



# waag society

institute for art, science and technology

picture by @dailylaurel



## BioHack Academy Microscope Design



# Why we need a microscope

- Morphological identification
- Check purity of a culture





# Industry Standard



Moisey - CC-BY-SA 3.0



Paul Hartzog - CC-BY-SA 2.0



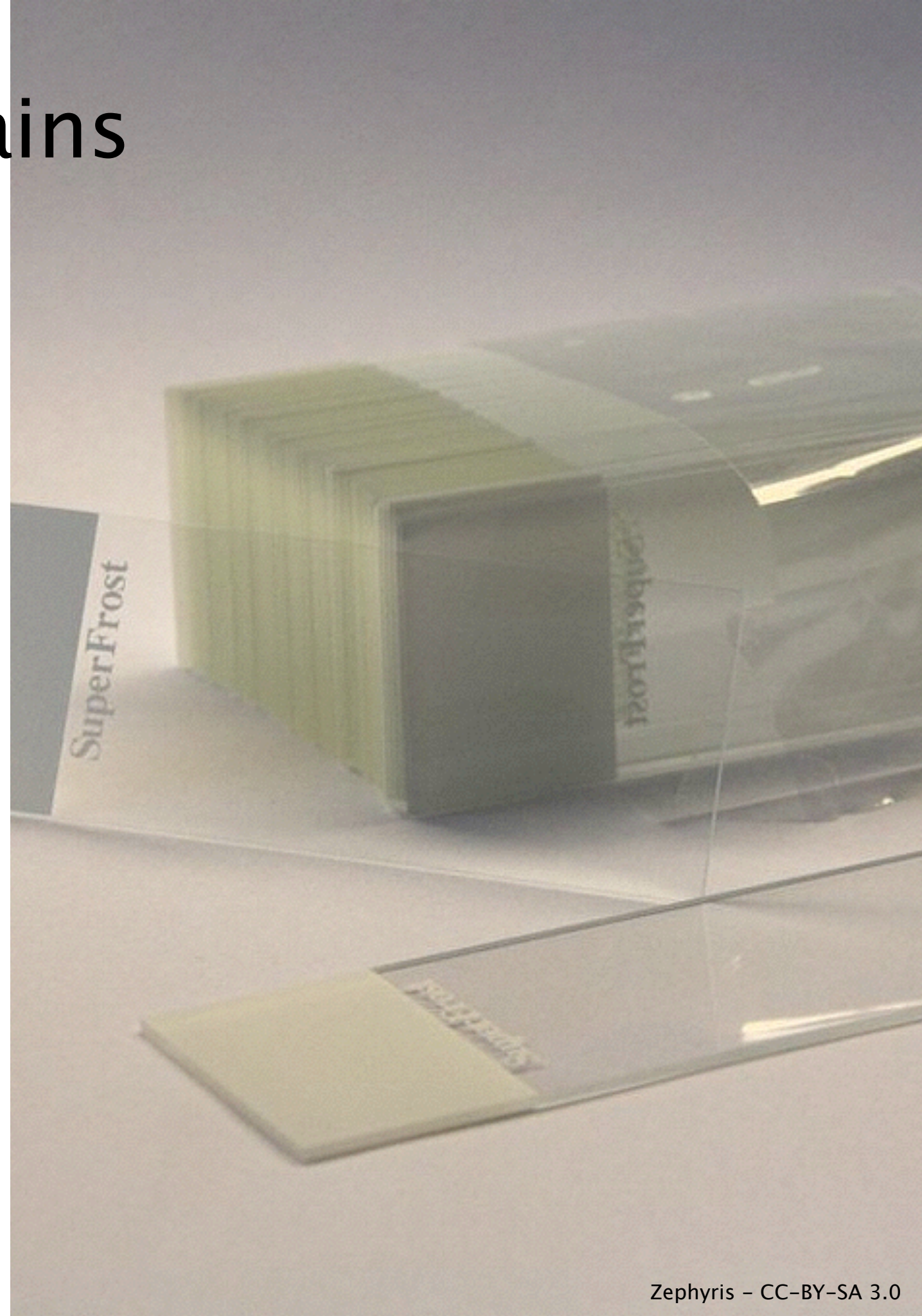
Pixabay Public Domain





