gram 17 comes with an Intel Core i7-8565U processor, which we've seen in almost every laptop we've reviewed this year. There's also 16GB of RAM and a 512GB SSD. We'd say that's a pretty good line-up for the price, but will be frustrating if you want more storage, for example.

There's no dedicated graphics card though, so you'll be relying on the built-in Intel UHD Graphics 620 on the processor. Still, performance is solid as we've come to expect from this i7, and the memory is double the capacity of most rivals.

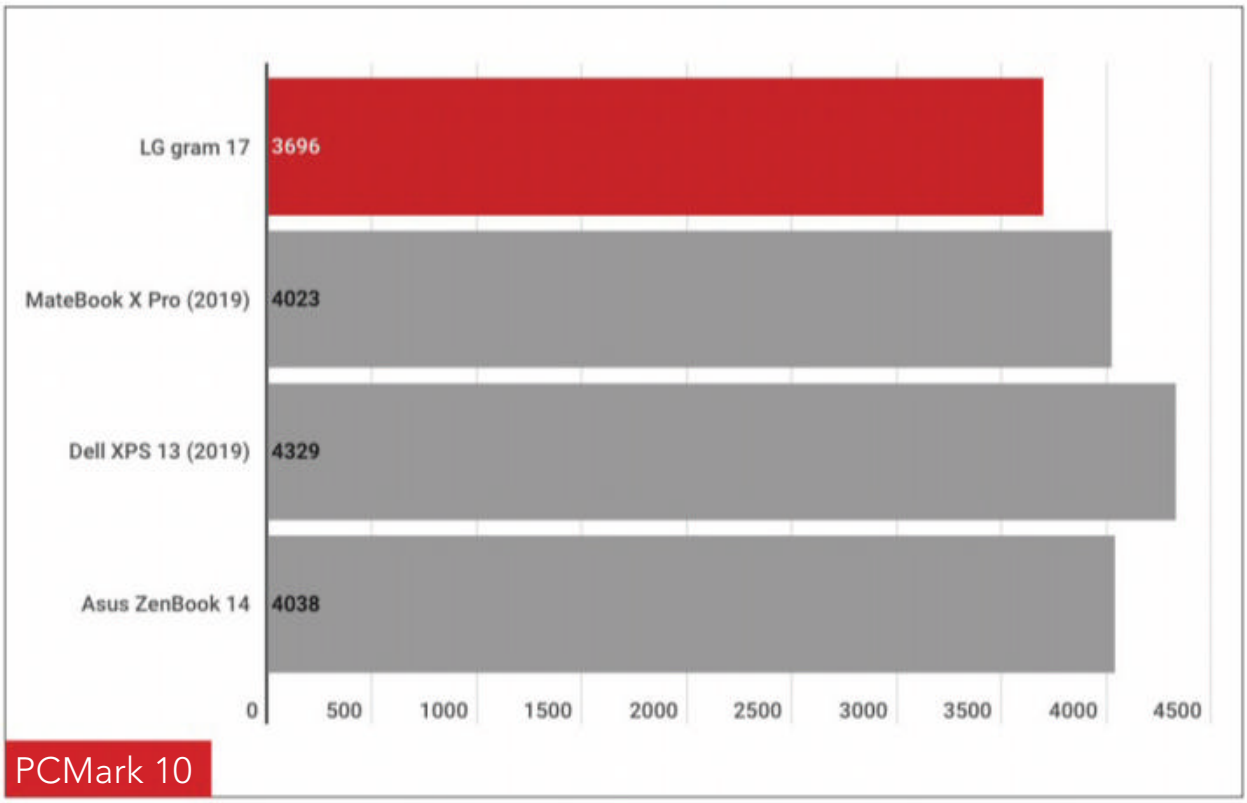
As you can see in our benchmarks, the LG gram 17 matches up to rivals with similar specs. The scores are marginally behind, we think, due to a slightly slower SSD here – SATA3 instead of PCIe. In the real-world, there's no noticeable difference.



3DMark (Sky Diver)



Geekbench 4 (multi-core)



PCMark 10

The MateBook X Pro and MacBook Pro both have dedicated graphics cards, which explains why they're out in the lead. With smooth performance for general tasks on Windows 10 Home, that's the key point here. If you need something with a proper GPU for more hefty workloads or gaming, then the X Pro or MacBook Pro are good choices.

Connectivity and audio

A plus point here, especially compared to many modern laptops, is the solid array of ports. It's the same line-up as the gram 15, with 3x USB-A (all version 3.0), USB-C, an HDMI port, a microSD reader and a headphone jack. There's also an Ethernet adaptor in the box, which uses USB-C.

You won't need to take up that USB-C port – which supports Thunderbolt 3 – for charging either as the gram 17 has a traditional AC plug.

Things aren't so positive on the audio side though, with two downward-facing 1.5-watt speakers. Their proximity to whatever surface the gram 17 is resting on means they sound muffled.

Battery life

LG claims that the battery life is a whopping 19.5 hours. Unsurprisingly, we took this with a pinch of salt. Still, the gram 17 managed an impressive 16 hours in our usual battery test – that is looping a 720p video at a screen brightness of 120cd/m^2 (50 percent in this case). That's up there with some of the best results we've seen, especially from an Intel laptop. You can get more from a Qualcomm-powered device, but the performance is way off.

Verdict

The LG gram 17 is a great buy with its huge and high quality screen inside an extremely light chassis. Add in excellent battery life and you've got a great candidate for a portable computer with lots of real estate.
Core specs and performance are decent as are the range of ports and little extras such as the fingerprint scanner. Our main complaint is the poor audio and slower hard drive. Chris Martin

Specifications

- 17in (2,560x1,600) IPS panel
- Windows 10 Home

- Intel Core i7-8565U 1.8GHz/4.6GHz processor
- Intel UHD Graphics 620
- 16GB DDR4 2,400MHz RAM
- 512GB SSD
- HDMI
- USB 3.1 Type-C (Thunderbolt 3)
- 3x USB 3.0
- USB 2.0
- MicroSD card reader
- 3.5mm headphone jack
- 2x 1.5-watt stereo speakers
- HD webcam
- 802.11ac Wi-Fi
- Bluetooth 5.0
- 72Wh lithium-ion battery
- 381x266.7x17.78mm
- 1.34kg

Raspberry Pi 3 B+

Price: £35 from **fave.co/2NaZGjN** ★★★★½

The Raspberry Pi mini computer just keeps getting better. It's been three years since we reviewed a major upgrade to the Raspberry Pi line, and it was worth the wait. If you've been wondering if the Raspberry Pi 3 B+ is a worthwhile upgrade let me answer that with an emphatic yes.

Once again, we're seeing a noticeable jump in performance compared to the Raspberry Pi 3 Model B that we looked at in early 2016. Some of

the downsides of the Raspberry Pi still exist with the Pi 3 B+. Nevertheless, if you're looking to tinker with hardware, start programming, or just create an everyday PC for very basic needs, then this is an excellent choice.

The basics

On paper, the hardware for the Pi 3 B+ isn't that different from its predecessor. There isn't any extra RAM, the GPU is the same, and the processor's clock speed made a small jump. And yet, the Pi 3 B+ performs far better than previous boards.

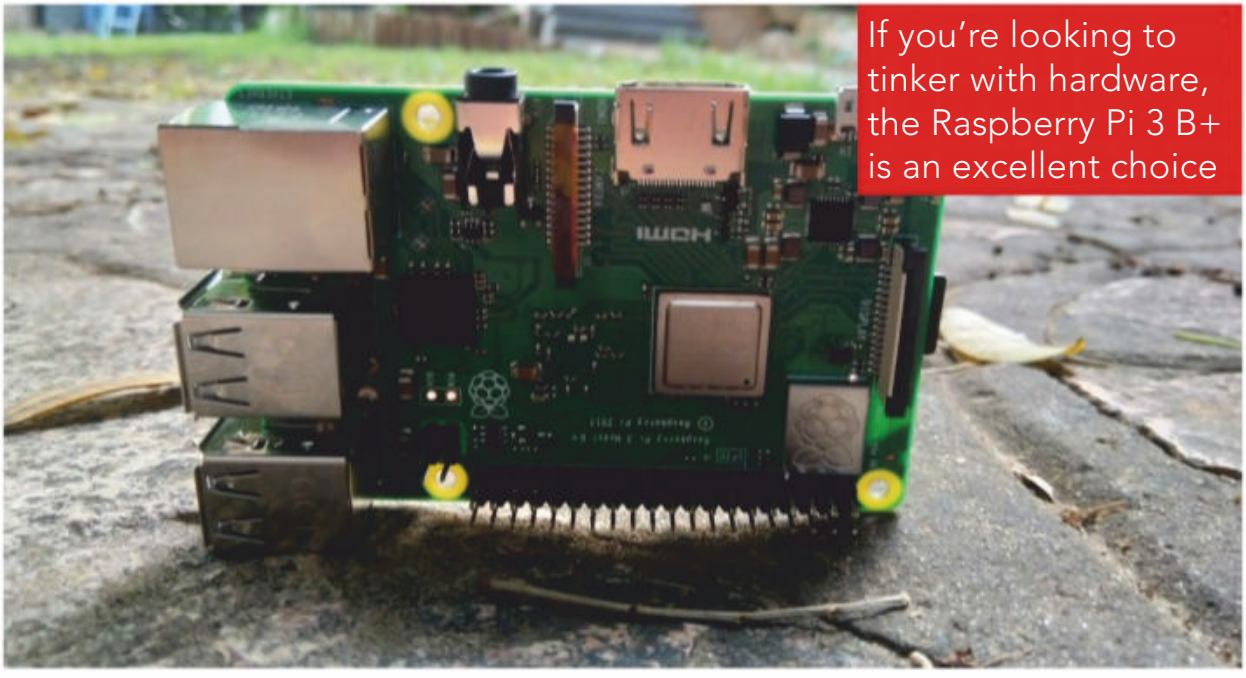
SoC: BCM2837B0 64-bit system-on-chip with four ARM Cortex-A53 CPU cores clocked at 1.4GHz
CPU: 4x ARM Cortex-A53, 1.4GHz
GPU: Broadcom VideoCore IV
RAM: 1GB LPDDR2 SDRAM
Networking: Gigabit Ethernet (via USB channel), 2.4GHz and 5GHz 802.11b/g/n/ac Wi-Fi
Bluetooth: Bluetooth 4.2, Bluetooth Low Energy (BLE)
Storage: microSD
GPIO: 40-pin header, populated
Ports: HDMI, 3.5mm analogue audio-video jack, four USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)

The biggest difference between this model and the Pi 3 B is the 200MHz boost in processor speed. This version also adds a shiny new heat spreader, which helps reduce throttling and maintain that speed boost. It also adds a little 'chrome' to the board, as does the

new shielding around the wireless circuitry (the little metal box with the Raspberry Pi logo on it).

Beyond the speed boost and new look is the same underlying CPU architecture. The RAM also hasn't changed, and here I really think the board is missing something. Perhaps upping the RAM to 2GB has technical or cost issues we're not aware of, but it's high time this board added a little more volatile memory to the overall package.

The Bluetooth connection gets a point upgrade to 4.2, and the networking capabilities add dual-band Wi-Fi. The Ethernet port is also faster, with two to three times better performance over its predecessor, but don't say the 'G' word. Raspberry Pi's introductory video for the board says this is not true Gigabit Ethernet. While the physical component is a Gigabit port, it's connected to the board over a single USB 2.0 bridge, limiting the theoretical maximum throughput to 300Mb/s.



If you're looking to tinker with hardware, the Raspberry Pi 3 B+ is an excellent choice

There are also a few changes that will matter more to hardware hobbyists than anyone looking for a cheap home cinema or retro gaming console. It's Power-over-Ethernet ready, but you'll need to buy the HAT module, sold separately. Finally, there's a new power management integrated circuit (PMIC) that replaces the discrete components for a smoother power draw.

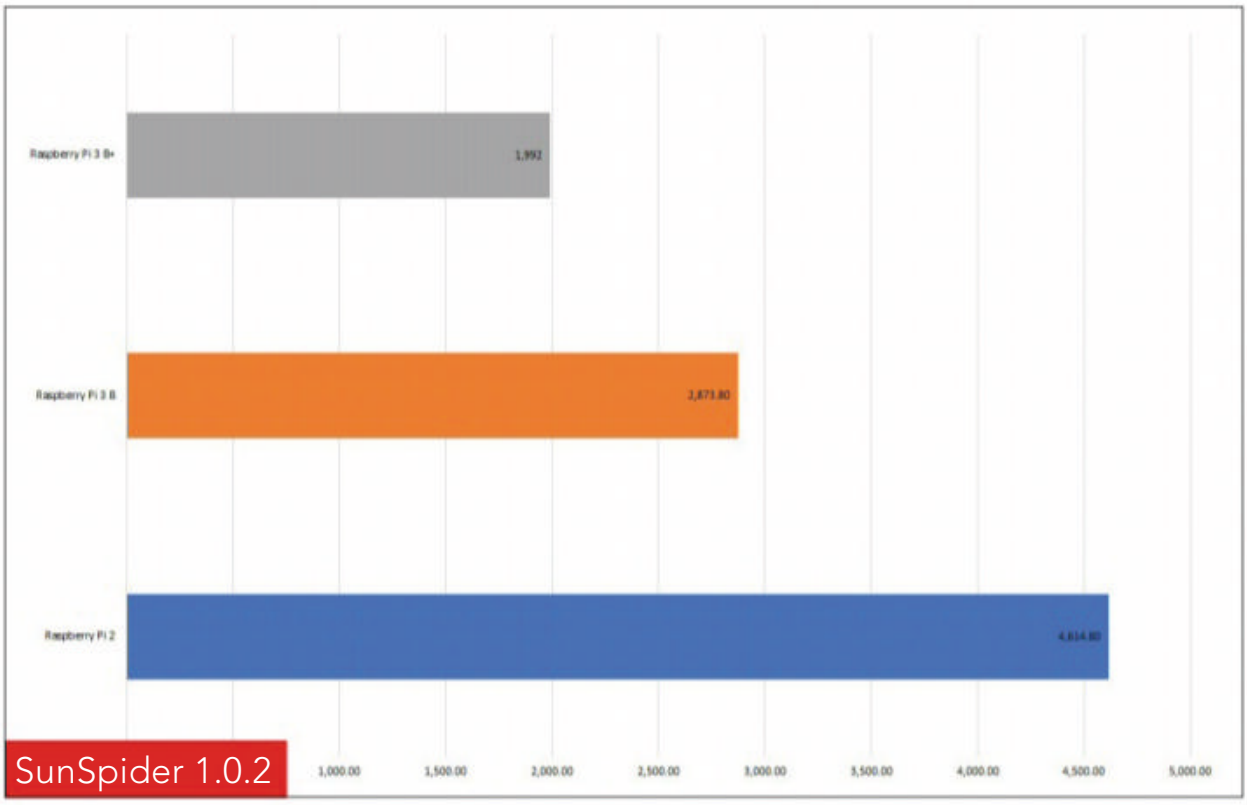
Since the introduction of the Raspberry Pi 2 model B in 2015, the RPi has been rocking four USB ports, meaning you can connect a good number of peripherals when necessary. With the Pi 3 B+, however, some users may find that a USB hub with an external power source would be a better option.

This device is serious about its power needs, and a hub can alleviate that. The days of getting by with whatever old phone or tablet charger you have lying around are long gone. If you don't have a 5V/2.5-amp wall charger, then you aren't going to see the new Pi perform up to snuff – you could even have some issues with data loss. Most phone and tablet chargers output 1- or 2 amps, which is not enough for the Pi 3 B+.

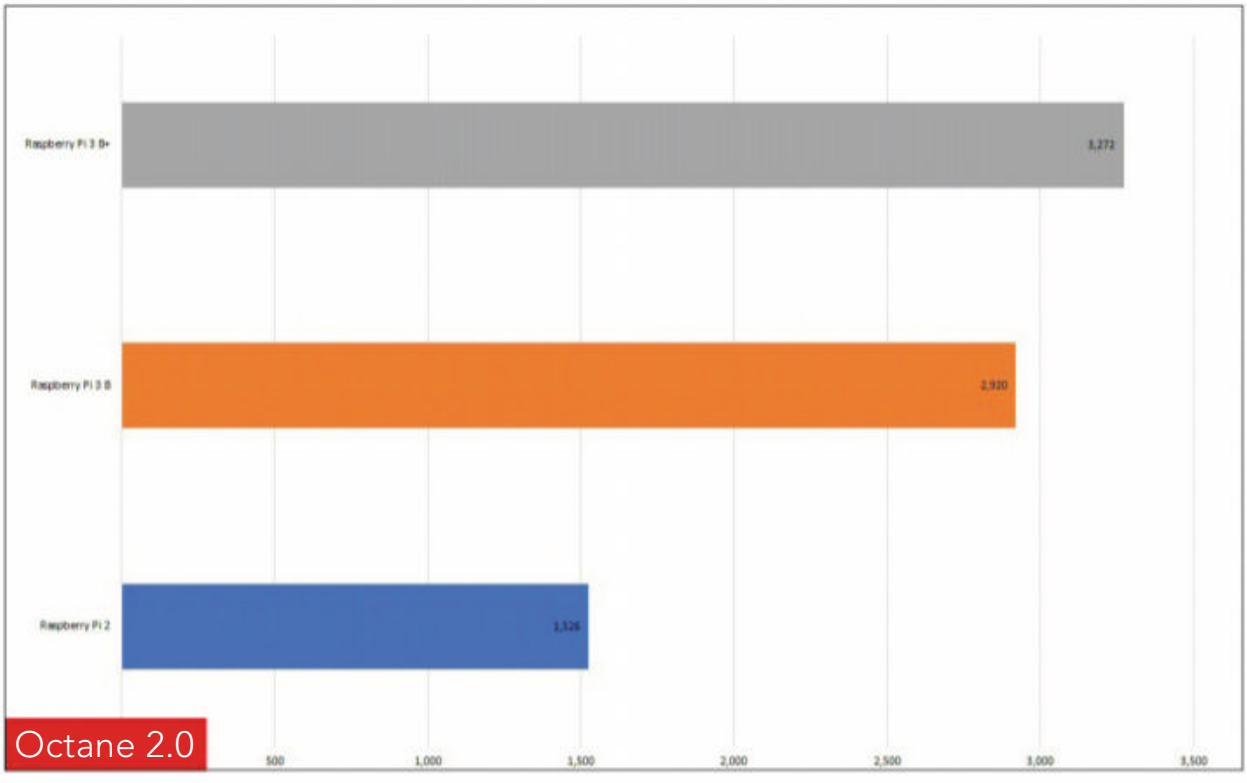
Users on various forums claim that a 5V/2.4-amp charger will get the job done, but we haven't tested that. For our tests, we used a 5V/3-amp charger, and it did a fantastic job.

Performance

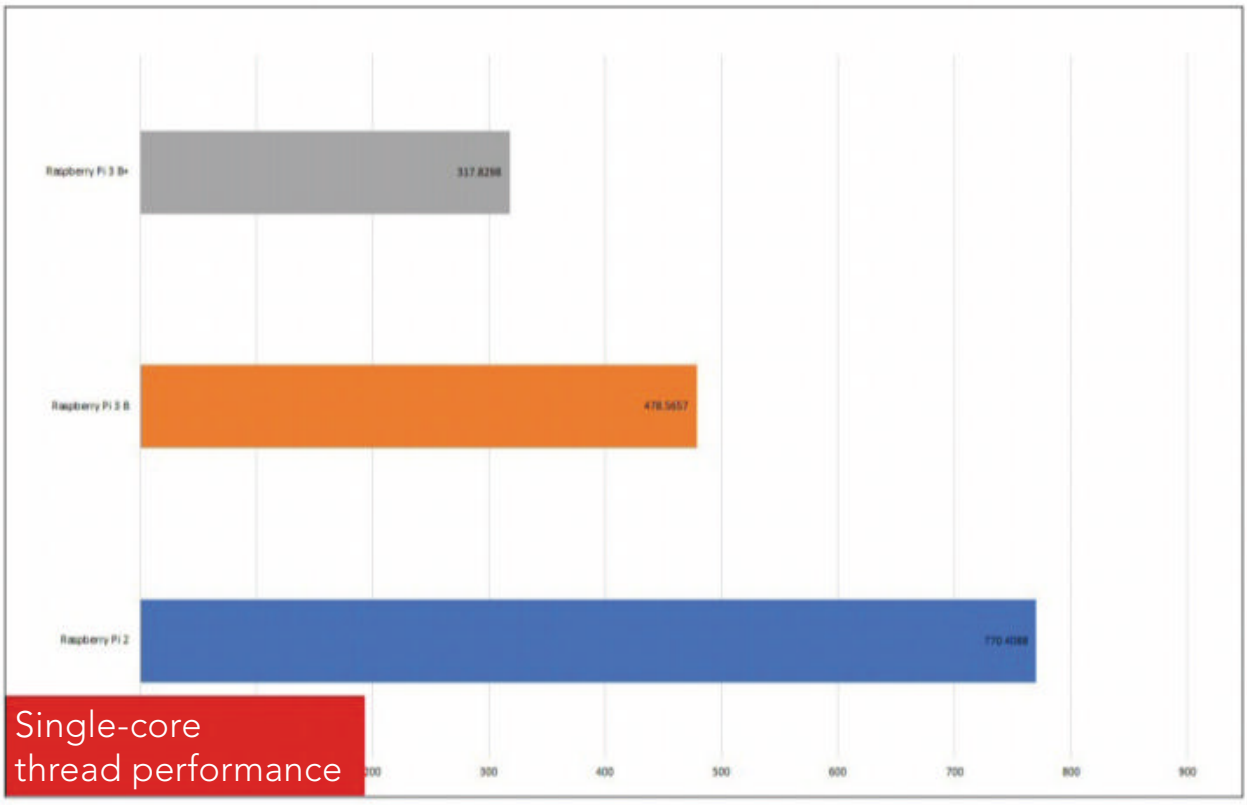
We took this board through the usual set of synthetic benchmarks and browser tests to give you a sense of how it performs. For our tests, we loaded up the Raspberry Pi with the latest version of the Raspbian Stretch build (**fave.co/2RvFQOE**) – released in



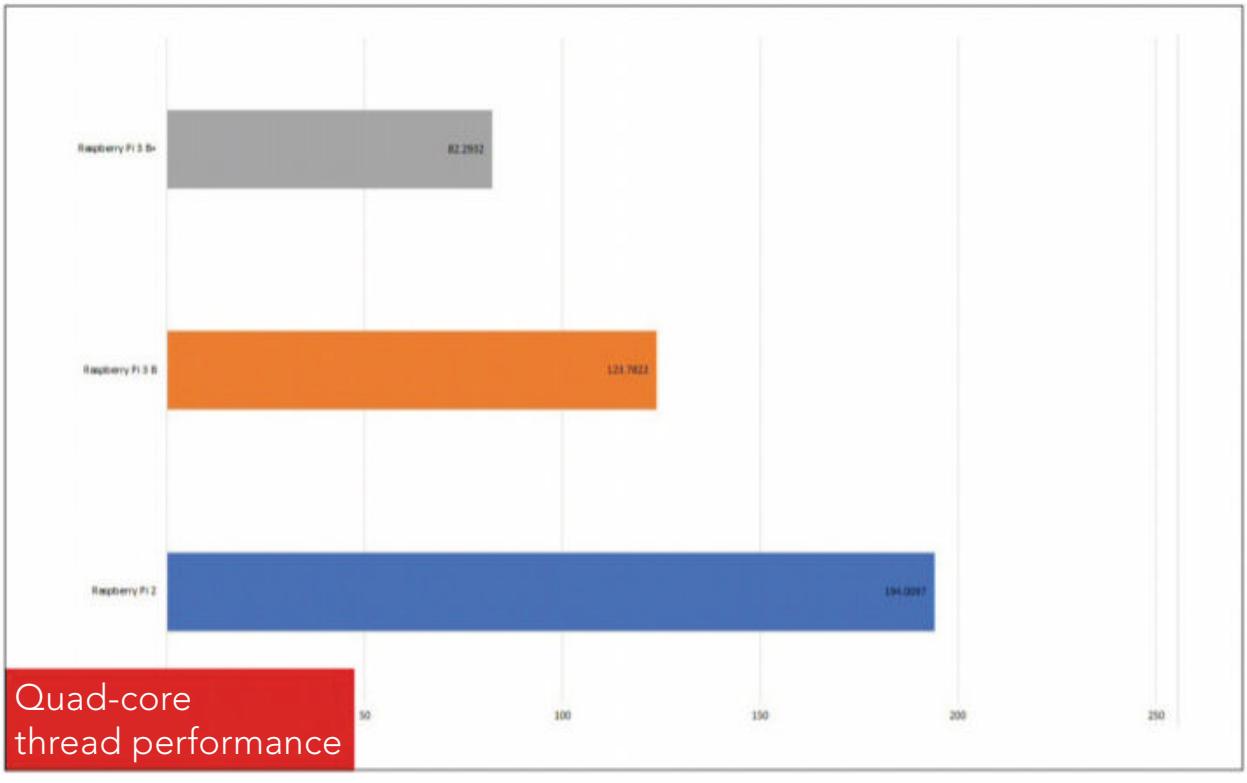
SunSpider 1.0.2



Octane 2.0



Single-core thread performance



Quad-core thread performance

April 2019 – at this writing. Our first benchmark was SunSpider 1.0.2 using the built-in Chromium browser. Last time we tested this JavaScript benchmark with the Epiphany browser, which was the default at the time. Lower results are better in this case, and as you can see the Raspberry Pi 3 B+ smoked its predecessors.

