

Composition of colours

A digital microscope allows a close examination of how colours are created on a display of a computer or on a paper with colour printing.

What you need

- notebook
- digital microscope [PS-EDU](#)
- colour image printed with an inkjet or laser printer

How to handle digital microscope

Digital microscope PS-EDU can be connected to:

- a) LabQuest 2 (*Home icon → Accessories → Camera App*)
- b) to your PC (the programme *Celestron MicroCapture Pro* comes with the microscope)

You can hold the microscope in your hand (for example when examining your facial hair), or you can use the stand, as shown in the figure below. The stand provides a stable (not shaking) image, and it allows sharpening with a fine vertical slide mechanism.

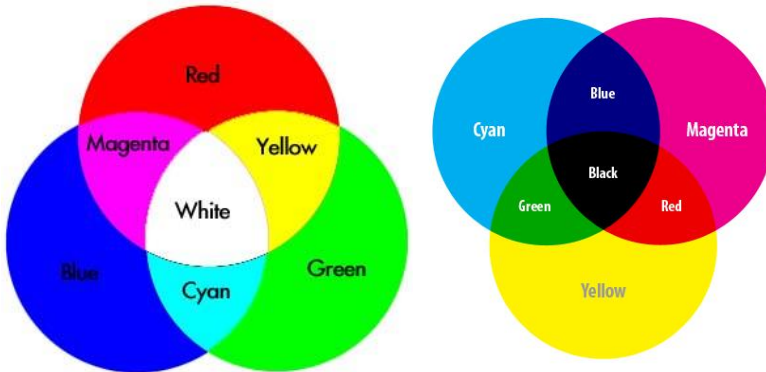


The magnification (small or large) and focus can be adjusted with a knob on the microscope body. The intensity of the LED light is adjusted by a knob on the microscope cable - if the source emits light itself (for example, pixels on the computer screen), switch the light off. On the other hand, it is recommended to have the light on when examining leaves, fabric, hairs and so on.

Methodology & Worksheet

Colour mixing

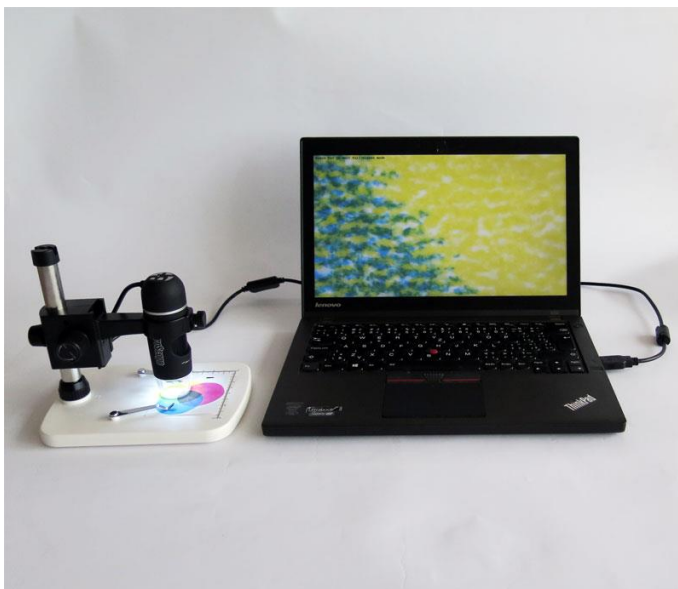
The display of a computer and a colour printer can produce a wide range of colours and hues. All colours, however, are created by mixing only three components. The principle of colour composition of a printer is completely different from the principle used by the computer display. By a composition of three primary colours (red, blue, green) in a computer display we obtain a perception of a white colour in our eye (or rather in our brain) (see the left figure below). On the other hand, composing all three components of colour printing (cyan, magenta, and yellow) gives black (see the right figure below). However, the black colour is frequently used in printers, so the printers have black ink as well as the cyan, magenta and yellow.



The difference is that whereas in the case of the display we add different colours to the resulting light (which is why it is sometimes called the *additive* colour mixing), pigments (printing inks, food dyes) act as colour filters, so this principle is also called the subtractive colour mixing. The pigments remove some parts of a light spectrum. So for example, the blue-green (cyan) dye absorbs everything except the blue and green colours, which are reflected.

