



Hello, I'm Justin McDowell. You can find me on Twitter at revoltpuppy. I am the web designer for



The Evergreen State College in Olympia, Washington. I didn't go to school there, though.



- University of Nebraska at Kearney
- Like at most schools, many of the upper level classes were qualified by prerequisites, especially the fun classes, like graphic design or figure drawing.
- Dreading Color Theory 101, and the reason why is because of—



—an exercise very similar to this one.

• Take a color, squirt a bunch of it onto a palette and then—



--paint a square of that color on a piece of paper. Then I had to take a tube of white paint and add a single drop into the red, then [paint] another square. Then [repeat] those motions. Each time, a single drop of white was added, and [a bit] of red was removed. [A bit] of white in, [a bit] of red out. [White] goes in, [red] comes out. [White] in, [red] out. [Repeat]...

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...until the square is white.



This was the grunt work I had to do before I could take an actual graphic design class.

- That was not a thrilling exercise
- Ten years later, I almost feel grateful to have had that level of control over color.
- Speaking as a web designer, the intervening years have not been easy on me.



- First, keywords and hexadecimal codes.
- Hex codes confusing jumble—

red	maroon	purple	fuchsia	
green	lime	olive	yellow	
navy	blue	teal	aqua	
black	gray	silver	white	

- Keywords were pretty intuitive.
- Just 16 designated colors to choose from.

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- With hex codes, the 216-color web-safe palette
- Lacks subtlety.



- Eventually, at long last, we were graced with 24-bit color.
- Still stuck with those cryptic hexadecimal codes.



- Anybody know what color this is? [It's this] purpley color.
- Really familiar with the hexadecimal to RGB relationship.
- I mean, you guys didn't even know I was lying to you. [This hex code] is actually aqua green! It's just really hard to tell until you see it.



Thankfully, color has continued to mature.

- [Gradients], [Shadows], [Opacity] and alpha channel support is really good now.
- Finally, finally! it's a good time for color on the web these days.



The good news is, CSS keeps getting better. What's the next thing we get to look forward to? One answer: blending modes.



Blending modes are one of those things that have been in Photoshop for a long time, but are finally gaining traction on the web. Technically, color blending applies mathematical operations to the color components of image pixels on overlapping layers. What that means to you is you can create quickly some rad effects.

Let's spend a bit of time on this.



Blending modes can be broken up into a few different groups. Darken modes are so named because they tend to create darker pixels.

Read them!



Lighten modes, as you can probably surmise, will tend to lighten pixels.

Read them!



• Contrast modes: both darken and lighten at the same time.

Read them!



Composite modes affect images based on each particular component, whether it's the hue, saturation, luminosity. [There's also] a color mode that uses both the hue and saturation of the source, so it kinda combines two of them in one. These composite modes are good for creating that [old-timey] wanted poster look.



old-timey wanted poster look.



Finally, comparative modes are a little weird, and you probably won't use them that much, but they're often used to compare and align two images.



Out of all of them, these are what I would call essential blending modes. I'm going to share with you a couple that I think are particularly useful: multiply and screen.



We're going to use this painting by Claude Monet as our main image.



And I'm going to blend this texture on top of it. You'll see how the different shades get applied to the base image.



Let's take a look at the multiply blend mode. This mode is called multiply because it literally multiplies the properties of the color on the top layer with the layer below it.

This is how the function looks: *a* is the top layer and *b* is the bottom layer. *x* is the resulting color. Yeah, all this creative stuff is just math underneath!



More practically, though, what you need to know is the darker the pixel on top is, the more likely it is to show through at its full value.

If the pixel on the top layer is black, it becomes completely opaque. If it's white, it becomes completely transparent and the image on the bottom layer shows through. Everything in between darkens to some degree. So, why is this good?



Here's a practical example. Say your boss wants you to add his signature onto an image, like this.

Clande Monet

He gives you a scan. And so you just slap it on top of your image.



Well, not quite the effect we're looking for. The white background box is covering up the image!



So we go into Photoshop, select all the white...



and delete it, so now we have a transparent background. Slap it back on the image...



...and you still end up with an unattractive halo around the signature. This is where the multiply blend mode comes in handy.



Because when you blend with multiply, all that white fades naturally into the canvas behind it, and you have nice, smooth edges.