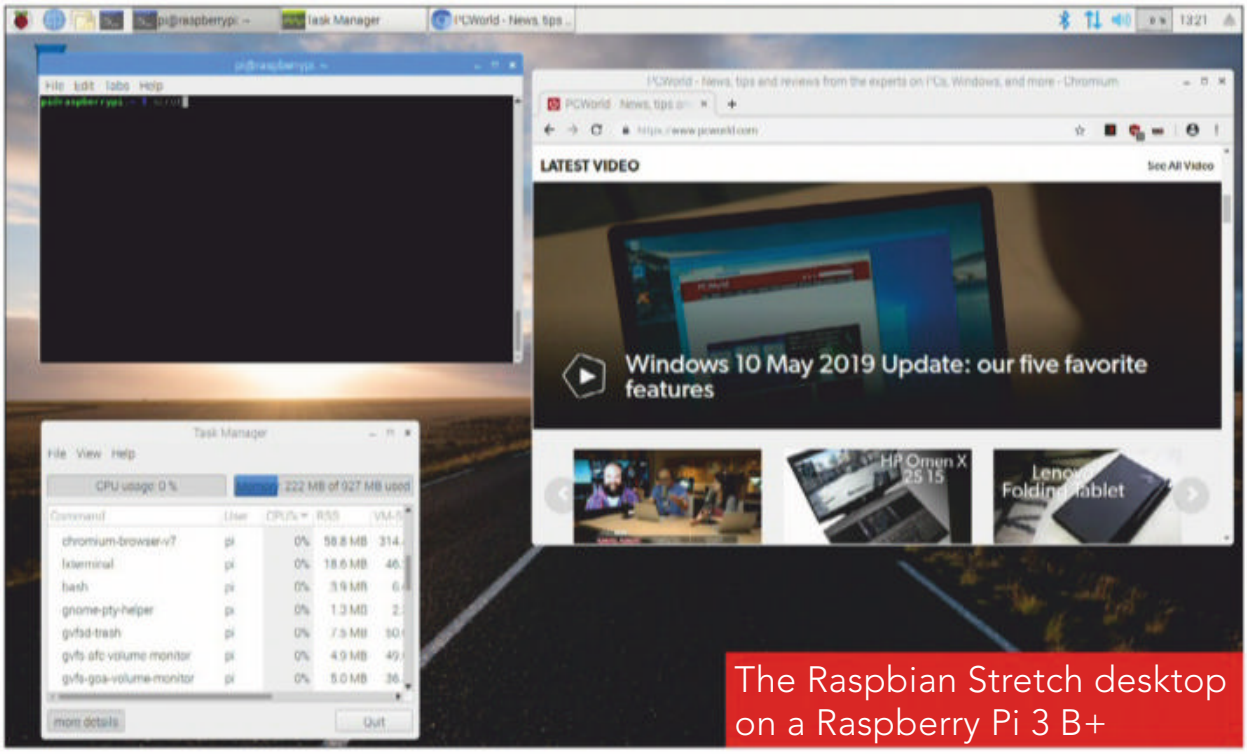
The Octane 2.0 test was a little closer with the Pi B+ only improving upon its predecessor by 352 points. An incremental improvement for an incremental upgrade.

Next up we took a look at the Pi 3 B+ with sysbench. As with our previous tests for Raspberry Pi hardware, we tasked the Pi 3 B+ to calculate all prime numbers between 0 and 20,000 using a single processor thread. The Pi B+ was able to complete the task nearly three minutes faster than its predecessor. Similarly, when we allowed the mini computer to use all its processing power, it completed the same task in 82.2932 seconds – a full 41 seconds faster than the Pi 3 B.

The full Pi

The Raspberry Pi is a powerful little computer for its size and cost, but it takes a lot more than just the board to make a PC. You'll also need a mouse, keyboard, and display to make it all work. On top of that, you'll need a microSD card loaded with the aforementioned Raspbian operating system or another OS such as LibreELEC (**fave.co/2xasfTx**) for media streaming or Retropie (**fave.co/2KC2vly**) for classic gaming.

The easiest way to install Raspbian is to use the Noobs installation tool (**fave.co/2N6ZdyX**). alternatively you can flash the Raspbian disc image to a microSD using a third-party app such as Etcher.



The Raspbian Stretch desktop on a Raspberry Pi 3 B+

Raspbian with the Stretch desktop interface makes the operating system very usable, especially if you choose the version of Raspbian with recommended software. This includes the LibreOffice suite, VLC, a ton of tools to learn and practice programming, the Chromium web browser, and Minecraft Pi Edition.

That said, there are still some issues in day-to-day use with Raspbian. I spotted some unnatural-looking, almost choppy movement in YouTube videos at times. This is a common problem with all Raspberry Pi devices and likely due to its limited power draw. Watching Netflix also isn't an easy achievement on Raspbian. Having multiple browser tabs or windows open at one time can be a real problem, but like video streaming that's to be expected. Playback for local videos is fantastic, however.

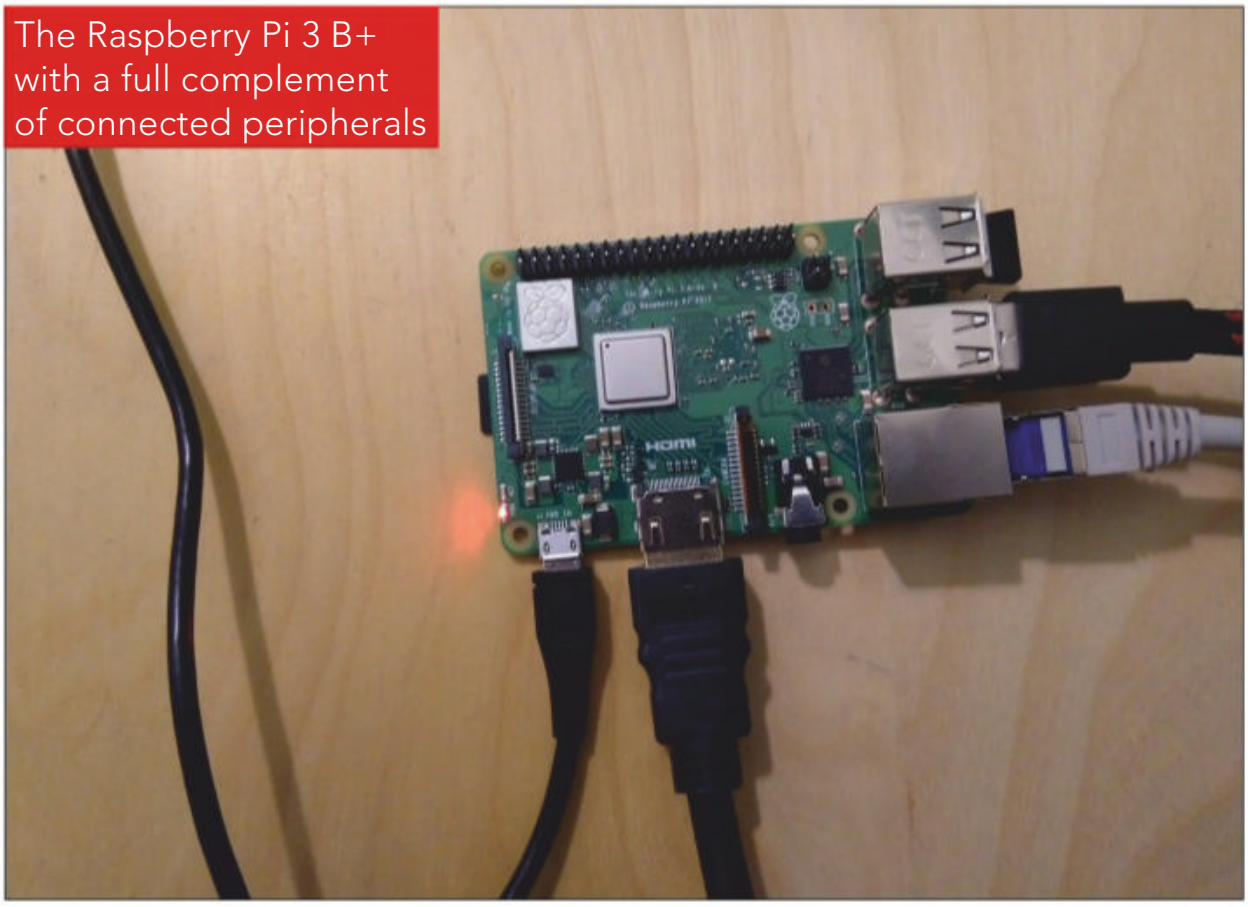
Minecraft Pi is very basic, and for what it is it's great; however, if prospective Raspberry Pi users are accustomed to playing on PC (Java or Windows 10) or console, this version will not appeal.

Raspbian also has an app catalogue of sorts where you can download and install other programs, but It's not the best experience. The buttons aren't well labelled, and at times they didn't seem to work. A better approach would be to learn how to install programs from the terminal using the built-in package manager, APT. The command line seems scary, but it's fast and easy once you learn the few basic commands needed to get things done.

Verdict

For £35, and the addition of a few peripherals many people already have lying around, you can put together a nice little basic-needs PC for children, an entertainment console, or a classic gaming machine. I'd highly recommend the Pi 3 B+ for any budding programmer, because it has all the tools necessary to get started. For elementary and perhaps even middle school students the Raspberry Pi 3 B+ is up to the task as a daily driver for homework and basic web surfing – especially if you buy a case to go with it. Anyone beyond that age will likely be disappointed with the Raspberry Pi as an everyday desktop.

That's not all a Raspberry Pi can do by any stretch, as we've seen some insanely innovative Pi projects. Beyond the aforementioned uses, it can also function as a home-based server for everything from Minecraft to chat and home automation. Ian Paul



The Raspberry Pi 3 B+ with a full complement of connected peripherals

Specifications

- 1.4GHz Broadcom BCM2837B0 processor
- 1GB DDR2 SDRAM RAM
- 802.11bgn, 802.11ac
- 4x USB 2.0 ports
- 5 volts
- 90x60x20mm
- 4.54g

Withings Move

Price: £59 from **fave.co/2xbtrX6** ★★★★½

Fitness trackers are a dime a dozen these days, so it's hard for even established players like Withings to stand out. The Move does its best by offering core features at a friendly price and letting the design do the talking – with a bit of help from you. That's because while the standard issue Moves look attractive enough, the real selling point is customizability: you can get a Move in a load of different colour combinations and even pick the design of the watch face itself.

Design

The Withings Move looks more or less like a standard sporty wristwatch. The slim body comes with a rubber-y

wrist strap, and is lightweight and unobtrusive enough that you'll almost forget it's there. There's a single button on the right side, and that's about it.

It's available off the shelf in five colour combinations: a black body with black strap (pictured), black body with a mint strap, and a white body with mint, blue, or coral straps. Head into the customization and you get a lot more options: nine different strap colours, ten activity tracker dial colours, five case colours, and 13 different faces ranging from plain colours to interesting Venetian speck designs.

Build quality is mostly solid, and the strap is comfortable, but whatever plastic the face is made of is definitely a bit too soft. After only a week or two of day-to-day wear it's already picked up a few scuffs and scratches, and it's only going to get worse. It's not too bad – nothing that gets in the way of using the thing – but if you worry about keeping your tech pristine then this might get on your nerves.

The face has two dials: the standard watch face and a smaller central dial that goes up to 100. This is your step count for the day, measured not in steps (100 would be manageable even for the laziest among us) but in percentage. That means you can use the accompanying app to set any step goal you'd like, and get real-time updates on your progress from your wrist.

Once you hit 100 percent the dial resets to zero and begins to climb again, so it will still track your progress beyond your goal. It then automatically resets to zero at midnight every night.

There's other functionality baked in the Move of course, but Withings keeps it all in the app, freeing

the watch itself to be simple, minimalist, and easy to read. That means the fitness tracking never gets in the way of the timekeeping, and this is a device you'd be happy to use to replace your existing watch, rather than merely supplement it.

Fitness tracking

So beyond how it looks, what does the Move actually do? The core fitness tracking is the previously mentioned step counter, which is the only bit of data that sits on the watch itself. The Move will record your steps during the day and sync that data with the accompanying Health Mate app, which lets you change your daily goal, get more detailed information on your days steps, and look at historic data.

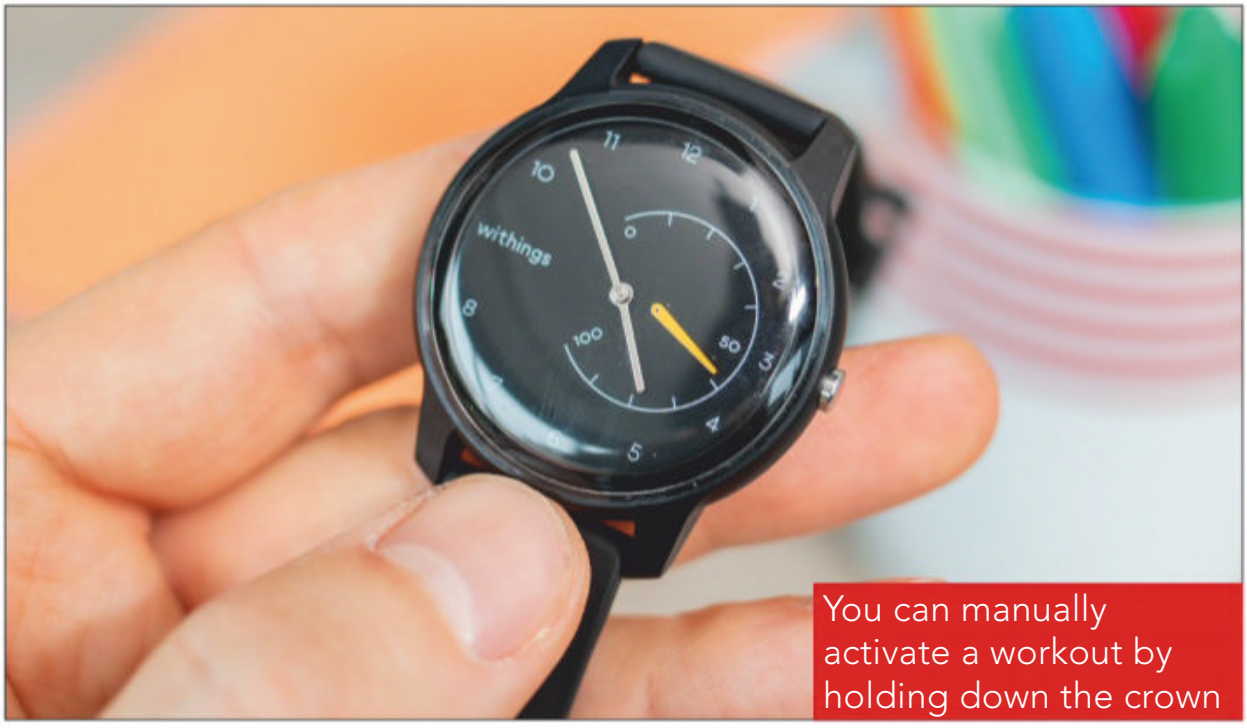
Automatic exercise detection means the Move will track your walking, running, cycling, or swimming by default, but you can also manually activate a workout

The Move will record your steps during the day and sync that data with the accompanying Health Mate app

mode to track those or other activities, running from tennis and squash to yoga, and even windsurfing.

Holding down the crown for a second begins the workout, resetting both dials to zero. The regular watch hands then become timers, recording how long you've been exercising, while the step counter displays only your steps during that period. Holding the button again ends the workout, while a quick double-tap lets you see the time and your overall step count before returning to the workout.

Head into the app after you're done and you'll find a recording of the duration, distance and pace (if applicable) and an estimate of your calorie burn – though without a heart-rate sensor you should definitely take this with a pinch of salt. As long as you keep your phone with you you'll also get a map of your route on a run/walk/cycle, driven by the phone's GPS.



You can manually activate a workout by holding down the crown

The Move won't just track your activity though – it's also great at inactivity. Wear it overnight and it'll track your sleep, giving you info on the duration and depth of your rest. It then factors in how regular your sleep schedule is to give you a daily 'Sleep Score' along with feedback on how you can improve it.

You can also take advantage of sleep monitoring for your alarm – you can use the app to set an alarm window, and the Move will try to detect the optimum moment in your sleep cycle to nudge you awake.

You can link the app up to the likes of Google Fit or Apple Health, along with more specific apps like RunKeeper or MyFitnessPal, so it's easy enough to keep all your health data connected. Data should in turn sync from the Move to your phone automatically every few hours, but this seemed a little shaky on my Huawei P30 – though opening the app forces a sync, so as long as you keep an eye on the app every now and then you shouldn't lose any data.

I've already mentioned swim tracking, but in case that didn't give it away, the Move is waterproof. It should be able to survive up to 50m depth – so it'll definitely survive a few laps in the pool or a shower. Pressing the crown underwater breaks the seal and risks damaging it though, and prolonged saltwater exposure isn't good for it either.

There's one final edge that the Move has over most of its rivals: battery life. Forget counting in days or even weeks, the Move is expected to last a whopping 18 months at a time, so you really won't ever have to think about charging it or worrying about it dying. The downside is that it uses a standard CR2430 watch

battery, and to replace it you'll probably need to go to a jeweller or watch shop – especially since botching the job yourself could accidentally ruin the waterproofing.

Verdict

The Move is a slick fitness tracker from Withings that's ideal for anyone who wants to keep things simple. It only does the basics, but it does them well, and the analogue form factor keeps things clean and easy to read. The 18-month battery life is obviously a major selling point, and the customizable designs are a big appeal, too. A heart-rate sensor would really seal the deal, but it's an understandable omission at this price point, and with waterproofing, sleep tracking, and great app support, everything else about the Move is easy to love. Dominic Preston

Specifications

- Battery life up to 18 months
- Compatible with Android (6.0 and higher); iOS (iOS 10 and higher)
- Water resistant to 50m
- 195x38x13mm
- 32g

Best camera phones

Being able to take decent photos is a must for smartphones. We put the best handsets through their paces. JIM MARTIN reports

Cameras are among the most important features of a smartphone for many buyers. After all, their phone is their camera, so their quality can be the deciding factor in opting for one model over another. And given that most phones – especially flagships – are otherwise very similar in terms of performance and screen quality, photography and video is where manufacturers can differentiate their offering from rivals.

Our aim with this comparison is to reveal which phone has the best cameras for taking photos, videos and selfies. You won't find every flagship phone here, as we're including only those which have cameras good enough to be called 'the best'. That isn't determined by specs or features, it's judged by the quality of the photos and videos they produce.

How we test

Rather than using controlled conditions and attempting to compare the cameras scientifically, we took photos and videos just as anyone would. That means using the default settings out of the box and taking pictures hand-held, not with a tripod.

The only settings we changed were to turn off any beauty modes on the selfie cameras, and to choose the highest resolution and frame rate for the video samples. Most manufacturers make 1080p at 30fps the default setting because it uses so much less storage space, but this is far from the best quality available: all the phones here will record in 4K.

Camera tests

We've kept the comparisons to the core functions: photos with the main camera (including portrait modes with blurred backgrounds), selfies and videos. Extra modes, or the lack of them, have no impact on our verdicts.

Camera apps

The experience of taking photos is almost as important as the results, so the stock camera app is a key factor

in our reviews as this can make the difference between a phone that's a joy or a pain to use as a camera.

