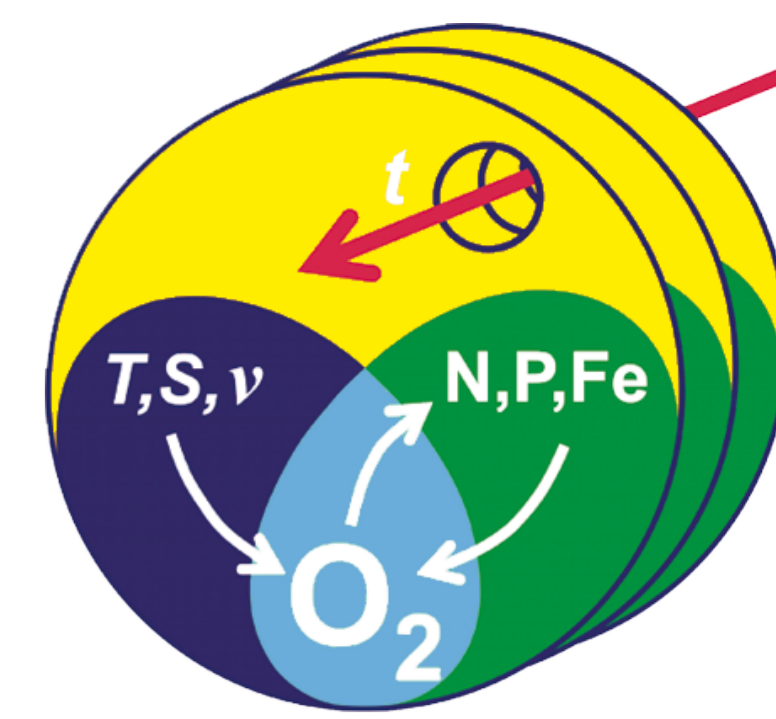
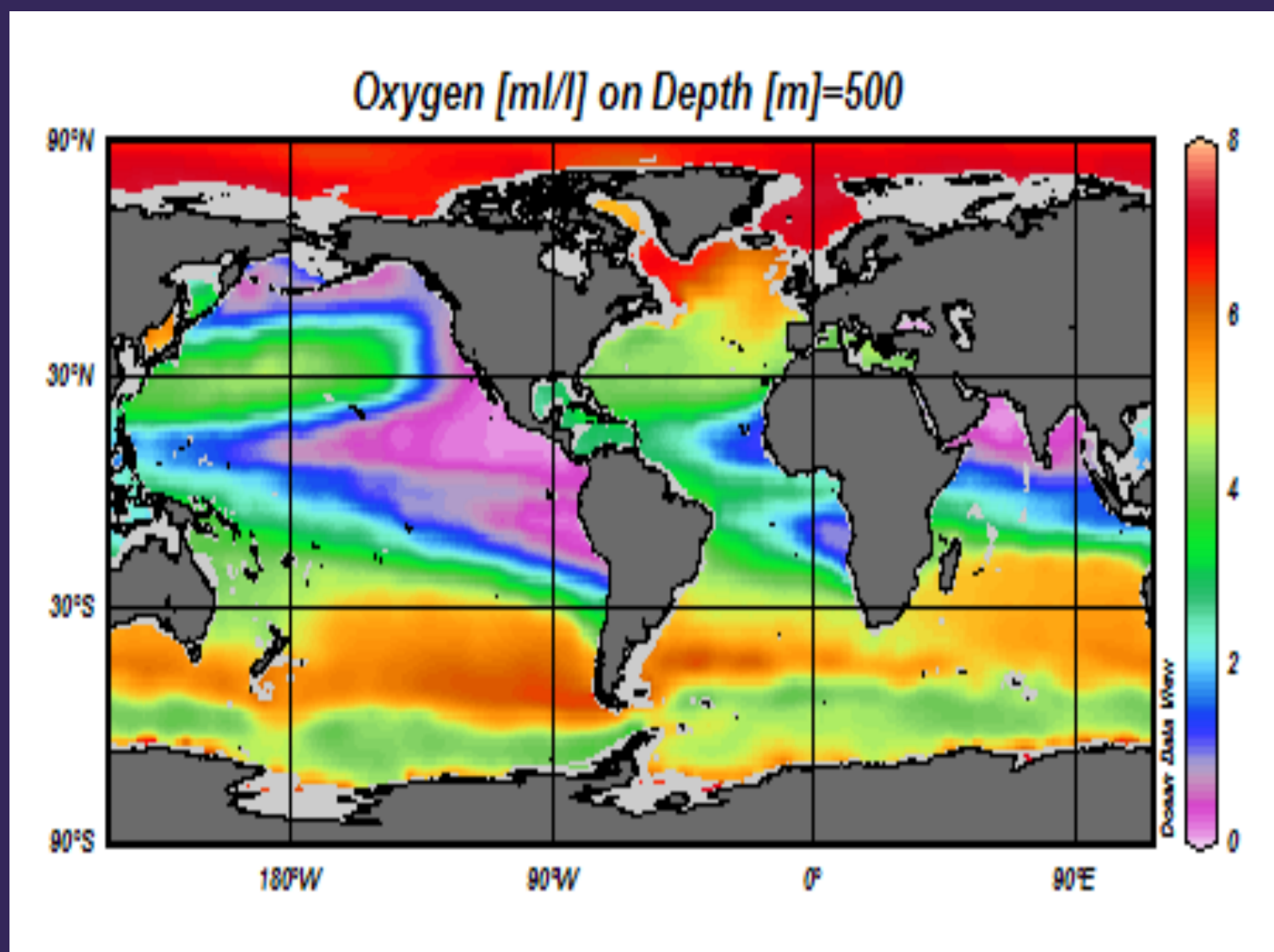