It ends up looking like the signature was inked right on top of the image without having to do a lot of graphics processing. I use this all the time with logos, as well.

But what if we wanted light pixels to shine through instead?



That's where screen comes in handy. But why is it called screen instead of divide? Because, again, if you look at the math, you can see that we're not doing any division here. Instead it's taking the inverse of the inverse of *a* times the inverse of *b*.

If you hate this already, the formulas only get more complicated in other blending modes, but luckily unless these kinds of details interest you, you don't really need to know them. I'm just showing you because it's sometimes useful to take a peek behind the curtain.


In this case, screen lightens the image. A top layer pixel that's white is opaque this time, while a black pixel will become completely transparent. Everything in between becomes lighter to some degree or another. I'll show you another quick example of something you can do with this.



This time, I want it to look like I've somehow spray painted Monet's painting onto a wall with a stencil.

I just have to set the blending mode on the stencil to Screen and the computer takes care of all the rest!



## Et voila!

As you can see, blending modes can help you easily add effects to your images. There are two good ways to figure out what you can do with them: one is to do a little bit of research to figure out what they do, and the other is to just play around with them. I find it's useful to try a little of each tactic.



Blending modes can be applied in CSS in two different ways. The background-blend-mode property blends between multiple backgrounds of an element, but not whatever is underneath it. The mix-blend-mode property blends an HTML element with whatever is below it.



One snag with mix-blend-mode is that it applies to an element and all of its children as a fully composited element.

To show you what that means, I created this graphic here in Photoshop. Our goal is to reproduce this with just CSS. We want to put a text box on top of an image, and we want that background image to shine through the background color of the text box.



We can get this far in CSS before we need to start blending anything. So far, so good.

To blend that text box with the background, we want to choose the screen blending mode, because that will make the painting shine through the white text box:

```
<style>
.wrapper{
background-image: url(monet.jpg);
}
.text-box{
mix-blend-mode: screen;
}
</style>
<div class="wrapper">
<div class="text-box">
<pYou can't spell MONETIZE without
MONET
</div>
</div>
```

In code, that would look like this.



But what comes out, looks like this! The painting is shining through the background color, but our text is invisible!



Remember, this is what we wanted it to look like.



The thing about mix-blend-mode is that it composites the .text-box along with everything inside of it, and *then* applies the blend mode. With the screen blend mode, black becomes invisible, therefore our text becomes invisible.



What I want is for it to apply the blending mode to the .text-box, then put the content on top of it. Unfortunately, I haven't found a way to isolate those child nodes.



You would think that's where the new companion property called isolation might come in handy, but that will prevent a background layer from being blended, instead. And I'm not sure why you would even do that instead of just turning off the blend mode.

At any rate, I've been playing around with it a bit at this link, so feel free to poke around and let me know if you figure anything out.



Blending modes are [supported] in most major browsers... [except] Internet Explorer and that includes Edge.



Right now it's listed as "under consideration" on status.modern.ie, and it's marked with a low roadmap priority. But you can help! If you go to to that site, you can click through to their Uservoice forum and vote for the features you want to see them implement.



These properties need our votes. mix-blend-mode currently has 420 and I started one for background-blend-mode and right now it has just has 4 votes! The good news is, Edge supports the same blending modes for SVG, and they upgraded both properties as "on the backlog", so there's some hope there.



Another thing to watch out for is the performance of you web page. I noticed some blend modes can degrade the smoothness of your scrolling. If you're looking for 60 frames-per-second buttery smoothness, they might not be quite ready for use. I noticed this with more extreme blending modes, like color-dodge and color-burn in Firefox. Be sure to test in your target browsers and on your target devices!



Also, Safari is missing the four composite blending modes: hue, saturation, color, and luminosity, so no old-timey wanted poster effects there.



Clearly we still have a ways to go with blending modes. Nevertheless, I hope you can see that color on the web continues to march forward, adding another tool to the designer's belt.

This is really great! But... CSS alone is *still* pretty inflexible with color.



It doesn't, for example, allow for modifying and mixing color values on the web, just like I did back in Color Theory 101.



In other words, if you were to anthropomorphize CSS, in this case in the form of a lovable little squirrel, it still wouldn't have the prerequisites to take graphic design.