Subjectivity

Our hope is that you end up with a very good idea of how each phone's cameras perform in the real world, but judging image quality is inherently subjective. Some people prefer processed images which are sharpened and have saturated colours, while others prefer a more natural look. Plus, the screen on which you view the photos and videos has an influence, too.

That's why we've uploaded the original files from each phone so you can view the full-size photos and videos and decide for yourself – bearing in mind your own priorities – which phone you should buy. We'll provide the link in each review.

Specifications

	Google Pixel 3/3 XL	Huawei P30 Pro	Samsung Galaxy S10+	Xiaomi Mi 9
Rear camera(s)	12.2Mp	40Mp, 20Mp (wide), 8Mp (5x zoom), Depth	12Mp + 16Mp (wide), 12Mp (2x zoom)	48Mp + 16Mp (wide), 12Mp (2x zoom)
Front camera(s)	8Mp + 8Mp wide	32Mp	10Mp + 8Mp	20Mp
Video (highest quality)	4K at 30fps stabilized	4K at 30fps stabilized	4K at 60fps not stabilized	4K at 60fps not stabilized
Special features	Top shot, Super Res Zoom, Night Sight	Night mode, light painting, 960fps slo-mo, Cinema AI	960fps slo-mo, HDR10+ video	Night mode, light effects

Drawing conclusions

Rather than judge the photos by viewing them on each phone's screen independently, we opened in them in Photoshop on a calibrated Philips Brilliance 272P. This is a 27in 4K display which allowed us to see all the detail in 4K video. Bear in mind that your own display may have a lower resolution, and may not produce accurate colours.

Best camera phone

Winner: Huawei P30 Pro

The P30 Pro has the best cameras of any phone right now. The main rear camera is simply amazing, able to take fantastic photos even in very low light. The other cameras can't match it for quality, but add huge versatility. The ultra-wide camera is great when you're shooting indoors or for landscapes, but it's the 5x optical zoom that impresses most.

Like every phone here, the P30 Pro isn't perfect: the screen has a lower resolution than we'd like for the price and the mono speaker feels like a step backwards. Video quality is improved, but still lags behind the best (Xiaomi Mi 9). But if you can live with those things and you take more photos than videos, the P30 Pro will not disappoint.

Runners-up

Although we didn't include it in this round-up, Huawei's Mate 20 Pro is almost as good, and if you're not bothered about a zoom or a wide-angle camera, Google's Pixel 3 and Pixel 3 XL delivers sharp and detailed pictures.

Xiaomi's Mi 9 easily deserves to be in this comparison, and is capable of fantastic photos and stunning video.

And it's no surprise to see the Galaxy S10+ as our new favourite from Samsung: it's the first to sport a triple rear camera, so bests the S9 if you're keen to have a wide-angle as well as telephoto lens.

Also consider

The models mentioned above are the best, but if you can't justify buying a flagship phone, here are some cheaper alternatives that we've tested and been impressed by:

- OnePlus 6T
- Samsung Galaxy S9
- Honor View 20

Samsung's Galaxy S9 is a good alternative if you are looking for a cheaper model

- Google Pixel 2
- Huawei P20

1. Huawei P30 Pro

Price: £899 from **fave.co/2I5D3Yp**
Test images: fave.co/2Wdlv6y

Huawei is now in a leading position for smartphone photography, having changed opinions with the impressive P20 Pro and then the building on that success with the Mate 20 Pro.

The P30 Pro steps it up another notch with a 5x optical zoom using a periscope arrangement. It then adds a fourth camera that's dedicated to detecting the depth of objects in the scene. One of the advantages of the system is that the P30 Pro is able to use its main camera for portrait photos and therefore offers the

It's impossible not to be impressed by the detail the P30 Pro can capture

same field of view. Most of its rivals zoom in which, while not a damning problem, can be a bit irritating.

However, it's the zoom capabilities that really set the P30 Pro apart. If you think a 2x telephoto lens is adequate, you'll quickly change that opinion once you've use the P30 Pro's 5x lens.

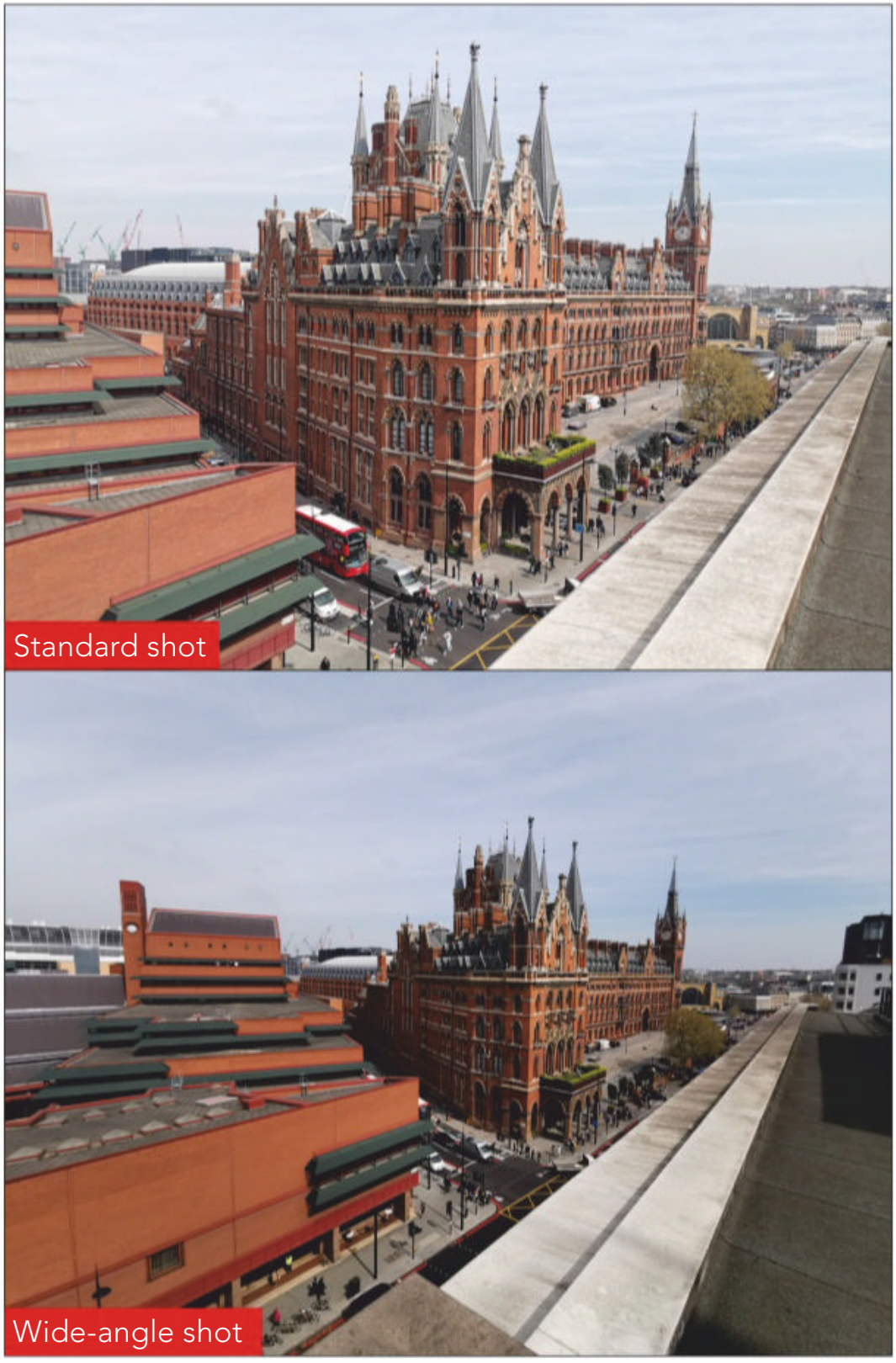
As before, there's a hybrid mode that uses the extra detail available from the main 40Mp sensor along with the 8Mp sensor behind the periscope lens to offer what Huawei terms 'lossless 10x zoom'. It's a different way of doing things than Google's Super Res Zoom. We think it's more effective, but it's obvious just from looking at the photos at 1:1 in Photoshop that it is not lossless.

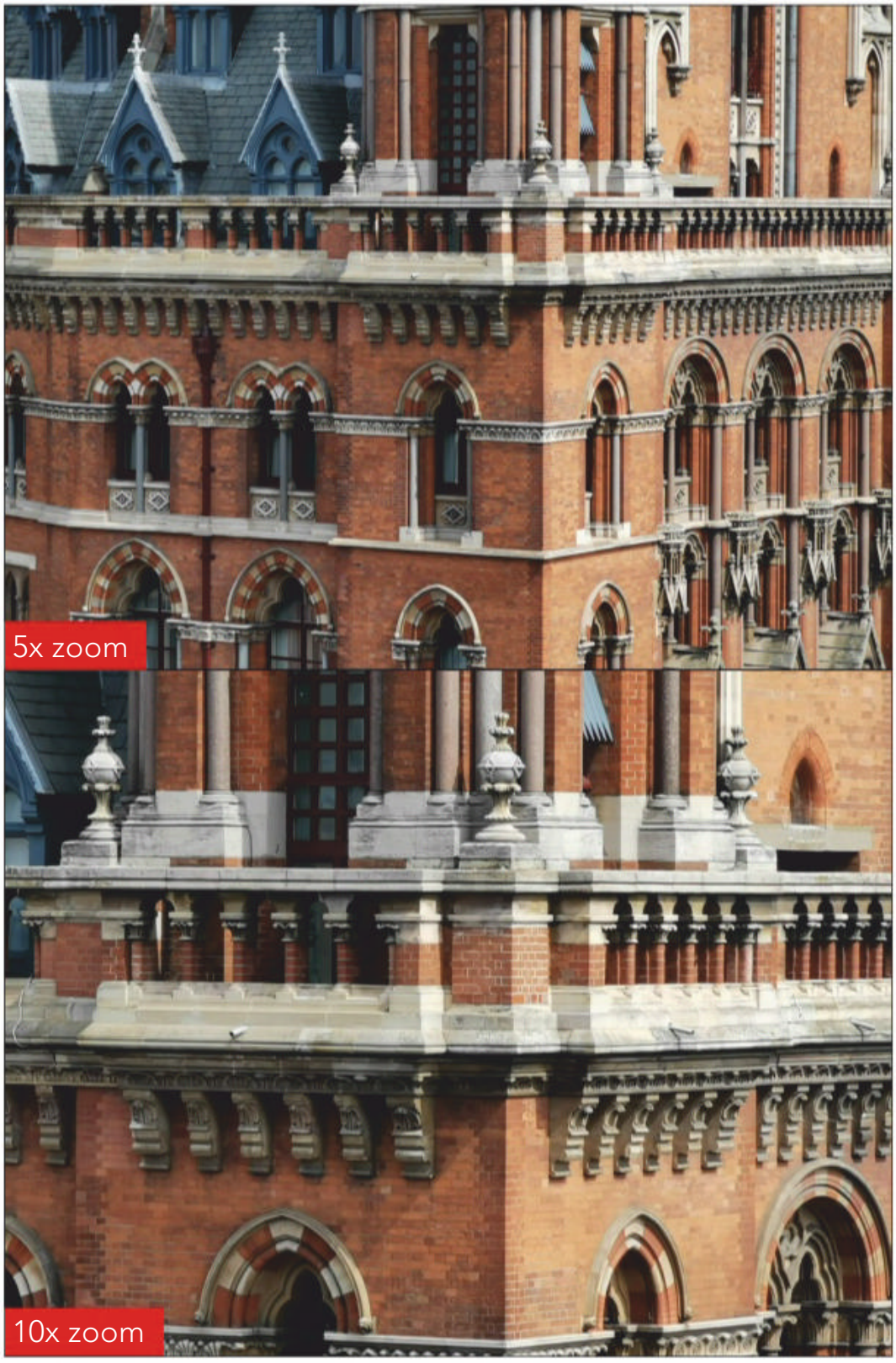
Close scrutiny aside, it's impossible not to be impressed by the detail the P30 Pro can capture. In our sample shots, we use St. Pancras Renaissance Hotel (see overleaf) and there's a surprising amount of detail and clarity in the 10x photo. Even at 5x, the P30 Pro blows everything else here out of the water: there's simply no contest from the 2x zooms.

What's even more impressive is when you consider the range on offer, from the 16mm equivalent ultra-wide-angle lens to the 125mm equivalent 5x telephoto: no other phone is that versatile.

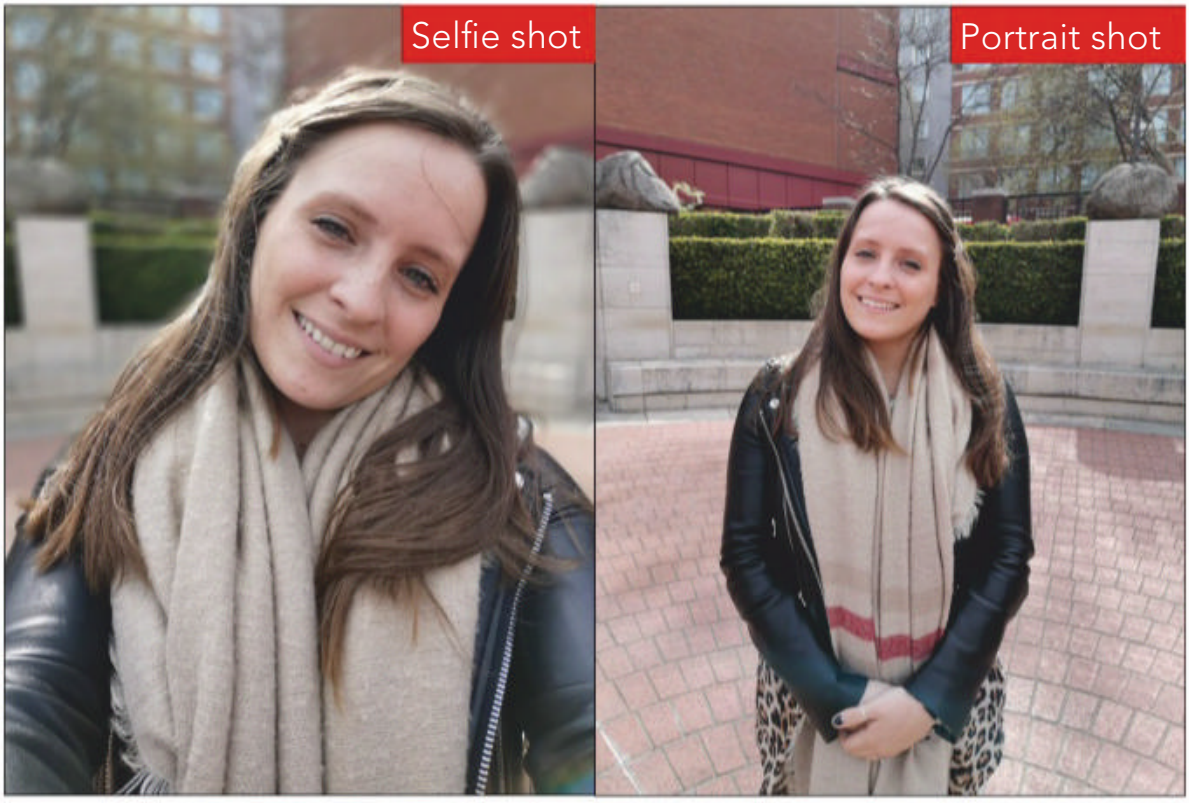
By default, Master AI – the 'artificial intelligence' image processing – is switched off, and for the most part you'll probably leave it that way. There's still a tendency to over-saturate everything when it's on, but not to the extent that it did on the P20 Pro.

What we haven't even talked about yet is the upgraded 40Mp 'Super Sensing' camera. Huawei


Standard shot
Wide-angle shot


5x zoom
10x zoom


Low light shot
Night Mode low light shot
Night shot
SAY CHEESE!
SAY CHEESE!



ditched the traditional RGB sensor for one with two yellow sub-pixels instead of green. That's because yellow is more sensitive to light and it makes the sensor able to capture 40 percent more light.

So in addition to taking sharp, detailed images during the day, it's possible to shoot astounding photos in the dark, even if you have shaky hands. The Night mode works in a similar way to the P20 Pro's, combining a selection of photos taken over a period of 8 seconds. So, yes, we've seen it before (and the Pixel 3 brought us Night Sight). However, the super-high sensitivity means you can get colourful images even when it's almost pitch black. Frankly, it's magic.

The main camera is the one to use for the majority of the time as it delivers the best photos. On the sample

phone Huawei provided for this test, photos from the ultra-wide camera had noticeably different colours to those from the main and telephoto cameras, being darker and more saturated.

That's most annoying when you're shooting video and you switch from the main camera to ultra-wide, as the colours visibly shift.

The Apple-like camera app is easy to use, but is packed with a few too many settings and features. One feature we wish it had was auto HDR. But no. Even though Huawei has improved the HDR mode on the P30 Pro, it remains a separate mode of its own which you have to switch to manually. And so, for the vast majority of the time, you won't use it – a shame as it's very good.

The P30 Pro is Huawei's first phone to offer stabilization in 4K, but there's still no option to record it at 60fps. Video quality is very good (see **fave.co/2Wqd1Z2**), with lots of detail and good stereo sound. Stabilization isn't great in 4K, sadly, so you may want to stick to 1080p or invest in a phone gimbal.

As if 24Mp weren't enough for the front camera, Huawei has upgraded it to 32Mp on the P30 Pro. And it does take a good selfie, but we couldn't see a whole lot more detail than the P20 Pro's 24Mp camera. Look up close and details are smeary (see **page 47**), as you tend to see when there's heavy noise reduction going on, but it's possible there's some 'beauty' processing even when the slider is set to zero as it was for the selfies we took here.

So, the P30 Pro isn't perfect: the ultra-wide and zoom cameras each have their flaws. But overall the

versatility and fact that you can zoom in and get detail where other phones can't, as well as shoot in impossibly low light makes this our pick of the bunch.

2. Samsung Galaxy S10+

Price: £899 from **fave.co/2WyVsG0**
Test images: fave.co/2I6wtAP

The S10+'s cameras are quite different from the S9+'s. Instead of minor tweaks, Samsung has added a third camera to go with the 12Mp main and 12Mp telephoto ones. It's an ultra-wide one with a 16Mp sensor, meaning the S10+, and regular S10, which shares the same rear camera setup, now have a bigger range than ever before.

The main camera is basically the same as you'll find in the Galaxy S9. Its iris can switch between two

The Galaxy S10+'s cameras take wonderful pictures in good light


Standard shot
Wide-angle shot

apertures: f/1.5 (bigger) and f/2.4 (smaller). That's useful as it can open up to let in more light at night, and close up in bright light to offer sharper photos.

The telephoto camera is also the same, with a 2x zoom and optical stabilization. The newcomer gets a 16Mp sensor and a wide-angle lens which is the 35mm equivalent of 13mm with an f/2.4 aperture.

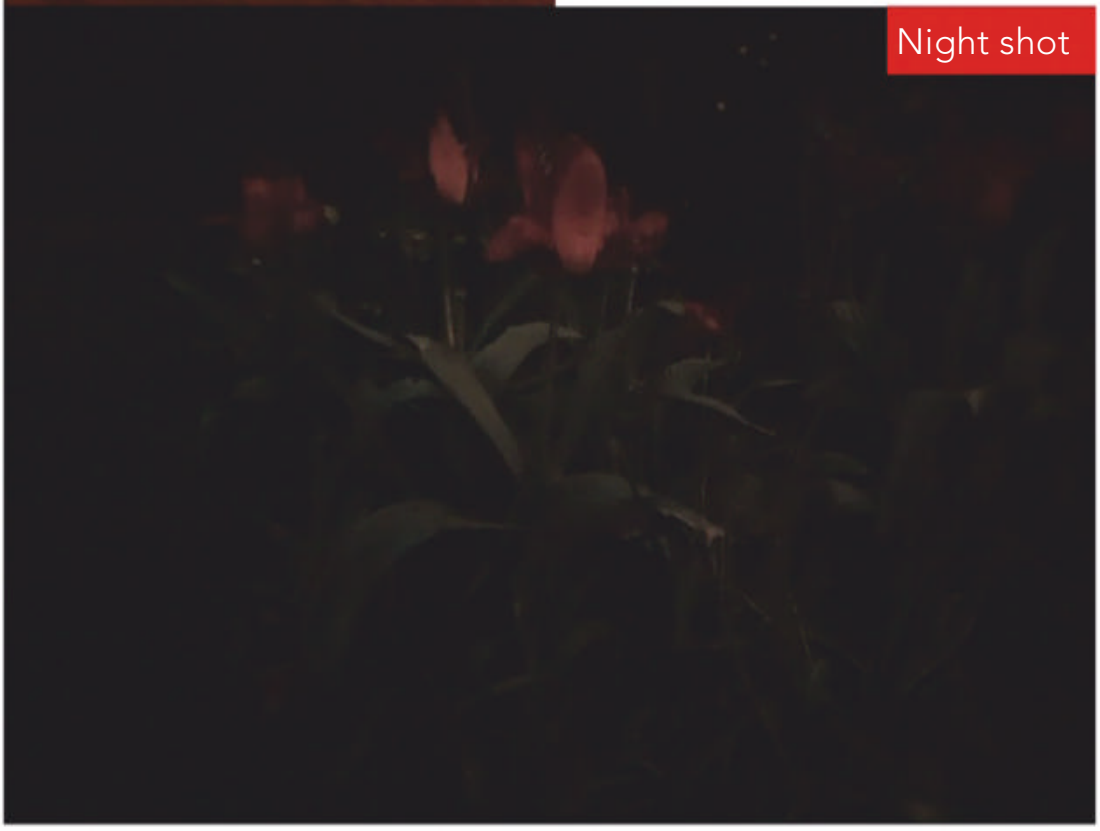
Given how good the S9's cameras were, it's no surprise to see similarly good quality from the S10+'s photos. They have great dynamic range, so there's lots of detail in both shadows and highlights. Auto HDR means you don't have to think about whether you need to enable this setting or not.

White balance is generally reliable so colours are very good in just about all lighting except when it's

Low light shot

really dark. Zoom in on a big screen and there's a lack of sharp, fine detail, but this is a minor complaint. You won't notice the effect of the variable aperture, as it'll mainly stick to f/2.4 in daylight.