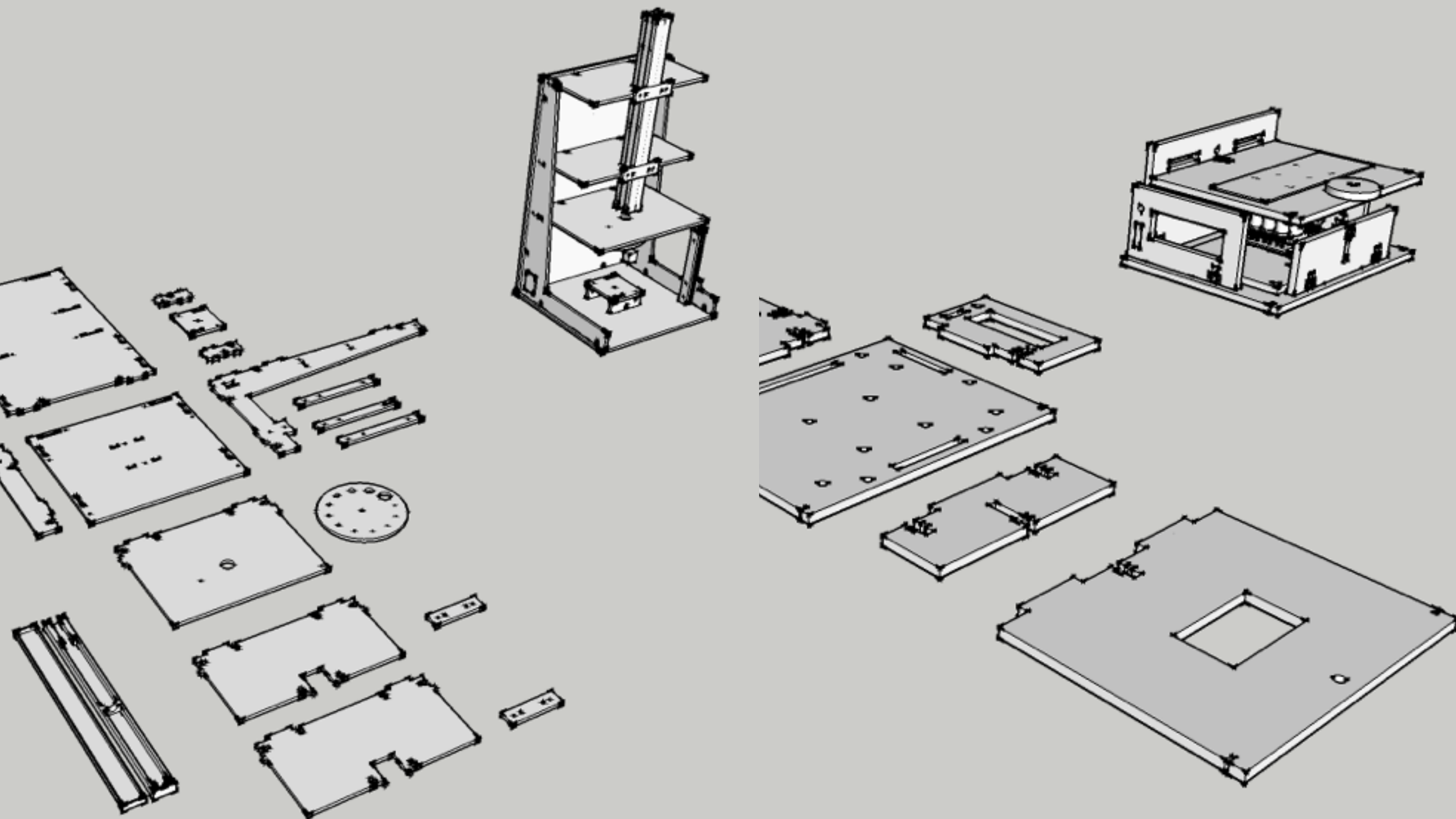
# Design Constrains

- Microscope slide





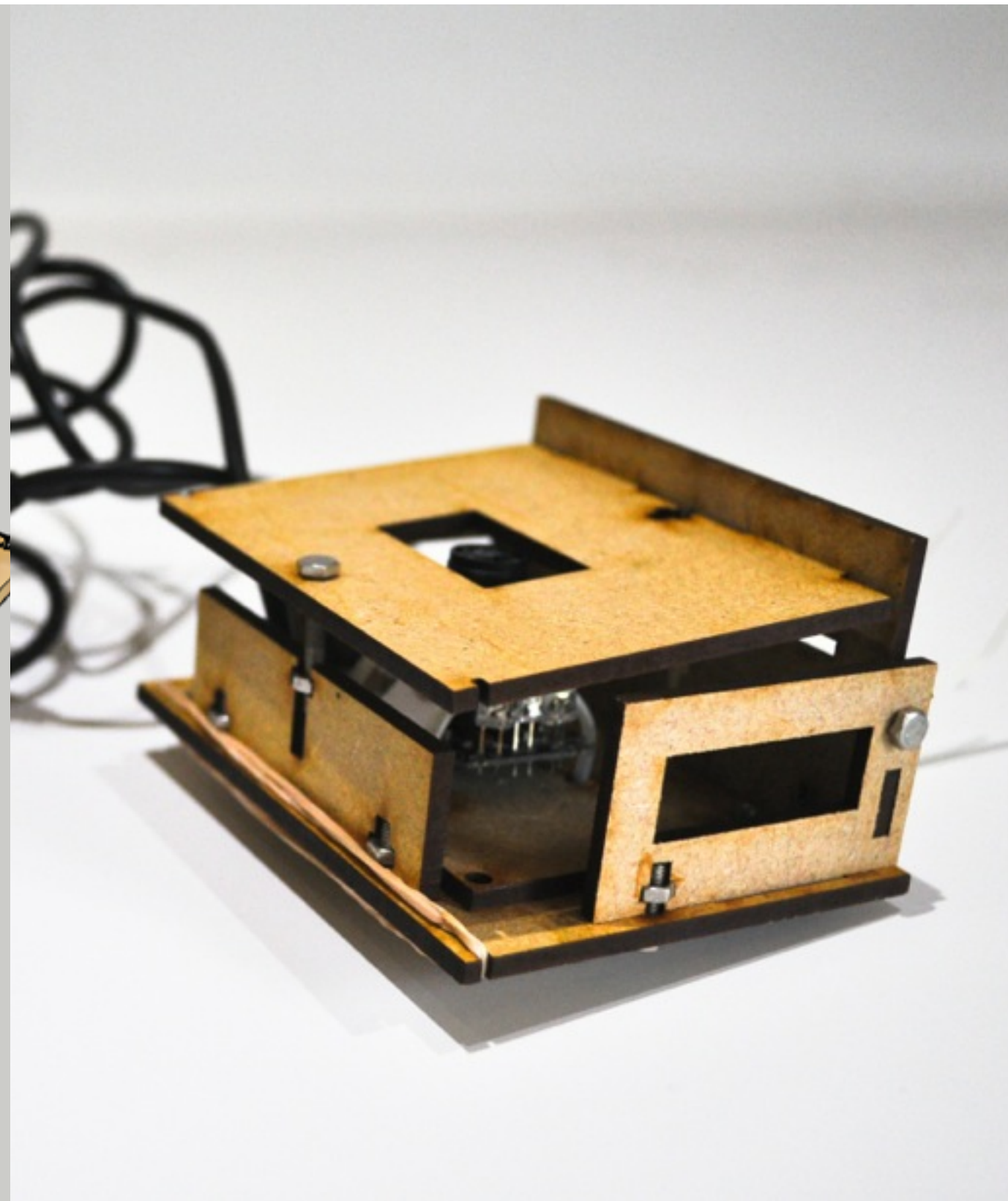
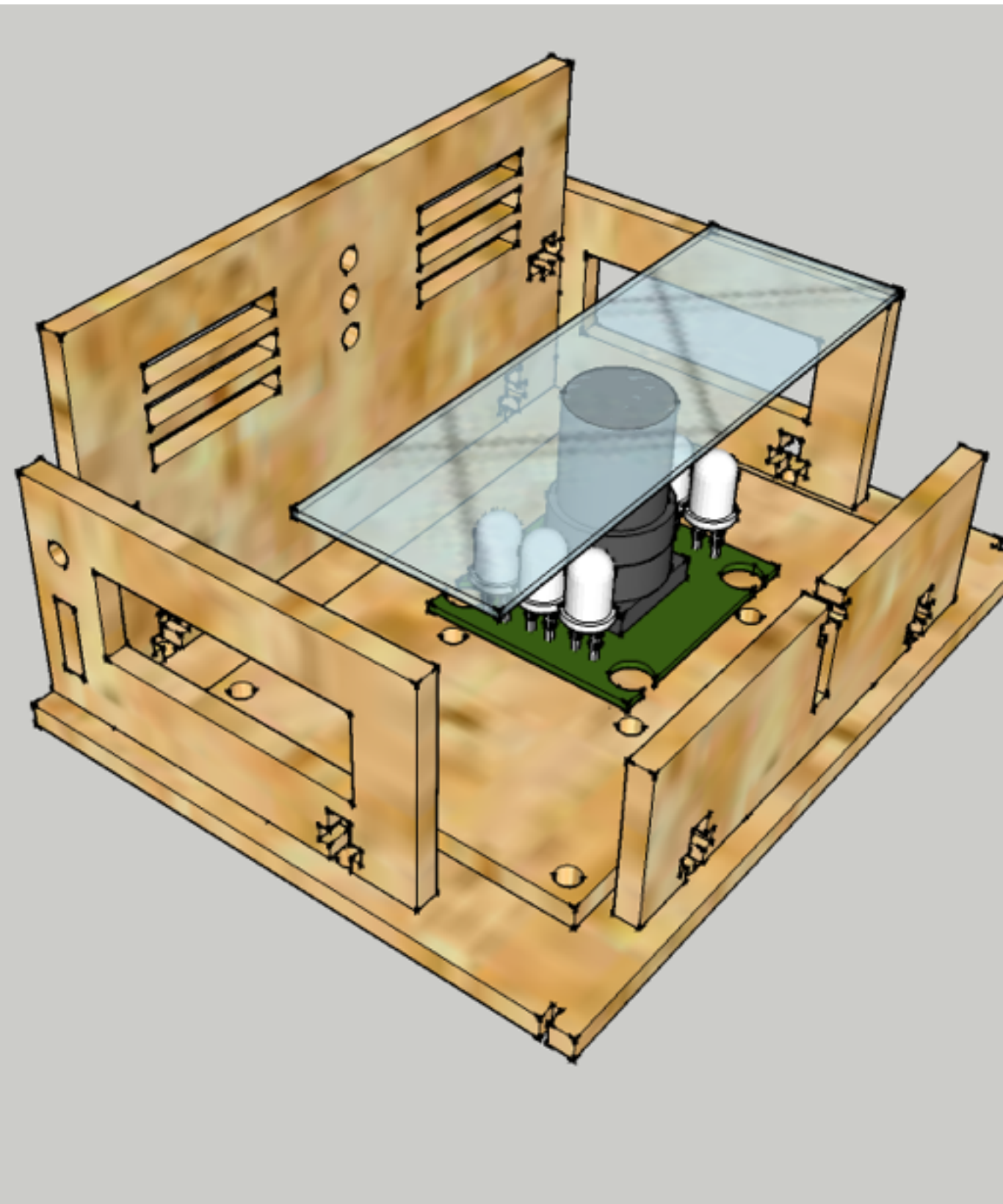
# Biohack Academy Designs







