



biological · biophysical · engineering

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mol daenke

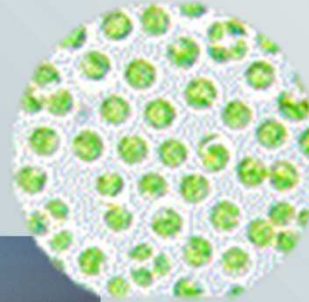
2nd Webinar bbe AlgaeTorch



Algae and Cyanobacteria measurement



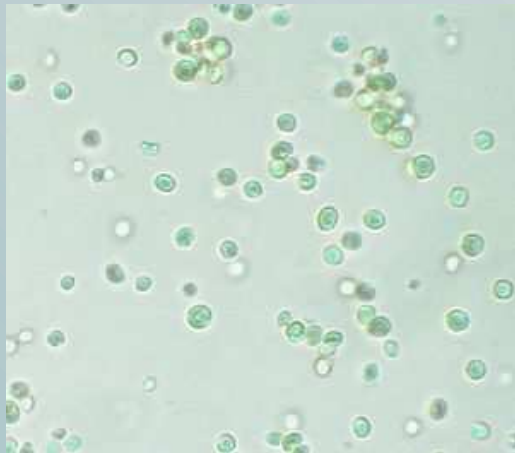
6.000.000.000 tons CO₂ released / year





Algae and cyanobacteria, terrestrial plants

→ perform oxygenic photosynthesis



Nannochloropsis



Spirulina

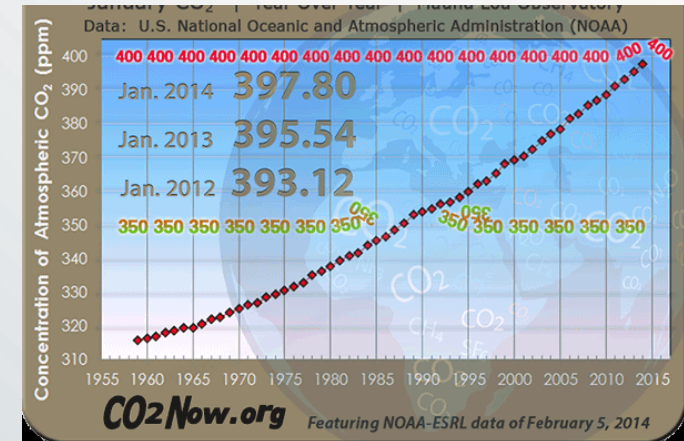


Tolypothrix



Algae benefits

- produce biomass & energy
- high efficiency
- food production
- products for health care
- reduce CO₂ in atmosphere
- water splitting, release oxygen

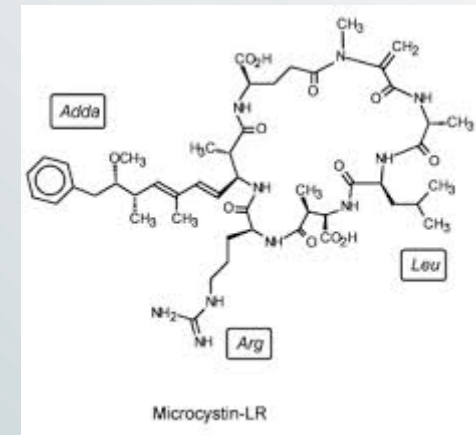




Algae disservices

- reduce drinking water quality
- algal toxins
- algal blooms (HAB)
- fish kills
- removal of algae is costly

*



*NOAA :Hazard of *Microcystis* Blooms for Human Health through Fish Consumption



How to measure algae amount?

Biomass

Carbon Content

Dry Weight



^{14}C - Incorporation

Biovolume

Chlorophyll

Cell Number



How to measure algae amount?



Chlorophyll



Why measure chlorophyll?

- accessibility of the parameter
- sensitivity of measurement
- sample preparation
- real-time calculation
- calibration procedure
- proxi for other scale basis





What is the value of chlorophyll readings?

- Chlorophyll reports algae content (phytoplankton)
- Algae content indicates water quality
- Cyanobacteria detection which poses a threat (cyanotoxins)





How to measure algae content?

- microscopy cell counting
- HPLC* pigment analysis
- spectrophotometry, empirical equations
- *in vivo* fluorometry



*HPLC = High pressure liquid chromatography



What are the features of the different methods?