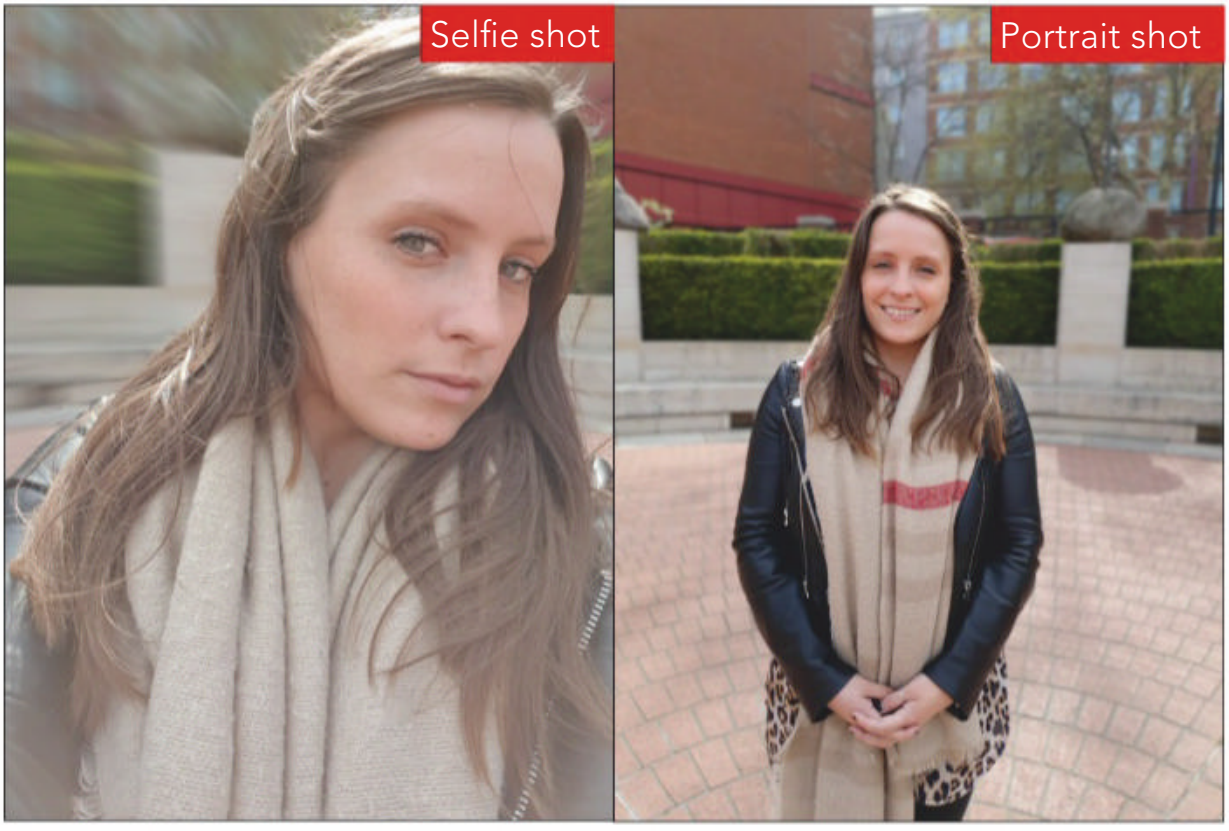
The 2x zoom works well enough but obviously can't compete with the P30 Pro's 5x lens. As with the main camera, exposure, white balance


Night shot

and colours are very good. Images shot with the ultra-wide camera obviously lack detail when you zoom in, but there's no obvious drop-off in sharpness as you often find at the edges of the lens.

In portrait mode, the S10+ uses the same field of view as the main camera, and does a good job of depth detection. There's a more realistic gradient to the blurring from foreground to background that makes the S10's portrait photos more convincing than from other phones. But it still can't adequately isolate wisps of hair, as any close examination will reveal.

For video, the S10+ offers great stabilization in 4K, but not if you choose to record at 60fps. However, you're no longer limited to five minutes per clip as with the S9. Another upgrade from the S9 is a beta option to



record video at up to 4K at 30fps in HDR10+, which is great if you have a TV that supports this standard. Just viewing HDR video on the S10+'s screen, the difference was obvious to see with better contrast and colours. You can see our test video at **fave.co/2Mfgg1z**.

The camera app uses the same format as most others, so you swipe between the various modes. Usefully the settings allow you to customize which modes are shown, so you can remove 'Food' and others that you don't use.

Where the S10+ struggles is in low light. There's no night mode and no hand-held long exposure mode. This means you'll end up with blurry photos if you select a long shutter speed in the Pro mode, although if you're determined you could use a tripod.

The dual front cameras could easily be mistaken for a standard and wide setup as on the Pixel 3, but the right-hand lens is purely for depth detection. There's an option for a wide selfie, but it's nothing like the difference you get with Google's phone.

Selfies are pretty good, though, and the depth camera certainly seems to improve subject isolation. There are various modes available in the 'Live Focus' mode, including Zoom, which we used for the portrait selfie in the gallery here.

Overall, the S10+ has excellent cameras. It takes wonderful photos in good light which are on a par with the best here. Its strengths include great portrait modes for both front and rear cameras, and great video stabilization (plus the capability to record in HDR10+). The zoom is much more limited than the P30 Pro's, as are the S10+'s low light capabilities.

But if you prefer to buy Samsung rather than Huawei, the S10 and S10+ are fine choices.

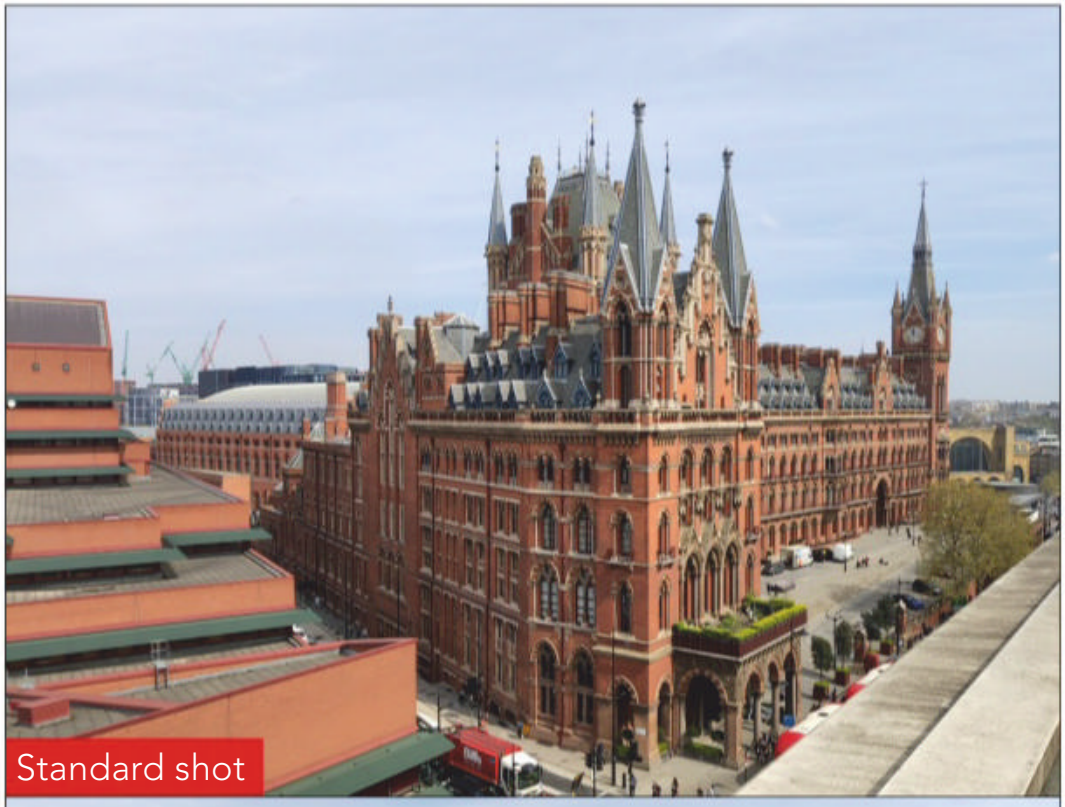
3. Xiaomi Mi 9

Price: £499 from **fave.co/2I4hG9Q**
Test images: fave.co/2I8bltM

Xiaomi has been playing catch-up to Huawei for a while, but in the Mi 9 it has produced something special. This is a phone that can compete with Huawei's best, as well as Samsung and Apple. The same is true for the Mi 9's cameras.

The triple rear setup is a first for Xiaomi. It's very similar to the Galaxy's S10+'s with an ultra-wide camera and 2x telephoto, but the 48Mp main sensor steals the show. This works in the same way as Huawei's 40Mp sensor: it uses a pixel-binning technique where a group

The Mi 9's cameras are highly impressive



Standard shot

Wide-angle shot

Telephoto shot

of four pixels are treated as one, with colours averaged across them (and other information) to produce a top-quality 12Mp photo.

And you need only look briefly at those photos to see that the Mi 9 is capable of fighting it out with the big boys. Exposure is spot on, colours are natural (white balance is generally reliable) and detail is very sharp. It's only when you really zoom in examine photos in Photoshop that it becomes evident that fine details are slightly soft compared to the P30 Pro, but this is a very minor complaint.

What's arguably more impressive is that the Mi 9's photos are better than Apple's iPhone XS's. Thanks to that high-res sensor there's more detail and noise is kept under better control, especially in low light.

Low light shot

Night Mode low light shot

Selfie shot

Portrait shot

Night shot

The Mi 9's telephoto lens is also better, resolving more detail than Apple's. We're particularly impressed by the Mi 9's portrait mode, which does a brilliant job of isolating the subject from the background for convincing bokeh. Plus, you can adjust the effect when editing a photo in the camera roll, just as you can on an iPhone XS.

Another of the Mi 9's strengths is video (see **fave.co/2I51Hs2**). It defaults to the usual 1080p30, but you can change this to 4K at 30fps or even 4K at 60fps. You won't see any messages about features that are disabled when you do this: the stabilization option remains active even at 4K at 60fps.

However, we found that it was pretty ineffective in that mode, but at 4K at 30fps you can expect excellent

results: smooth, detailed footage with very little noise. Autofocus performance is exemplary and changes in exposure aren't jarring. Stereo audio is pretty good as well and has decent dynamic range.

Xiaomi's camera app is intuitive to use. There are a couple of extra modes, but the Night mode isn't up to much when it's really dark. In very low light it will take a long exposure, but the results are unimpressive: it can't compete with the P30 Pro or Pixel 3. However, in moderately low light, there's a noticeable improvement as you can see in the shot of our scene-in-a-cupboard where there's a lot more detail in Batman's costume and a lot more shadow detail.

Round the front is a 20Mp selfie camera. It captures plenty of detail and even does a good job of portrait photos, again with very good isolation of subject and background.

Overall, the Mi 9's cameras are highly impressive. The zoom isn't as capable as the P30 Pro's and it isn't as good in very low light but if the Mi 9 takes your fancy (especially its low price), then you won't be disappointed with its photos or video.

4. Google Pixel 3

Price: £739 from **fave.co/2WahEHq**
Test images: fave.co/2I9upYI

The Pixel 3 and Pixel 3 XL have the same cameras. Although the hardware isn't that fancy, with just one rear camera, don't make the mistake of thinking it's no good. Far from it. With Google's 'Computational Photography' and the Visual Core chip there's a lot of

The Pixel 3's main camera takes outstanding photos

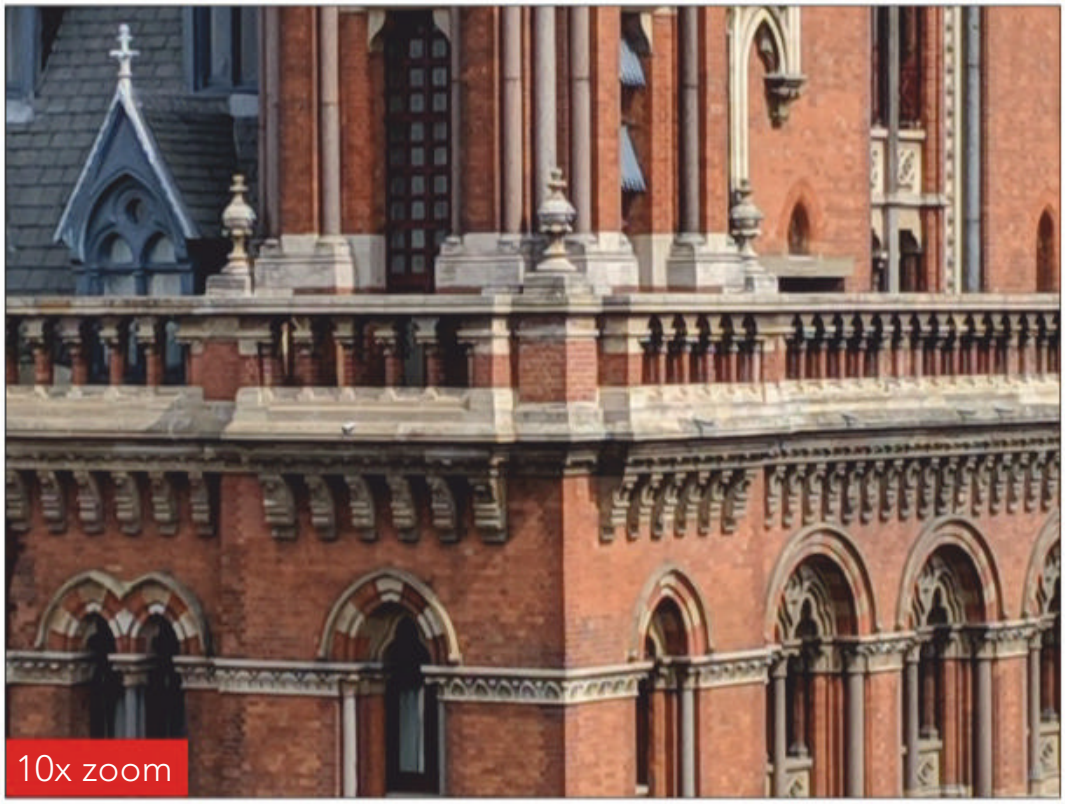
clever processing which makes for some great-looking photos and videos.

Starting with the hardware, the main camera still has a 12.2Mp sensor, a Sony IMX363. There's no laser focus (as the Pixel 2 had), but phase detection is used to good effect: auto focus is still very fast even in dim light.

Software features are the highlights here: Super Res Zoom, Night Sight and Top Shot. Super Res Zoom takes several photos and uses the slight differences along with Google's computing power to intelligently create pixels for a better-quality photo than mere interpolation would create.

Night Sight works in a similar way to create a correctly exposed image rather than one which is too dark. The exact technique hasn't been revealed but the results speak for themselves. It's possible to get some


Standard shot
Super res shot



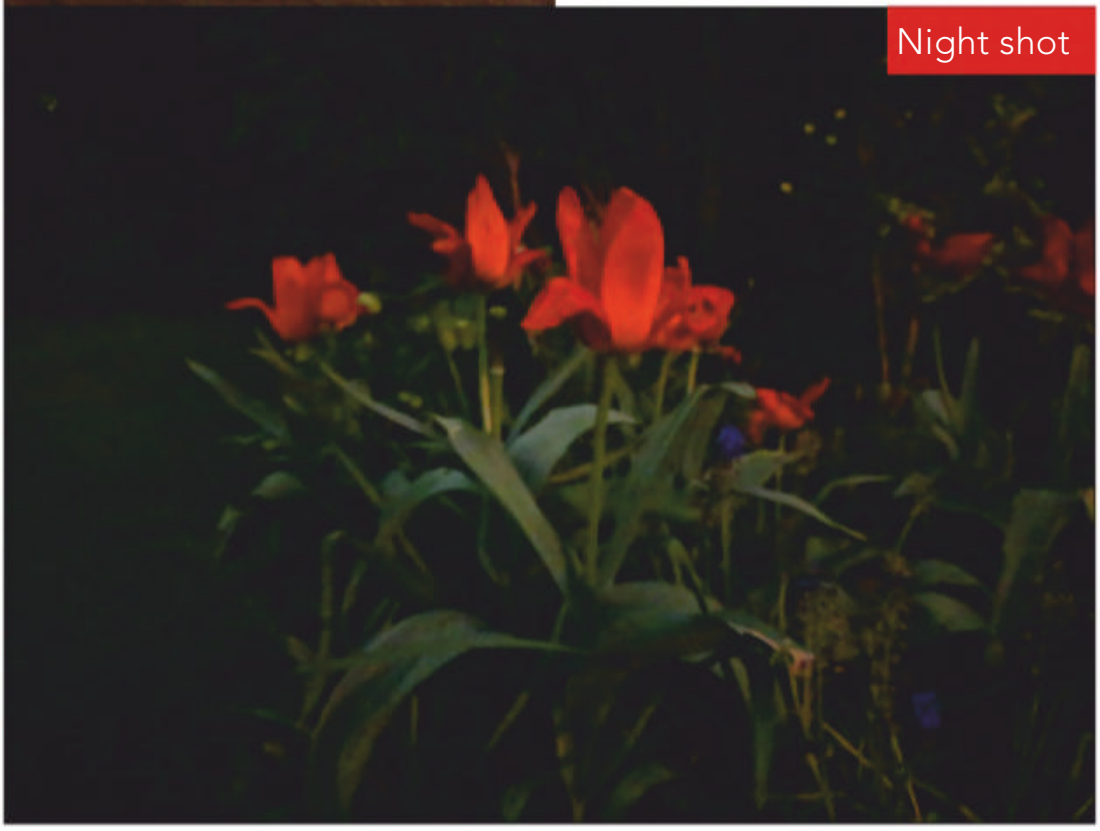
fantastic results in dark conditions so long as there's no movement in the scene beyond your shaky hands.

Top Shot shoots a series of photos and automatically selects the best one and eliminates any where a person's eyes were shut or not smiling. And it works really well. It doesn't always trigger, though, even if you think it should have.

In good light, the Pixel 3's photos are just as amazing as you'd expect. Detail is crisp, white balance excellent and – thanks to HDR+ – dynamic range is impressive. Despite the single camera, portrait shots are very good and the blurry backgrounds look authentic, with subject isolation generally accurate. It is easy to spot errors, though, and a trained eye will immediately know it's 'faked'.

Low light shot

For all the software smarts, the Pixel 3 now lags behind its rivals, which are sprouting more lenses than ever before. Super Res Zoom works as advertised, but only to a point. It isn't quite up to the standard of phones with a 2x optical zoom and certainly can't compete with 5x periscope lens on the P30 Pro (nor, indeed, the 3x telephoto on Huawei's



Night shot

P20 Pro and Mate 20 Pro). And, of course, it lacks a wide-angle lens for landscape shots, so you'll have to use the panorama mode.

The camera app is a pleasure to use. But the slider doesn't tell you the zoom factor, so we've approximated a 2x zoom, as well as 5x and 10x to match the P30 Pro. In these shots, the deficit becomes obvious where the brickwork of St. Pancras Renaissance Hotel becomes a blur.

Since the Pixel 3 isn't noticeably cheaper than its rivals, we can't help but wish Google had spent the money invested in Super Res Zoom on a second sensor and lens.

In fact, Google did spend go for an extra sensor and lens, but it's on the front. This is no doubt because

plenty of people now take more selfies than anything else. So in addition to the standard selfie camera there's also a wide-angle one. Both have 8Mp sensors, but with the great image processing that's enough detail for good-looking photos.

You don't choose which camera to use: there's a zoom slider that goes from wide-angle to zoomed-in and portrait mode works at any point in the range. The wide angle setting is great for group photos, but it does make the Pixel 3 better suited to people who prefer to take selfies rather than pictures of others.

Video capture is exactly the same as the Pixel 2, shooting 4K at up to 30fps. Stabilization is a combination of electronic and optical and works at all resolutions. It's a shame that 60fps isn't available at 4K and that Google still hasn't improved the slo-mo options: you're still limited to 120fps at 1080p and can only shoot 240fps at 720p. However, the Pixel 3 does gain a flicker sensor, which eliminates the shimmering effect you get from indoor videos shot under artificial light. You can see our test video at **fave.co/2WesUSR**.

There are benefits of buying the Pixel 3 including the fact that you get free, unlimited storage on Google Photos for photos and videos at full, original resolution. This lasts until 31 January 2022, and could save you a fair amount on cloud storage.

Although you can criticise Google for certain decisions about the Pixel 3's cameras and capabilities, the main camera takes outstanding photos. If you don't want or need the extra cameras and features available on other phones, the Pixel 3 is still a great choice for photography.

Who should buy Intel's 10th-gen CPU in a laptop

For some people, an existing 8th-gen laptop will be just fine. GORDON MAH UNG reports

With Intel's 10th-generation Ice Lake CPU finally here, you may be wondering whether to wait for laptops to come out with the new CPU, rather than buy an existing model with an 8th-gen CPU (Note: Intel's 8th generation offers a full range of mobile CPUs, while the 9th generation offers only high-end 'H' mobile parts). We'll walk you through the

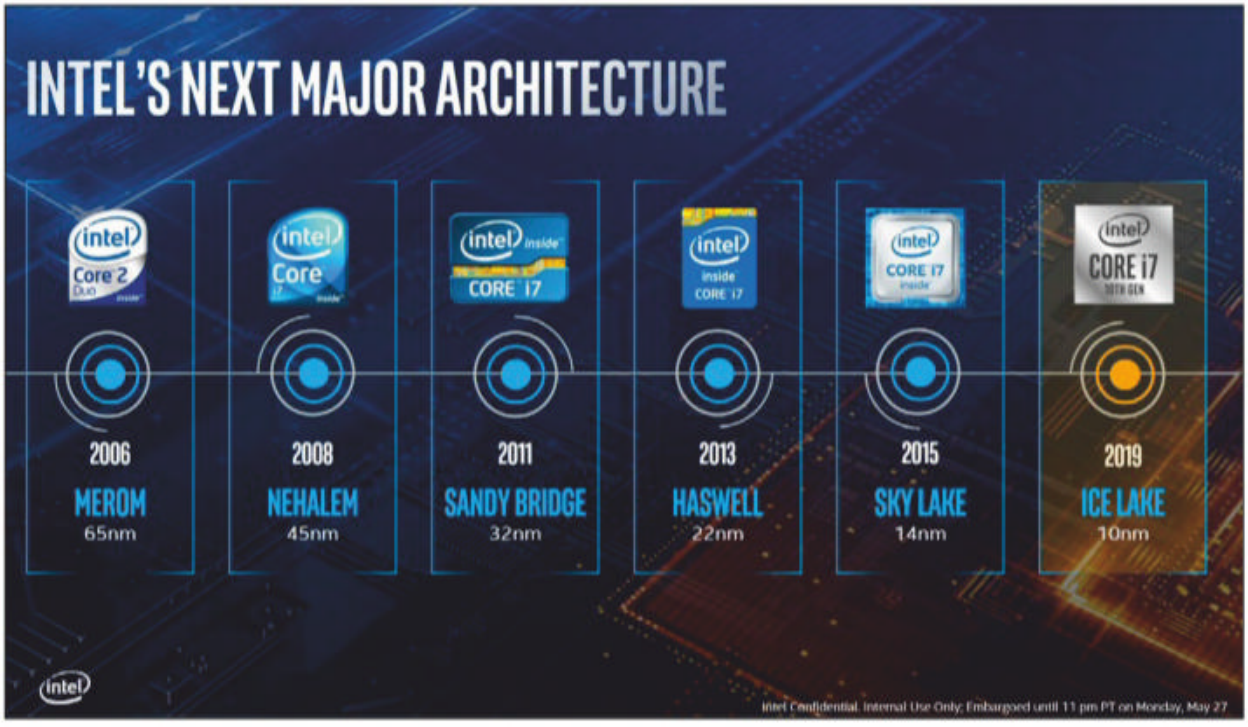
reasons why you'd want to wait for a 10th-gen laptop, and five reasons why you don't have to.

