Photosynthaics:

biohybrid devices for solar energy harvesting

Introduction to the art-science project ‘Symbiotic machine’

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het Glazen Huis
LASERLAB
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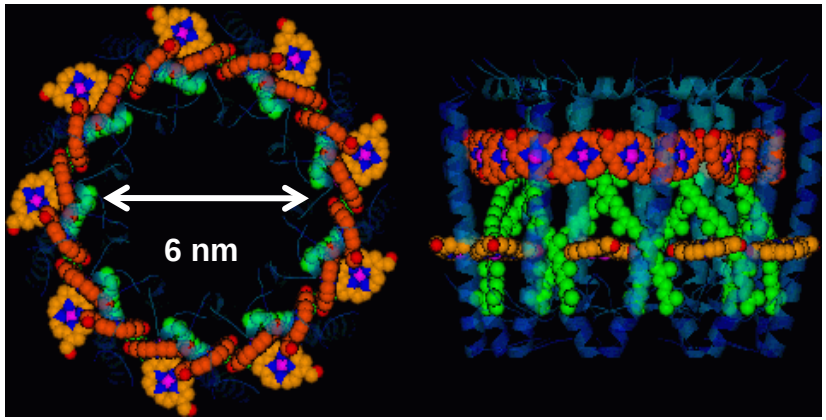
ULF-FORTH

