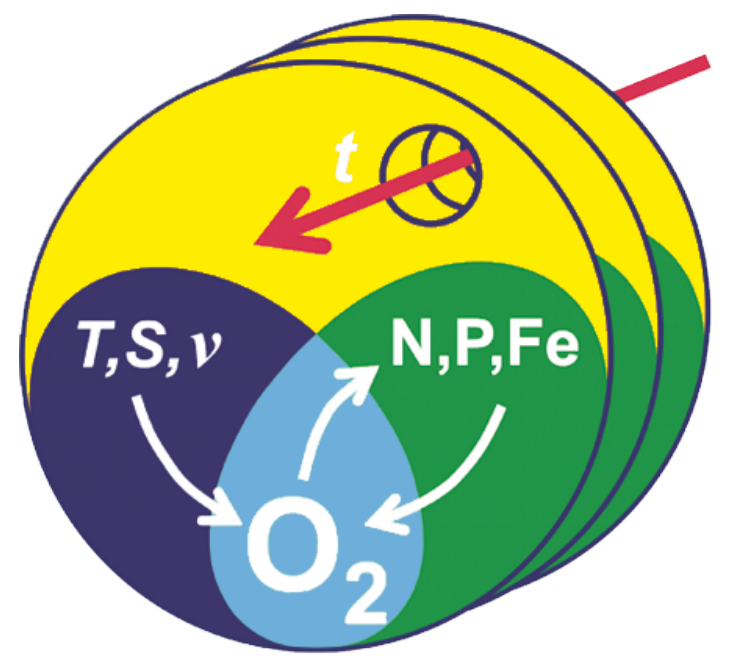


# All about oxygen: Hands-on experiments for Grades 5-12

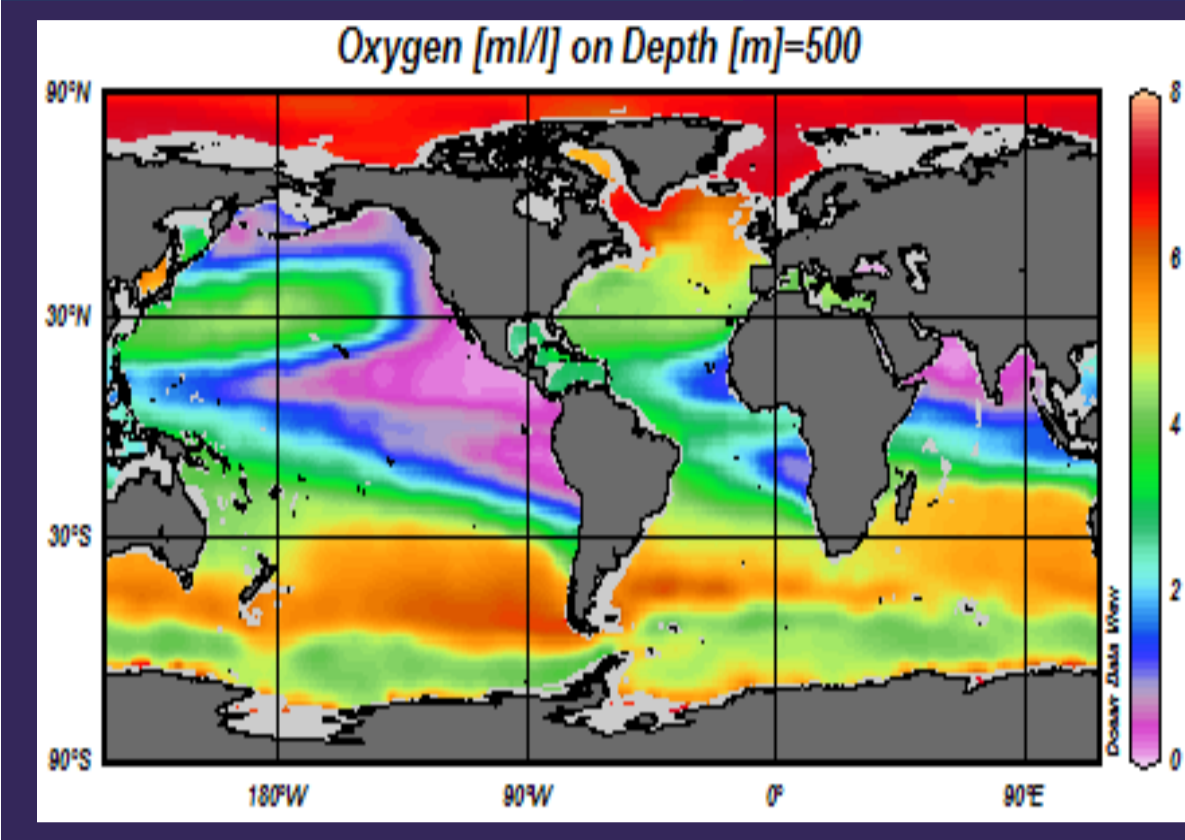
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SFB 754



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

## Oxygen Uptake Experiments

The factors affecting the solubility of oxygen in fluids are determined quantitatively using Luer-Lock syringes. These are simple, inexpensive, re-useable and safe.

