Workshop AFT - misura dei nitrati per acque potabili

Teorico: Misura in continuo “optical measurement principles”

Overview

Morning

- Definitions of important terms optical measurement
- Characteristics of the absorption of light (visible and invisible)
- Characteristics of nitrate and organic compounds

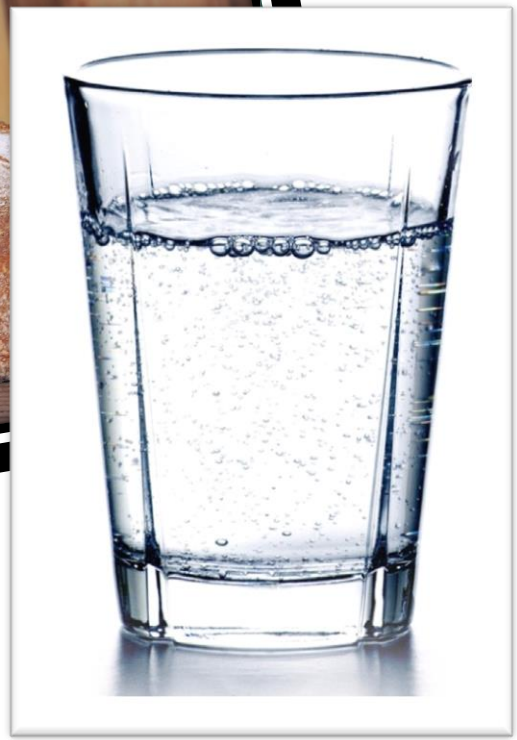
Afternoon

- Photometric construction: CAS51D Viomax
  - Nitrate sensor
  - SAC sensor
- Experiment: Turbidity and Absorption
- Measurement loop in drinking water
- Discussion

Definition of important terms optical measurement

- Dispersion and dissolved substances
- Absorption, color, intensity, scattering, turbidity
- Lambert Beer law

What do you see...? → Flipchart



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Dispersion and dissolved substances

Dispersion – heterogeneous fluid → turbidity

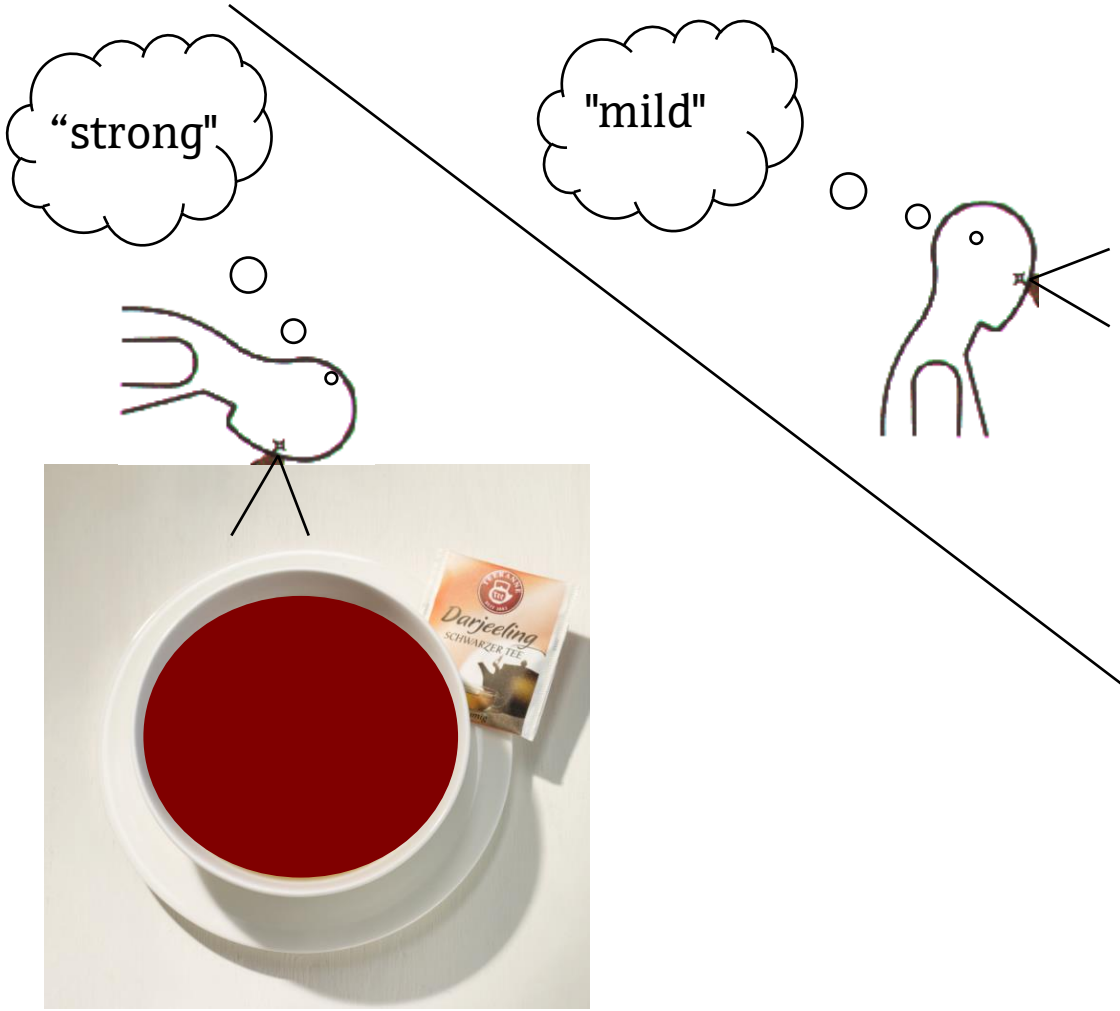
- Emulsion: Two not mixable fluids
- Suspension: Solid in fluid
- Foam: Gas in Fluid

Dissolved substances – homogeneous solution → color

- Molecules, ions or atoms homogeneous distributed

Relevance for drinking water?