Protein complexes are building blocks

Excitonic building block

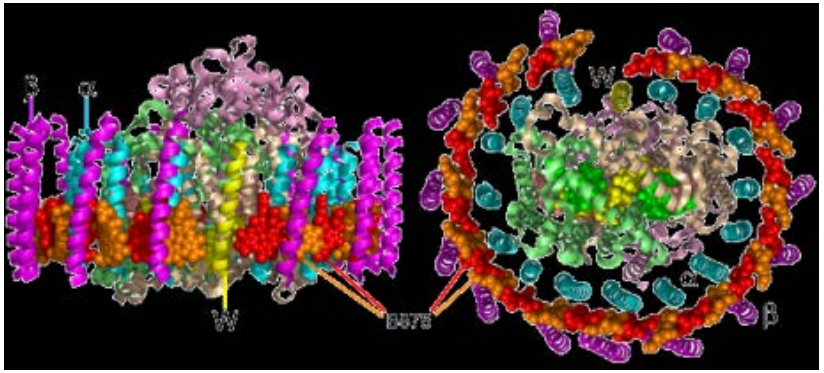
Light harvesting 2 complex



$$\psi_k = \Sigma\, c_{ki}\, \varphi i$$

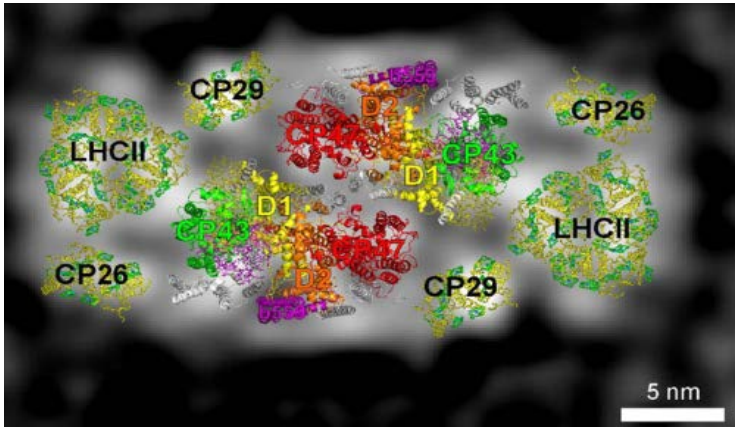
Photovoltaic building block

Reaction center - Light harvesting 1 complex



Catalytic building block

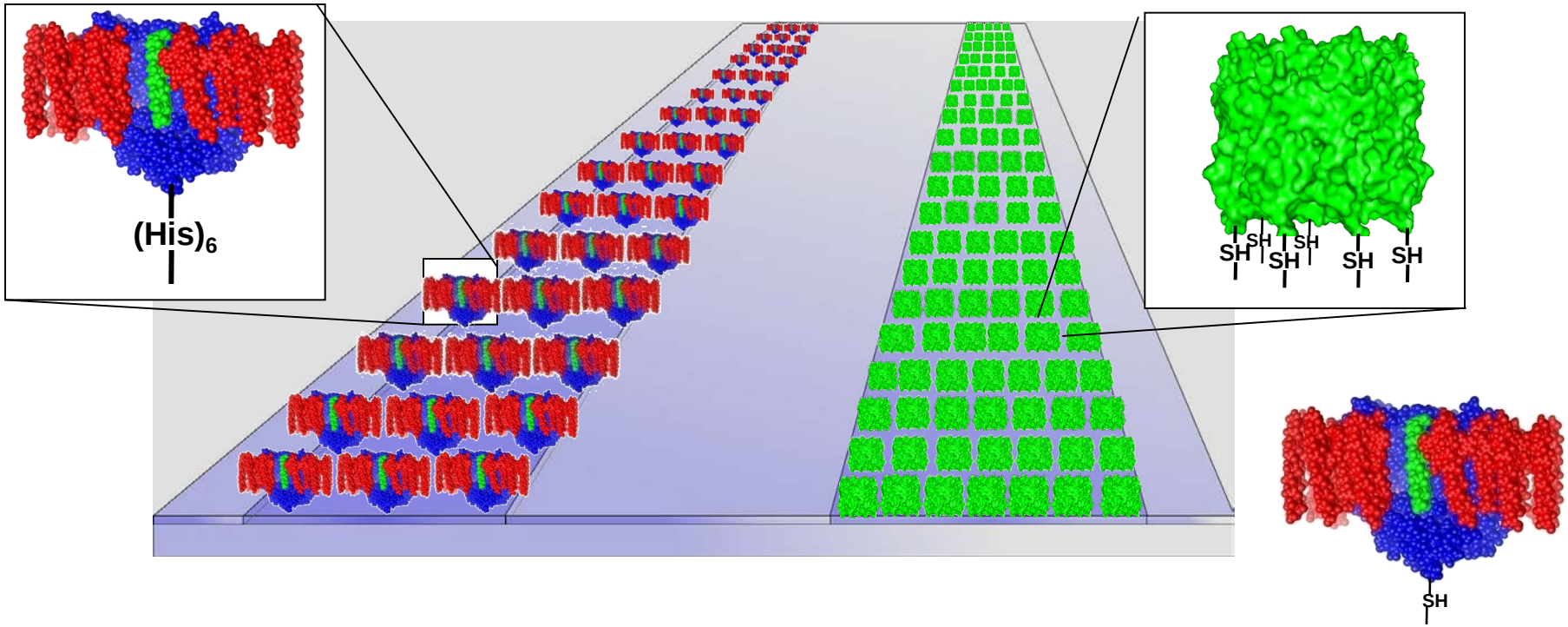