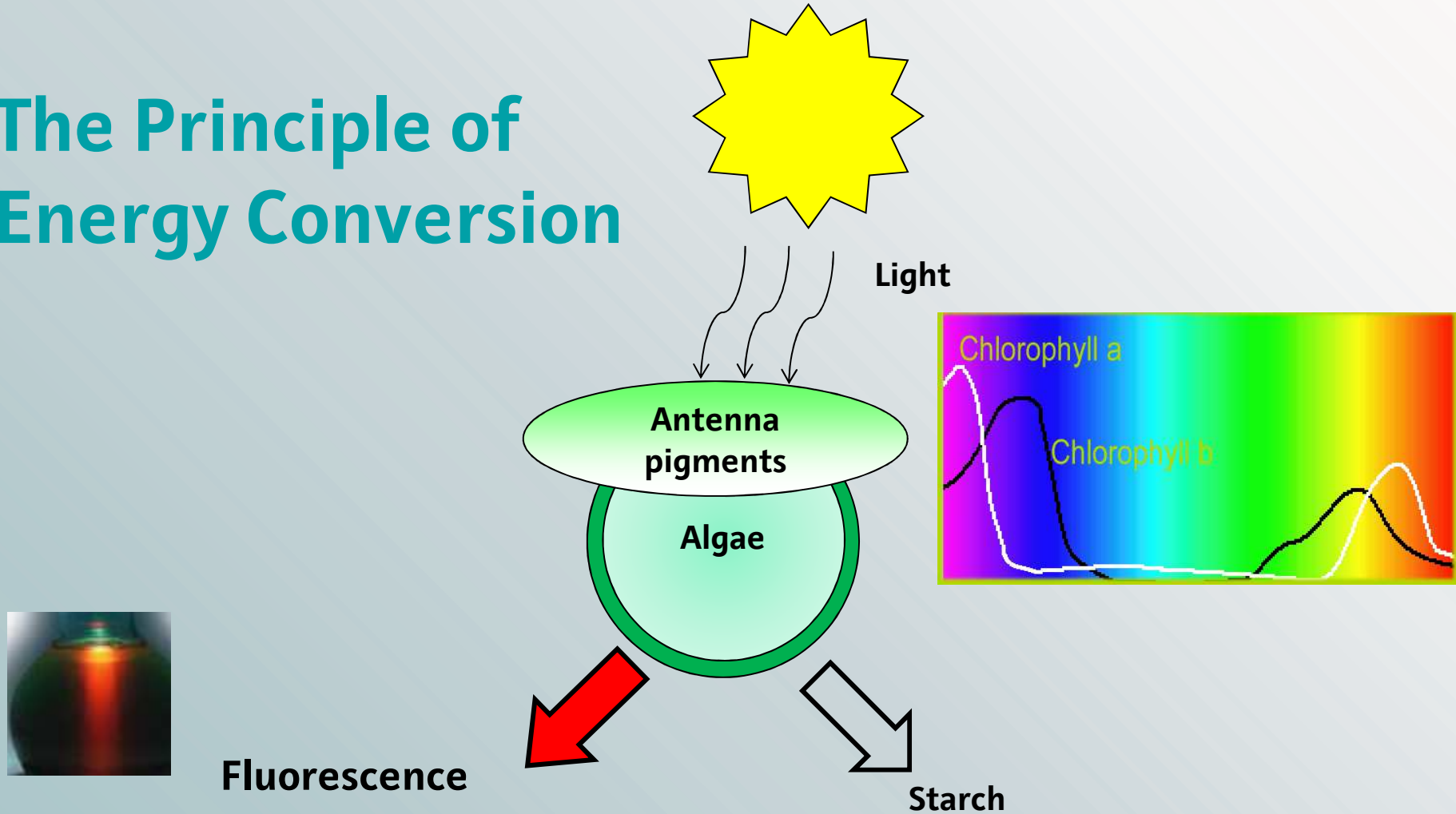
- **Microscopy** laborious
- **HPLC*** costly
- **Spectrophotometry*** interference prone
- ***in vivo* fluorometry** cheap,
no sample preparation