Color intensity at same concentration



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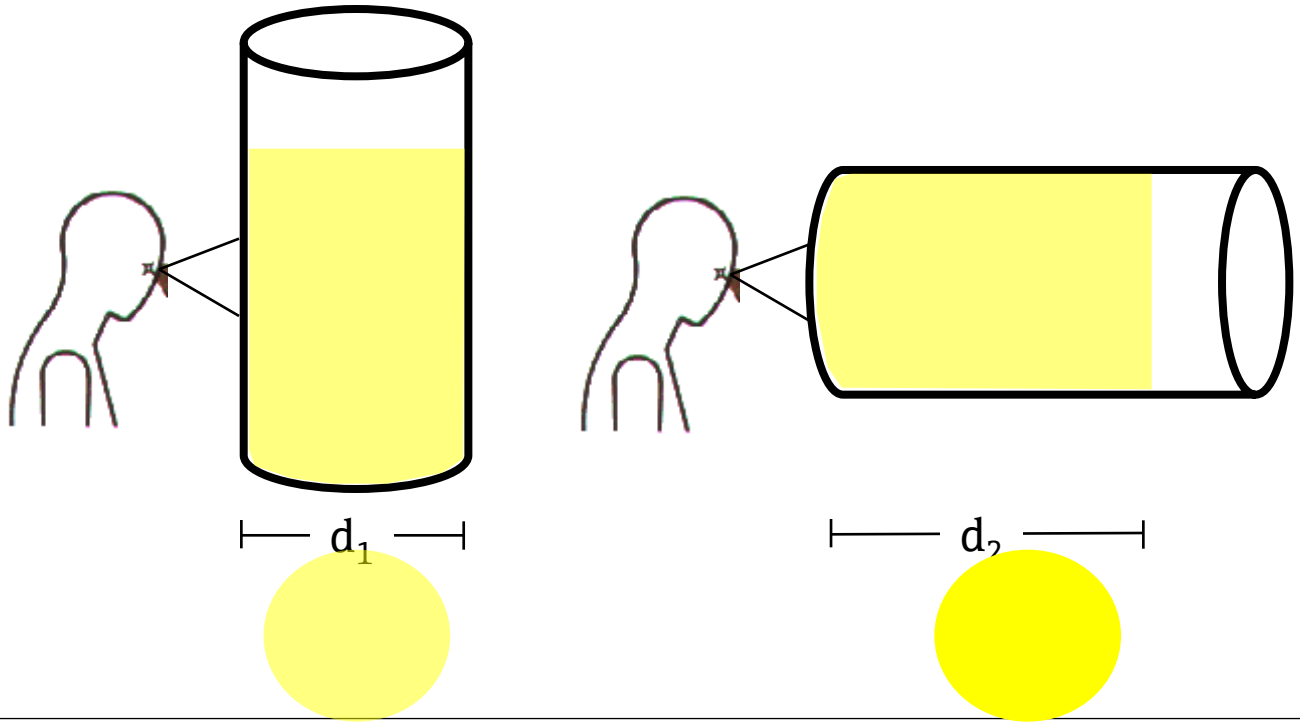
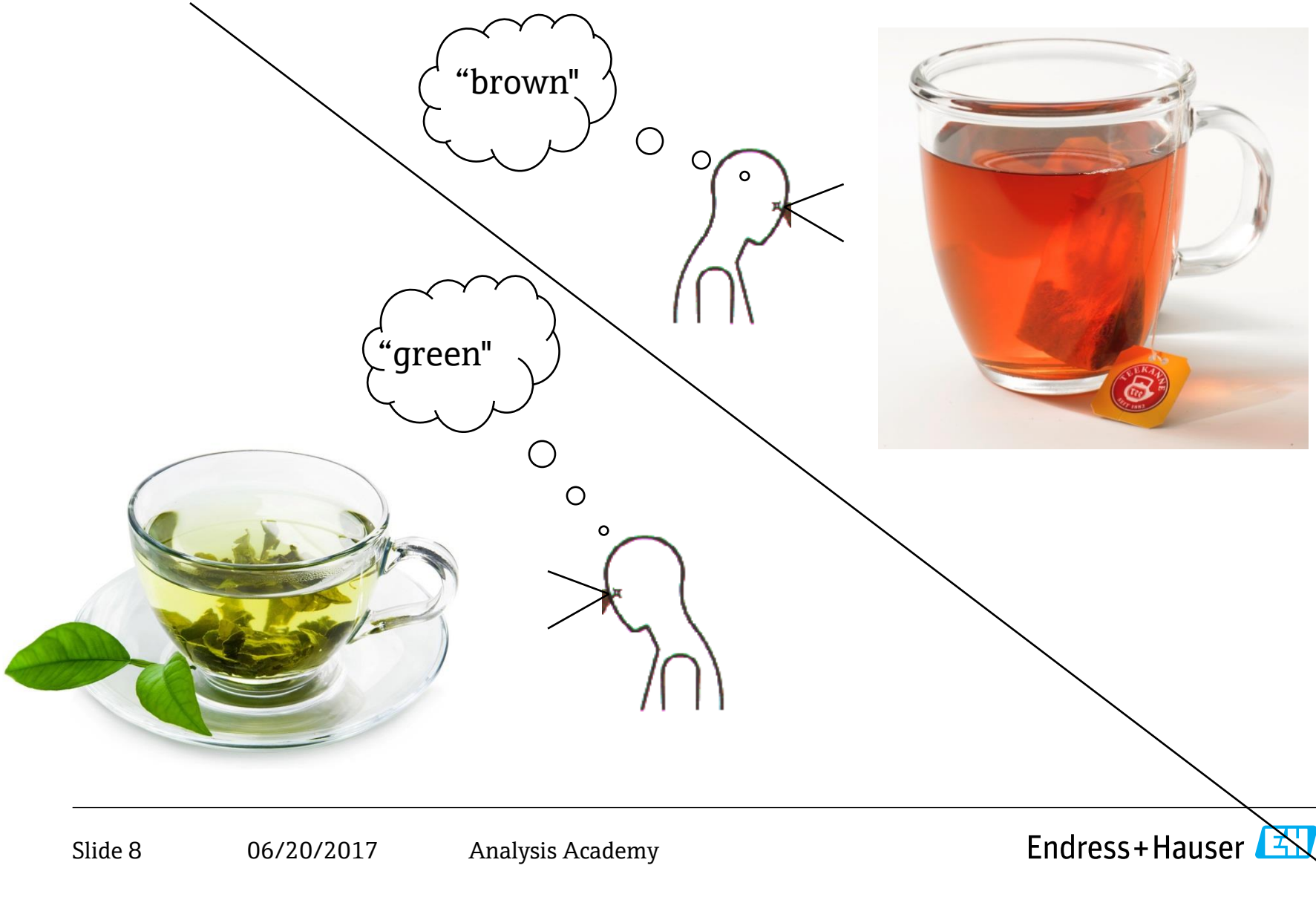
Lambert-Beer-Law - Küvettenlänge