Photosystem 2 supercomplex

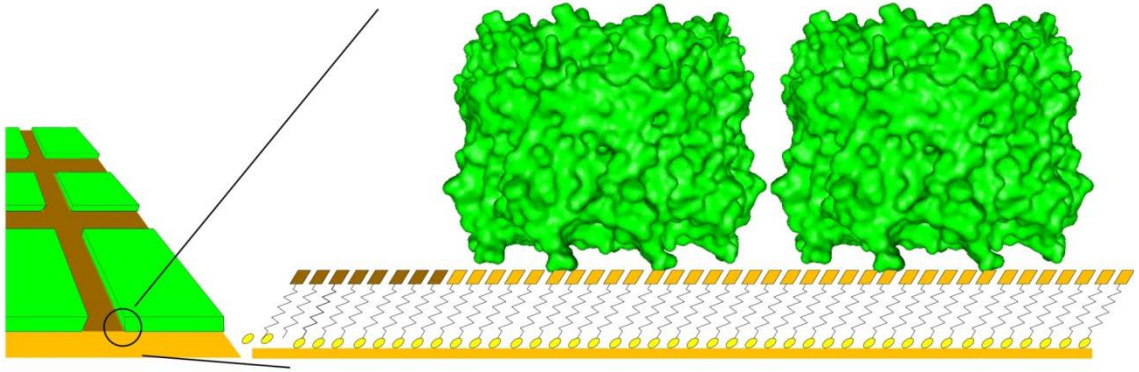


$$\frac{\eta,\text{in}}{\eta,\text{out}}$$

$$FF = \frac{Vmp \times Imp}{Voc \times Isc}$$

Patterning photosynthesis on gold electrodes

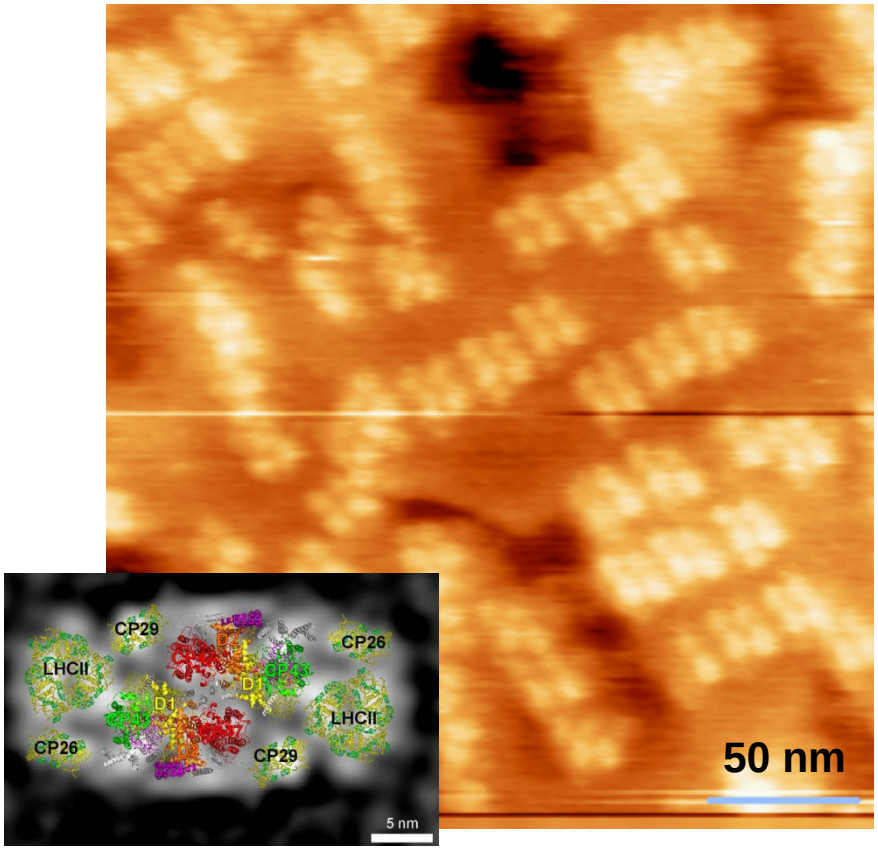




Slide Hunter, Sheffield

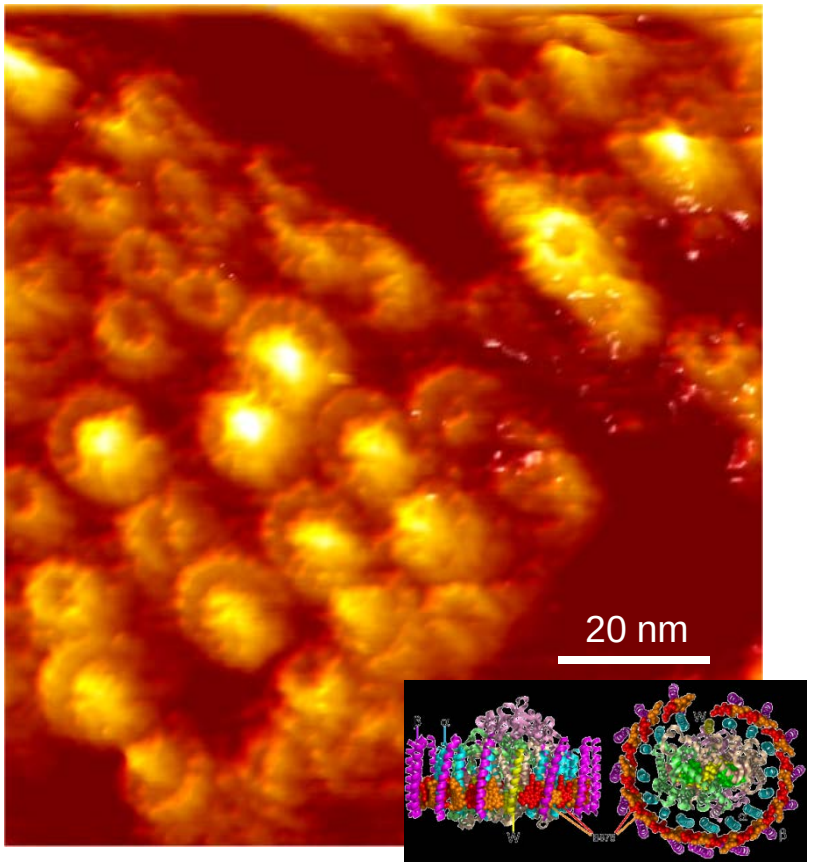
Membranes are intrinsically ‘patterned’