5 reasons you should wait for Intel's 10th-gen Ice Lake CPU in your next laptop

We know, you want shiny new things. And you know what? The shiny new thing in laptops are Intel's new 10th gen-chips. Here are five reasons why it would be worth it to wait.

1. It is actually new

With its 10th-generation CPU, Intel moves to a 10nm process. This has been a long time coming: Intel's chip architecture has been stuck on 14nm since 2015's Sky Lake 6th generation. In the image below from Intel, the company actually shows the 6th-gen Sky Lake chip as the last major advance, tacitly admitting that



7th-gen, 8th-gen, and 9th-gen CPUs were rehashes to some degree (even though each brought some incremental advances, especially the 8th generation). If you like to latch on to the newest thing, Intel's 10th-gen Ice Lake chips are it.

2. It is going to be faster for applications

The Sunny Cove cores in the 10th-gen chips are 'faster, wider' (according to Intel) and basically increase the IPC (instructions per clock) by roughly 18 percent over the cores used in the previous 8th-gen chips. Add to that a new Dynamic Tuning 2.0 feature that more efficiently manages the Turbo Boost capability, and the 10th-gen chips are easily going to outpace previous chips despite running at slightly lower clock speeds.

3. It will have Thunderbolt 3 and Wi-Fi 6

In one of the biggest integrations since Intel stuffed graphics into the 2nd-gen Sandy Bridge CPUs, Intel said it has included Thunderbolt 3 in its 10th-gen CPUs. This hasn't been the case up to now: Thunderbolt 3 support has been an option available to laptop makers via a discrete Thunderbolt 3 controller from Intel. With 10th-gen chips, users get the feature, while PC makers save on cost and space inside the laptop.

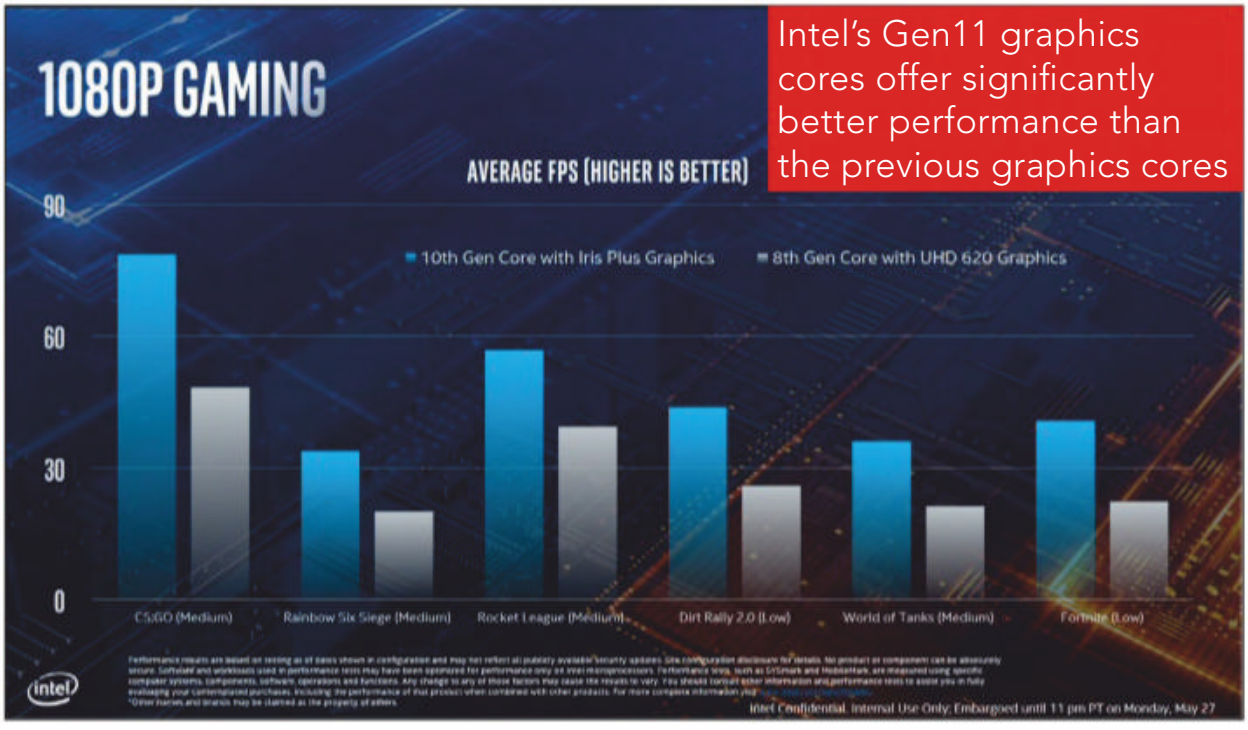
The other real nice icing on the cake is that 10th-gen laptops will likely all have Wi-Fi 6, the wireless networking standard formerly known as 802.11ax. As our *Macworld* colleague Jason Cross writes, the new standard should give you much faster speeds at 2.4GHz, with better juggling of multiple devices. It supports the 5GHz operating frequency as well. If

you're going to build out your home with a new Wi-Fi 6 router system, you'll feel pretty burned with your pathetic Wi-Fi 5 laptop that can't use it.

4. It finally supports faster (and more) memory

A very welcome change with Intel's 10th-gen chips is support for LPDDR4X RAM. The obvious improvement is about 50 percent more memory bandwidth, which will aid everything from application performance (a little) to games (a lot).

The other real benefit will be the amount of memory. The current LPDDR3 memory limits both memory bandwidth and memory amount – laptops that use it max out at 16GB of RAM. While that's plenty for most people, those editing photos or using large memory-footprint applications will finally be able to add more RAM with the move to LPDDR4X.



Intel's Gen11 graphics cores offer significantly better performance than the previous graphics cores

5. It will be significantly faster for gaming

Intel's integrated graphics have been the butt of gamer's jokes for years, but the reworked graphics cores in the 10th-gen chips take a big step forward. Intel says the new Gen11 graphics in the 10th-gen CPUs can hit 1 teraflop of performance and is capable of 1080p gaming. With its support for VESA Adaptive Sync, gaming on 10th-gen parts should be far smoother, too.

Laptops also won't need embedded DRAM to get the highest graphics performance. Intel says Gen11 can outperform previous Iris Plus graphics without the use of eDRAM.

5 reasons you don't have to wait for Intel's 10th-generation CPU in your next laptop

We've just given five good reasons to wait for a 10th-generation CPU in your next laptop, but the 8th-generation family is hardly obsolete. Here are five reasons you could still buy a laptop with an 8th-gen CPU, with no regrets.

1. 10th gen is faster, but not that much faster

With their increased efficiency and smarter use of Turbo Boost, Intel's 8th-gen CPUs are pretty spectacular. The 10th-gen chips will be faster, but probably not enough for most people to tell the difference. Its fancy new AI performance offers an advantage only in apps that can use it. The encoding will be much faster only if the software supports it. For the average user buying an ultrathin laptop to drive Office or a web browser, the difference between an 8th- and 10th-gen laptop will

mostly be incremental. It's not the quantum leap we saw with the change from 7th- to 8th gen, where you doubled the amount of CPU cores.

2. Gaming is better, but it's not a gaming laptop

Graphics performance on the new 10th-gen cores are indeed a big step forward for integrated graphics. Adaptive Sync support also helps by smoothing out less-than-ideal frame rates. Unfortunately, these big improvements don't mean 10th-gen laptops can suddenly game. Far from it. In fact, if you look again at the '1080p Gaming' chart on **page 70**, the performance will probably be far worse with newer games. We're not being haters, but if you want to play games on a thin, light, 10th-gen machine, learn how to use an external GPU with a laptop for far better results.

3. Laptops will be pricier

If you're driven by a deal more than sheer performance, 8th-gen laptops are the better choice at the moment. In the early days, sparse availability will keep 10th-gen prices high. The new LPDDR4X RAM will also add to the cost. When 10th-gen laptops finally roll out in large volumes, you'll see 8th-gen laptops offering discounts and other incentives.

4. Laptops will be hard to get

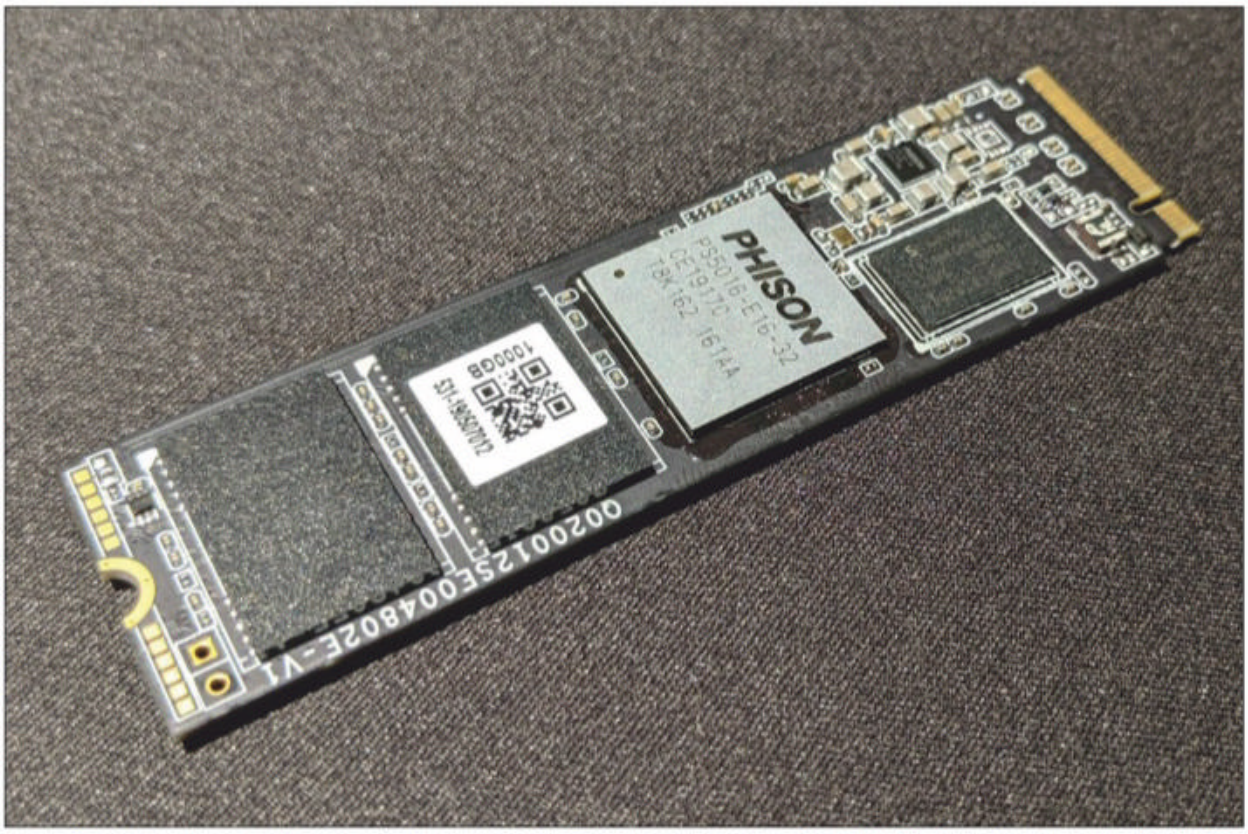
There are two kinds of CPU launches: the kind where the new CPU seems to replace the previous model overnight, and the kind where both live alongside each other in harmony for so long, you're confused as to which one to buy. Like this time. If you have to buy a


In the early days, sparse availability will keep 10th-gen prices high

laptop today for work or school, it'll be far easier and more affordable to get a good 8th-gen laptop.

5. 8th-gen Whiskey Lake laptops are really, really good

Intel's 10th-gen CPUs bring a lot of new advantages, but the current 8th-gen 'Whiskey Lake' laptops are really, really good. They're so good that the move to 10th-gen is going to be incremental for most people. Unless you must always have the newest hardware, or you really live in the edge of performance, buying from today's 8th-gen Whiskey Lake CPUs is not a mistake.



PCIe 4.0: Everything you need to know

AMD's new Ryzen platform ushers in the first big changes to PCIe since 2010. GORDON MAH UNG reports

Come July, AMD gets to hoist the trophy in the race to the next-generation PCIe 4.0 interface for desktop PCs. By combining its upcoming Ryzen 3000 CPUs, Radeon RX 5700 graphics, X570 chipset, and a new spate of PCIe 4.0 SSDs, consumers will be able to build or buy the first PCIe 4.0-based PC.

	RAW bit rate	Link BW	BW/Lane/Way	Total BW x16
PCIe 1.x	2.5GT/s	2GB/s	2500MB/s	8GB/s
PCIe 2.x	5GT/s	4GB/s	500MB/s	16GB/s
PCIe 3.x	8GT/s	8GB/s	~1GB/s	~32GB/s
PCIe 4.0	16GT/s	16GB/s	~2GB/s	~64GB/s
PCIe 5.0	32GT/s	32GB/s	~4GB/s	~128GB/s

PCIe 4.0 sounds exciting – it's the first big change to the interface since 2010. But as always, the questions of who can get it (and who can't), and who really needs it, are more nuanced than you'd think. Keep reading to get the all the details.

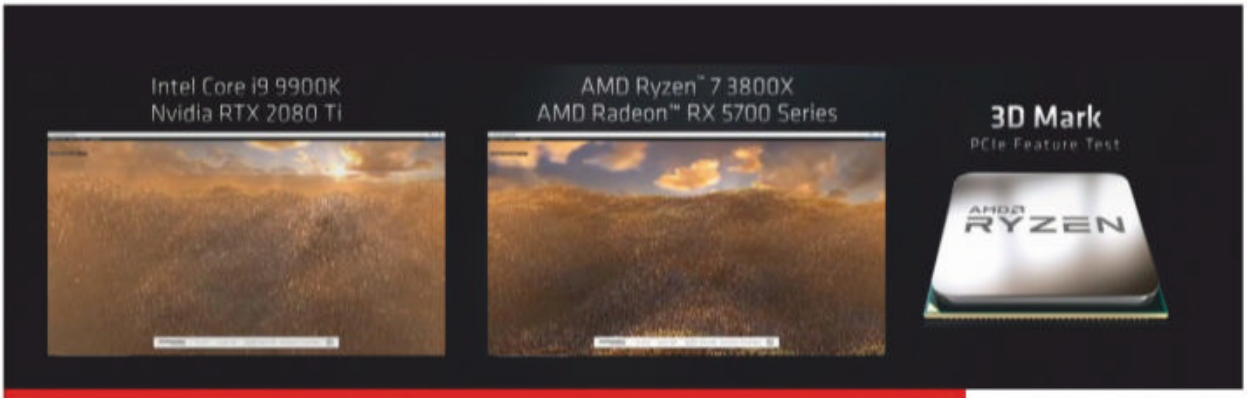
What is PCIe 4.0?

PCIe 4.0 is the next iteration of the PCIe interface. It's used for connecting add-in cards and M.2 drives, as well as interconnecting various chips inside a PC. Compared to its predecessor PCIe 3.0, PCIe 4.0 essentially doubles the overall throughput. The chart above lays it all out nicely.

If that looks like a boatload of bandwidth, it is. Seizing an opportunity to troll Intel and Nvidia, AMD ran Futuremark's unreleased PCIe feature test to show how a Ryzen 7 3800X coupled with a Radeon RX 5700 in PCIe 4.0 mode offered 69 percent more PCIe throughput performance than a Core i9-9900K and GeForce RTX 2080 Ti.

Reality versus hype

One problem with AMD's demonstration, however, is that '69 percent' performance, while most likely real,



AMD's demo featured Futuremark's new PCIe feature test. It showed a PCIe 4.0-based Radeon RX 5700 besting a PCIe 3.0 GeForce RTX 2080 Ti in transfer performance

probably doesn't actually translate into more practical gaming performance today. That's because few games ever saturate the 32GB/s of data today's x16 PCIe 3.0 slot can carry.

This disparity between demand and supply has been proven out many times over the years, including recently by TechPowerUp. Alienware's laptops actually limit the slot to x8 PCIe 3.0, siphoning off the rest to support the external graphics port. The reason? It doesn't matter (much).

Storage

PCIe promises a huge boost in other areas of the PC, though. The most obvious one is storage, where AMD also demonstrated the performance difference using solid-state drives. We witnessed a single Gigabyte Aorus M.2 PCIe 4.0 SSD hitting 5GB/s reads and 4.3GB/s write speeds. That's about 35 percent higher sequential performance than we've seen from some of the faster M.2 PCIe 3.0 SSDs.

CrystalDiskMark 6.0.1 x64

	Read (MB/s)	Write (MB/s)
Seq Q32T1	5,014.4	4,266
4KiB Q8T8	1,812.7	2,058.6
4KiB Q32T1	726.1	698.7
4KiB Q1T1	62.31	238.6

A Gigabyte M.2 PCIe 4.0 SSD can push 5GB/s reads and 4.3GB/s writes, a hefty increase over PCIe 3.0 drives

It gets even crazier if you run them in RAID 0, which is what Gigabyte did using a PCIe 4.0 add-in card holding four 2TB PCIe 4.0 M.2 SSDs. You can see the card below with its shroud off. The card is essentially one big passive PCIe extender.

The performance of that card is impressive, at 15.4GB/s reads and 15.5GB/s writes. Compare that to Intel's VROC demo from the Computex 2017, which used eight M.2 x4 PCIe 3.0 drives in RAID 0 on an X299 motherboard. That hit only 11.6GB/s.

CrystalDiskMark 6.0.2 x64

	Read (MB/s)	Write (MB/s)
Seq Q32T1	15,385	15,509
4KiB Q8T8	2,128.3	1,826.4
4KiB Q32T1	2,056	1,742.9
4KiB Q1T1	112.5	143.9

With four M.2 PCIe 4.0 drives in RAID 0, the AMD-based Gigabyte Aorus M.2 RAID card can push 15GB each way

SSD versus GPU

While seeing 15.4GB/s of drive speed is cool, one thing you should keep in mind is that it will involve a small compromise. Note that the card above is a x16 PCIe 4.0 card. Because Ryzen 3000 'only' can support a single-slot x16 PCIe 4.0, you have to choose whether to put your x16 PCIe 4.0 graphics card or your x16 PCIe 4.0 SSD in that slot.

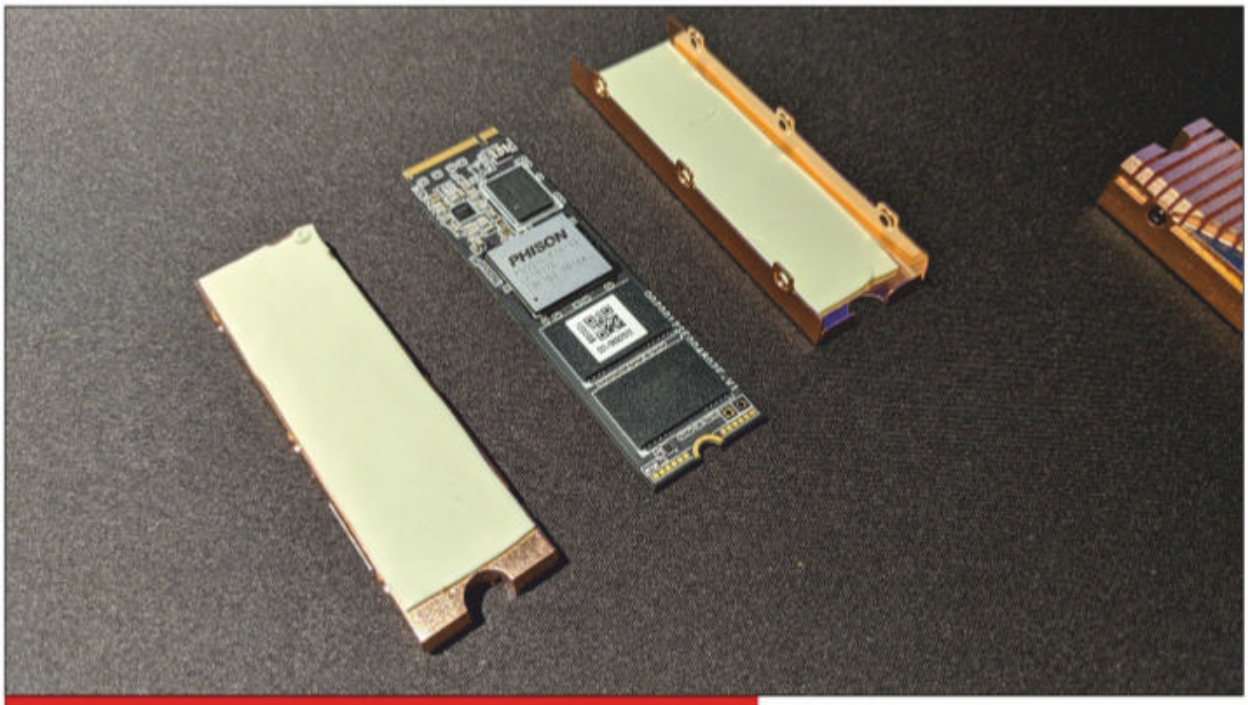
Maybe you've seen marketing and stories that claim the Ryzen 3000 has 40 PCIe lanes, so 'there's plenty'. It doesn't quite work out that way.