$$A = \varepsilon * c * d$$



Different colors



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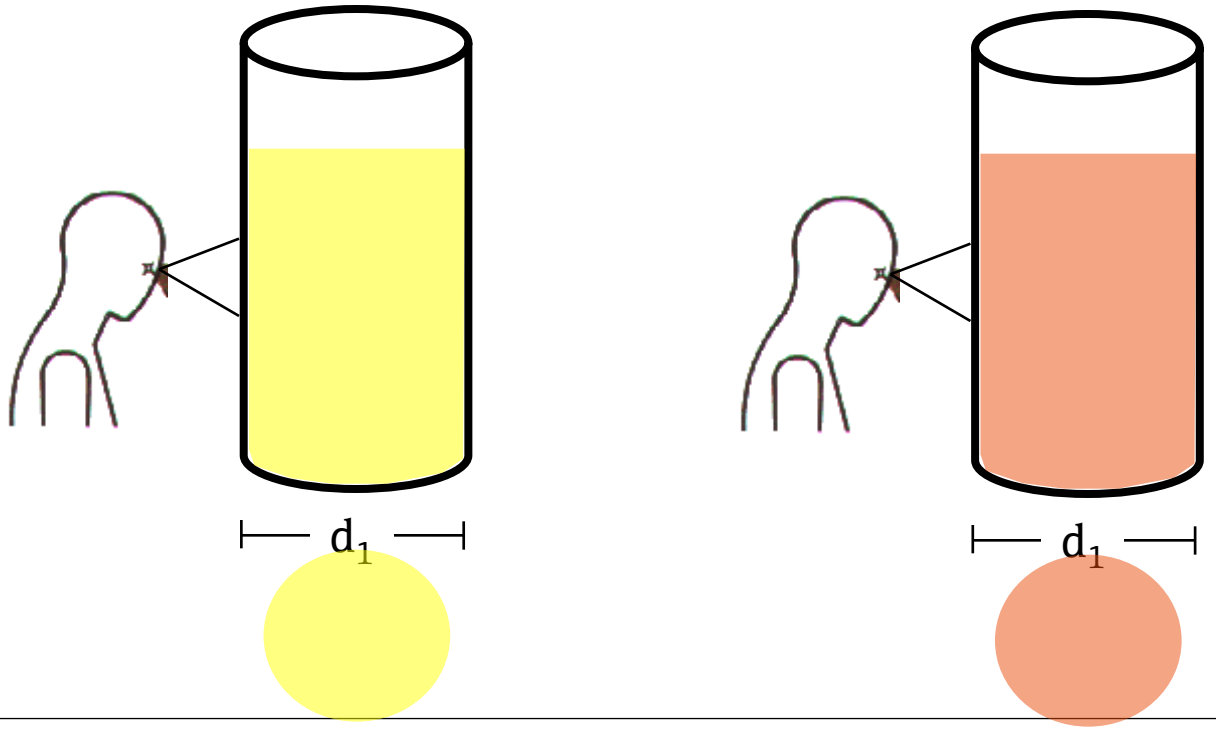
Lambert-Beer-Law - Absorptionskoeffizient