# From the Research Project to the Classroom: I. Translating Complex Science into Simple Experiments

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SFB 754



Source: SFB 754 based on World Ocean Atlas

SFB 754 is a research project funded by the German Research Foundation. The outreach component of the project aims to acquaint high school students with the mechanisms leading to ocean de-oxygenation (formation of Oxygen Minimum Zones) and the complex processes affected by this phenomenon. This is achieved through low-cost, easy to follow experiments and games which can be readily adopted in schools.

## The Experiments

The experiments were designed for students from grades 8 to 13. They address topics such as: the sources of oxygen in the ocean; its vertical and lateral transport; the factors affecting the solubility of oxygen in seawater; oxygen consumption by bacteria and sediment. The experiments do not

require proximity to the ocean so that even schools which do not have access to the sea can use them. More abstract processes like the ocean nutrient cycles are introduced through board games making learning more fun.

## Oxygen Uptake

Several experiments using Luer-Lock syringes were developed to show the effects of different factors on oxygen solubility.

## Oxygen Transport

The use of tank experiments is invaluable in demonstrating the vertical and horizontal transport of oxygen.

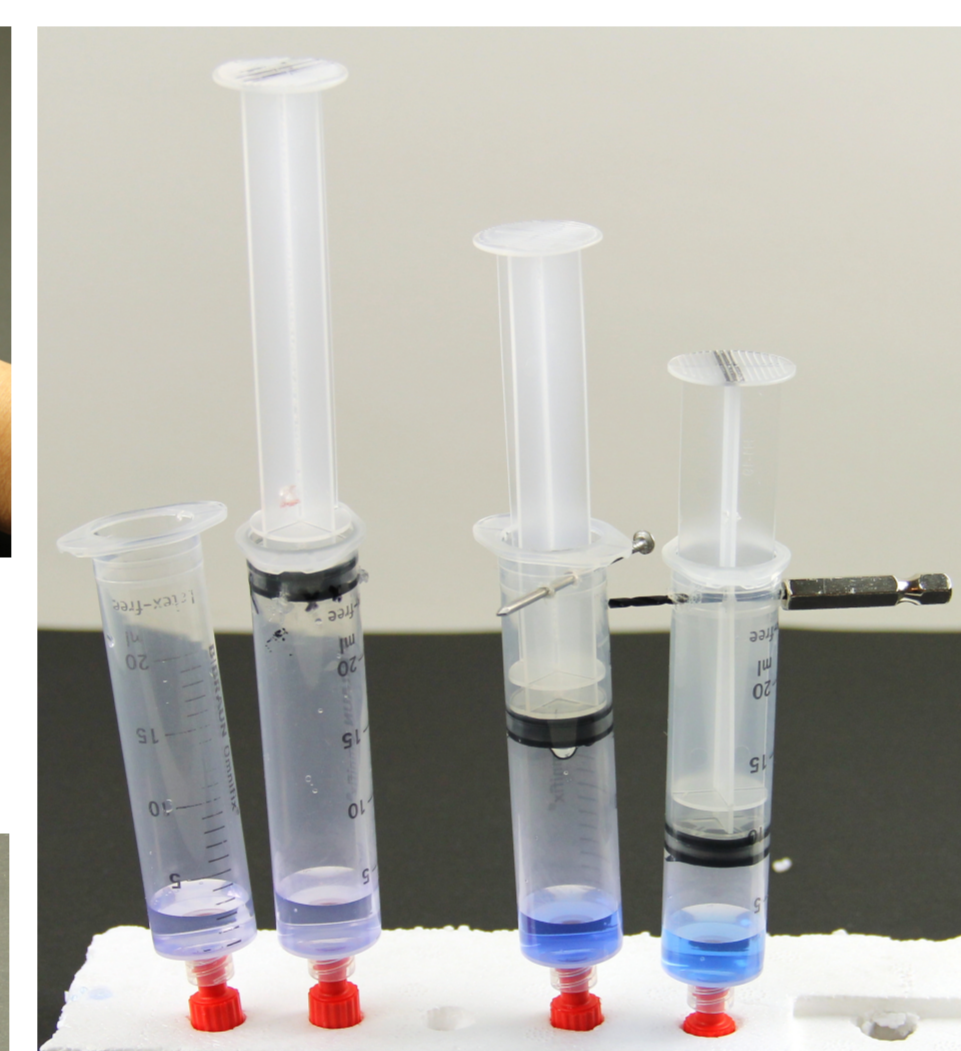


Low-cost materials

Oxygen is generated using yeast and  $H_2O_2$



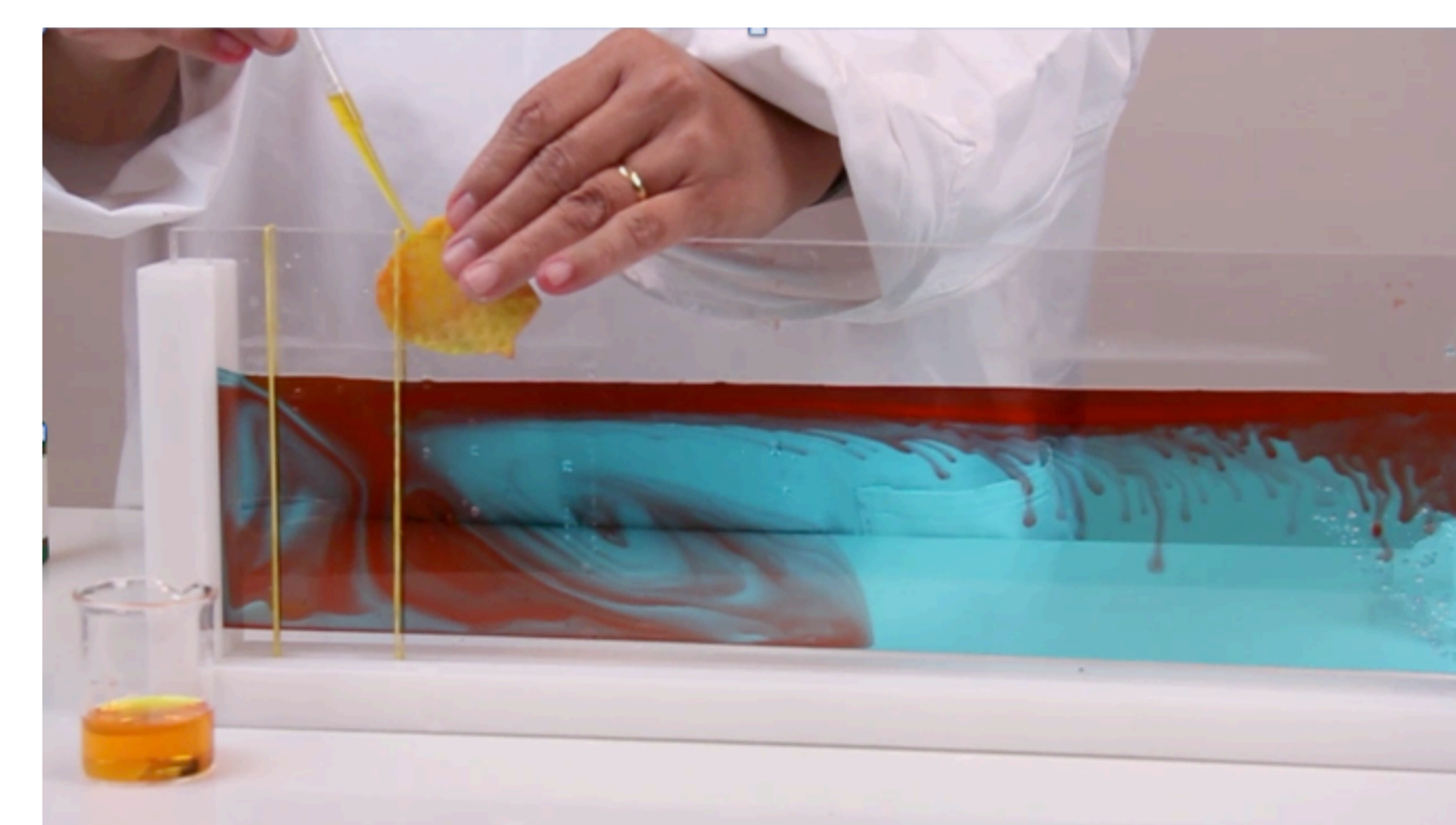
Set-up for measuring the oxygen uptake capacity of water



Experimental set-up showing the effect of partial pressure on the solubility of oxygen



Simulating vertical oxygen distributions



Simulation of deep water formation by thermal convection

## Nutrient Cycles

Phytoplankton, bacteria, sediments and enzymes immobilised in alginate are used in hands-on experiments to demonstrate several topics like oxygen production and nutrient uptake by microalgae and the role of enzymes produced by bacteria in some steps of the nutrient cycles.