# Webcam Microscope

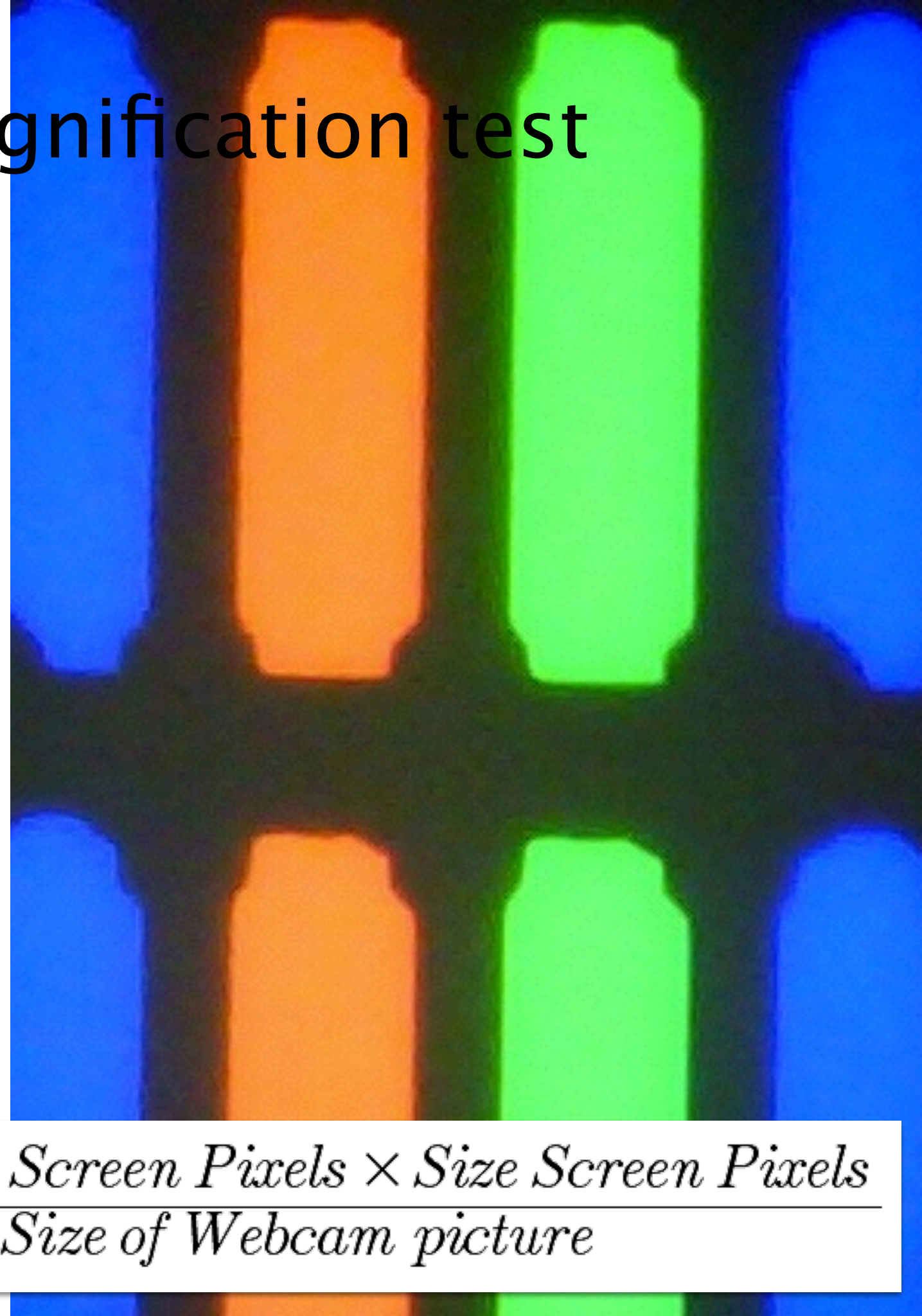






# Pixel Based Magnification test

- Take a picture of your screen up close
- Count the number of pixels in the frame
- Calculate the magnification



$$\text{Magnification } M = \frac{\text{Number of Screen Pixels} \times \text{Size Screen Pixels}}{\text{Size of Webcam picture}}$$