Inkjet and laser printer

Print this page with an inkjet or a laser printer and use the microscope to see how the colours in the colour schemes above are created. When you focus the lens on the border of yellow and green, it is possible to see (using a large magnification) that green is actually created by mixing yellow dots and blue-green (cyan) dots, as shown in the figure below.

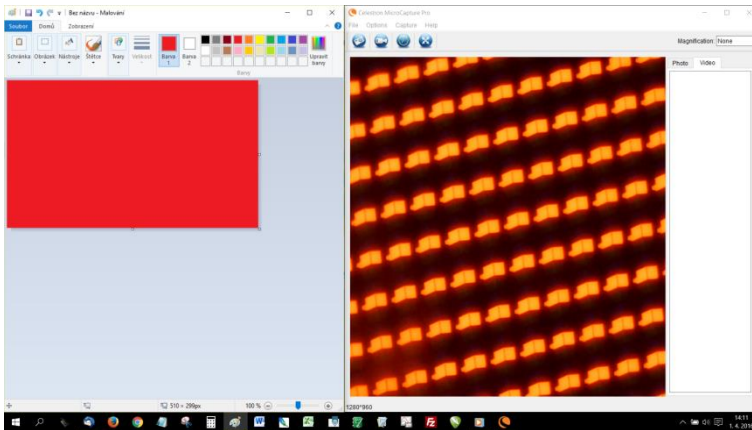


Computer display

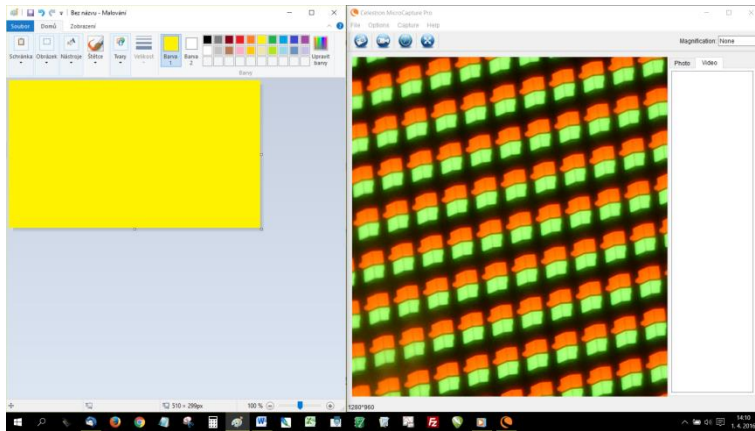
When observing the pixels on the computer screen, you can tilt the notebook display as is shown in the figure and rotate the microscope on the stand by 180 degrees.



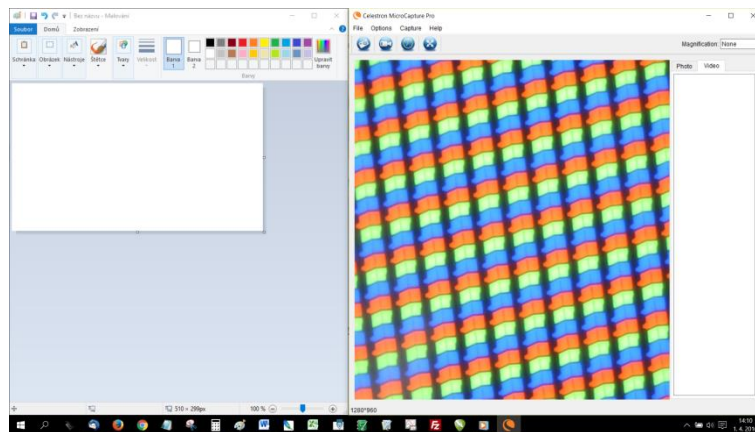
Launch the programme *Paint* in your computer and simultaneously display the application *Celestron MicroCapture Pro*. Use the "bucket" tool in *Paint* to make the whole area red. The microscope with large magnification reveals that only red subpixels are lit in the computer display.



Now change the colour to yellow. The microscope reveals that actually no yellow colour is used by the display. The red subpixel is now accompanied by a green one. Our eyes and brain, however, evaluates these two colours as yellow.



The perception of a white colour is achieved by combining red, green and blue.



The black colour is achieved by turning all of the subpixels off.