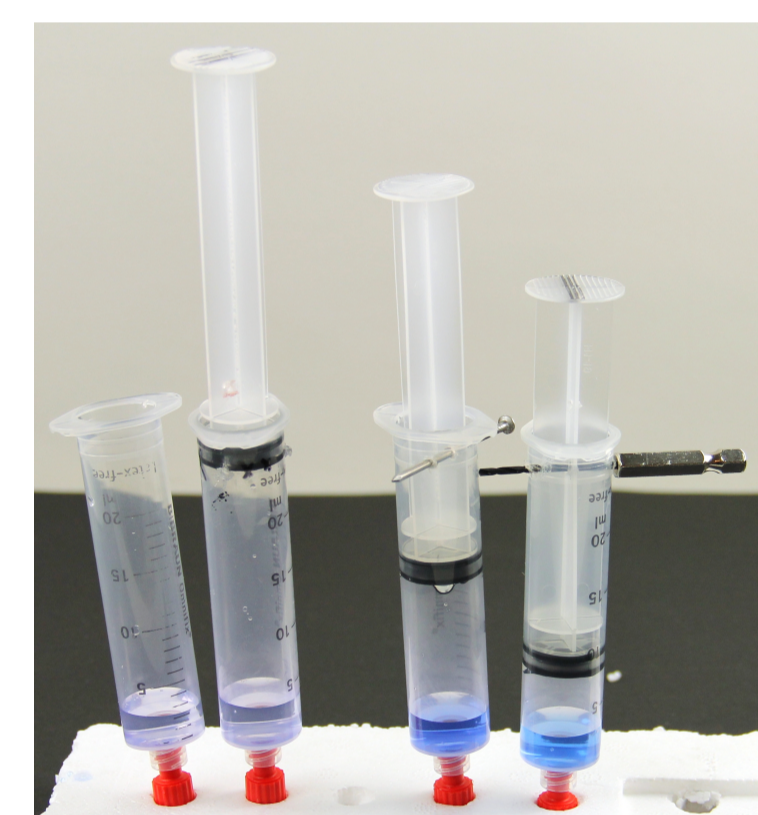


Low-cost materials

Oxygen is generated using yeast and H<sub>2</sub>O<sub>2</sub>



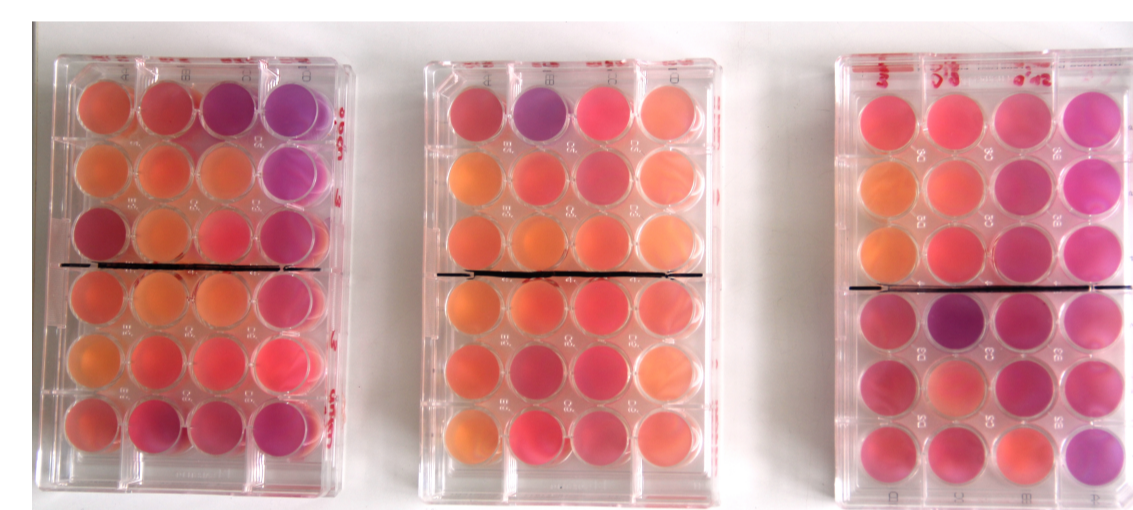
Set-up for measuring the oxygen uptake capacity of water