Unlike a Ryzen Threadripper, which has 64 PCIe lanes (Gen 3.0) in the CPU, the Ryzen 3000's 40 lanes are platform lanes. That means there are 24 in the CPU, with 16 reserved for an add-in card (typically the GPU), and another four for an M.2 or other device. The last four PCIe lanes are used to connect the CPU to the chipset. The chipset itself contains another 16 PCIe 4.0 lanes.

Obviously, you can't squeeze the bandwidth from 16 PCIe 4.0 lanes through four PCIe 4.0 lanes to the CPU, so any 16-lane device running through the chipset's southbridge would be limited. Intel has done the same for its small-socket Core chips.

There is an actual use for these additional PCIe lanes in the southbridge, as they allow motherboard makers to connect multiple M.2 SSD slots, PCIe, SATA, and other ports and devices without having to turn things off – something that was done in the past when they ran out of PCIe bandwidth.

Although we don't know the final configurations of how x570 can be split out, early indications suggest



The Gigabyte Aorus PCIe 4.0 SSD features beefy copper heat sinks, and it needs them

the southbridge can be configured with a single x4 and three x1 slots at PCIe 4.0, with the rest being broken out among other hardware in the motherboard.

While you might recoil at the idea of putting your x16 GPU into a x4 slot shared with other devices, you'll likely take a small and relatively painless hit, given that it's still the equal of a x8 PCIe 3.0 connection.

PCIe 4.0 will run hot

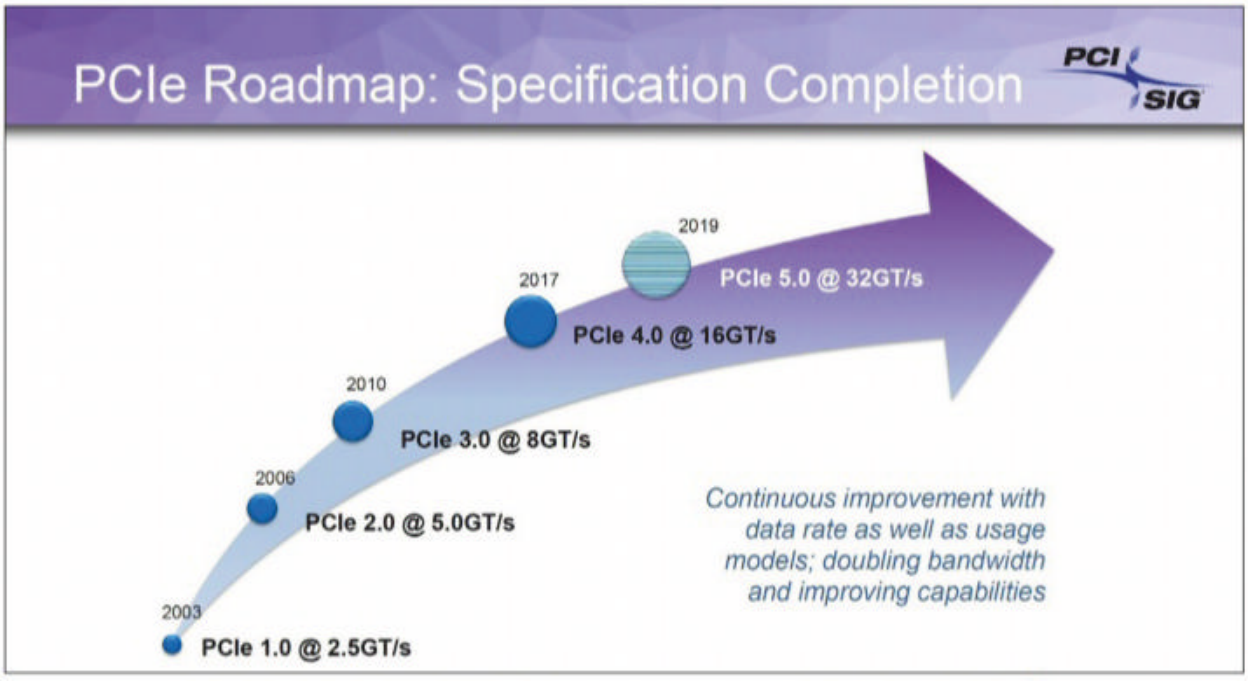
Heat will be a challenge for PCIe 4.0. With the move from PCIe 2.0 to PCIe 3.0, a considerable amount of performance was squeezed out of it by increasing the efficiency of the protocol. With PCIe 3.0 to PCIe 4.0, most of the performance comes from increased clock rate, which brings more heat – so much that the fancy

One Reddit user had high hopes after a Gigabyte BIOS/UEFI update seemed to enable PCIe 4.0 support on older AMD motherboards

heat sinks aren't just fashion statements, but necessity to maintain performance.

The chipset to supply the PCIe 4.0 is hotter, too. Vendors tell us it'll generate anywhere from 11 watts (at idle, most likely) to 16 watts of heat. It's hot enough that just about every PCIe 4.0 motherboard we've seen featured a fan for the chipset. Fans on southbridge chips were common just 10 years ago as well.

This is a consideration, but likely not a concern. Fans do add to system noise, but if done properly you'll be hard-pressed to hear it.



It's taken almost two years to see our first PCIe 4.0 hardware. You'll likely see a similar time frame for PCIe 5.0

PCIe 4.0 is not backward-compatible

Initially, AMD fans were juiced to hear that PCIe 4.0 compatibility could be done on older x470 motherboards. In fact, Gigabyte released a UEFI update that appeared to show an older x470 going from PCIe 3.0 to PCIe 4.0.

AMD officially dumped a bucket of cold water on that idea. "PCIe 4.0 will not be supported on motherboards released prior to the X570, so 400-series and 300-series will have PCIe 3.0 support," an AMD spokesperson told us. "These boards were designed and built prior to the capability to ensure PCIe 4.0 functionality, and we cannot adequately ensure a performant, stable user experience. We do not believe this is an acceptable experience for our consumers."

What about PCIe 5.0?

Confusing the news around PCIe 4.0 was the seemingly simultaneous release of the PCIe 5.0 spec, finalized by the PCI SIG. The confusion is somewhat false, because announcing a spec doesn't mean the hardware is available. The PCIe 4.0 spec was finalized in 2017, and now, about two years later, we have the first PCIe 4.0 hardware. We're likely to see the same lag between final specifications and released hardware for PCIe 5.0.

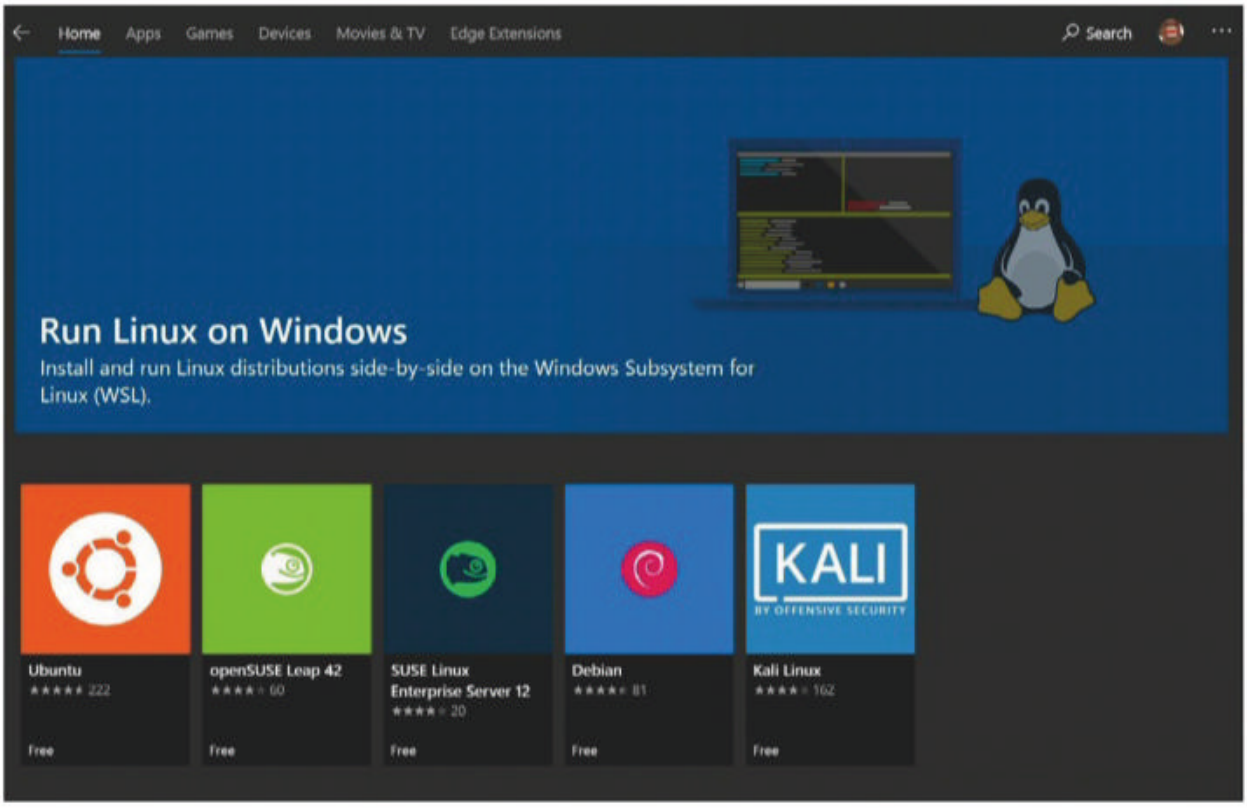
Intel doesn't have PCIe 4.0 yet

The only thing that could usher in PCIe 5.0 faster than expected is if Intel or Nvidia decided to accelerate its adoption to throw some mud on AMD. Officially, however, Intel hasn't even announced any plans to implement PCIe 4.0, let alone PCI 5.0. Its current products remain rooted in PCIe 3.0.

PCIe 4.0 will quietly bring more speed

The move to PCIe 4.0 is, overall a good move for the PC, removing a bottleneck for ever-faster components down the road. Just remember that these interface ships are hard to turn. The PCIe 4.0 interface, and parts that can take advantage of it, are just beginning to come out.

So while we wouldn't say no to PCIe 4.0 in a new system or build – we'd also have to seriously weigh whether it makes sense to pay extra cash for the feature. For example, does it make sense to pay £250 for a PCIe 4.0-based X570 motherboard, or save £100 and buy a PCIe 3.0-based X470 motherboard instead?



Why 2019 is the year of Linux on the desktop

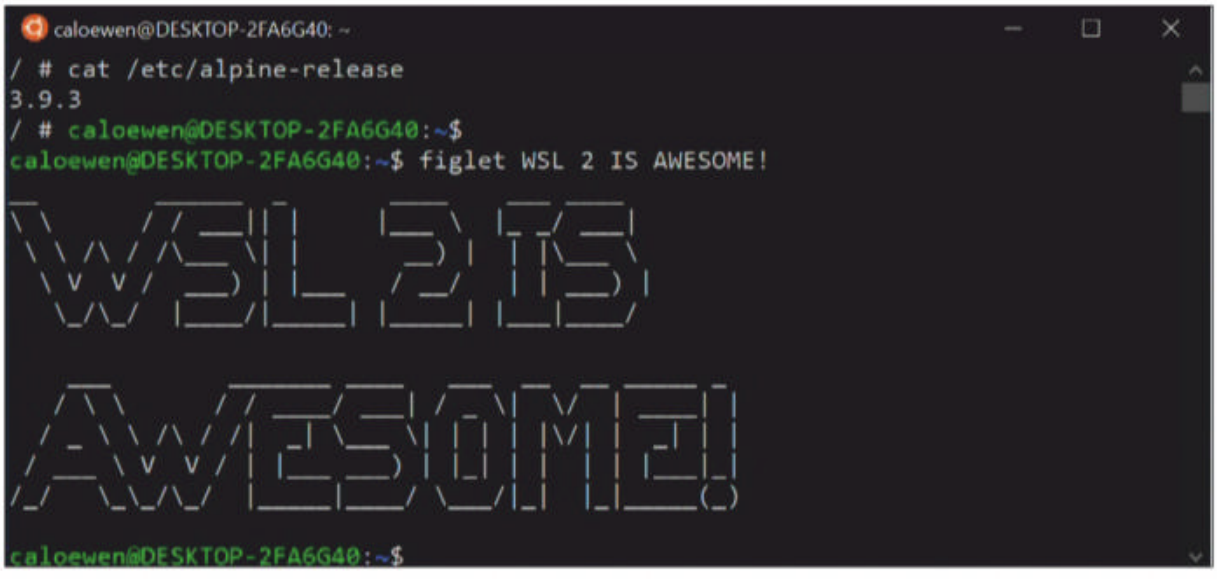
Both Windows 10 and Chrome OS are embracing the Linux kernel and the software that runs on it. BRAD CHACOS reports

After years of endless jokes, 2019 is truly, finally shaping up to be the year of Linux on the desktop. Laptops, too. But most people won't know it. That's because the bones of the open-source OS kernel will soon be baked into Windows 10 and Chrome OS, as Microsoft and Google revealed at their respective developer conferences earlier this year.

Microsoft is overhauling its Windows Subsystem for Linux, which surprisingly debuted in the operating system three years ago. It allows users to run the iconic Bash application and other Linux software via the command line, but because it relies on emulation, performance often suffered.

The cleverly named Windows Subsystem for Linux 2, announced at Microsoft's Build event this week, shakes things up by shipping a full Linux kernel (version 4.19) within Windows itself as a lightweight virtual machine. Doing so should supercharge performance for developers who use the tool.

"This same kernel is technology used for Azure and in both cases helps to reduce Linux boot time and streamline memory use," Microsoft corporate vice president Kevin Gallo said in the announcement post. "WSL 2 also improves filesystem I/O performance, Linux compatibility, and can run Docker containers natively so that a VM is no longer needed for containers on Windows."



A companion post by Craig Loewen, the program manager for the Windows Developer Platform, filled in more details. "File intensive operations like git clone, npm install, apt update, apt upgrade, and more will all be noticeably faster," he wrote. "The actual speed increase will depend on which app you're running and how it is interacting with the file system. Initial tests that we've run have WSL 2 running up to 20x faster compared to WSL 1 when unpacking a zipped tar ball, and around 2- to 5x faster when using git clone, npm install and cmake on various projects."

Those are impressive jumps indeed, with the bigger 20X improvement numbers fuelled by changes in how the Windows Subsystem for Linux's file system management behaves. It'll be interesting to see how WSL2's performance holds up in the real world when it ships later this year. Microsoft's also planning to release a jazzed-up Windows Terminal to run your Linux commands, complete with tabs and the sexiest trailer for a command line tool that I've ever seen – see **fave.co/2Nc5uJK**.

Linux software on all Chromebooks

Chromebooks have been intertwined with Linux since their inception. Chrome OS is built atop Linux, so you've been able to install Linux on Chromebooks for years. In 2018, Google added the ability to run Linux applications on Chromebooks by moving to a beta channel. That capability has been limited to specific Chromebooks, however – but not for long.

During its recent I/O developer conference, Google pledged that going forward, all Chromebooks will

be able to run Linux apps, regardless of whether the processor inside was built by Intel, AMD, or ARM, ZDNet reports. You'll be able to run terminal commands and even graphical applications like GIMP and LibreOffice, right from inside the standard Chrome OS interface. Giggity. How-To Geek has an excellent explainer on how to coax Linux software into running on compatible Chromebooks today (**fave.co/2Kzosbr**).

Get this: Chromebooks also support Android apps, as Google's mobile operating system is also built on Linux. Which means that developers could run software from three different operating systems at the same time on a Chromebook. So much for the stigma of Google-y laptops being glorified web browsers.

Whither Linux?

There you have it: between lurking in Windows 10 and Chrome OS, and the tiny portion of actual Linux distro installs, pretty much any PC you pick up will run a Linux kernel and Linux software. Macs won't, but it's based on a Unix-like BSD system that already runs many Linux apps with relative ease (hence Apple's popularity with developers).

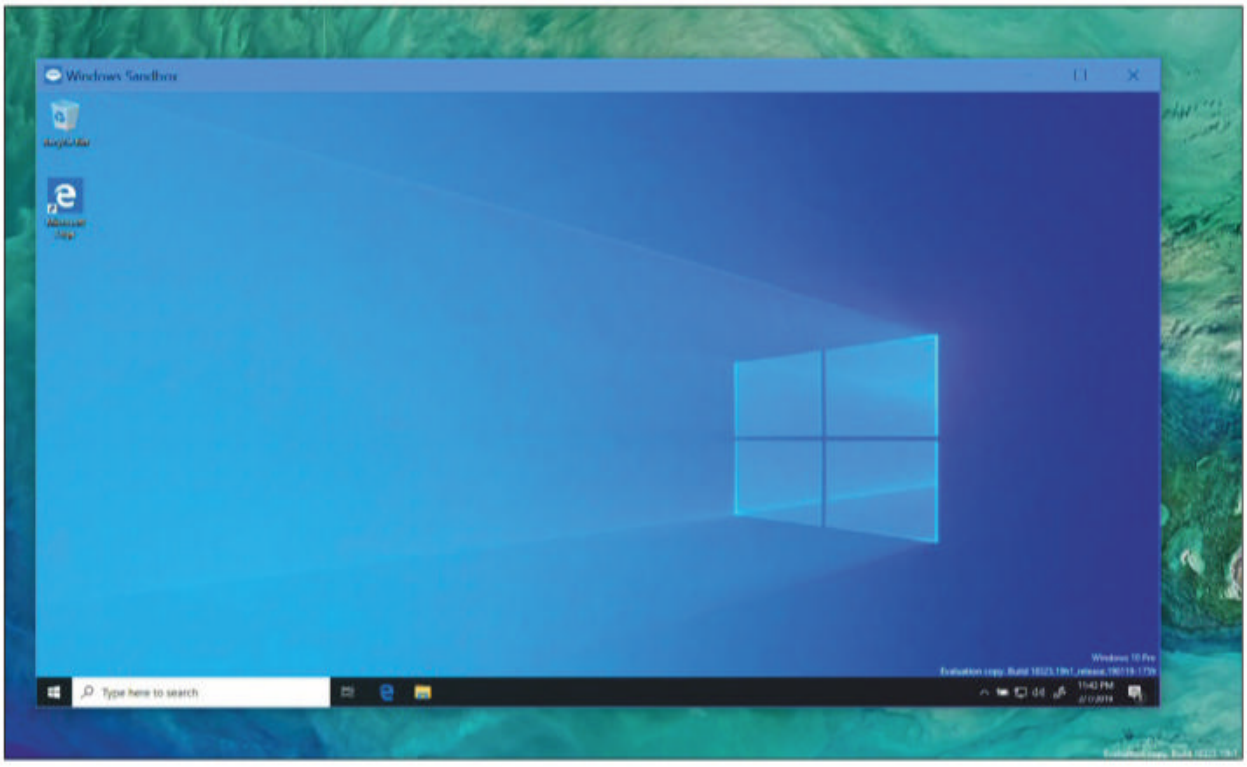
You have to wonder where that leaves proper Linux distributions like Ubuntu and Linux Mint, though. They already suffer from a minuscule user share, and developers may shift toward Windows and Chrome if the Linux kernels in those operating systems get the same job done. Could this fruit wind up poisonous over the long term?

We'll have to see. That said, Linux is healthier than ever. The major distributions are far more polished

Ubuntu Linux running on a Dell laptop

than they used to be, with far fewer hardware woes than installs of yesteryear. You can even get your game on relatively well thanks to Valve's Proton technology, which gets many (but not all) Steam games working on Linux systems. And hey, Linux is free.

Normal users may never be aware of it, but 2019 may finally be the year of Linux on the desktop – just not Linux operating systems on the desktop.



How To: Use Windows Sandbox

Protect your real PC from harm when you try out suspicious software or sites. MARK HACHMAN reports

Microsoft may be positioning its upcoming, easy-peasy Windows Sandbox within the Windows 10 May 2019 Update as a safe zone for testing untrusted applications, but it's much more than that. Windows Sandbox, and sandboxing PC apps in general, give you a solution for trying a 'utility' that may be malware, or a website that you're not sure about. You could leave those potentially dangerous

elements alone, but with Sandbox, you can be a little more adventurous.

Windows Sandbox creates a secure 'Windows within Windows' virtual machine environment entirely from scratch, and walls it off from your 'real' PC. You can open a browser and surf securely, download apps, even visit websites that you probably shouldn't. Sandbox also includes a unique convenience: you can copy files in and out of the virtual PC, bringing them out of quarantine if you're absolutely sure they're safe.

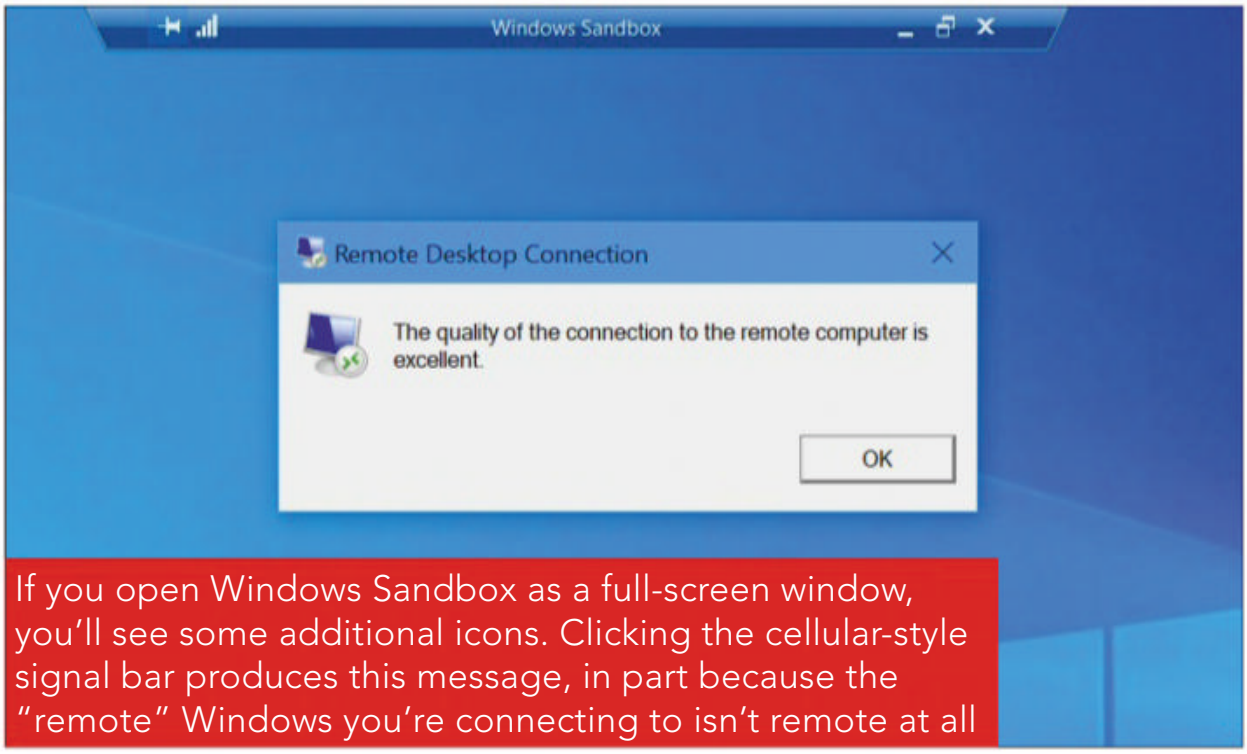
At any time, you can close Windows Sandbox, and when you do, anything left there is totally obliterated. If that dodgy website rains malware down on your Sandbox, all it takes is one click to shut it down, without harm to your actual Windows installation. Next time you launch a new version of Sandbox, it will launch a pristine version of Windows 10 to start anew.