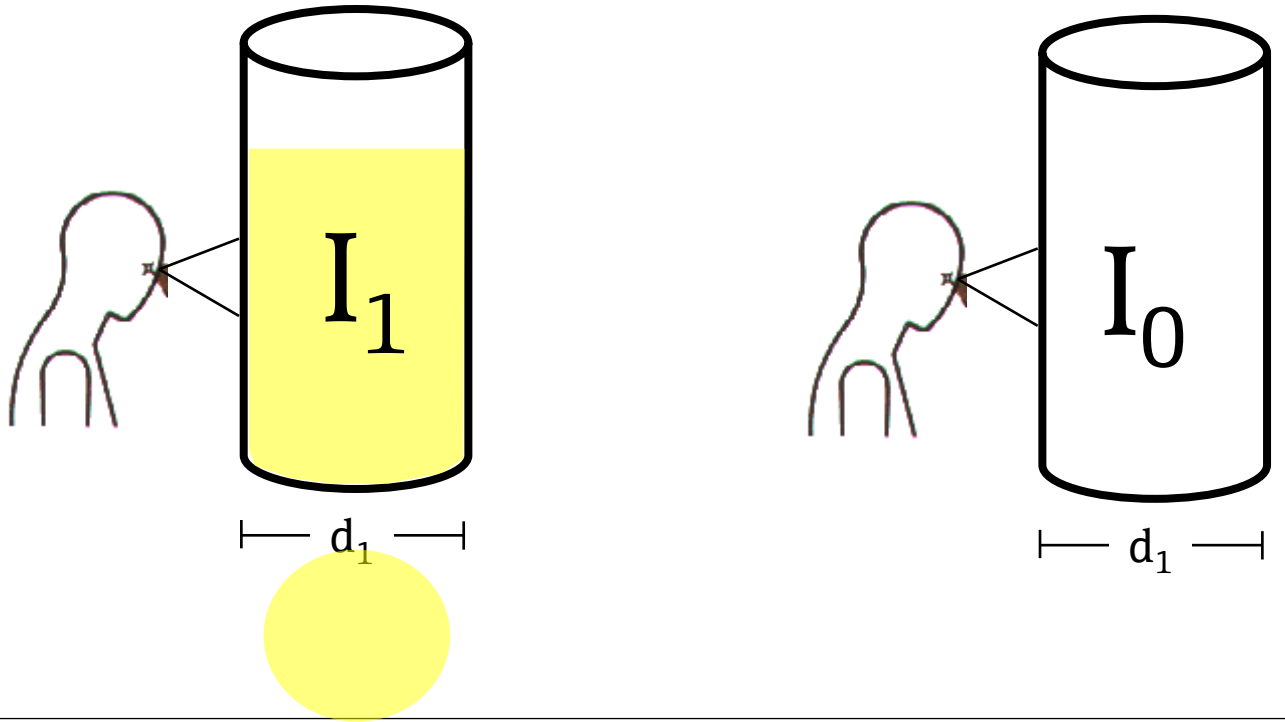
$$A = \varepsilon * c * d$$



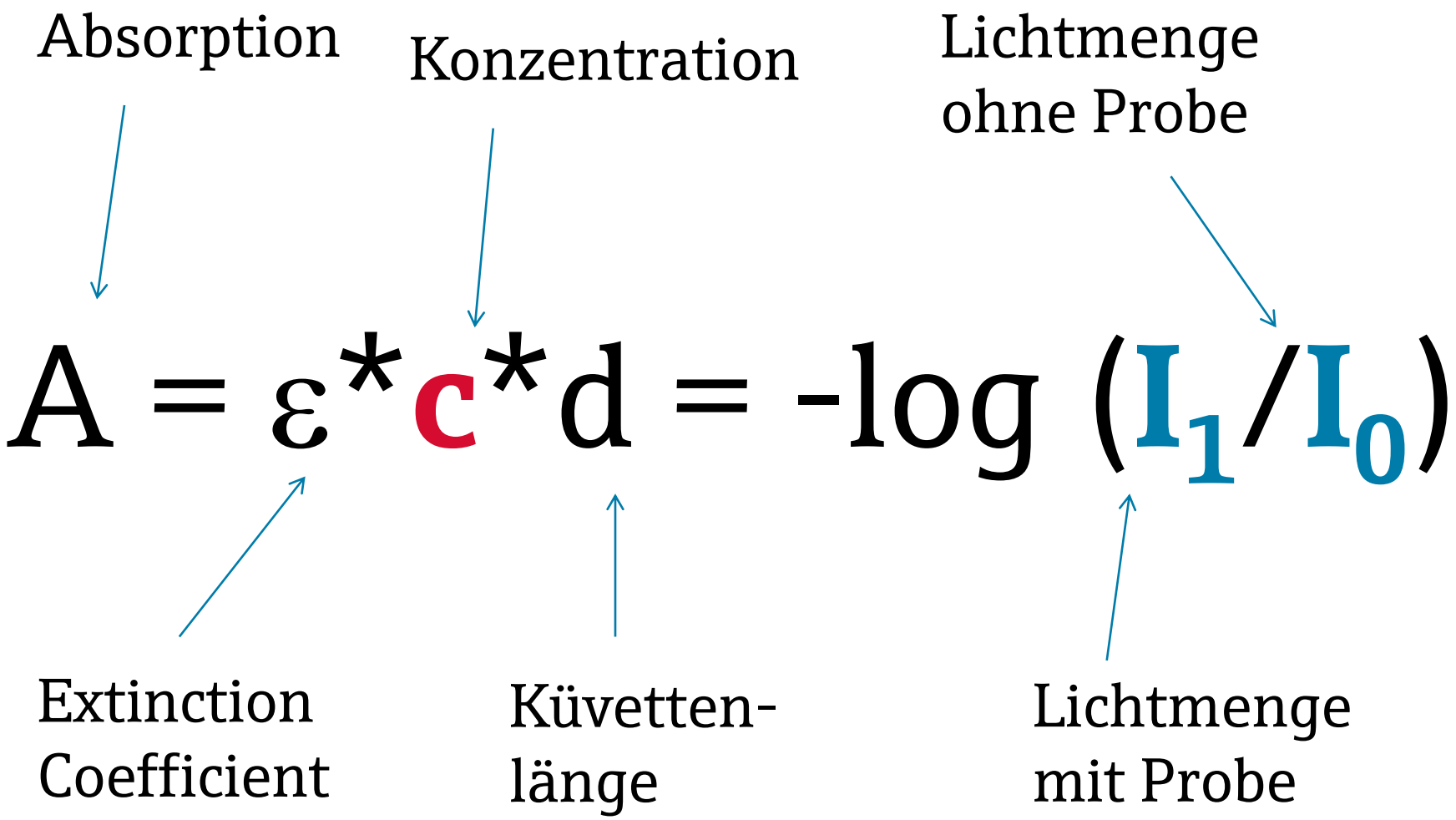
Color intensity at same view points

Lambert-Beer-Law - Concentration

$$A = \varepsilon * c * d = -\log (I_1 / I_0)$$



Summary Lambert-Beer-Law



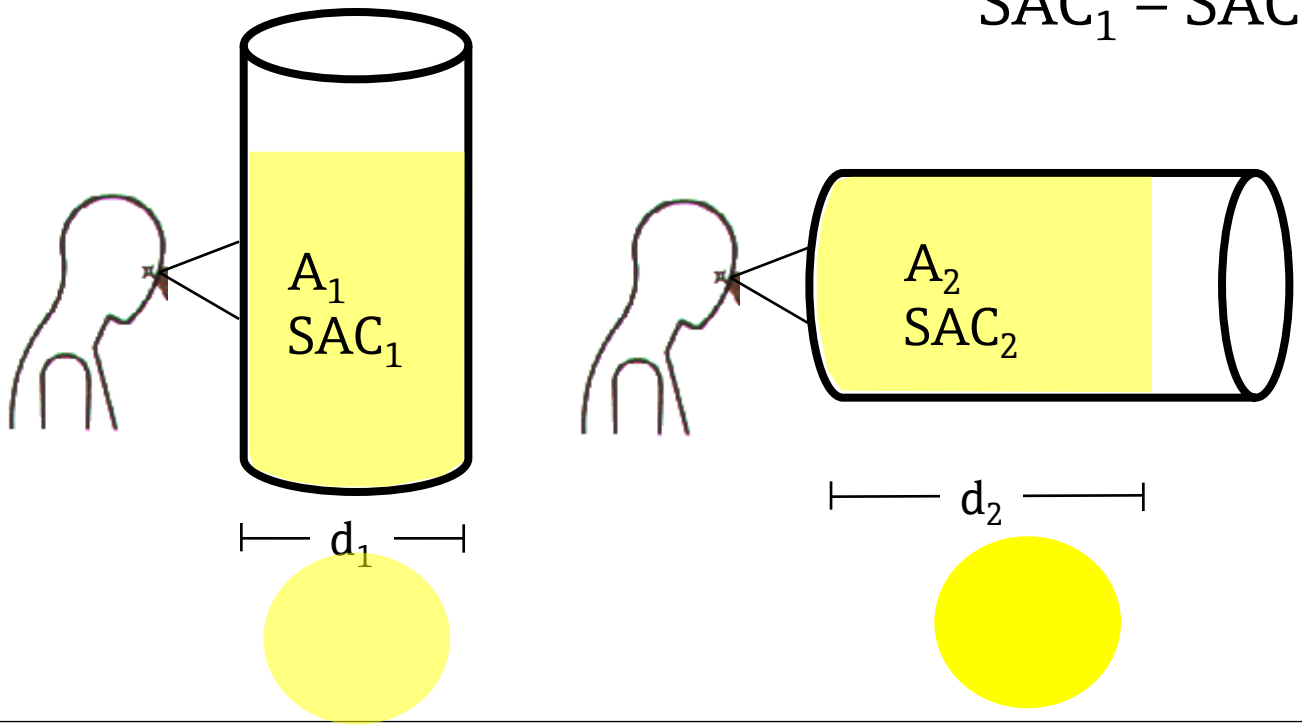
SAC: specific absorption coefficient (definition)