Plant Grana membrane



Sznee et al. JBC 2012

Purple Bacterial membrane

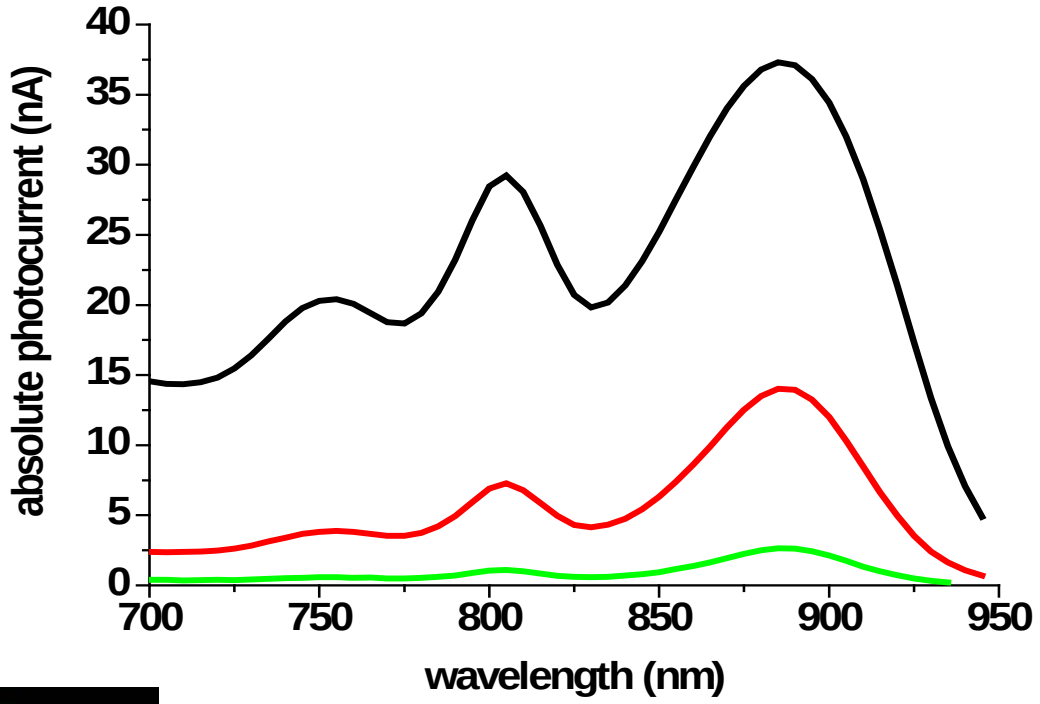


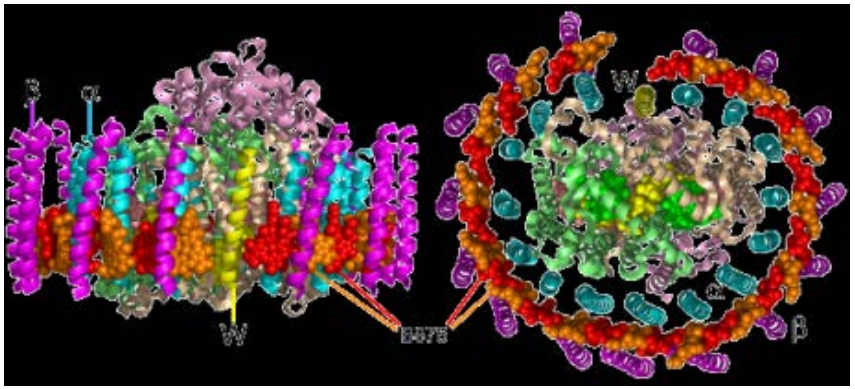
Bahatyrova et al. Nature 2004

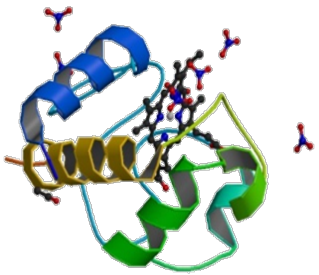
Protein complexes as biophotovoltaic building block

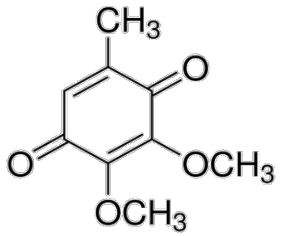
High photocurrents can be obtained by direct adsorption of RCLH1 on bare gold,