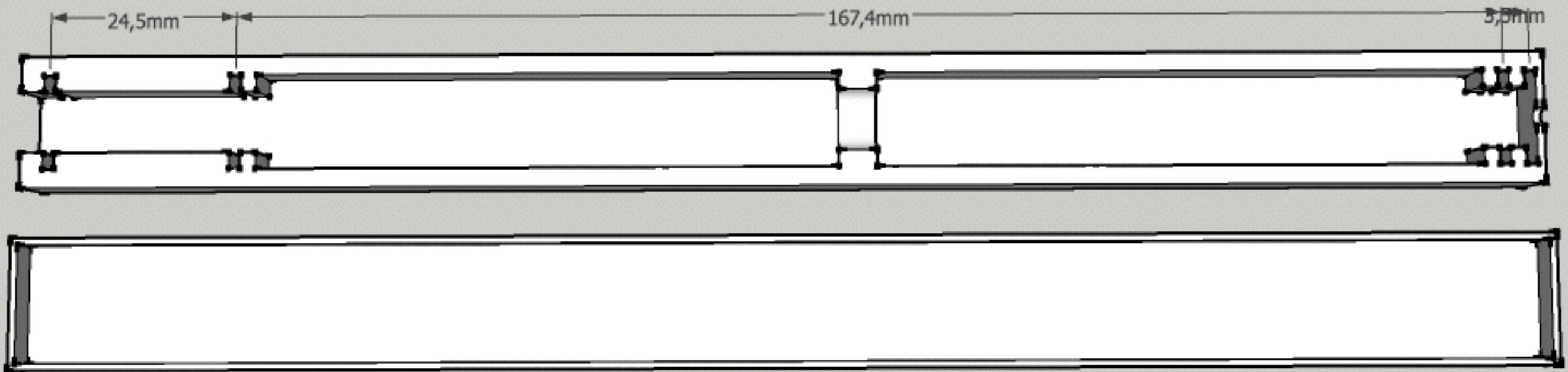
# Compound microscope





