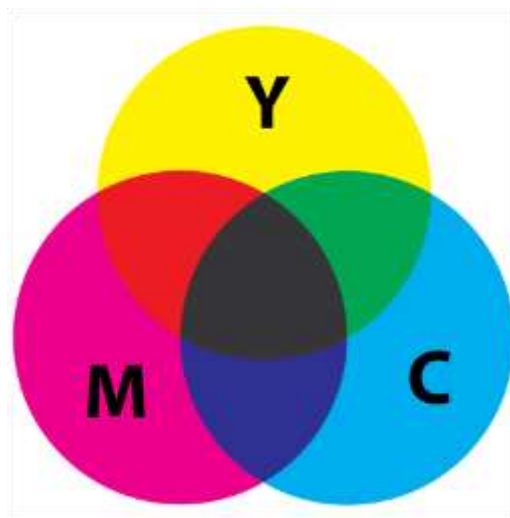




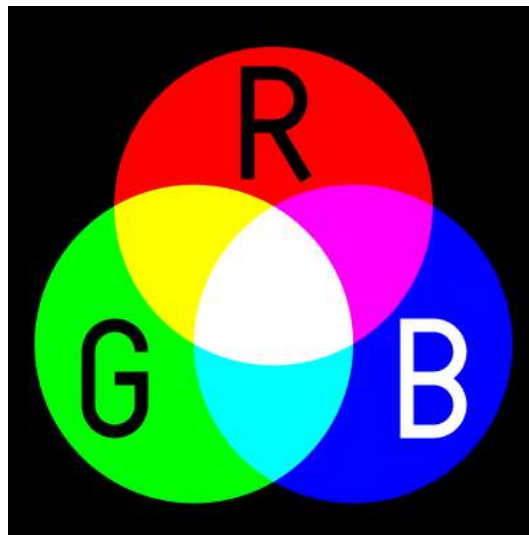
De Chameleon

Mixing colors

Everyone has mixed colors with paint. With three basic colors (yellow, red, blue) all other colors can be made. If we put all these three colors together with equal amounts, we get brown/black. This way of mixing colors is called subtractive color mixing.



Another form of colour mixing is with light (additive colour mixing). In this way, the colors are also made on a computer screen or on the television. Here too, three basic colors (red, green, blue) are used, so these are slightly different colors than when mixing paint. If all three colors of light are equally bright, we get white light (so opposite to mixing with paint).

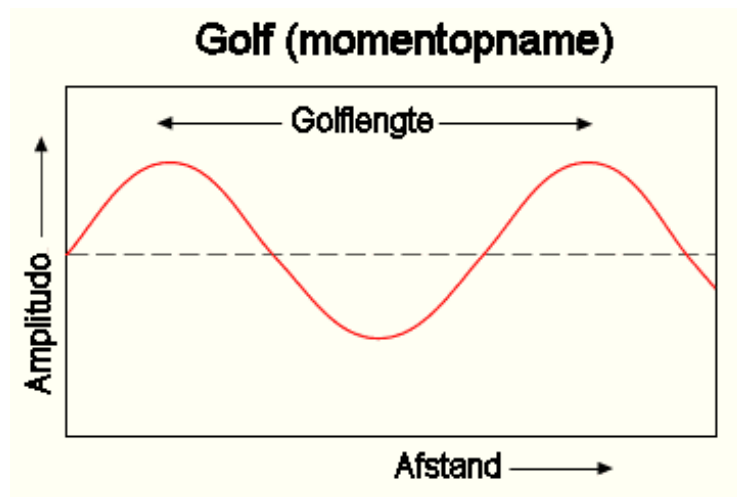


The Chameleon has a special three-color LED, actually three LEDs in one housing. The LEDs can be turned on individually, but also combined. This allows 7 different colors to be made. The eighth option is all LEDs off, so no light ("black").