Lambert-Beer: $A = \varepsilon * c * d = -\log (I_1/I_0)$

$SAC = A / d = [m^{-1}]$

$A_1 < A_2$

$SAC_1 = SAC_2$



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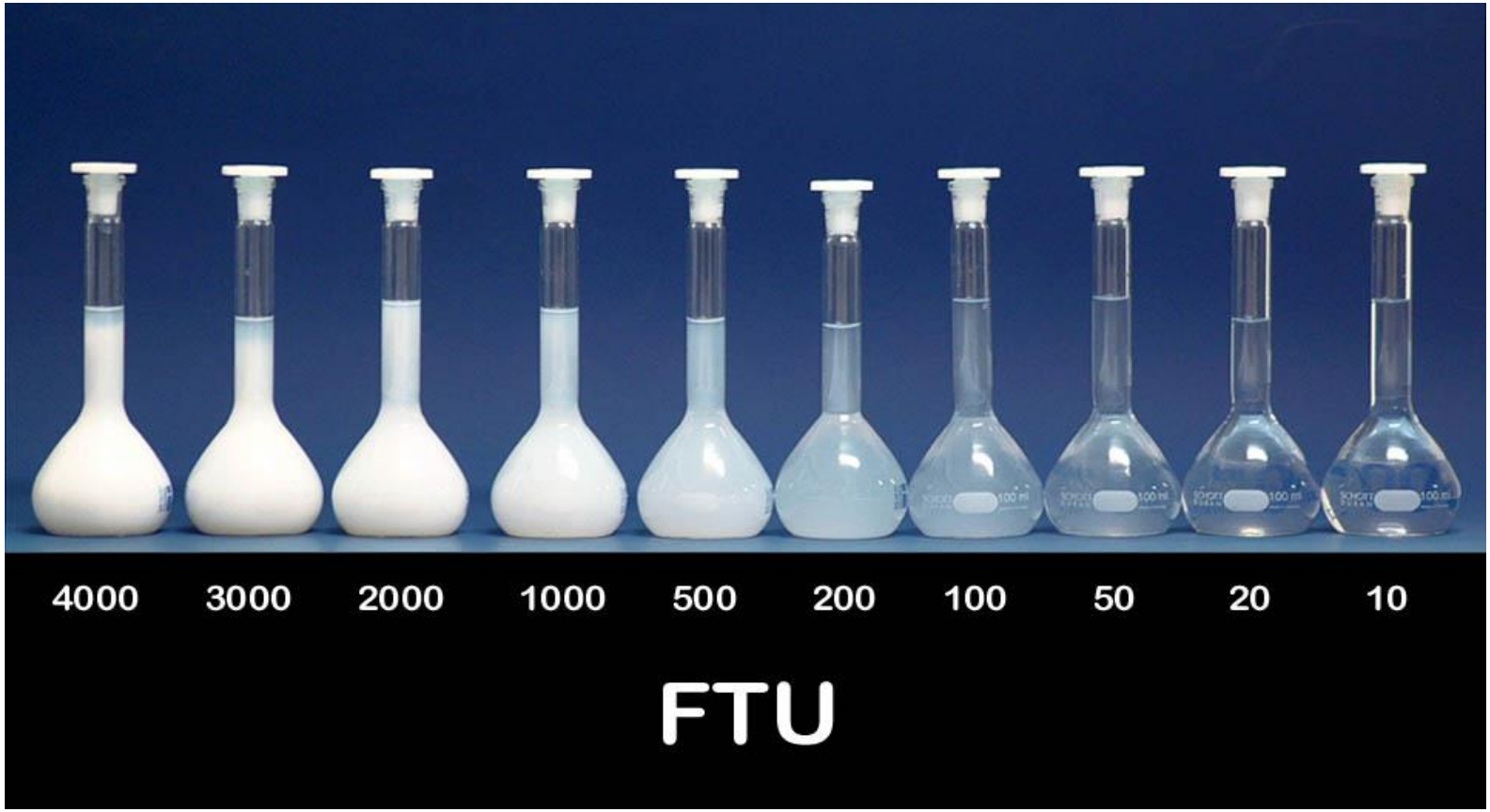
What is Turbidity...?



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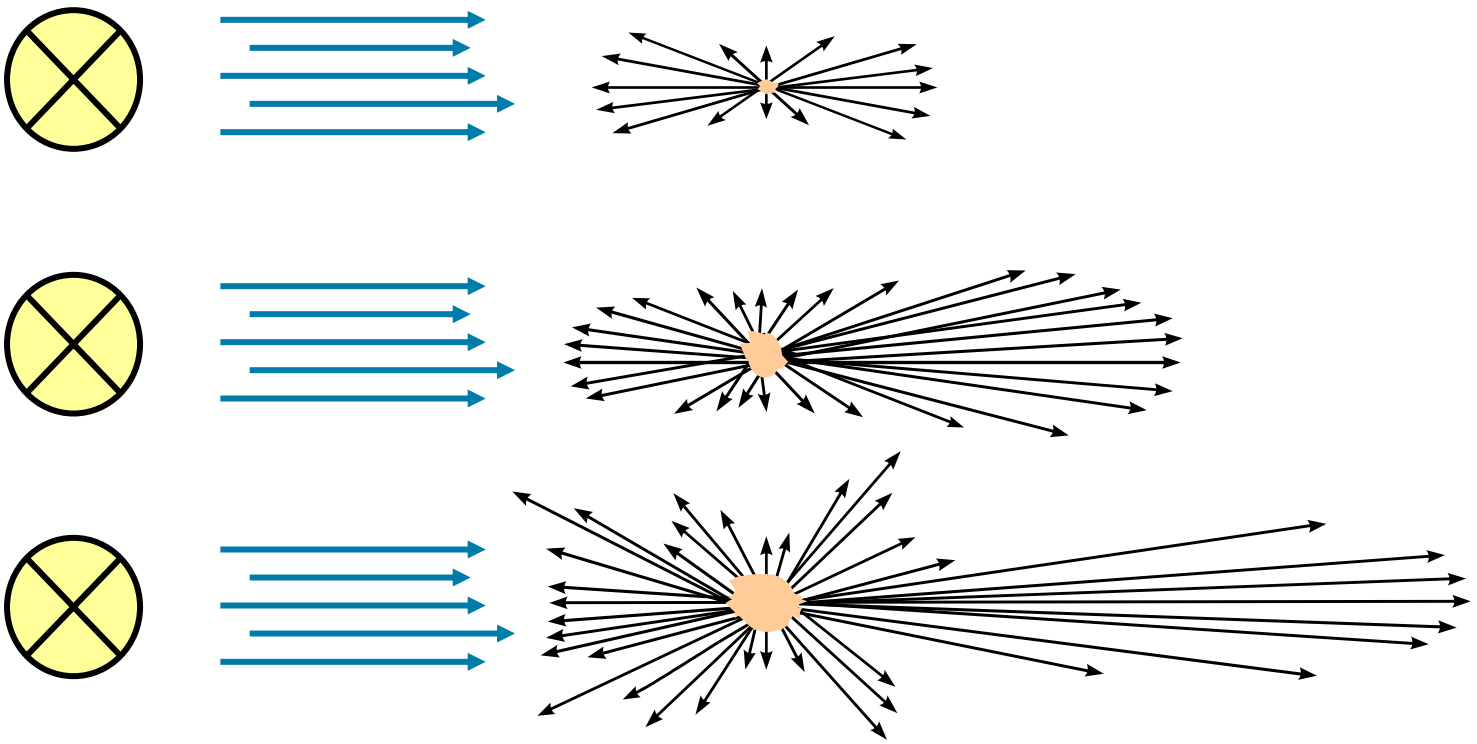
What is Turbidity...?