Using semi-natural mediators Hhcytc and Q0

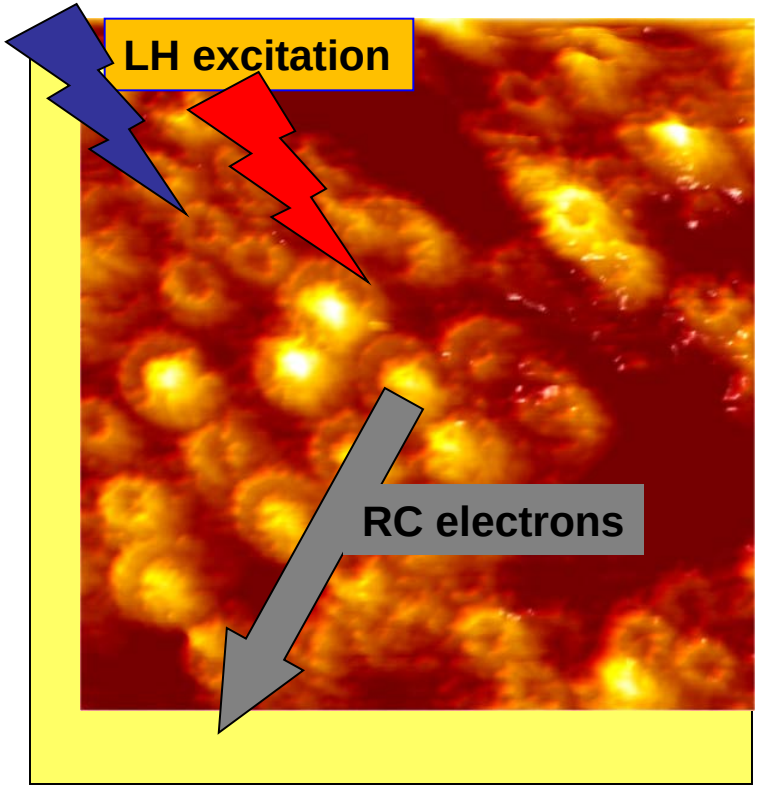


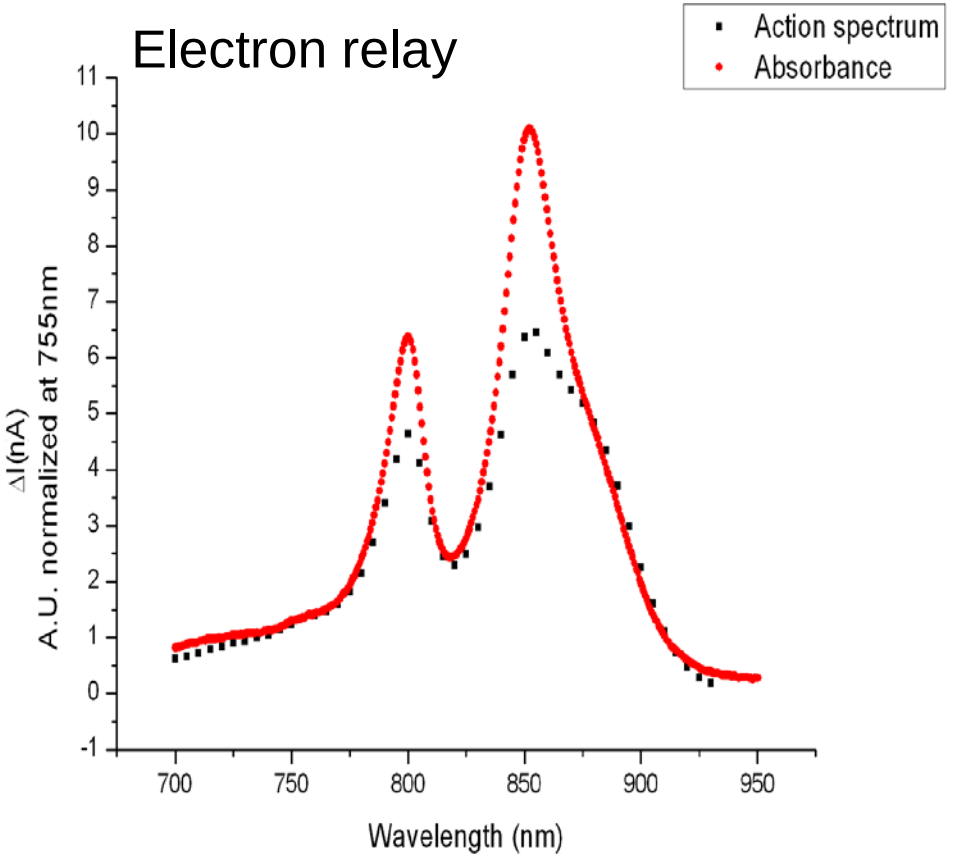






Photosynthetic membranes as a PV module



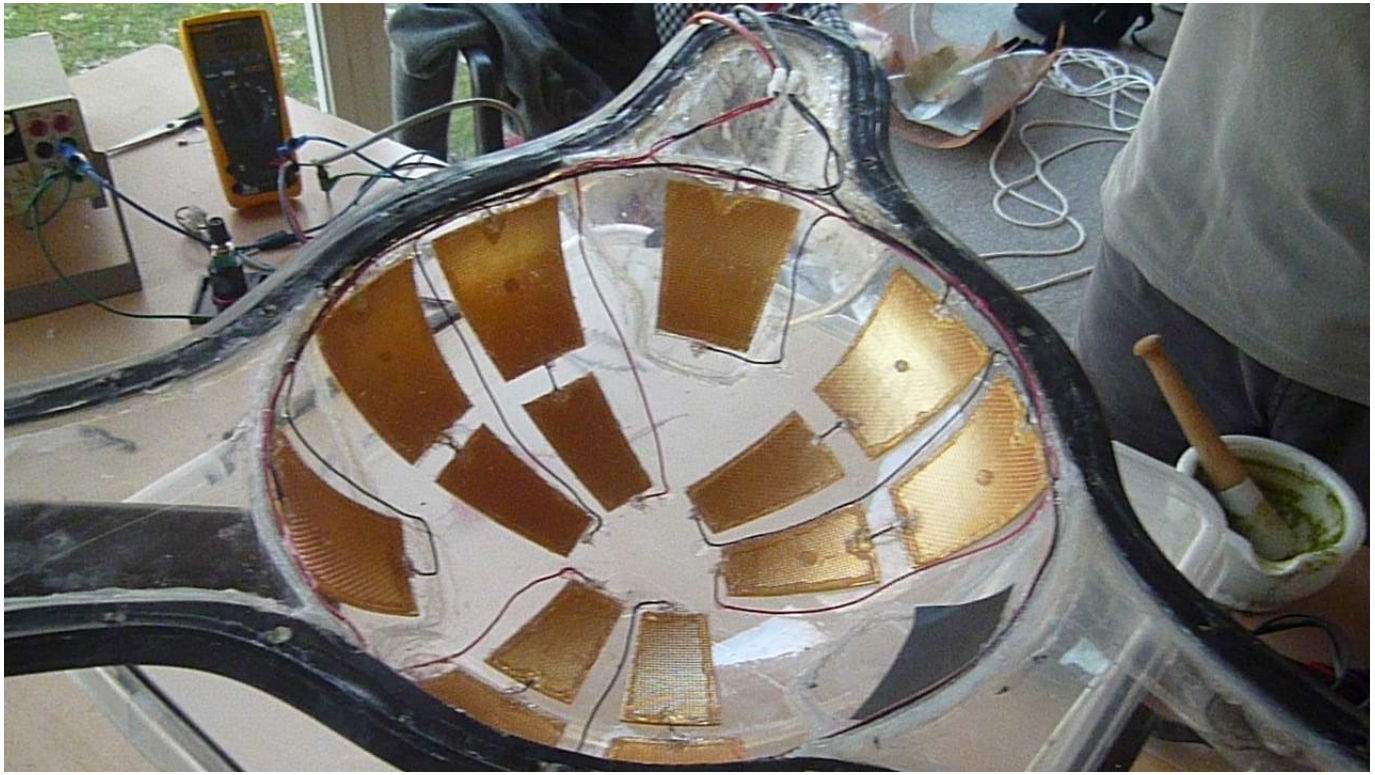


Bacterial membranes open up spontaneously when adsorbed onto bare gold

No Tech Solar cells

Algae, bacterial cells or spinach can be directly applied as PV material.

The symbiotic machine



Art Science collaboration: ultrafast application of science.

No need for: technology transfer office university, industry collaboration, patents

VU VRIJE UNIVERSITEIT AMSTERDAM

"A project where science and art meet"

The Symbiotic Machine

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Michiel van Overbeek[3], Ivan Henriques[4] and Raoul Frese[1]

