

# Why do Saturation and Luminance go all the way to 240, but Hue goes only to 239? And why 239 anyway?

 [devblogs.microsoft.com/oldnewthing/20151013-00](http://devblogs.microsoft.com/oldnewthing/20151013-00)

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If you open the [common Color Picker dialog](#), the custom color picker lets you specify the color in one of three ways.

- Graphically, by clicking a color in the rainbow and using the slider to change the brightness.
- Numerically by specifying Hue, Saturation, and Luminance.
- Numerically by specifying Red, Green, and Blue.

Let's look at the Red, Green, and Blue values first. Theoretically, color channels are expressed as floating point values between 0.0 and 1.0 (inclusive). In Windows, it is common to change the scale to integers 0 to 255 (inclusive), since that corresponds to the color values in a 24-bit color space. This is the color space you've probably spent a good amount of time dealing with, since it corresponds to the `RGB` macro in `wingdi.h`, the `COLORREF` data type, and the way colors are typically expressed in CSS: `#RRGGBB`.

The Hue, Saturation, and Luminance is a bit trickier. The theoretical range for Hue is an angle, normalized to be greater than or equal to  $0^\circ$  and strictly less than  $360^\circ$ . The upper value of the range is not reached because Hue is cyclical, so a value of  $360^\circ$  is equivalent to  $0^\circ$ . On the other hand, Saturation and Luminance are floating point values between 0.0 and 1.0 (inclusive).

In Windows, the Hue, Saturation, and Luminance ranges are rescaled so that they go from 0 to 240. Hue is endpoint-exclusive (because  $360^\circ = 0^\circ$ ) whereas Saturation and Luminance are endpoint-inclusive (because 1.0 is achievable).

Okay, but why rescaled to 240? Why not rescale to 255?

The Hue value works out best when the range can be equally divided into 12 segments, because the important points of the Hue occur every  $30^\circ$ . The highest multiple of 12 that is still less than 256 is 252, but 240 makes for prettier values.

RGB	Name	240-based	252-based
FF0000	red	0	0
FF8000	orange	20	21
FFFF00	yellow	40	42
80FF00	chartreuse	60	63
00FF00	green	80	84
00FF80	spring green	100	105
00FFFF	cyan	120	126
0080FF	dodger blue	140	147
0000FF	blue	160	168
8000FF	electric indigo	180	189
FF00FF	fuchsia	200	210
FF0080	deep pink	220	231

(Color names taken from Colblindor.)

Saturation and Luminance could have gone up to 255, but I guess they used 240 out of solidarity. The original code was written in the 1980's for a now-defunct program called *Chart*, and it has been carried forward ever since.

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