- The reflection is a function of the size and shape of the particles



Summary

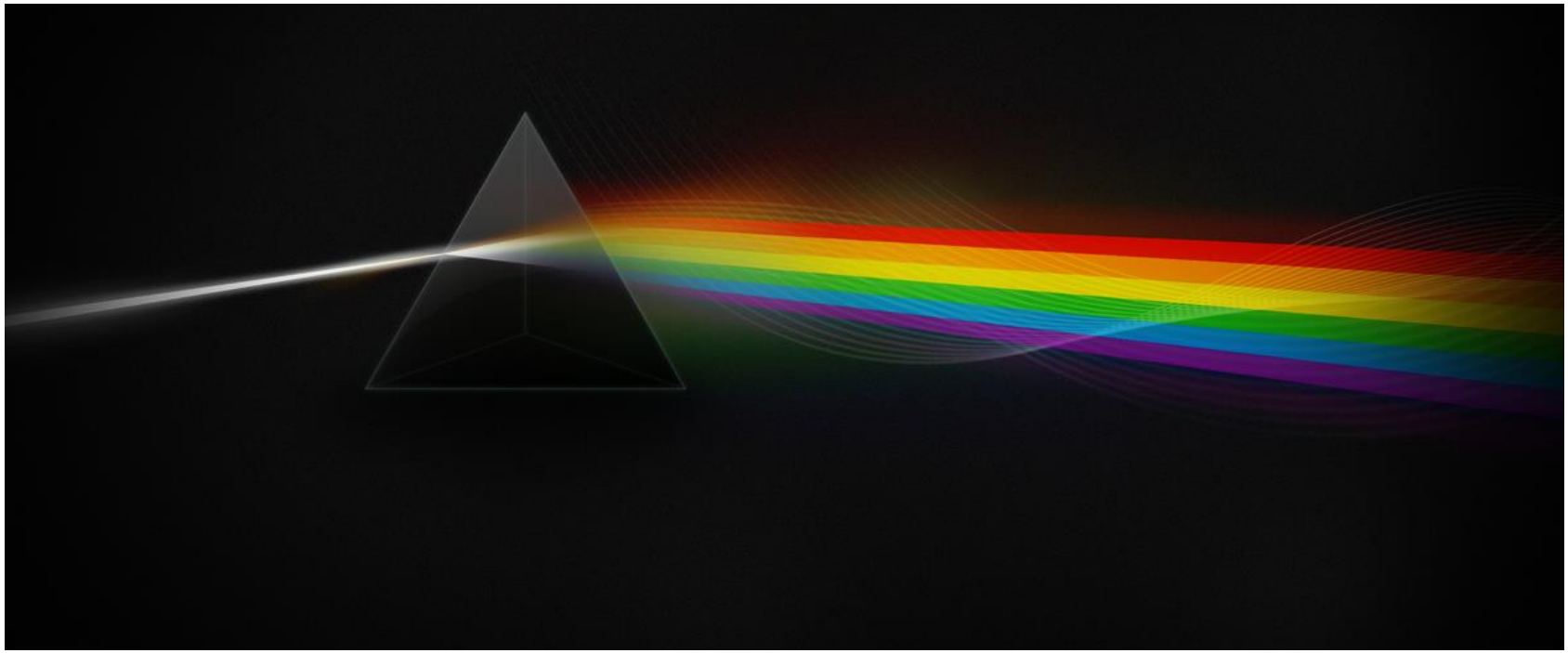
- Dissolved substances lead to absorption at certain wave lengths (color)
- Emulsions and air bubbles lead to scattering (turbidity)

Keep in mind:

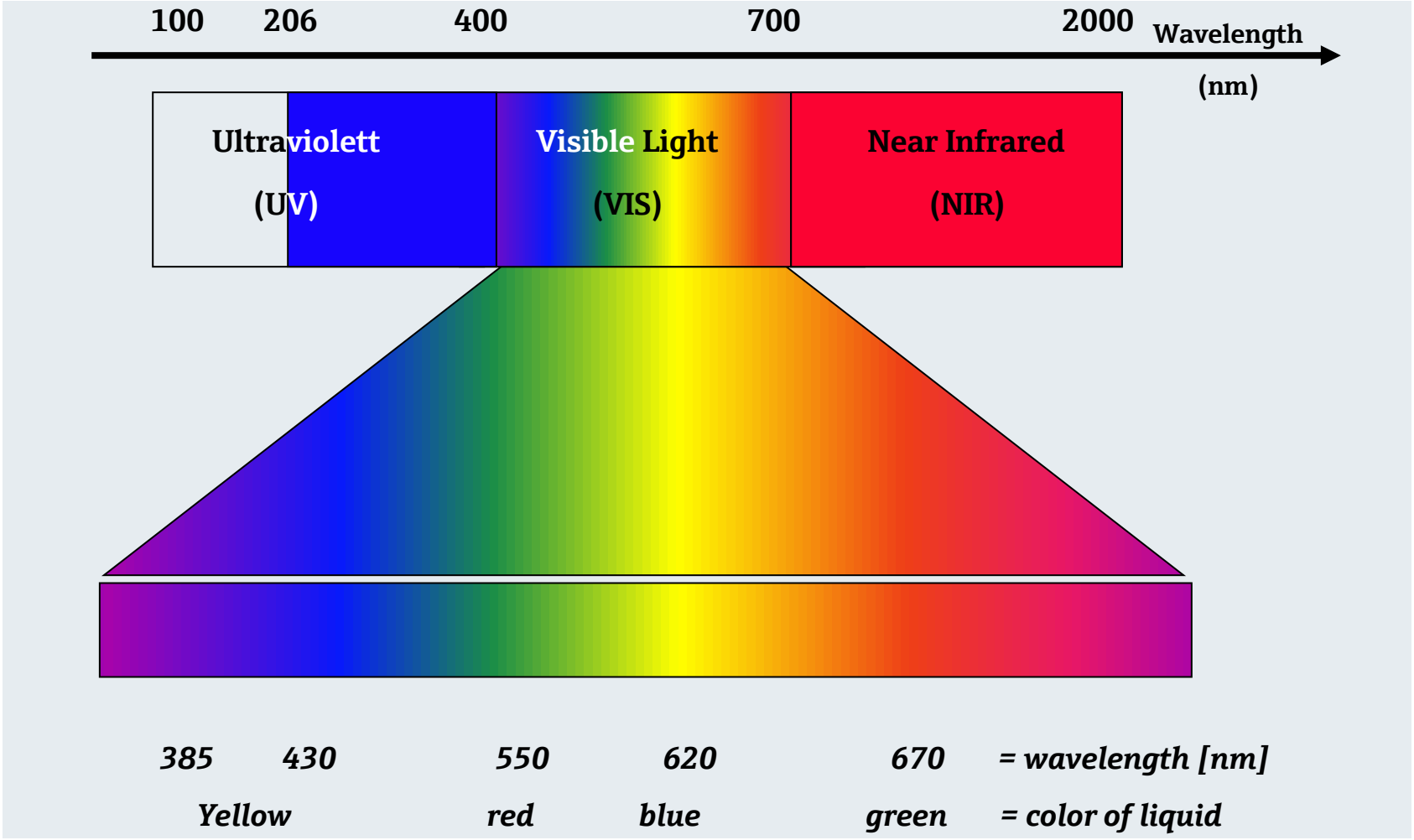
“Every turbidity leads also to absorption – but NOT every absorption leads to turbidity!”

Characteristics of the absorption of light

- Visible and invisible light – why do we see colors?
- Characteristics of nitrate and organic compounds (specific absorption)



Visible light: Colors and wavelengths



Characteristics of nitrate and organic compounds

- Nitrate: Strong absorbance at 214nm
  → **Concentration = mg/L NO_3^-**
- Organic compounds: Strong absorbance* at 254nm → **SAC = m^{-1}**

Are there any restrictions...?