You won't need to buy a second copy of Windows to use the feature either – though you will need Windows 10 Pro or Enterprise. The Home version doesn't support it. And right now, Windows Sandbox is a preview feature that's reserved for Windows Insiders only. It was introduced in build 18305, and is part of the Windows 10 '19H1' released in late May.

Here's everything you need to know to start using Windows Sandbox.

Get started

Technically, Windows Sandbox is a lightweight virtual machine, a tool often used by developers and researchers to test new software within a controlled environment. Virtualization creates an entire virtual



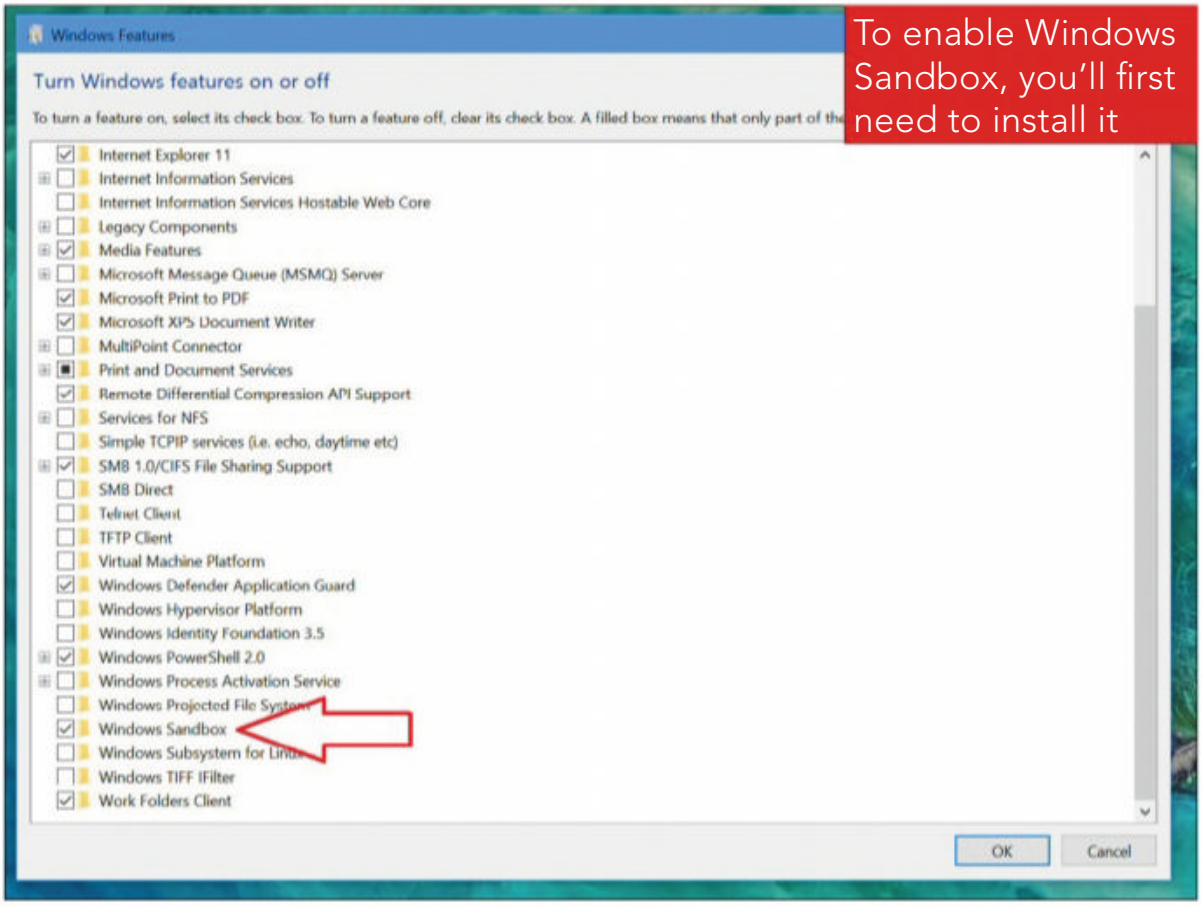
If you open Windows Sandbox as a full-screen window, you'll see some additional icons. Clicking the cellular-style signal bar produces this message, in part because the "remote" Windows you're connecting to isn't remote at all

computer, complete with operating system, storage, and memory, within your existing Windows PC.

Granted, Windows already offers Hyper-V to achieve similar tasks. What makes Sandbox so appealing is that Sandbox is to Hyper-V as Windows 10's Mail app is to Outlook: a simplified, user-friendly version of a much more complex application.

Beyond the Windows 10 Pro requirement, Windows Sandbox's performance impact demands a modern, fairly powerful machine with virtualization capabilities. Here are the minimum specifications for the feature:

- A 64-bit processor capable of virtualization, with at least two CPU cores; Microsoft recommends a quad-core chip. (Virtually all Intel processors sold since 2016 support virtualization, though this Intel guide



To enable Windows Sandbox, you'll first need to install it

explains how to check (**fave.co/2xe5aPU**). Otherwise, the Performance tab within the Task Manager will tell you whether virtualization is enabled – credit to Shailesh Jha for the reminder.)

- Virtualization enabled in your motherboard BIOS, if it's not already
- Windows Pro, Enterprise, or Server
- At least 4GB of RAM (8GB recommended)
- At least 1GB of free disk space (SSD recommended)

Windows Sandbox is an alternate feature of Windows, and it won't be installed by default even if it's available to you. To enable it, you'll need to go to

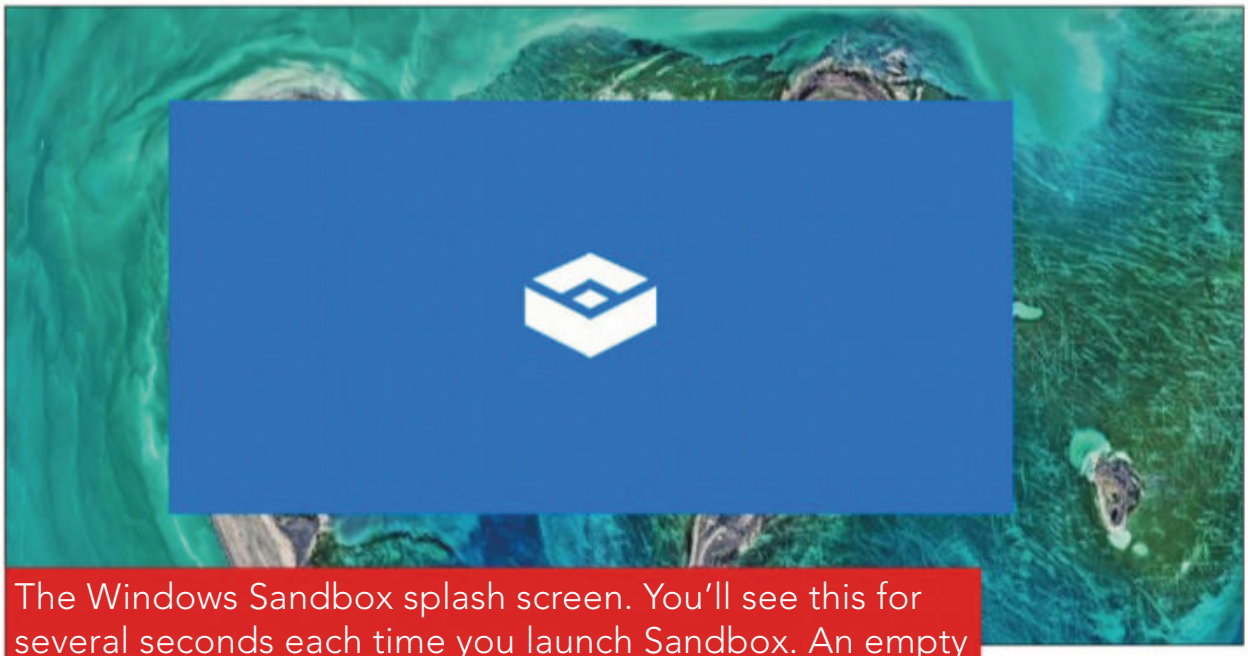
the Windows Features control panel, which you can find by searching for Turn Windows features on and off. To enable Sandbox, you'll need to scroll down and check the proper box. Windows will install the necessary files and may need to reboot your PC.

When the installation process is completed, there won't be any bells or whistles. To enable Sandbox, you can simply type Windows Sandbox into the Windows search box. It may take a minute or two to load, if only because Windows needs to establish the virtual machine. Microsoft has said previously that it will 'freeze' the state of the virtual machine, archive it, and bring it up when you launch Windows Sandbox again – basically, everything should launch faster next time around.

How to use Windows Sandbox

Sandbox appears as a small window on your desktop. Within it, there's another Windows desktop, like what you might see if you installed Windows 10 and decided to use a local account.

The Sandbox virtual PC isn't quite like your own. For one thing, none of the personalization options you've installed will carry over, such as favourites and themes. And that's good. One of the ideas behind Sandbox is not to put your personal information out into the wild, so don't be tempted to log in with your personal account. None of your third-party software will appear either. You still have access to File Explorer, but it's restricted to the Sandbox, with a subset of your PC's resources available. Note, too, that only one instance of Windows Sandbox is allowed at a time.



The Windows Sandbox splash screen. You'll see this for several seconds each time you launch Sandbox. An empty Sandbox window consumed about 1.2GB of memory in our tests running on a first-generation Surface Laptop, so you may be able to leave a Sandbox window open

You'll probably be immediately tempted to open Windows Sandbox as a full-screen app. That's fine, especially as Microsoft has helpfully placed a large, Windows XP-style header at the top of the window, reminding you that you're working within Sandbox. Pay attention to it – the last thing you want to do is carelessly switch back to your 'real' PC and open that dodgy website that you meant to launch in Sandbox. Edge browser and File Explorer windows opened within Sandbox won't identify themselves as the Sandbox versions. Feel free to play around with the Windows Settings within Sandbox, if you'd like, and see how it differs from your main Windows installation.

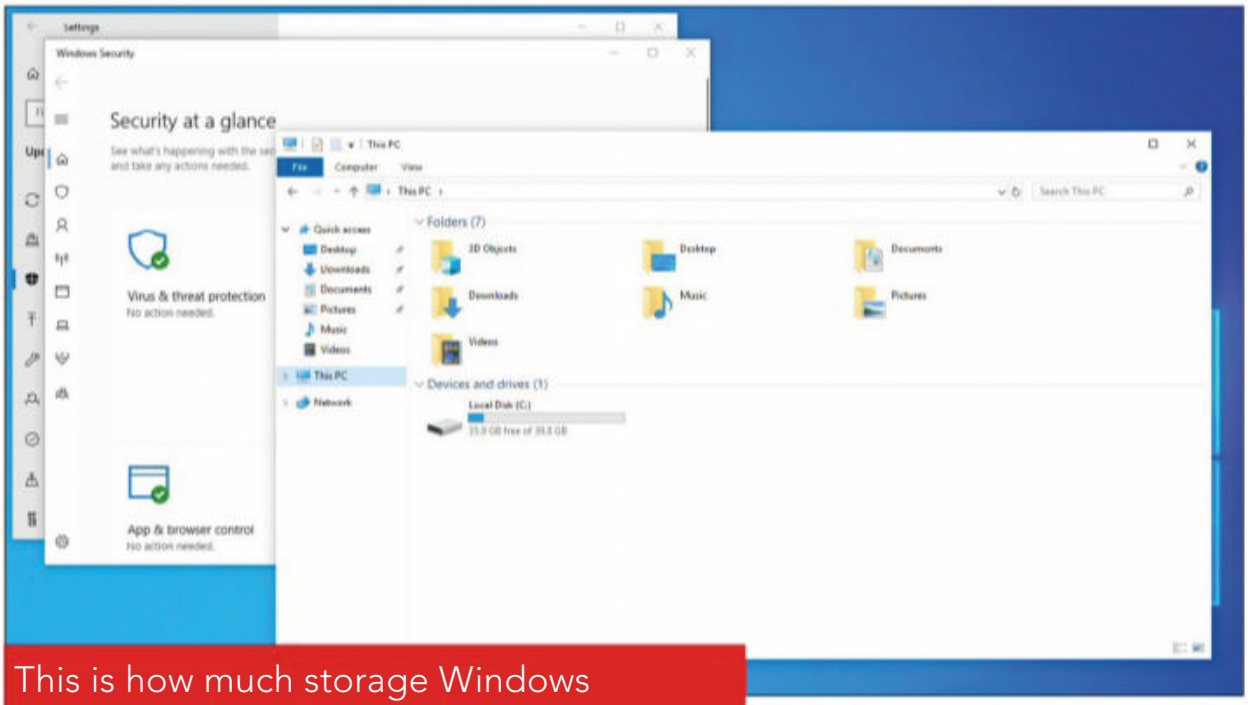
Because Windows Sandbox isn't run as a virtual machine, but as an app, there's not as much of a

performance hit on your PC as a true virtual machine. (If you'd like to know more about the technical underpinnings of Sandbox, check out Microsoft's support page.) But be aware that Sandbox is going to take a chunk of your PC's resources for its own use, including a portion of the CPU, memory, and disk space. If your PC is already pokey, both it and the Sandbox virtual PC will run even more slowly.

Sandbox's app status also benefits you if you ever want to interact with any files you may have downloaded. A Hyper-V virtual machine isolates the file system so that malware can't escape. Any files you want to copy out of a Hyper-V VM requires a Remote Desktop connection or Enhanced Session Mode. Normal people don't want to deal with any of that. Sandbox simply allows you to cut and paste (or copy) any file on it right to your 'real' desktop. That's very handy if the utility you were testing turns out to be useful after all.

I didn't notice any bugs or crashes associated with Sandbox, with one exception. If you're having trouble accessing the Internet from within Windows Sandbox, as I did, you may want to tweak your firewall settings to allow access to the Sandbox apps, or simply adjust your global protection settings.

Windows Sandbox won't tell you if a dodgy program is secretly sending information back to a third-party server, or whether some other pernicious activity is taking place without your knowledge. (Advanced users could monitor network traffic if they desired, however.) But if that file a 'friend' sent you turns out to be ransomware, it won't do any harm in Sandbox.



This is how much storage Windows assigned to Windows Sandbox, with 132GB free on our Surface Laptop test machine

Remember, you can close down Windows Sandbox at any time. When you do, you'll receive a message that whatever is stored within it is gone for good. The protections Sandbox offers go away if you copy a hazardous file from within the virtual machine out to your main Windows installation, of course.

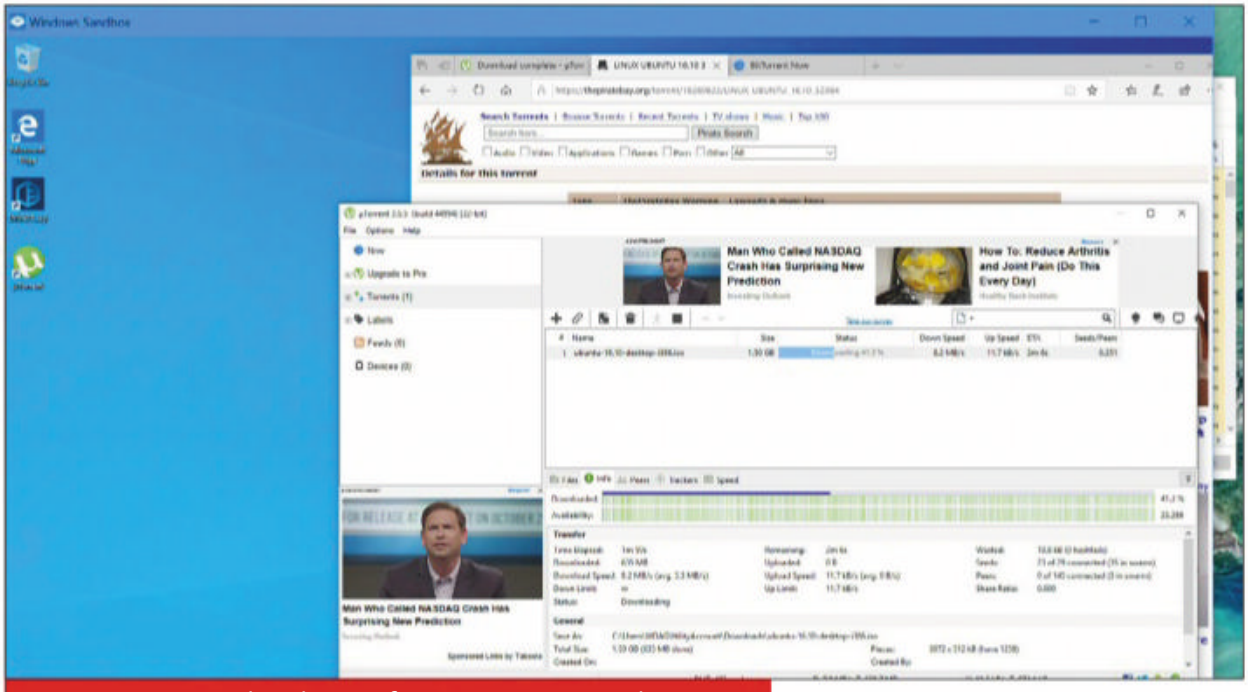
Adapting Windows Sandbox for everyday use

What you may quickly realize, however, is that Sandbox is more than just a test bed for apps you're not sure about. It's also a bonus layer of security when you're poking about the web. We liked Windows 10's hidden secure browser, Windows Device Application Guard, but it allowed you to download files only to its own

secure environment. With Sandbox, you can copy files between Sandbox to your PC.

Both Microsoft Edge and Google Chrome include their own sandboxing elements to protect your PC. But if you really don't trust a particular site, you can always open Edge within your Sandbox (creating a sort of 'sandbox within a Sandbox') and open that untrusted site. Are you a bit sceptical that Chrome's Incognito mode doesn't track your browsing? Download Chrome within Sandbox, surf away without logging into your Google account, then destroy your whole session by closing Sandbox.

Windows Sandbox doesn't anonymize your viewing – your Internet provider will still theoretically have a record of what sites you've visited, unless you also



BitTorrent worked just fine. You never know what exactly you're downloading, though, which is why Sandbox might be a good idea

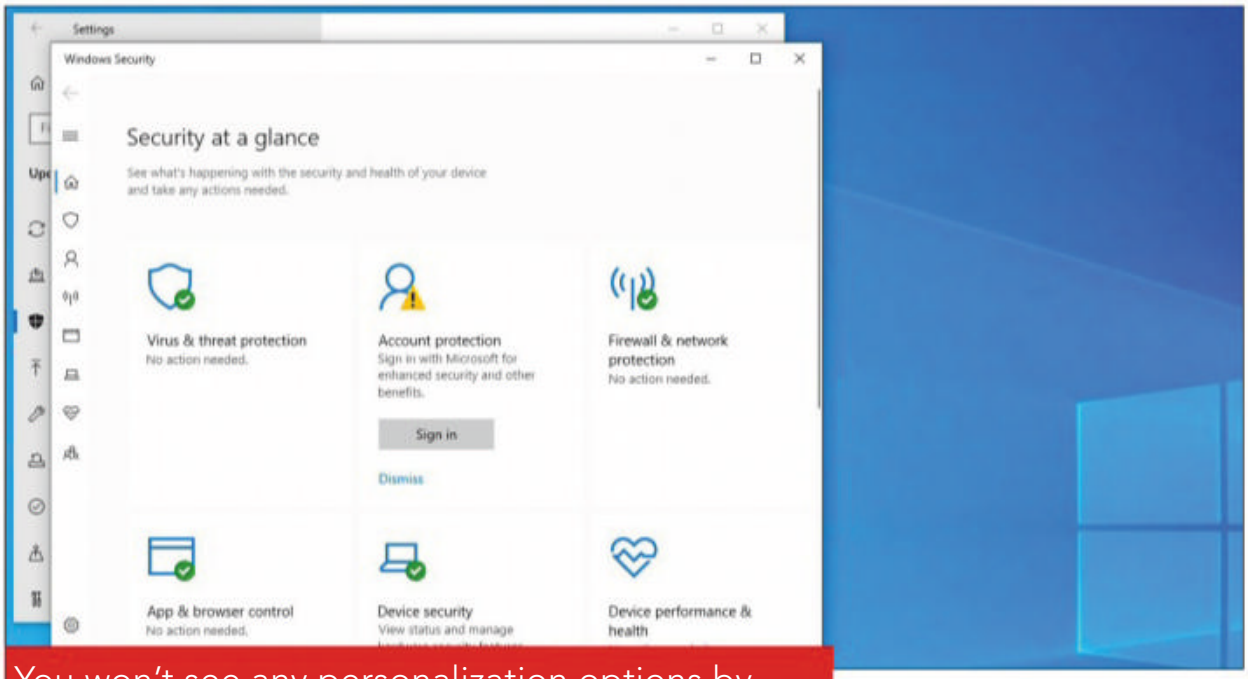
use a VPN – but when you destroy the Sandbox, that browsing record totally disappears. And if you download something you're not sure about, you can always test it within Sandbox to help determine whether it's actually malicious.

Oddly, Windows Defender doesn't seem to work within Sandbox, but I downloaded a free third-party antivirus from BitDefender and was able to check individual files for malware.