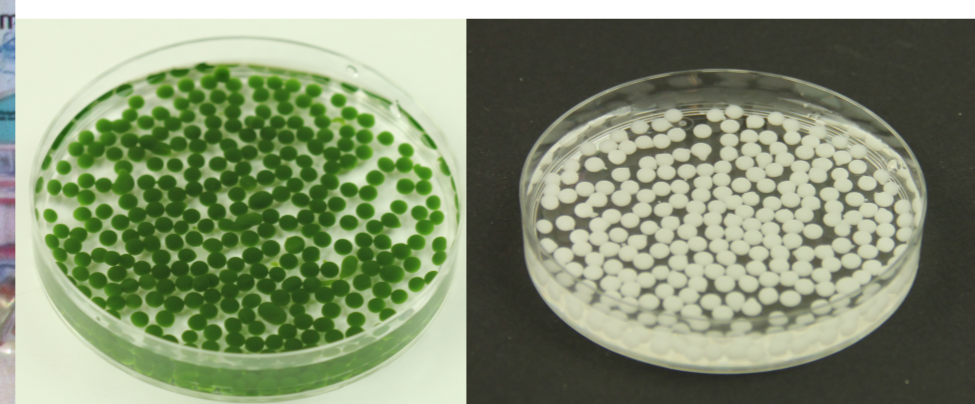
## Microbial $O_2$ -Consumption

Based on the use of redox indicators like methylene blue and resazurin, a method was developed to determine microbial oxygen consumption in the water column and in the sediment. Experiments demonstrating microbial substrate preferences and eutrophication in "small-scale" have been successfully piloted in class and student projects.