1. Dept of physics and astronomy, VU University Amsterdam
2. Cefet (Rio de Janeiro)
3. KRISTALHELDER (www.kristal-helder.nl)
4. Independent artist

WHAT IS THE SYMBIOTIC MACHINE?

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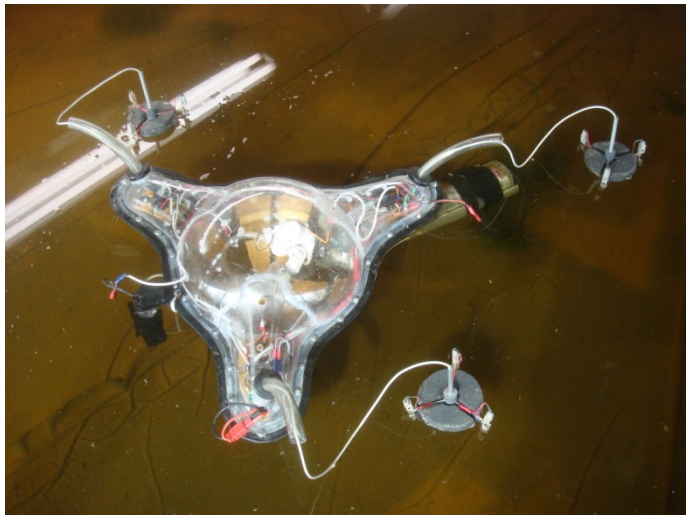
1. The team

2. The construction

3. The exhibition



The Symbiotic Machine is a robot that autonomously searches for photosynthetic material, which functions as an energy source for the Machine.

1. THE TEAM

"How an idea became reality in coproduction with scientists, artists, engineers and art production specialists"

2. THE CONSTRUCTION

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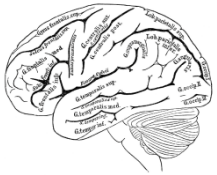