**Each organic compound has its own ε – the correaltion to the concentration is only possible, if the matrix is stable (alcohols and suggars do not show any absorbance)*

Lunchtime

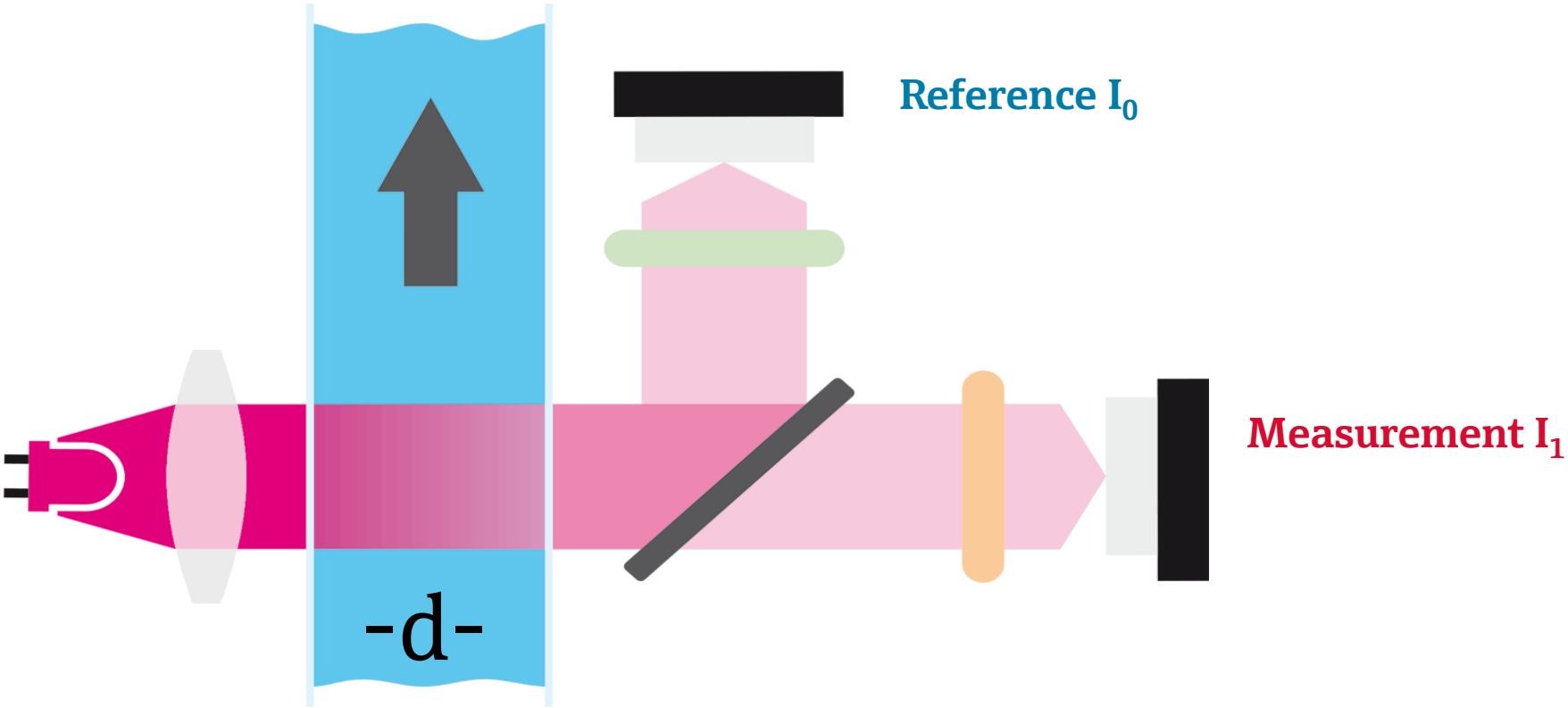
....

Workshop Pratico: Misura in continuo

- Photometric construction: CAS51D Viomax
- Experiment: Turbidity and Absorption
- Measurement loop in drinking water
- Discussion