But the web is marching ever-forward and we have some new tools in CSS and beyond that can take our colors to the next level.



As you have seen, CSS has changed very slowly over the years, and in general, I think this is okay. But every so often evolution needs to make a giant leap forward.

We used to only get that kind of giant leap when we would deprecate old versions of Internet Explorer. [Click.]

Today though, all you need is a little Sass. Sass gives us a number of new tools that help us blaze trails at a quicker clip.



Let me show you what I mean. [Let's make] a simple three-color palette.

The first thing I'm gonna do is give them names.



Remember at the start of The Joy of Painting when Bob Ross would tell us which colors we were going to be using today? Colors like hsl(113, 100%, 70%) and rgb(255, 161, 0) and #ffa100? No, he'd call them by unique, memorable, identifying names: Titanium White, Alizarin Crimson, and Phthalo Blue. Whether you're using hexadecimal, rgb, or hsl, it will never be as easy as remembering color names.



So let's use some human names.



Now, we might be able to do something cool with this vibrant color scheme, but chances are we're going to be using a few variations on these colors. Sometimes we might want a [very light] version of a color, and sometimes we might want a [very dark] version. As it turns out, we don't have to do any work, because Sass can do this for us.



To lighten a color, we can use the [lighten] function that's built right in. And to [darken] a color, we can use the [darken] function. Simple as that! Now we have a pair of tools to mix color on the fly. Go wild! Okay, actually don't go too wild. This can get a bit tricky. Consider this:



Can anyone tell me how much we need to lighten hulk to get to white? [The answer] is 30%. So, now knowing this, how much do we need to lighten berry to get to white? [This time,] the answer is 65%. And what about crunch? To white-out crunch, we need to [lighten it by 50%]. There's not a lot of consistency in these numbers.



But there's a way to figure this out. I didn't quite give you enough information to solve that on your own, but there's a clue in the HSL values of each color: the L stands for lightness, and the inverse is the maximum percent you can lighten a color before it becomes perfectly white.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%

In this color grid, you can see what I mean.



And here are the darker colors. Now, at some point, each color is gonna become black, and it's not going to get any blacker. So in order to master this new color palette, you'll simply need to memorize the lightness values of each of your colors. Kind of annoying, but hey, it's better than memorizing hex codes, right?



Okay, okay! Let's try something else.



Sass has another color function called scale-color that can move the color components proportionally. Note that it cannot move the hue value in hsla. For that, you'll need the adjust-hue function, but I'm not going to cover that here.



So in this case, if we were to lighten hulk by 50%, it would blow out to pure white...



But if we were to scale the lightness by 50%, it would be halfway between where the color was, and white.



So, *now* how much do I need to scale hulk's lightness to make it 100% white? The answer is 100%. If I scale the lightness to 99%, it's going to be 99% white and 1% hulk. So, knowing that, how much lightness will make berry 100% white, keeping in mind that berry is much darker than hulk? The answer is still 100%. If I scale the lightness to 99% white, the color will still be 1% berry. Now, I know you've got this next one. How much white do I need to scale crunch's lightness to make it 100% white?
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%

So, here you can see we get a much more diverse, proportional, and predictable color table.



And here are the darker colors. This is great, because you don't have to memorize lightness values, you just have to know the names of your colors and relatively how light or dark you want to make them.



So let's see how we can put this together on a common UI element: the button. We want to give our button a sense of clickability.



We're not buying into the whole flat fad, so we know clickability can be easily achieved with a simple gradient.



Traditionally, this can be written in CSS like so. We figure out the top highlight color, and we figure out the bottom shadow color, and we include those in our gradient declarations.



These two colors, our highlight and shadow colors are not in our Sass constants. We would have to figure them out on our own. Probably go into Photoshop and pick a lighter variation of our swatch. Not too big of a deal, but...



If we want to add a second button color, once again, we need to go back into Photoshop and figure out the color values.



Well, so what, we'll just add some extra constants into the list.



But wait, each of these buttons needs a hover state where the *hover* highlight and hover shadow are lighter than the *button* highlight and shadow. So do we declare four more color constants, or do we just fill in these color values once and hope we don't need to use them again later?