* Pigment extraction with organic solvent



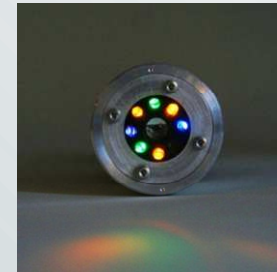


The Principle of Energy Conversion

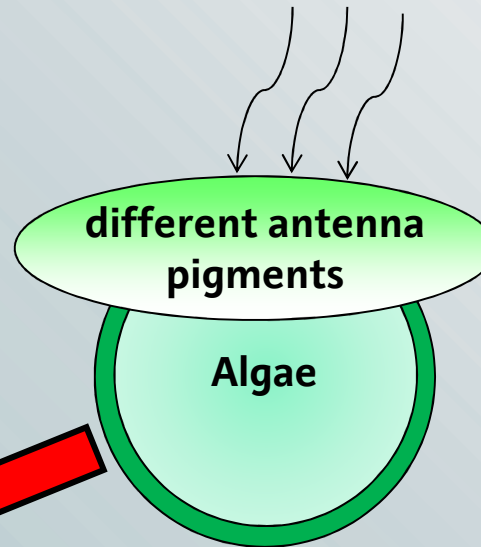




The Principle of the AlgaeTorch measurement



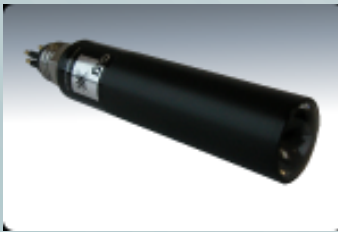
excitation light by
multispectral LED
3 selected wavelengths



chlorophyll fluorescence detector



3-optical -sensor-instruments with optional:

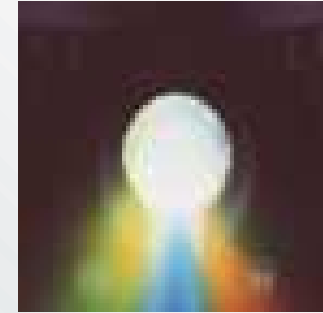


- Chlorophyll fluorescence
- CDOM fluorescence
- Phycoerythrin fluorescence
- Phycocyanin fluorescence

All measurements without
computation of spectral data and
interference correction



Why use different wavelength for excitation?

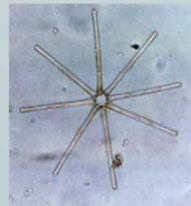
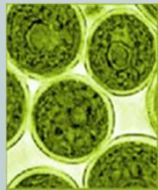


Multi-wavelength excitation

One wavelength

fluorescence emission

enables quantitative measurement total chlorophyll and cyanobacteria chlorophyll when...

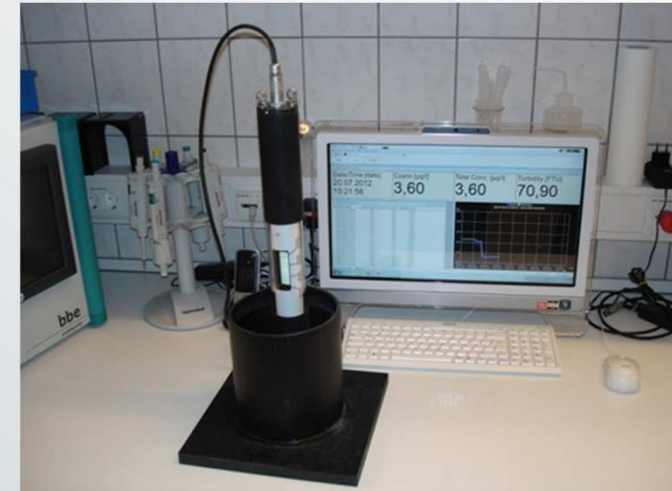


Accessory pigments plus chlorophyll a



Calibration

**bbe chlorophyll
determination of microalgae
is based on the calibration
with real algal cultures**





Turbidity measurement

- 700 nm reflection
- FTU display
- Automatic turbidity correction
- Formazin calibrated





Display: algae content and location





Methods: can we compare?

Biomass/chlorophyll microalgae $\hat{=}$ 100:1

Chlorophyll/cellnumber $\hat{=}$ 1 μg chlorophyll/
1.000.000 cells

1 μg chl of cyanobacteria chl $\hat{=}$ up to 0,5 μg
microcystin



- total chlorophyll in real-time
- chlorophyll of cyanobacteria
- turbidity measurement
- GPS
- integrated display
- all in one, robust housing
- internal data logger
- field use and laboratory use
- real algae calibration

Summary