Photometric construction: CAS51D Viomax

$$A = -\log (I_1/I_0)$$



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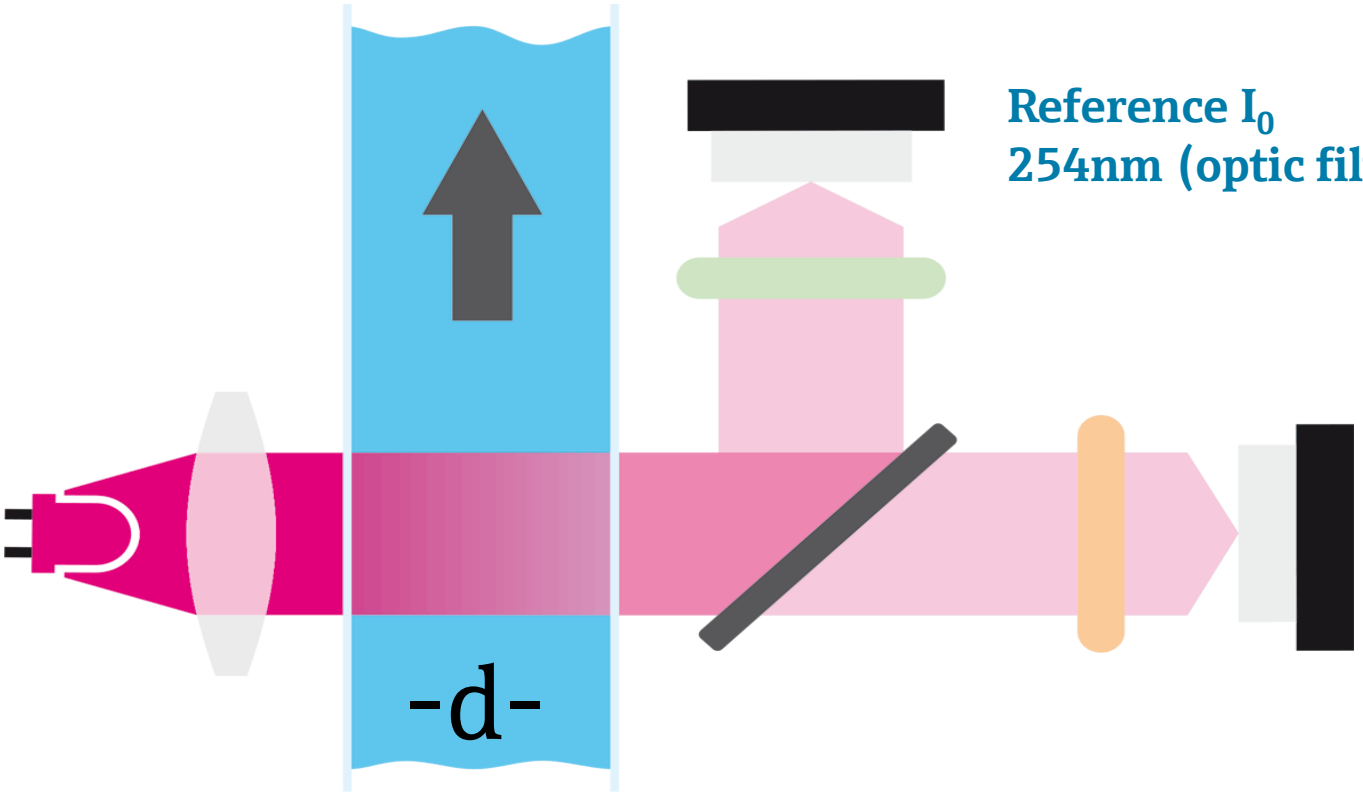
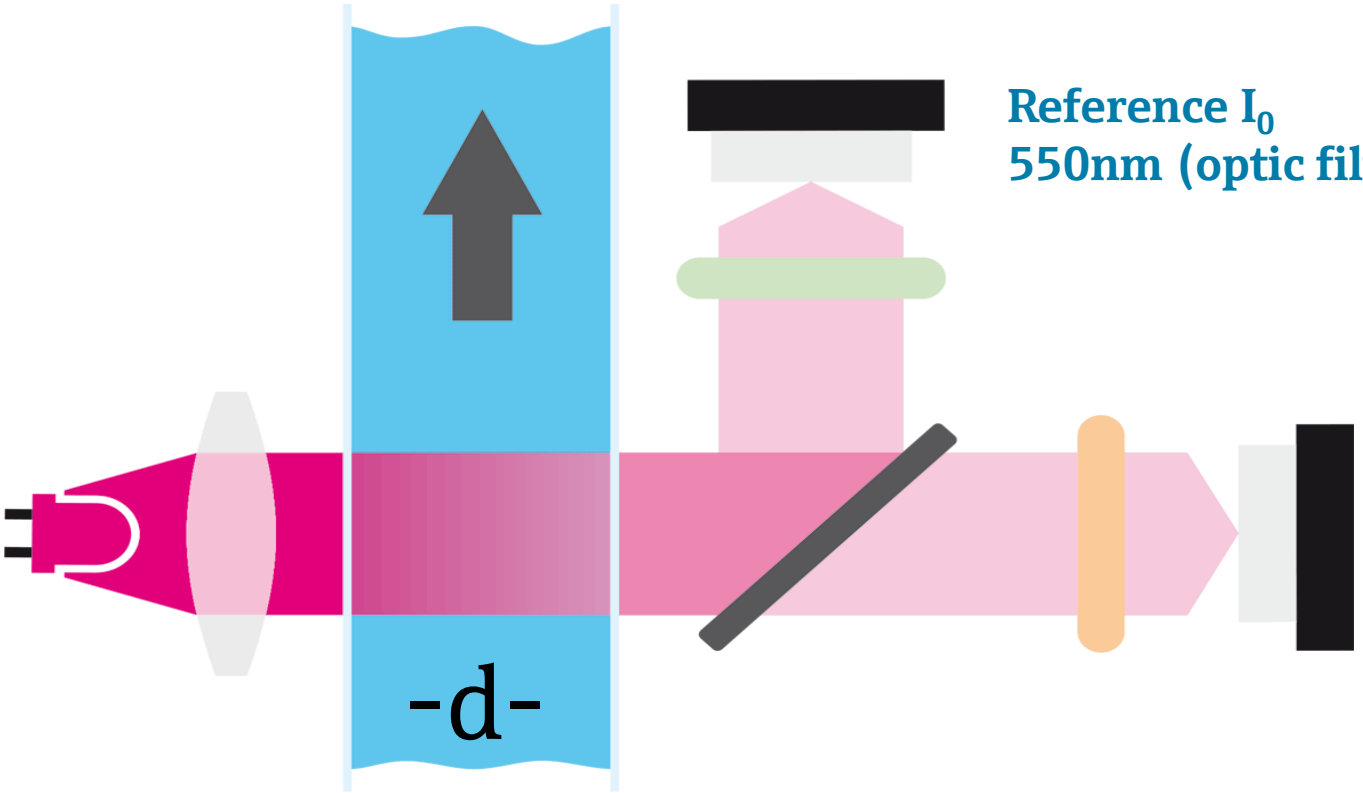
Photometric construction: CAS51D-AAA* (Nitrate)

$$c = [mg/L\ NO_3^-] = A / d / \varepsilon_{NO3-}$$



Photometric construction: CAS51D-AAC* (SAC)

$$SAC = [m^{-1}] = A / d$$



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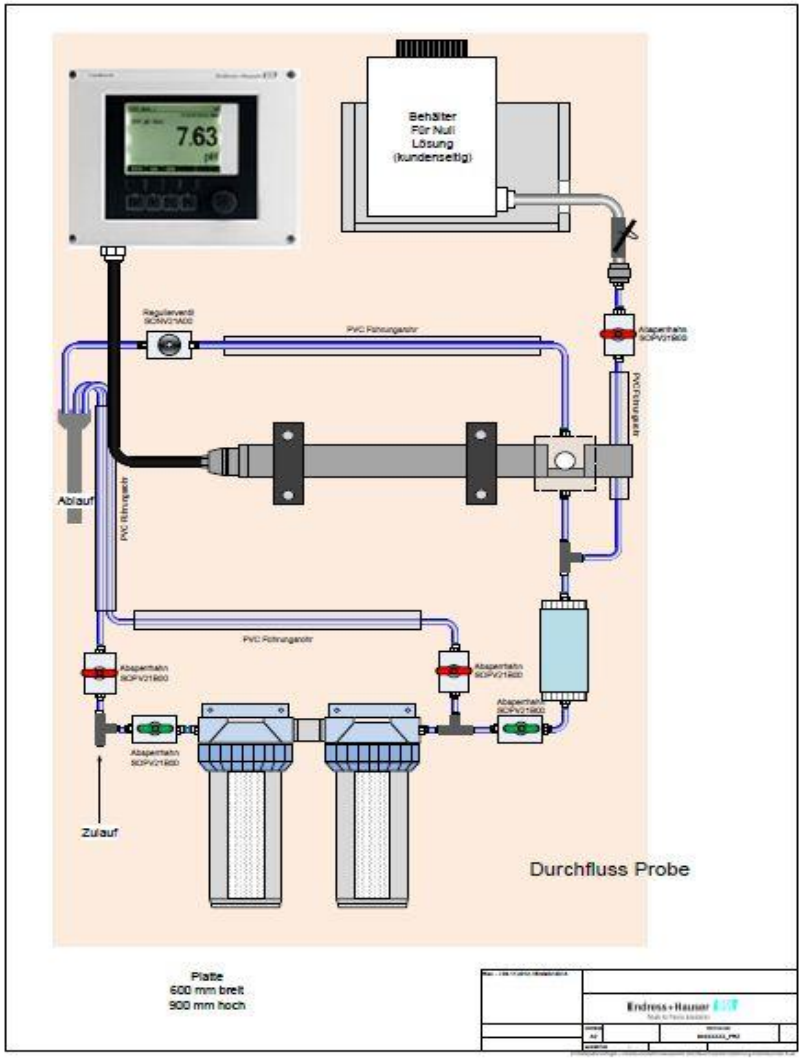
Experiment – tubidity and absorption

“Every turbidity leads also to absorption – but NOT every absorption leads to turbidity!”

Online measurement of nitrate and SAC

Bypass (Panel-Solution)

1. Transmitter Liquiline CM44x
2. Sensor Viomax CAS51D
3. Flow chamber
4. Optional: Filter (1 & 0.5µm)
5. Optional: Flow monitoring
6. Optional: Connection for calibration



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Examples

Discussion