By using scale-color, you can keep your color palette limited to your base constants, but still have incredible, intuitive flexibility with tints and shades.



Alright, so let's think back on this color exercise. My professor's point in making me go through this wasn't trying to show me how white makes red lighter. He was trying to show how mixing one color into another affects the appearance of the original color.



If we want to do that in Sass, [it turns out] there's a function just for that, and it's called mix. Mix accepts two color values and a percentage.



If we want to mix white into hulk by 60%, we'd write [mix white hulk 60%]. This is called tinting. Likewise if we want to mix black into crunch by 30%, we'd write [mix black crunch 30%]. This is called shading.



As it turns out, mixing with white and black does perceptually the same thing as scale-lightness, but conveniently it's shorter to type. But beyond that, mix has huge potential to create a look and feel on your websites that were previously not possible before.



If we can mix colors like paint now, can make our websites look more like paintings? I think we can; we just have to think more like artists.



Artists have been mixing colors for thousands now, because it's a perfectly intuitive thing to do. If you have one pigment and want to make it another pigment, you add in other colors. To do it in the digital realm, you have to understand how color math works and, as I've demonstrated...



that's not very intuitive at all. Once again, let Bob Ross show us the way.



In this episode of "The Joy Of Painting", as he does in many, Mr. Ross wants to paint some snow-capped peaks.



And snow is white, right? So that's just what he puts out onto his palette.



After that, he mixes in a little bit of red. Because this was the episode where someone was murdered in this snow and he needed to paint happy little corpses on his mountainside. But just wait.



Next he goes in with blue! Because oh well, why not!



In the end, he creates this lavender color. If you're like me, you may have a hard time believing that's the color of snow.



But in the context of the painting, it suddenly begins to make sense.



And when he's all finished, he's painted the perfect sunset. We think snow is white, but what Bob Ross understands—and what all great painters understand—is that light has color, and that color affects the color of the objects that it reflects off of.



Artists pay attention to the world around them. Perhaps nobody has paid more attention to light than Claude Monet. Over a century ago, Monet began painting the haystacks outside his window. But he didn't paint just one painting, and he didn't even paint just one painting at a time.



He would have his assistant cart out wheelbarrows of canvases and he would work quickly and minimally on each one as the light changed throughout the morning. Sometimes he would only work on a painting for just a few minutes before the lighting conditions had changed enough to warrant moving to the next canvas.



When he was finished, Monet had painted twenty-five canvases of the same haystacks in different light, seasons and through varied weather. The same haystacks, the same base colors, yet with myriad different ways to see them. It's a remarkable study of light, and wonderful from a purely aesthetic standpoint, but from a design standpoint, there's some utility.



Because, in the words of another French impressionist, Pierre Bonnard, "Color does not add a pleasant quality to design—it reinforces it."



See, the color of light can tell a story. One of my favorite times of day is about an hour before sunset. That's what's known as the Golden Hour. During this time, the sun's light is redder and softer, because it diffuses as it travels through more atmosphere to reach our eyes. It lends a feeling of optimism and peace.



Even artificial lighting. Here, in Spike Jonze's "Her", the reddish color mimics the lighting from a perfect sunset.



Other colors can tell different stories. Here in "Only God Forgives", the color palette uses a vibrant blues and reds. On a color wheel, blue clashes with red. It makes the film feel harsh and lonely.



Here, in Wong Kar-Wai's "Fallen Angels" the green lighting is unnatural. It makes the shot feel impersonal and sinister.



Since the '80s, cinematographers have used color grading to more closely match color across different shots (remember, lighting conditions can change in minutes), but "O Brother Where Art Thou" was the first film to have its entire color palette altered by computers. This time it wasn't just for consistency, it was to give the entire film a sepia-tinted old-timey wanted-poster feel to it. The Coen brothers used this coloring to help tell their story.



Jean-Pierre Jeunet also used color grading in "Amelie", and in this shot contrasts Amelie's red dress with green environmental tinting that hints at her playful imagination.



And by ramping up the contrast between foreground desert tones and cooler background colors, George Miller creates a cartoonish sense of energy in "Mad Max: Fury Road". Nothing else about this production is subtle, so don't expect the color to be restrained either!



In this panel from the comic book Young Avengers, we can clearly get the gist of what's going on in this scene by the drawing alone.