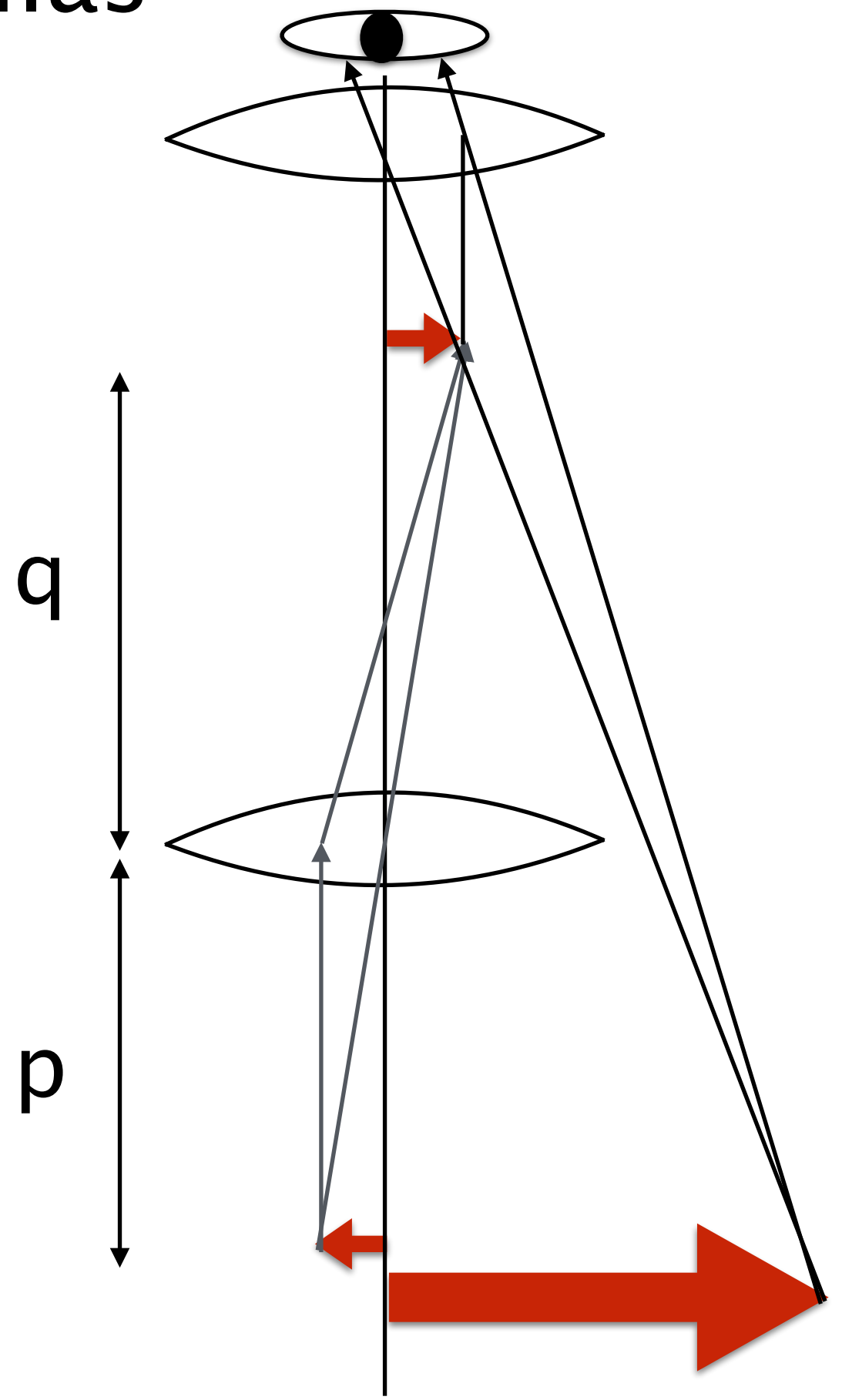
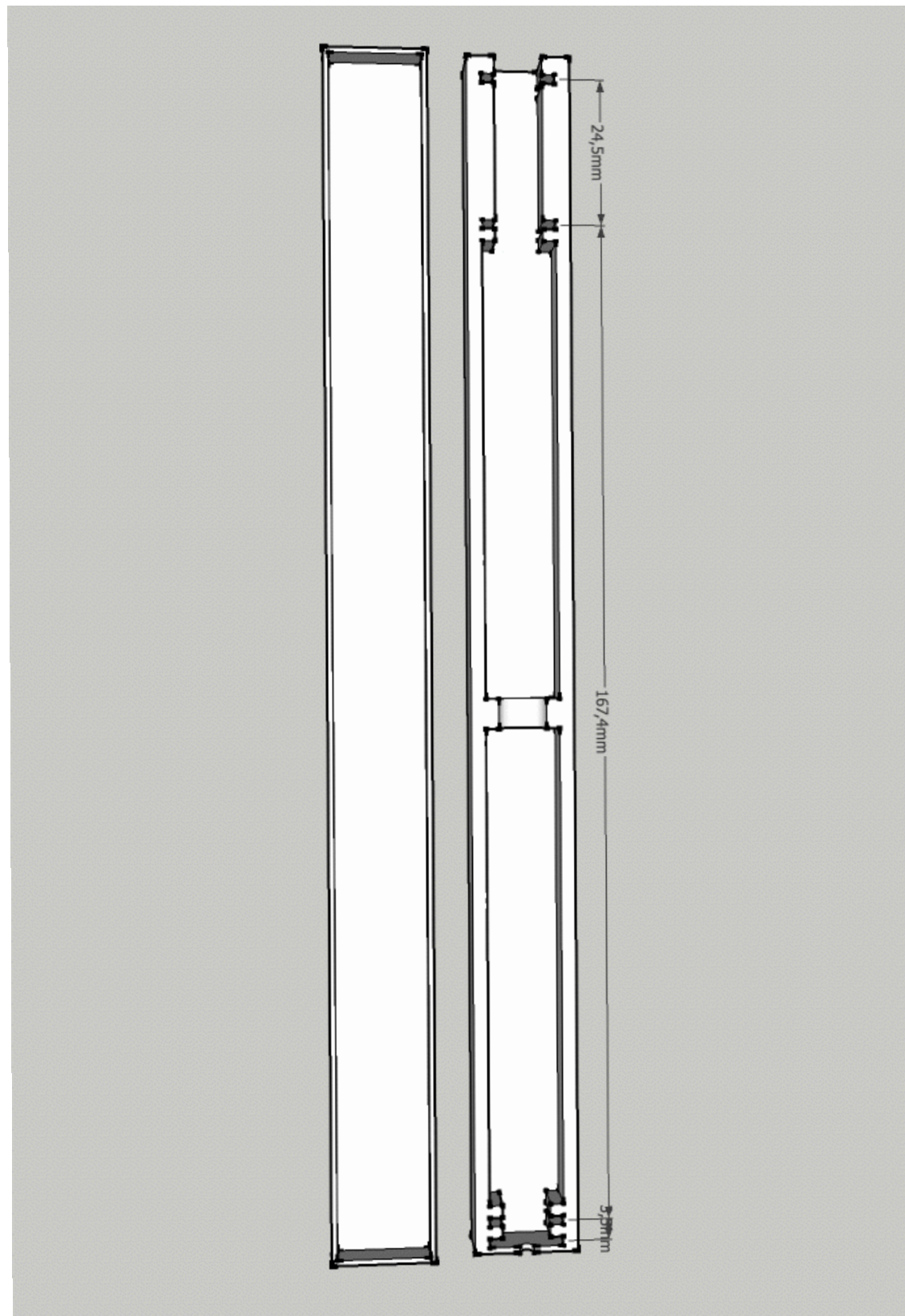