The Mechanics and the Brain

Graphic display

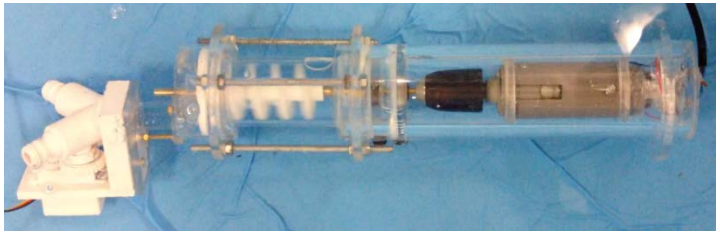
The forms

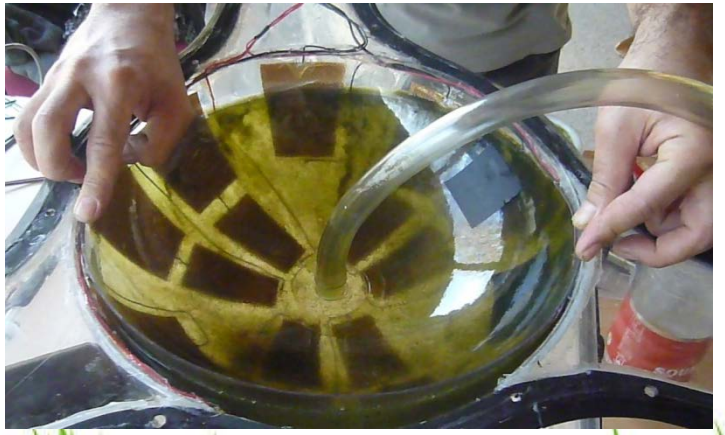
Building the biosolar cells

2. THE CONSTRUCTION The Mechanics

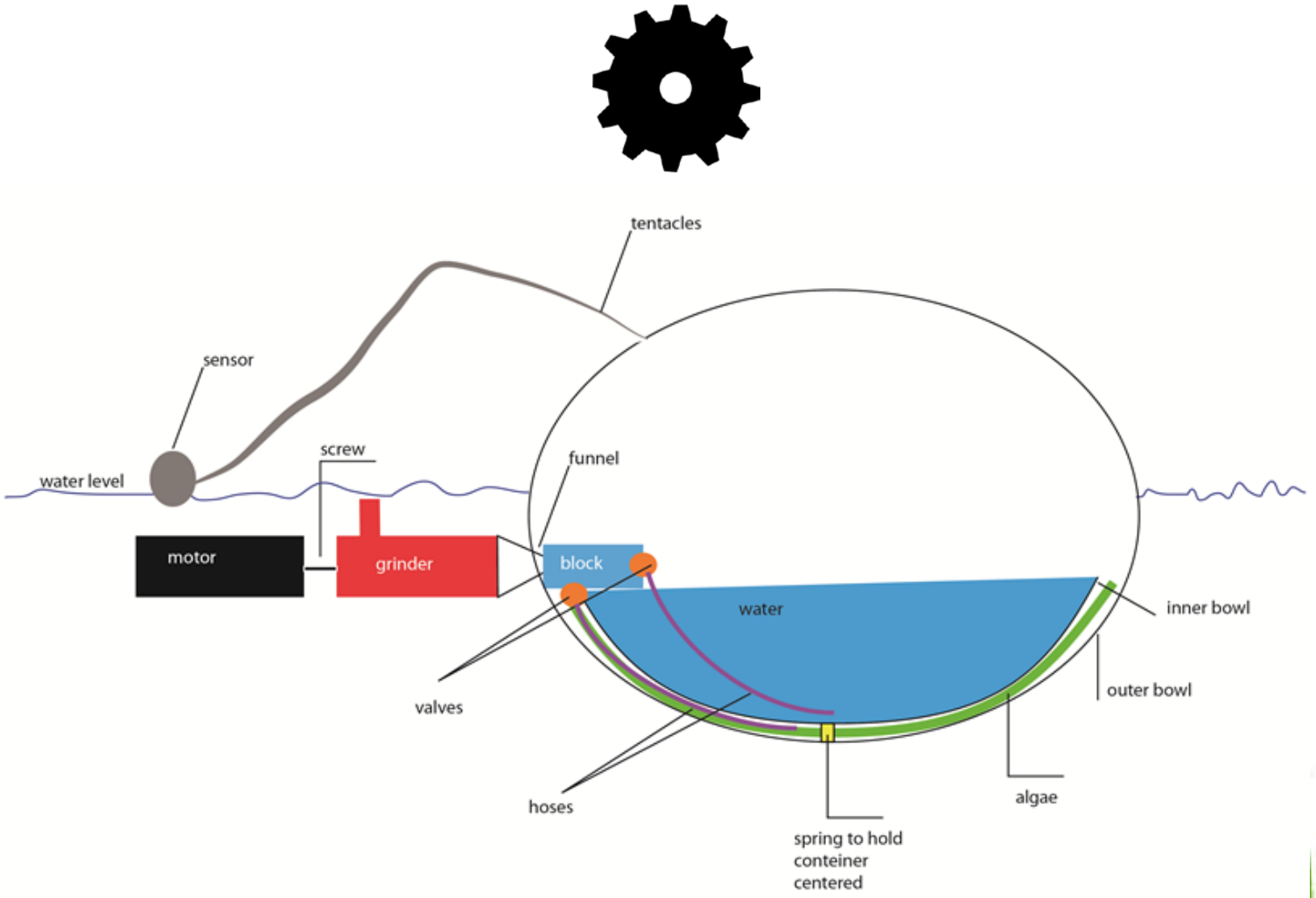
Parts of the Machine

- Motor
- Grinder
- Hoses
- Valve
- Outer bowl
- Inner bowl
- biosolar cells
- Sensors
- Wing
- Small motor
- Battery