But the color of the light amplifies the scene in a dramatic way. This couple could have been anywhere, but when they're in a club, that gives the scene context, a heightened mood, and a sense of feeling.



Which brings me to one of my favorite things. Comic books.



Just like color on the web, color in comics has come a long way from the crude process days...



To more diverse color palettes.



To complex and subtle details, with the aid of computers.



to the highly artistic rendering and stylization of today. While there's no house coloring style, former Marvel Comics editor Bon Alimagno began valuing colorists who used what he called the perfect sunset palette: "warmer palettes rooted in playing off reds and oranges and lighter yellows and blues." This style, he says, "gave Marvel's comics a much more inviting look and feel than most of the DC Comics line."



What if we could easily influence our color in our designs the same way a painter, photographer, or colorist does? With Sass, it's remarkably easy. Let's take our color palette and add in just a couple extra colors. [A highlight], and a shadow. Then we'll take Sass's mix function, but instead of simply mixing with black and white, let's mix with these new colors.



Suddenly the whole palette becomes very warm and inviting.



And the darker colors are rich and vibrant.



If I'm feeling inspired by Monet and want to see my design from a different perspective, I can simply change the values for those two constants, and the next time the Sass is compiled into CSS, the colors will automatically reflect the new changes. With this next scheme, I'm starting again with the same Hulkberry Crunch color palette, but now the highlight is bright pink, while the shadow is a quite dark, desaturated green.



It totally changes the look of the color palette.



Yet it still remains based around our original brand colors.



If we apply this to our buttons, they have have more warmth and more vibrance. The only difference in the code is that the one highlight and one shadow variable have been changed. This is going to be less clear on the projector, but the difference between the original colors and the new ones are subtle. That's the point, though. Your colors should work together to create an aesthetic that enhances your design.



What else can we learn from paintings of nerdy things? Well, notice how there are a couple sources of light in this one? There's what is probably a fluorescent light coming from above, which gives most of the painting a bluish cast, but there's another incandescent light source coming from below, creating warmer yellow highlights and orange skin tones. These two colors compliment each other, which really ramps up the vibrancy of the piece.



So maybe we want *two* different kinds of highlights and shadows to give the layers of our pages more depth, and really make them pop. Really, you could have as many highlights and shadows as you felt were appropriate, but realistically, more than a handful probably aren't going to solve any new problems for you.



I wanna cover browser support real quick, just in case this is unclear to anyone. This all gets compiled into basic CSS color declarations, so every browser will be able to see these effects, meaning you can start playing around with this today! If you include fallback colors for your gradients, any browser that supports color can benefit.



To demonstrate this concept, I created a little demo site.



You can see it at <u>http://demo.lighting</u> (which is clearly the most obvious use for the .lighting TLD).

You can follow along on your device if you like, but don't worry, I'll show you up here on the projector, too.



Here it is. The concept behind this site is to revitalize well-designed luggage labels that show off where you've travelled to around the world. You can view the different stickers and order the ones you want.



In this demo I picked some brand colors and decided to have three different highlight and shadow combinations for use throughout the page: a standard pair, a pair for higher contrast, and a pair just for use on the background layer. I'm essentially using monochromatic highlights and black shadows. This is basically your standard gray UI.



Here it is again. So, now let's click on this [first sticker] here for my current residence of Olympia, Washington. You can see that it's got lovely yellowy lighting with the purple hues of Mount Rainier in the background. I want my page to draw from those colors to give the page a cohesive appearance.



So instead of these sterile UI colors...



I'll choose highlight and shadow colors that convey a more organic atmosphere. My brand colors, of course, remain the same.



The mood of the page is totally different, yet all of the markup, typography, and basic layout remain the same. It's just that since nearly every color has been mixed to some degree with yellowy highlights or purple shadows, a new light, literally, has been cast on the page. Now the background is an eggshell color. The Add to Cart button is natural, yet vibrant. And the background purples mellow with the contrasting foreground.



Let's go back and look at another one. [For Lincoln], Nebraska, my hometown, the sticker features many examples of the city's public art, stacked on top of each other to mimic its distinctive capital building. Unlike Olympia's yellows and purples, this one is really, really red.



Again, I want this sticker's page to reflect that, so let's change some colors again.