# Dimensions





# Microscope formulas







# Magnification Objective

- Focal length of objective
  - $f_a = f_b = 35 \text{ mm}$
  - $d = 3.2 \text{ mm}$
  - $f_{ab} = 18.3 \text{ mm}$
- Objective-specimen distance
  - $q = 167.4 \text{ mm}$
  - $p = 20.6$
- Magnification power objective
  - $M_{ob} = 167.4 / 20.6$
  - $M_{ob} = 8.1$

$$f_{ab} = \frac{f_a \times f_b}{f_a + f_b - d}$$

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

$$M_{ob} = \frac{p}{q}$$



# Magnification Eyepiece

- Focal length eyepiece
  - $f_a = f_b = 35 \text{ mm}$
  - $d = 24.5 \text{ mm}$
  - $f_{ep} = 26,92 \text{ mm}$
- $M_{ep} = 250 / 26.92$
- $M_{ep} = 9.3$

$$f_{ab} = \frac{f_a \times f_b}{f_a + f_b - d}$$

$$M_{ep} = \frac{250}{f_{ab}}$$





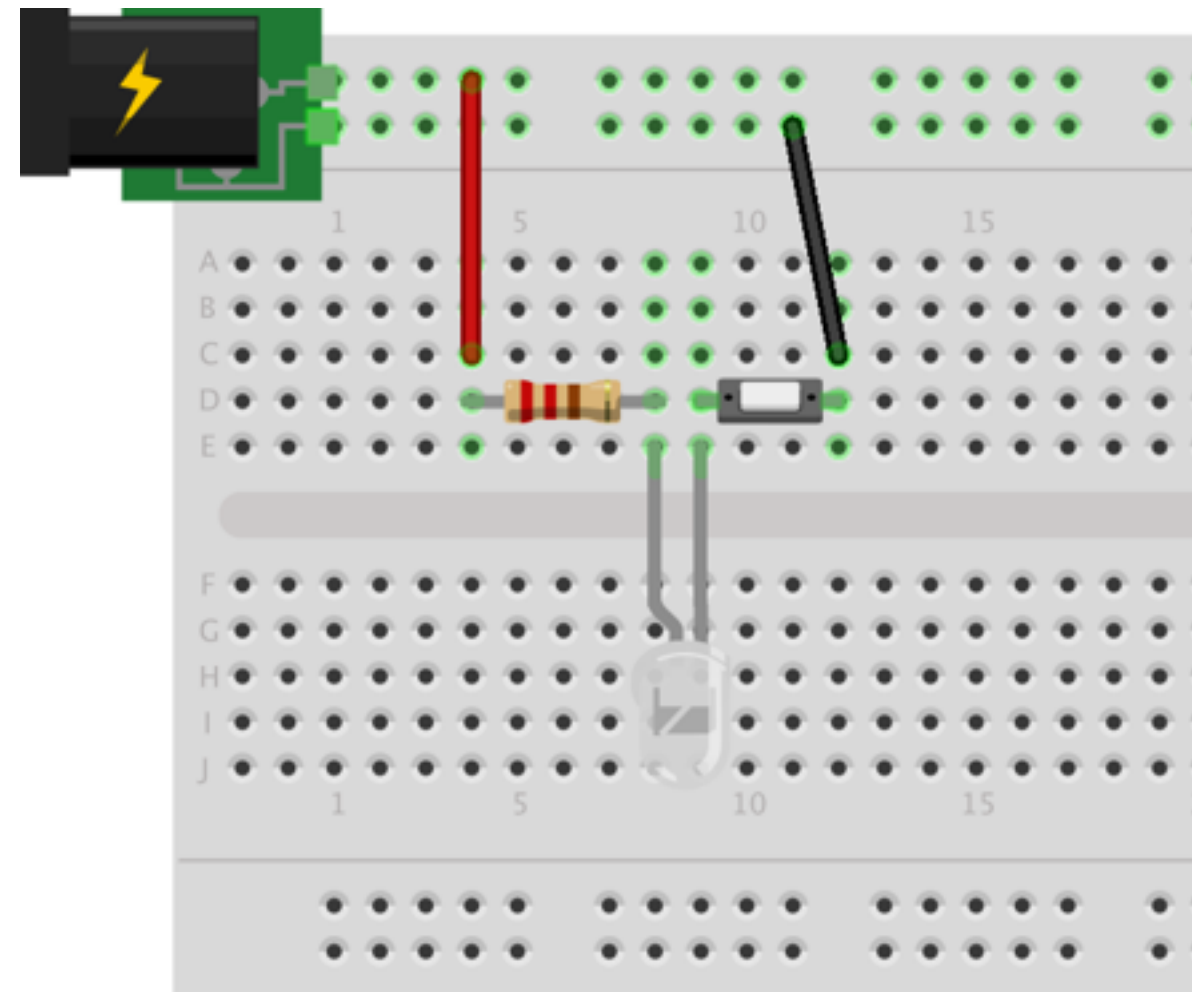
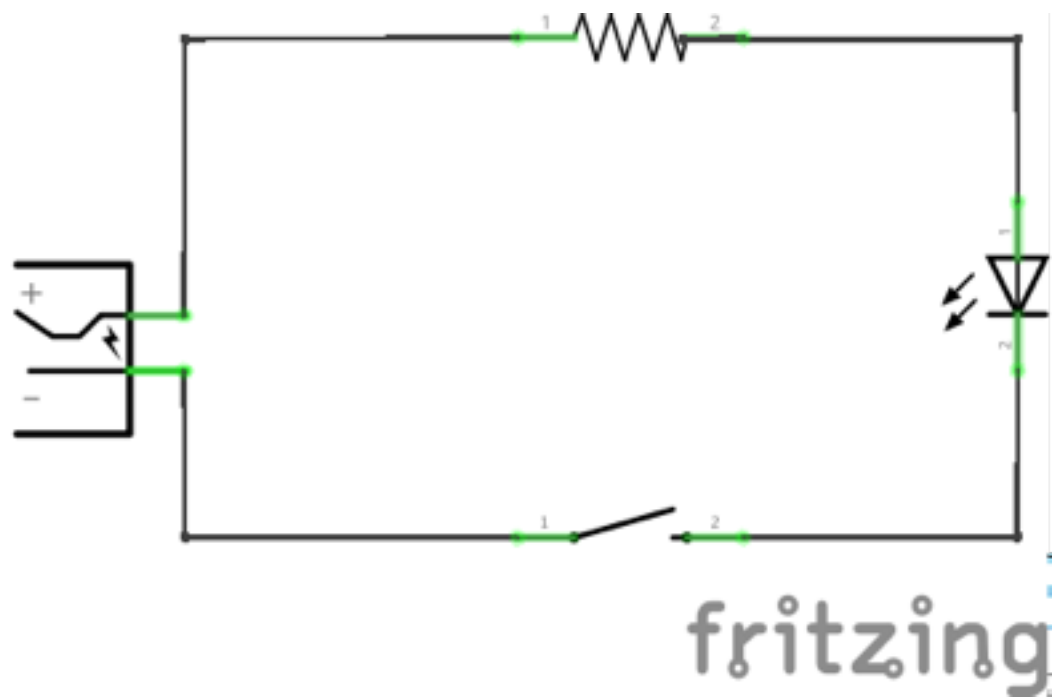
# Magnification Microscope

- $M_{mic} = 8.1 \times 9.3$
- $M_{mic} = 75.5$

$$M_{mic} = M_{ob} \times M_e$$



# Wiring







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