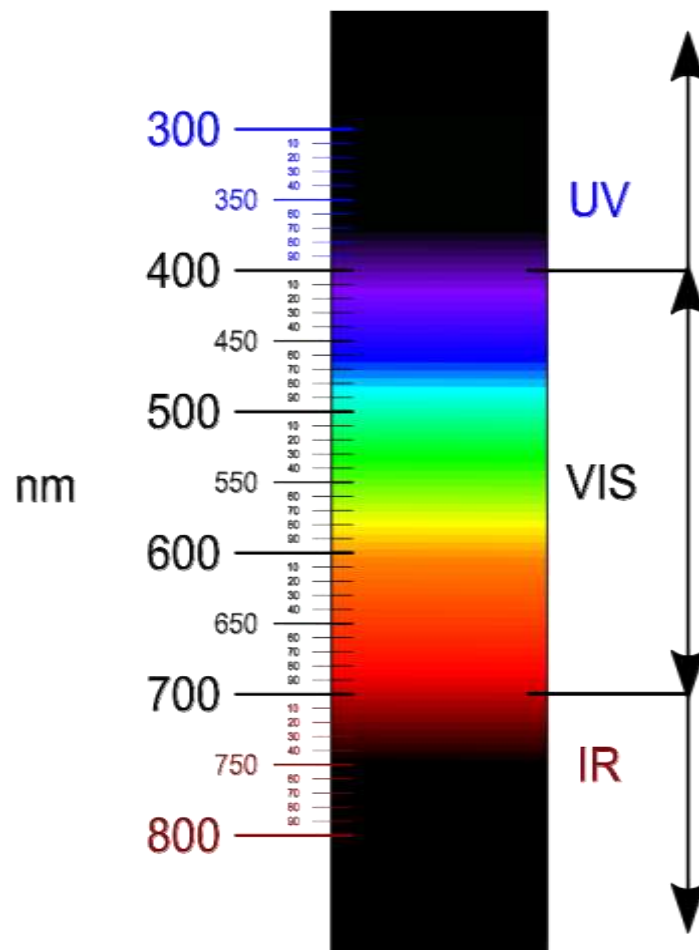


Wavelength

How can light be a different color? What distinguishes colours from each other? Light can be imagined as a vibration. Each color of light has a specific speed at which it vibrates (frequency). If the light propagates through space, at the speed of the light(!), then the light travels a certain distance with each complete vibration. This distance is called the wavelength.



Actually, light is an electromagnetic wave, just like radio signals. Here too we speak of wavelength, think for example of the 80-meter band or the 2-meter band. Light vibrates much faster, the wavelengths that occur are expressed in nanometers, a nanometer is a millionth of a millimeter.



Binary counting

The colors of the Chameleon change in a fixed rhythm. If we start with all LEDs off, we get the following combinations:

- all LEDs off → black/no light
- green LED → green light
- blue LED → blue light
- green + blue LED → turquoise light (or apple blue sea green according to our Belgian neighbours)
- red LED → red light
- red + green LED → yellow light
- Red + Blue LED → Purple Light
- red + green + blue LED → white light

The LEDs switch on or off in a fixed rhythm. This rhythm follows the same rhythm as in binary counting (the way a computer handles numbers).

	Red LED	Blue LED	Green LED	Red = 4	Blue = 2	Green = 1	Total of the numbers
0	Off	Off	Off	0	0	0	0
1	Off	Off	On	0	0	1	0+0+1=1
2	Off	On	Off	0	2	0	0+2+0=2
3	Off	On	On	0	2	1	0+2+1=3
4	On	Off	Off	4	0	0	4+0+0=4
5	On	Off	On	4	0	1	4+0+1=5
6	On	On	Off	4	2	0	4+2+0=6
7	On	On	On	4	2	1	4+2+1=7

The Chameleon uses a 3-bit counter. This allows 8 combinations to be made. If an extra bit is added, so a 4-bit counter, you can make 16 combinations. With 5-bit, that becomes 32 combinations and so on. A computer often uses "bytes", which are 8 bits, with which up to 256 combinations can be made!

Game: What color am I?

Chameleon on your back, look for the chameleon with the same color without talking.

Game:

What color is my Chameleon today?

Preparation:

Hang the Chameleon on the back of the scout and set a color using the color button SW1 (don't forget to turn off the motion sensor!).

Game:

The scouts have to guess which color he is by asking questions to which they can answer with "yes" or "no".

Then the scout has to find his doppelganger(s), the one with the same color.

The game is over when everyone has found their doppelganger(s).

Game: The right wavelength

With radio connections, the transmitter and receiver must be on the correct wavelength (frequency), otherwise they cannot talk to each other.

In this game, all Scouts activate the Chameleon's motion sensor. For one minute, the Scouts move across the playing field. After the minute, all Scouts stop moving, they turn off the motion sensor (without changing the Chameleon color!).

The idea now is to make a chain of Scouts and whisper a message. But beware: only Scouts "on the right" wavelength are allowed to talk to each other.

So a Scout with a green Chameleon can only talk to another Scout who also has a green Chameleon.

It gets interesting with the mixed colors, a Scout with a turquoise Chameleon can talk to a "green Scout" and with a "blue Scout" (turquoise is green and blue together). This way a long garland can be made.

A Scout with a white Chameleon can talk to anyone. A black Chameleon (LED off) does not participate for a while.

Internet links

Our Chief Scout, Freek Vonk, has an interesting video online, of his chameleon "Kamili":

<https://youtu.be/cr4kJw-Yn0s?si=kzjHTPtVNMTom-nk>

If you want to know why the chameleon can change color, take a look at this video:

https://youtu.be/qlDxYR5ziyM?si=8Vx28-QCSaNJ5_m5

An interesting video about camouflage: https://youtu.be/E5Vco95EkOM?si=rgH6n_RivIRv0PPJ

If you want to know more about color mixing, you can find a clear story here. This site also has interactive pictures, so you can play with color mixing yourself: <https://www.erco.com/nl/licht-plannen/kennis-over-licht/kleurenmetriek/additieve-kleurmenging-7492/>

English links:

Kleurmenging: <https://www.erco.com/en/designing-with-light/lighting-knowledge/colorimetry/additive-colour-mixing-7492/>

Why chameleons change color: <https://youtu.be/Dd7UVLkuxC4?si=QkvBTswDcKfRTK7g>