Now the highlights and shadows are red, with the exception of the background. The background uses green instead, which is red's compliment and helps bring the color out a little bit more, without sacrificing readability.



And here we have it. Same markup, same basic CSS, just different colors quickly and easily with Sass.



For Austin, Texas, I had one of my friends, Marcus Tegtmeier, create a sticker from one of his favorite hot spots there: Barton Springs Pool.



When you visit this page, the cool waters and green leaves are reflected throughout.



Here are the colors I used. Note that the official brand colors don't change through the whole site, yet it's a remarkable difference from page to page. But... so far it's been pretty low-key. Do you guys wanna see something a bit more dramatic?



Alright, let's get out of the United States and into The Grid. This one is for all you fans of Tron.



Whoaaa! Okay, okay, it's not the most inviting color scheme, but it kinda works in its own '90s hackery way. Especially the footer. Man, I love that. But whatever, this is still really cool!



To get this crazy look, I swapped all the highlights and shadows. Dark shadows became bright highlights, while highlights were turned into shadows. This shows how versatile your color palettes can be. Since nearly all the colors are mixed in some way, this dramatic change was achieved simply by switching around three color pairs!



There you have it. If you want to refer back to this later, just go to demo.lighting and you'll find everything there, including some links to some blog entries I wrote about it.



Let's take a look at one more thing before I let you go. For this, we're going to switch back to plain old vanilla CSS.

As you've seen, with highlight and shadow colors, we can take our inspiration from the sun, but soon we'll be able to use the actual sun to influence our palettes. That's because many of our devices have light sensors in them.


Typically this is used determine how bright or dim your screen should be. When you take your device from the bright outdoors into a dark room, it will automatically crank the brightness down to make using it more comfortable.

Right now, that's only available at the hardware level, but with luminosity media queries, we'll have a standardized way to use those sensors in supported browsers.



You write a luminosity media query similar to how you would write a height- or width-based media query.



There are three levels of luminance in the spec, normal, washed (for example, in direct sunlight), and dim (as in dark rooms). What can we do with these levels?



Tweetbot is an unofficial Twitter app that uses the device sensors to detect the ambient lighting in a room. When it's bright, the app displays black text on a white background. But when lighting is dim, it automatically switches to a dark theme.



Instapaper, a read-it-later app, uses the time of day to present its content in different ways. In the daytime when light is brighter, the app uses black text on a white background, and [at night] it switches to dark mode. However, during the golden hour, just before sunset, [it gradually tints] the screen with a sepia tone—sort of like an old-timey wanted poster. The app's creator Marco Arment claims, "it subtly increases reading comfort without being distracting or tacky."



We could try something similar in our CSS with luminosity media queries. One way we could do this by changing the amount we mix our highlight and shadow colors by.

- Here, in a bright environment, we want to make our highlight brighter and our shadow darker to ramp up the contrast.
- And in a dim environment, let's back it off more so we don't sear the corneas of our visitors.



Alternatively, we could set three highlight constants and three shadow constants and keep the mix percentage the same. I don't have any recommendations on which way to do it, because I don't know which way is better yet. That's because...



The bad news is, right now, no browsers or devices support these new media queries, but look for these in the future.



We now have the tools to take color on the web to the next level. Blending modes bring some advanced design capabilities out of graphics editors and into our hands. Sass color mixing gives us the most intuitive way to mix color on the fly, which is going to make even Photoshop jealous. And with luminosity media queries, we'll be able to create dynamic lighting Monet could never have dreamed.



Thank you for being here and listening to me! You've been such a great audience. You can find me on Twitter at revoltpuppy.

## **Additional Resources**

- Demo site: <u>http://demo.lighting</u>.
- "Coloring the Web" by Geri Coady: <u>http://</u> <u>hellogeri.com/blog/view/</u> <u>interlink\_conference\_2013\_colouring\_the\_web</u>
- "Color Theory" by Lea Verou: <u>https://</u> www.youtube.com/watch?v=8xjR7QXQKJ0
- "The Chroma Zone" by Lea Verou: <u>https://</u> www.youtube.com/watch?v=qqbZBnLVn74

Here are a few links that might interest you.

Coloring the Web is all about color: the science behind it and some accessibility considerations.