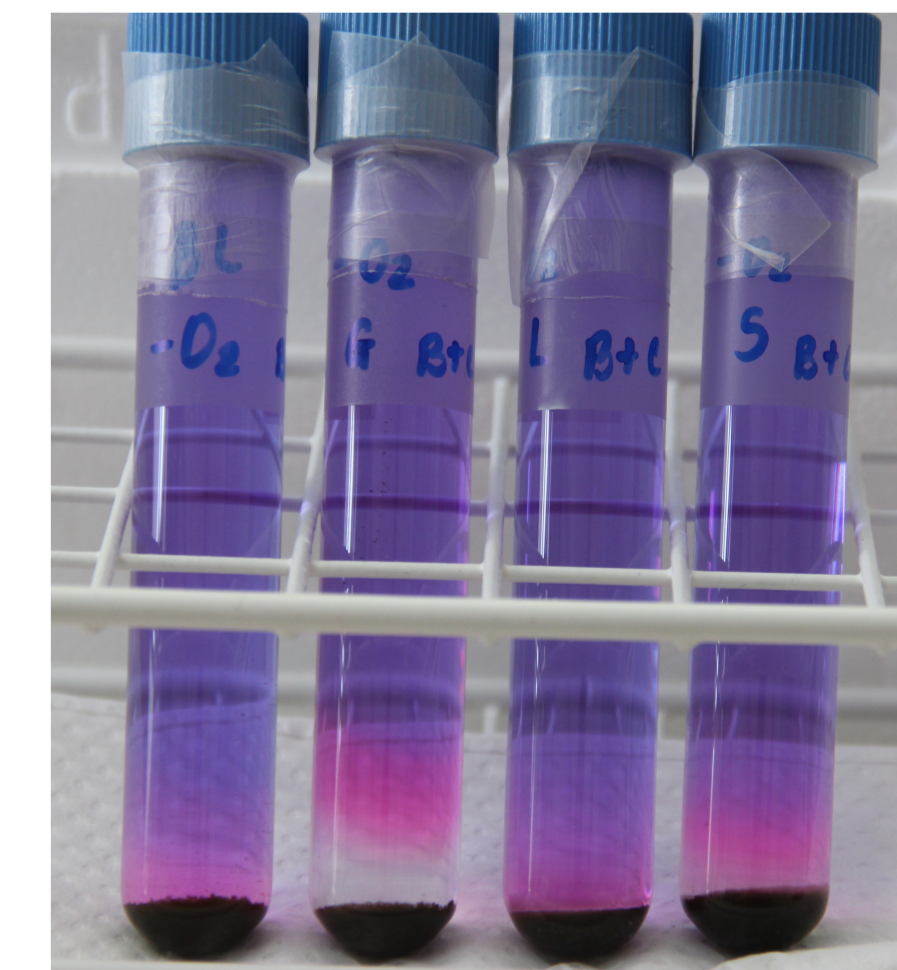
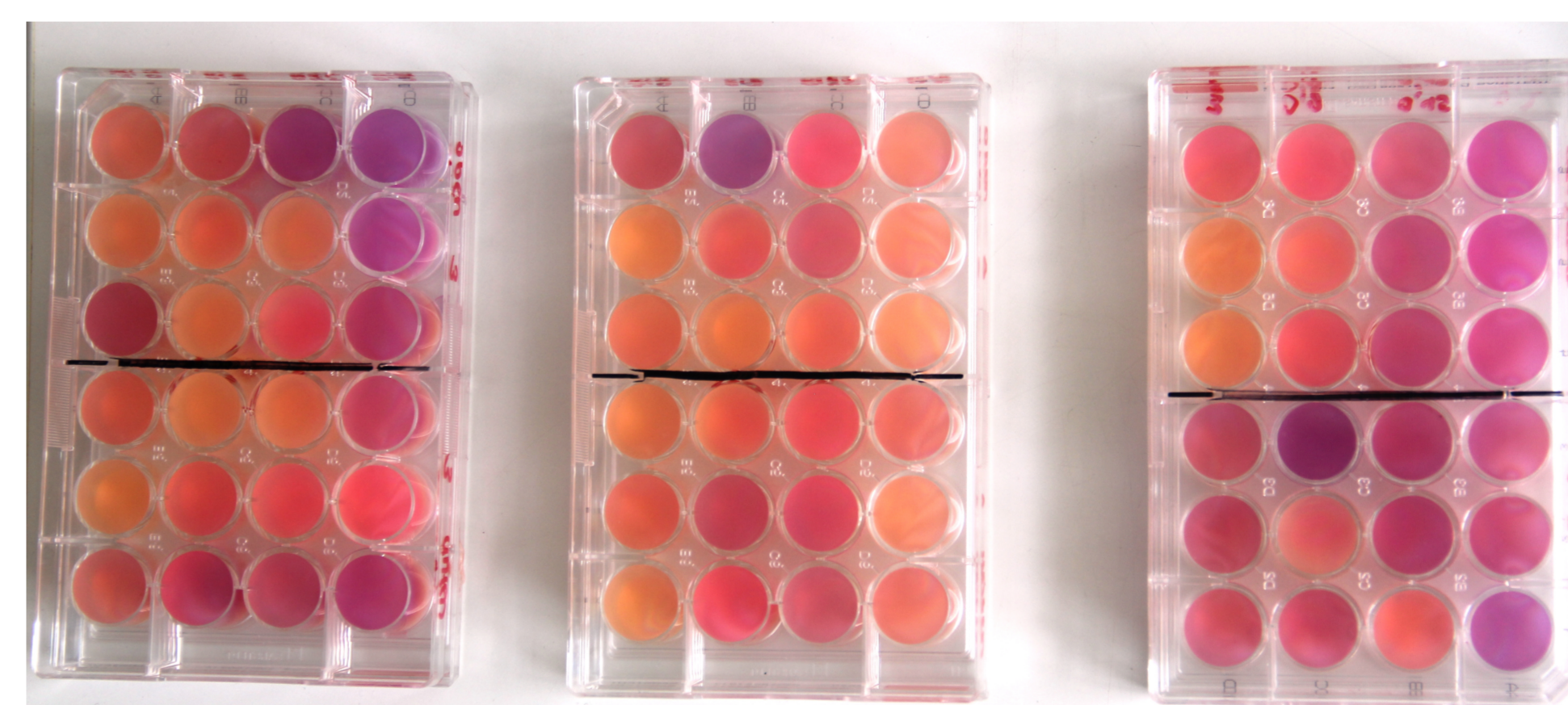


Pupils preparing phytoplankton alginate beads

Immobilised phytoplankton and bacteria



Resazurin test of  $O_2$ -consumption of sediments and water samples



## Game-based Learning

One of the foci of SFB 754 is the nitrogen cycle. Due to its complexity it is one of the more challenging topics to introduce to students. To augment lectures and experiments on nutrient cycles, games are being created to give students a more tangible method to learn an otherwise theoretical topic. The "Nitrogen Cycle Board Game" was successfully tested with high school and university students as well as with teachers.



The Nitrogen Cycle Board Game



Game Testing with high school students.