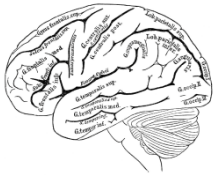




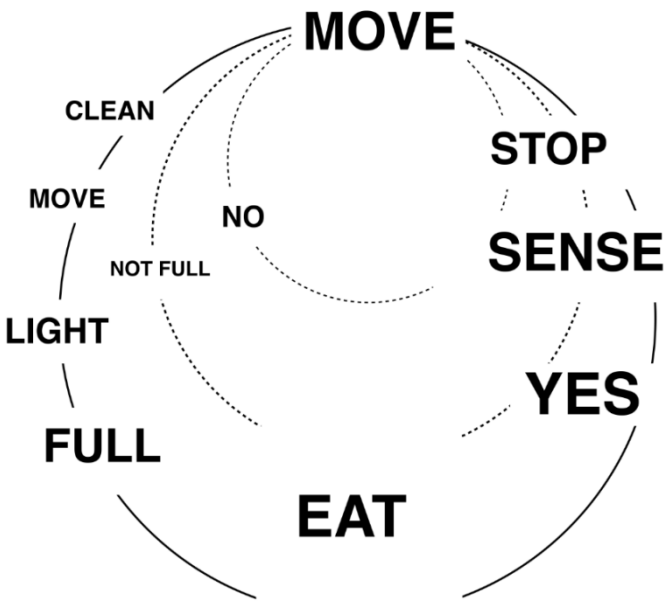
2. THE CONSTRUCTION The Mechanics



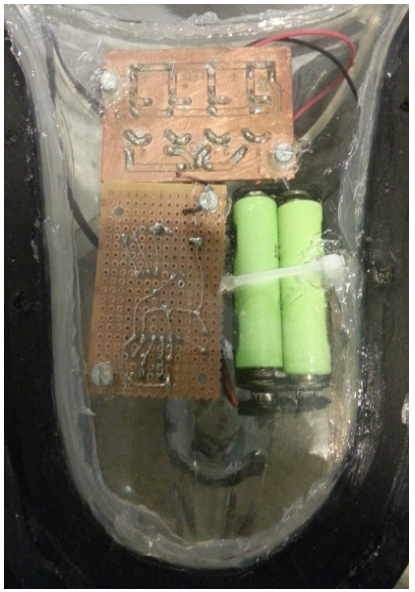
2. THE CONSTRUCTION The Brain



The compartments with the electronics



The program



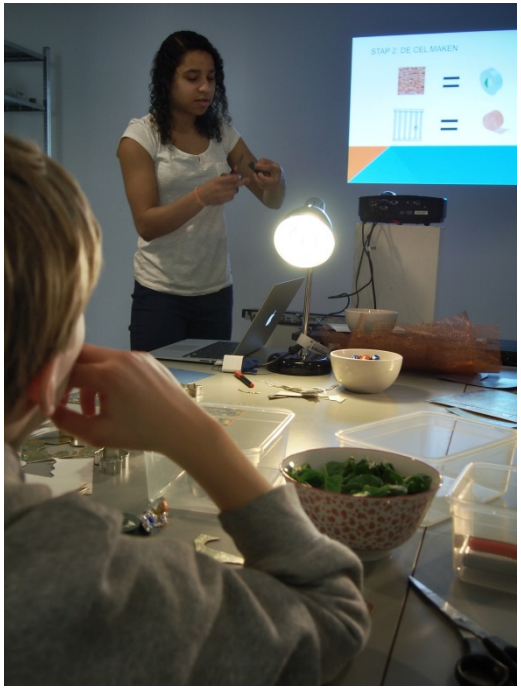
The energy harvester

3. THE EXHIBITION

The Symbiotic Machine is currently exhibited in “Het Glazen Huis” in Amsterdam where it swims in a pool.

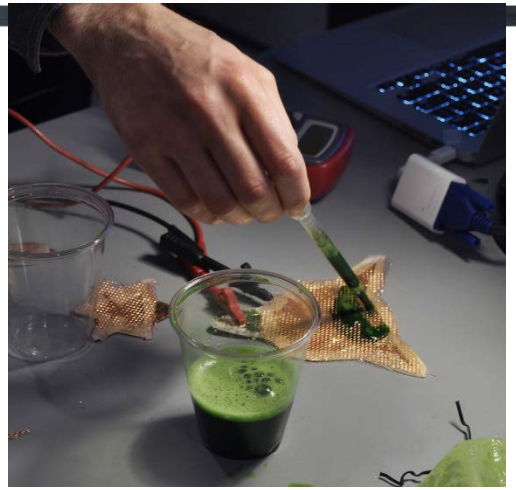
The general public gets the opportunity to look behind the “scene” of the Symbiotic Machine.

3. THE EXHIBITION Workshops

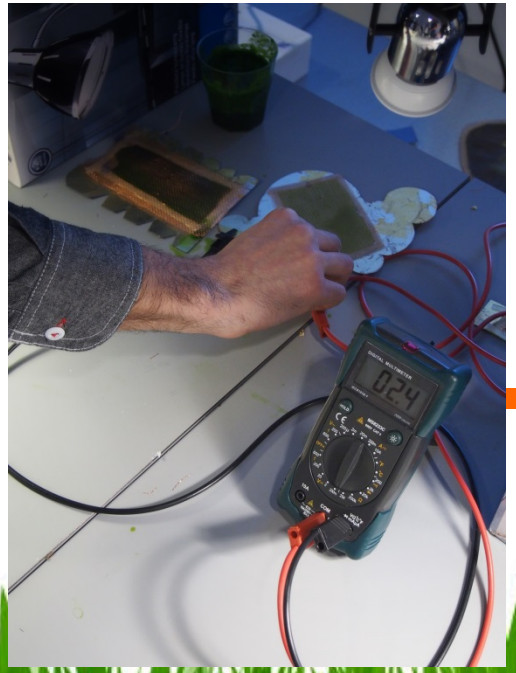


Explaining how to make a biosolar cell

Young participants making the biosolar cell



Testing the biosolar cells



SUMMERY

With the help of scientists, artists, engineers and art production specialists

The Symbiotic Machine: “connects and stimulates”

Art

Science

Innovation