As we noted above, Sandbox demands a price in terms of performance. Running on a first-gen Surface Laptop (with a Core i5-7200U Kaby Lake chip powering it), just three media-rich Edge tabs within Sandbox gobbled up enough resources to keep the total CPU utilization well above 90 percent. I occasionally saw a bit of stuttering when moving down a web page. With a more robust Surface Pro (2017) and a few code revisions later, Windows Sandbox ran much more smoothly.

Don't think that you'll be playing games within Sandbox. But opening an email via Outlook.com? Sure. Downloading what I thought was a Linux distribution over uTorrent? That worked just fine. (Trying to mount the ISO file within Sandbox, though, did not.)

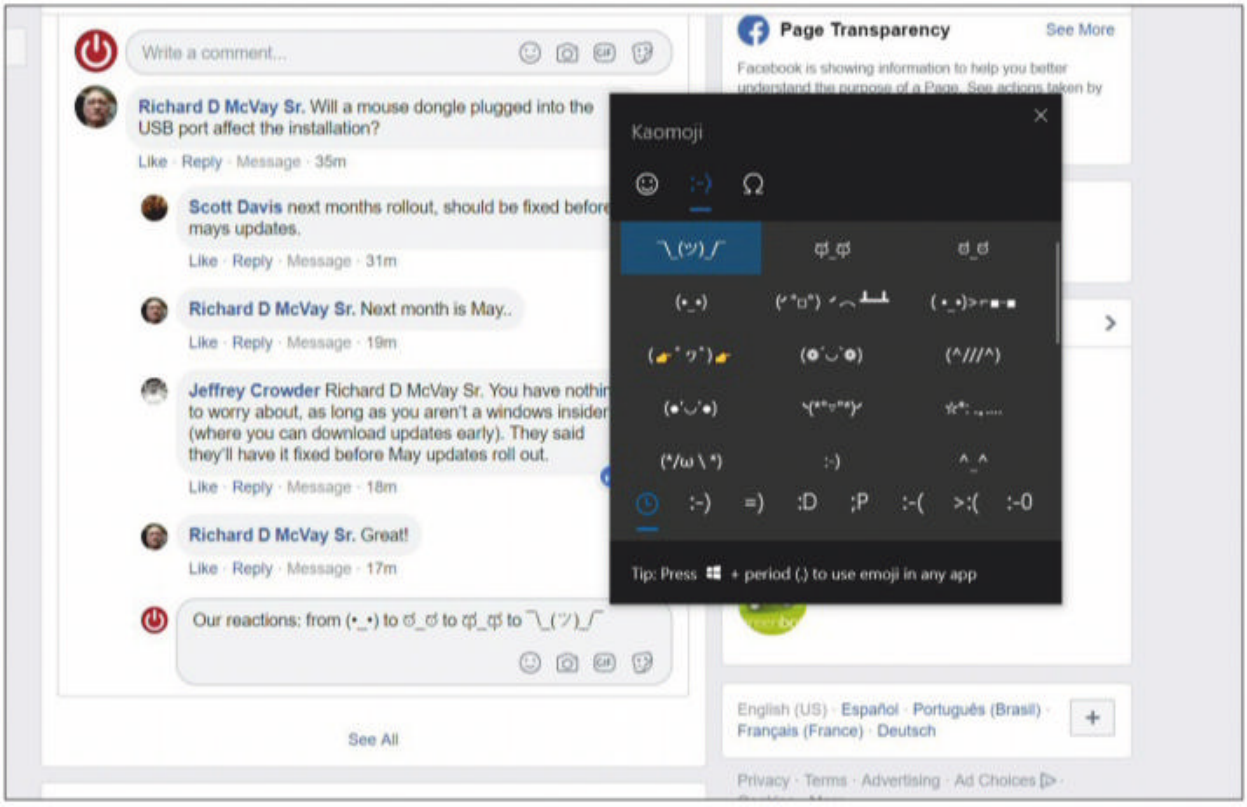
How far you incorporate Sandbox into your everyday life is up to you. We've already seen Sandbox videos demonstrating the effects of computer viruses – because when they've finished wreaking havoc on the Sandbox virtual machine, the Sandbox can be shut down. (We still wouldn't recommend this with known dangers, as we can't say for certain that malware won't be able to break out of the Sandbox virtual machine.)



You won't see any personalization options by default. It's probably a good idea to leave your personal data out of a Sandbox unless necessary

Nevertheless, Sandbox offers the potential for much more than app trials.

Note that there are other third-party sandbox applications that you can still try: Sandboxie (both free and paid versions); BitBox, designed specifically for browsing; ShadeSandbox, and more. All of them have their own pros and cons. What Windows Sandbox offers, though, is the convenience of a free, secure sandboxing solution built right into Windows. And soon, everyone with Windows 10 Pro will have it.



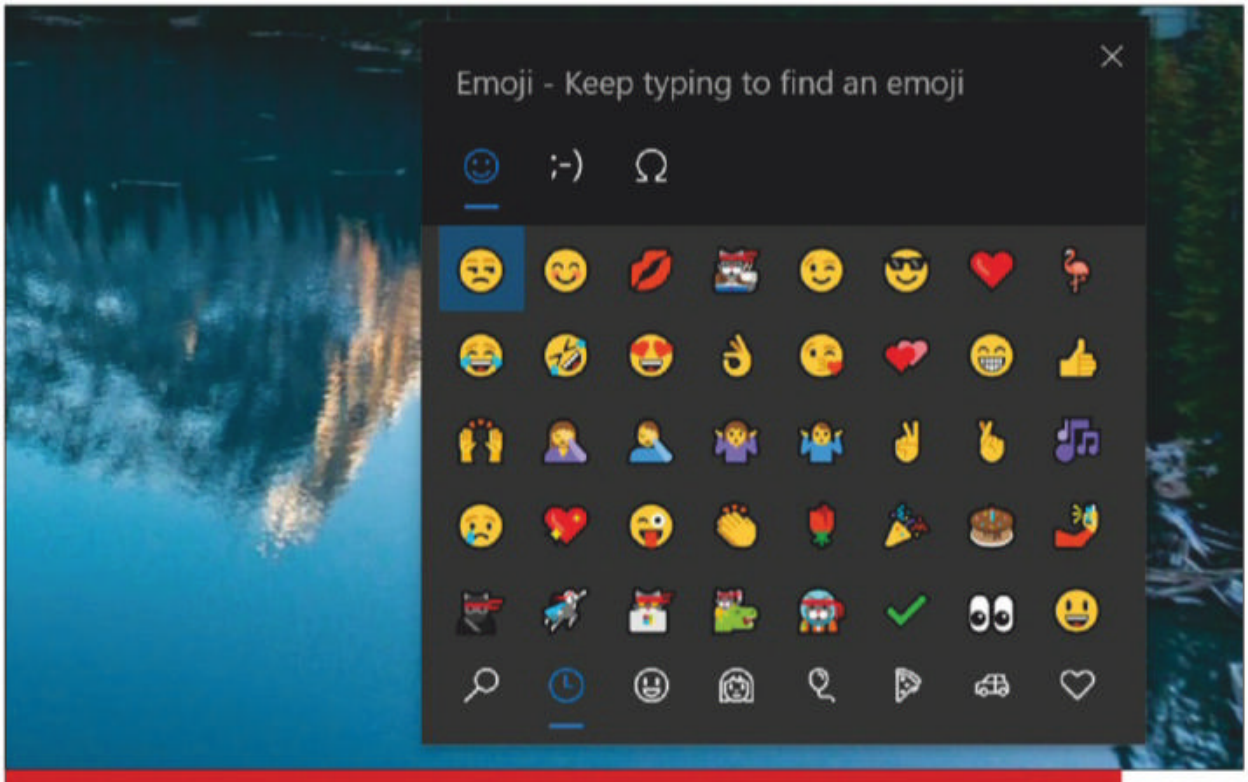
How To: Type kaomoji on a PC in Windows 10

We'll show you how to type emoji, kaomoji, and symbols, in a just a few easy steps. MARK HACHMAN reports

How can I type kaomoji on my PC? And what are kaomoji, anyway? Fortunately, the answers to both questions are simple, and easily accessible within Windows 10's May 2019 Update. The familiar emoji keyboard has been expanded to include both kaomoji and symbols, and adding them to Facebook, Twitter, and other social media apps is extremely easy.

What's a kaomoji? A kaomoji is simply a more complex emoticon, the predecessor to the emoji. You're probably familiar with the smiley :) or winky ;) which consist of familiar punctuation symbols combined to form an expression. That's an emoticon. Emoji are simply pictorial representations of emoticons, so that a winky symbol is represented as a 😉.

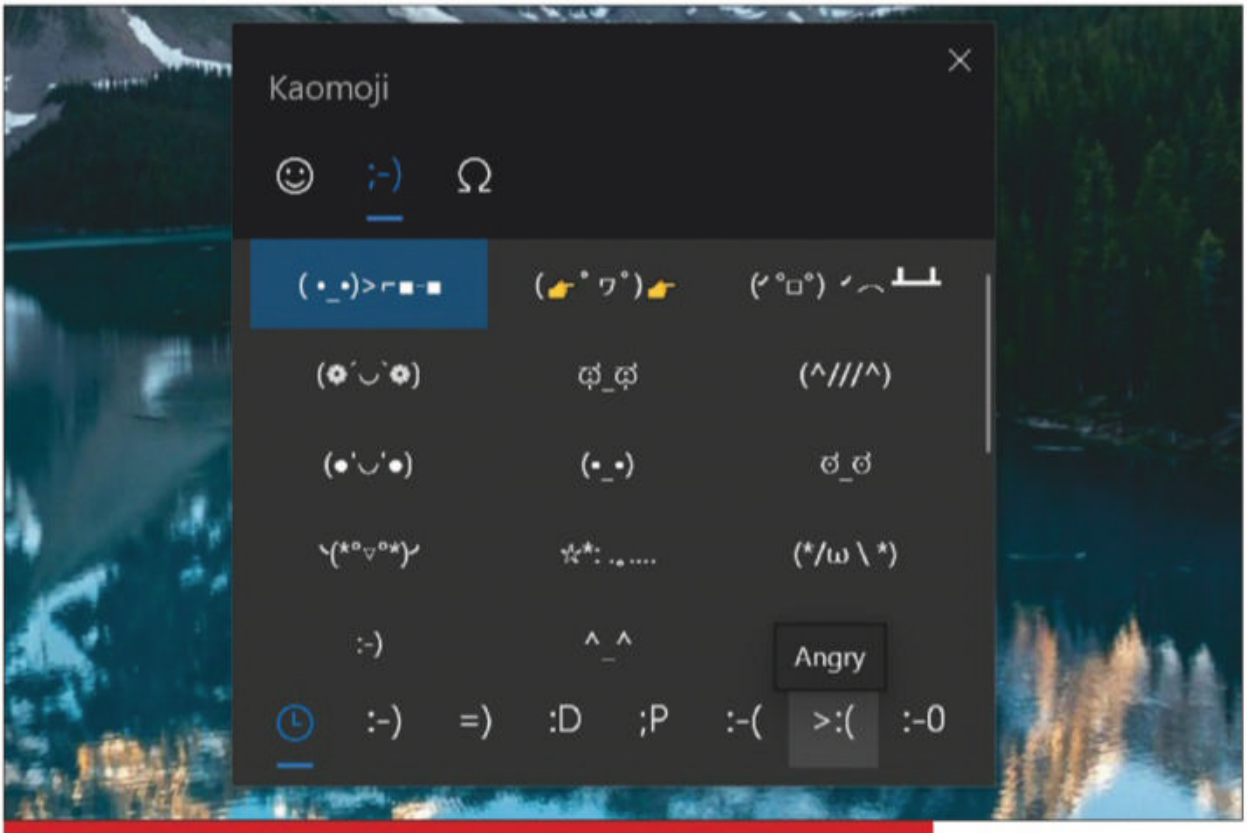
A kaomoji, meanwhile, is to an emoticon like a finished painting is to a rough sketch: a complex arrangement of symbols that approaches art. With a kaomoji, you can express a complex idea that an emoji or emoticon simply can't: flipping a table in anger



The first option that the emoji keyboard reveals, is, unsurprisingly, emoji. You can either click what you're looking for, type in a search request at the top, or move to the kaomoji or symbols tab. Notice the nav bar at the bottom to move between categories

(ﾉ °□°) ﾉ ﾐ┻┻, a double finger-pistol gesture (☞ﾟヮﾟ)☞, or even the obscure meme where *CSI Miami*'s David Caruso takes off (or puts on) his sunglasses before saying something profound (•_•)>⌐■-■.

How do you access emoji, or kaomoji, or symbols within Windows 10? You can do it all with the same Windows shortcut: the WIN + ; shortcut (or WIN + .), where you hold down the Windows key, then type a semicolon. You can even access the new Emoji 12 emoji from the same keyboard. Alternatively, you can right-click a text box, and you should see an emoji option pop up.



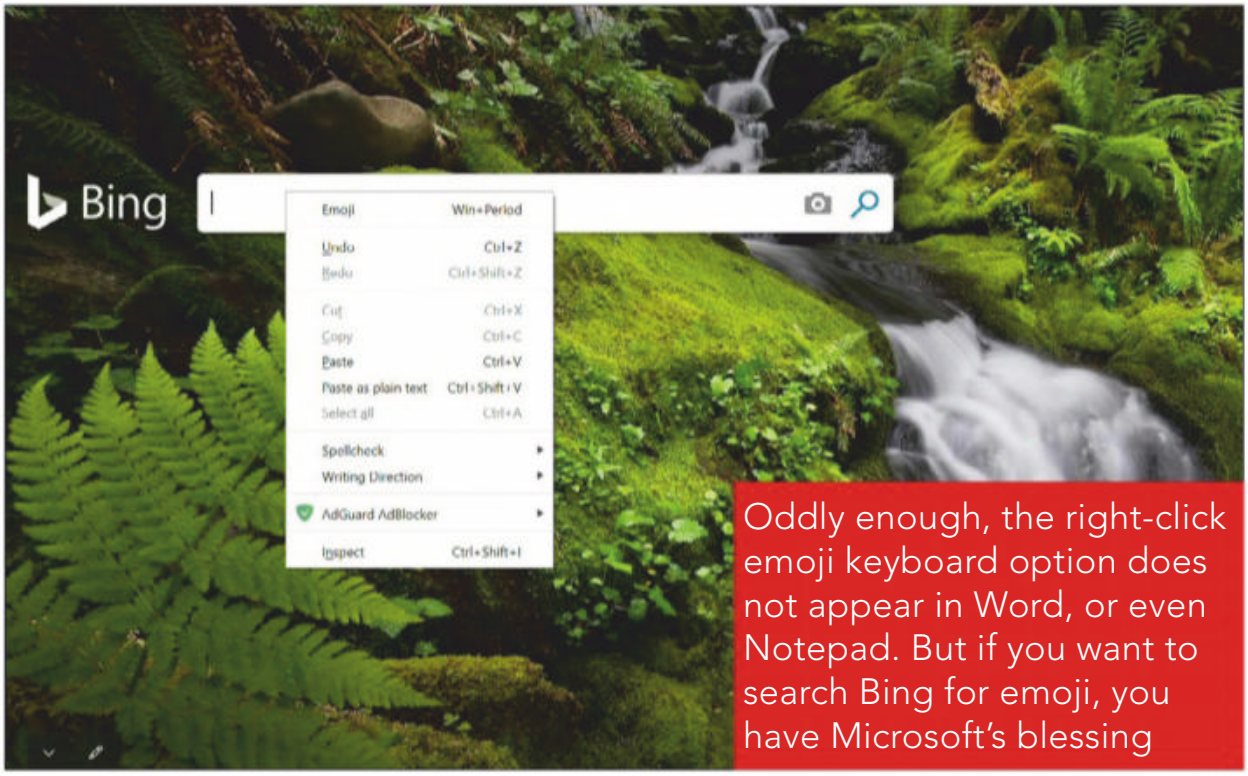
Here's what the kaomoji keyboard looks like. Note that there's a bit more explanation of how Windows organizes kaomoji as part of the nav bar at the bottom

There's just one catch: you'll need the Windows 10 May 2019 Update to access the new kaomoji, also known as version 1903. If you're having trouble accessing these new emoji and kaomoji, type **winver** into the Windows search bar, then make sure the second line says 'Version 1903'. The May 2019 update started rolling out May 21, and users will receive the upgrade in waves. (If you want the May 2019 update right away, here's how to get it.)

How to type kaomoji under Windows 10

There are some subtleties to typing kaomoji under Windows 10, however. For one thing, they're confusingly organized.

The emoji keyboard contains three tabs: emoji, kaomoji, and lastly symbols of all types. The emoji tab



Oddly enough, the right-click emoji keyboard option does not appear in Word, or even Notepad. But if you want to search Bing for emoji, you have Microsoft's blessing

is well organized, with a search function at the very top: type in 'lips', for example, and the 'kiss' 💋 and 'mouth' 👄 emoji will appear. For each emoji you'll also receive some explanatory text describing each one.

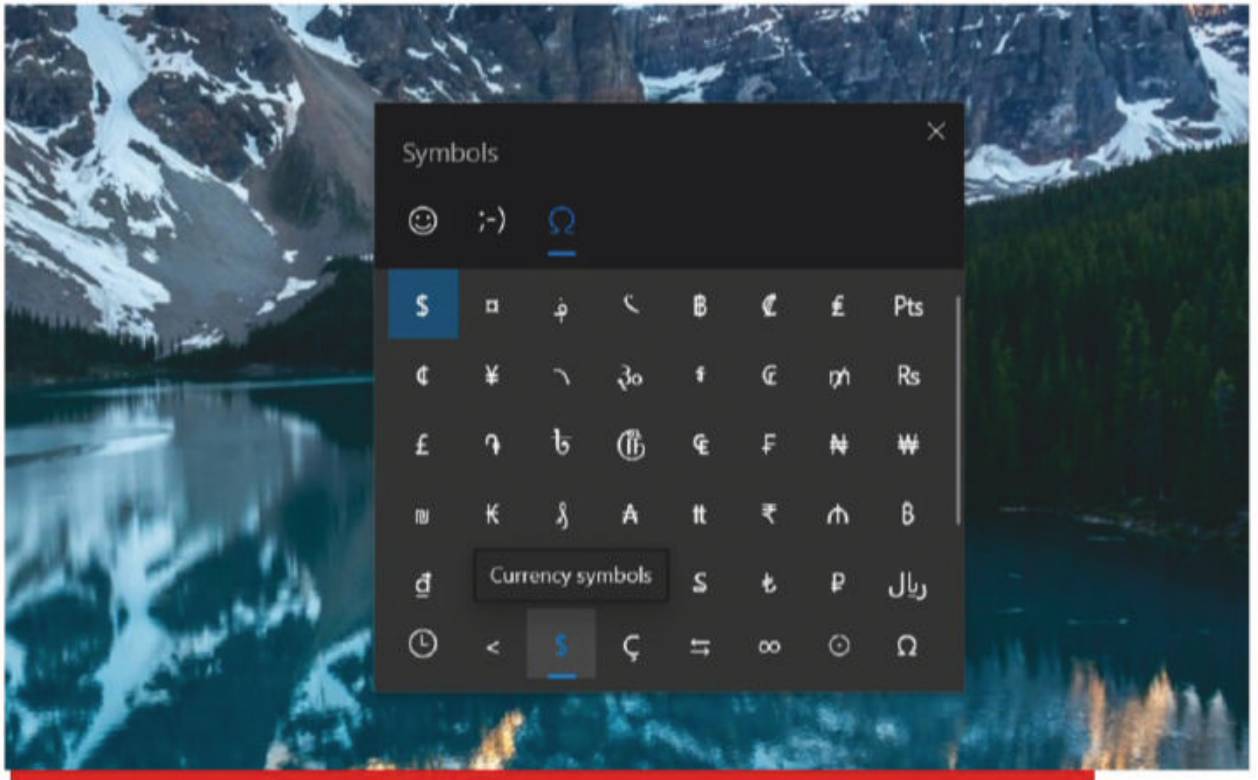
Tab over to the kaomoji keyboard, and there's nothing like that – yet. Hopefully you'll have a rudimentary knowledge of what symbol means what, or that they're detailed enough to figure out on your own. Yes, there's a nav bar of sorts on the bottom, a 'I didn't even see that' way to navigate between happy, sad, silly, and other kaomoji – but the nav bar itself is also done in emoji, which seems a little much. Pop-up text provides some rudimentary explanation. This is a largely self-guided tour.

(That same odd, bottom-row nav bar applies to the symbols menu, too. At least there's some explanatory text when you hover your cursor over the navigation bar, with categories that include 'general punctuation', 'currency symbols', 'Latin symbols', and more.)

Remember that emoji are single symbols, so that you won't have to worry about line breaks. Kaomoji and emoticons are not so lucky, and a long, complex cluster of symbols may end up broken over two lines by an app. You'll need to plan accordingly. Fortunately, whether they be emoji or kaomoji or ordinary symbols, they're all supported by Microsoft apps like Word, Edge, and even Notepad, so you should be able to type them within any app you choose. Just make sure you have the window or app in focus or active, open the emoji keyboard, and type away. While an early implementation of the emoji keyboard allowed only

one character per instance of the keyboard, that's a bug that's been fixed. Type as many as you want.

Because you'll be using this keyboard to type emoji as well as kaomoji, there's one change worth noting: the location of the 'swatch' drop-down menu, a key feature in the emoji keyboard we introduced you to two years ago. Instead of putting it under the 'most recently used' tab of the emoji keyboard – the one you'll see first every time you open it – Microsoft has moved it to the fourth emoji tab on the bottom. (It's there in the third tab if you're viewing this on something earlier than the May 2019 Update.) Regardless, if you hover over it, you'll see it labelled as People. Only emoji have various colour options.



Microsoft's symbols keyboard, part of the emoji keyboard within Windows 10, also has a large variety from which to choose

Microsoft could benefit from some improvement in the overall emoji keyboard experience: for example, a clearer signal, via colour or delineation, that a search box is actually present. Asking someone familiar with kaomoji to add some brief explanatory text that would display while your cursor hovered over it would provider a gentler entrance for those who have never used them before. A resizable window? Yes, please. You can't type kaomoji, then text, then another kaomoji while the keyboard remains open. And Microsoft really needs to fix the bug that causes the emoji keyboard to move slooooowly across your screen when you reposition it.

Otherwise, though, it couldn't be simpler: the WIN + ; opens the door to a new way of expressing yourself. Welcome to kaomoji. ヽ(*°▽°*)ﾉ