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

## Microbial O<sub>2</sub>-Consumption

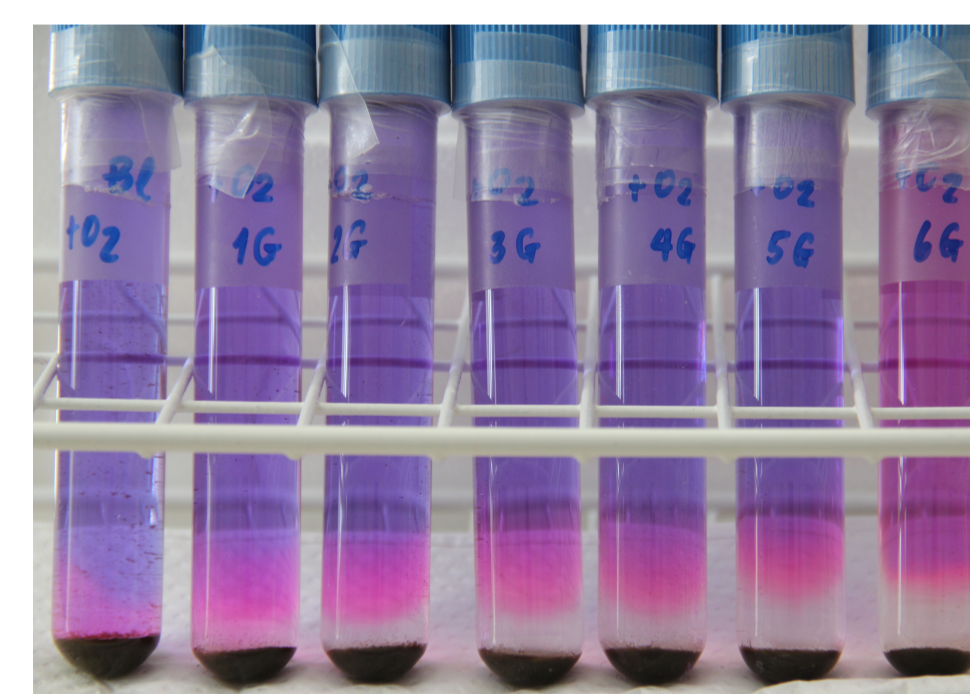
Based on the use of redox indicators like methylene blue and resazurin, a method was developed to determine microbial oxygen consumption in the water column and in the sediment. Experiments demonstrating microbial substrate preferences and eutrophication in "small-scale" have been successfully piloted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



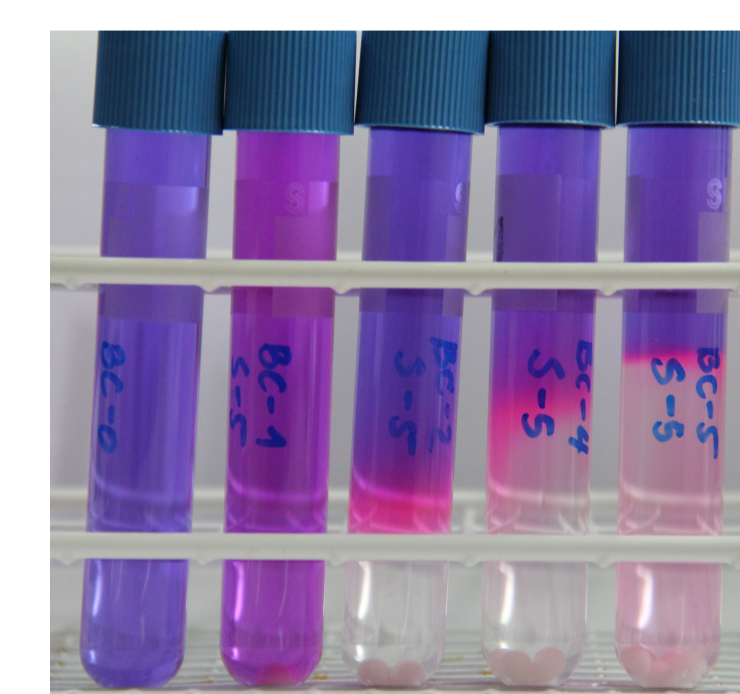
Resazurin agar-plates for measuring O<sub>2</sub>-consumption in water samples



Cell well plates have proven practical for multiple assay tests.



The resazurin test can also be used for sediment sample (left) and immobilised yogurt bacteria (right).

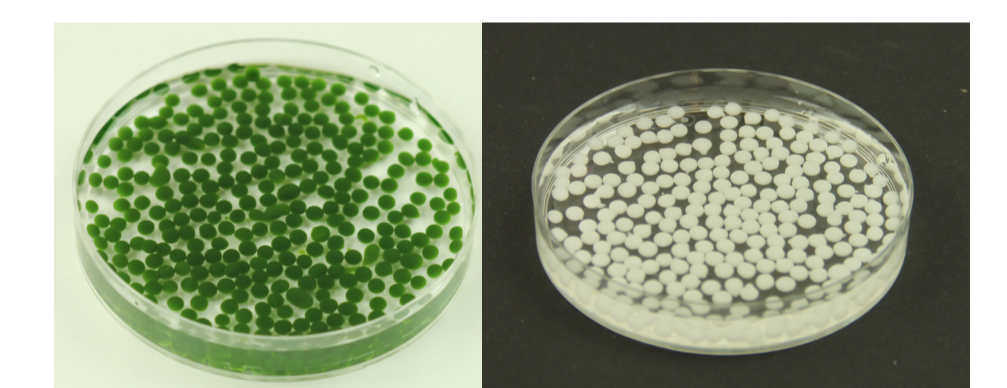


## Nutrient Cycles

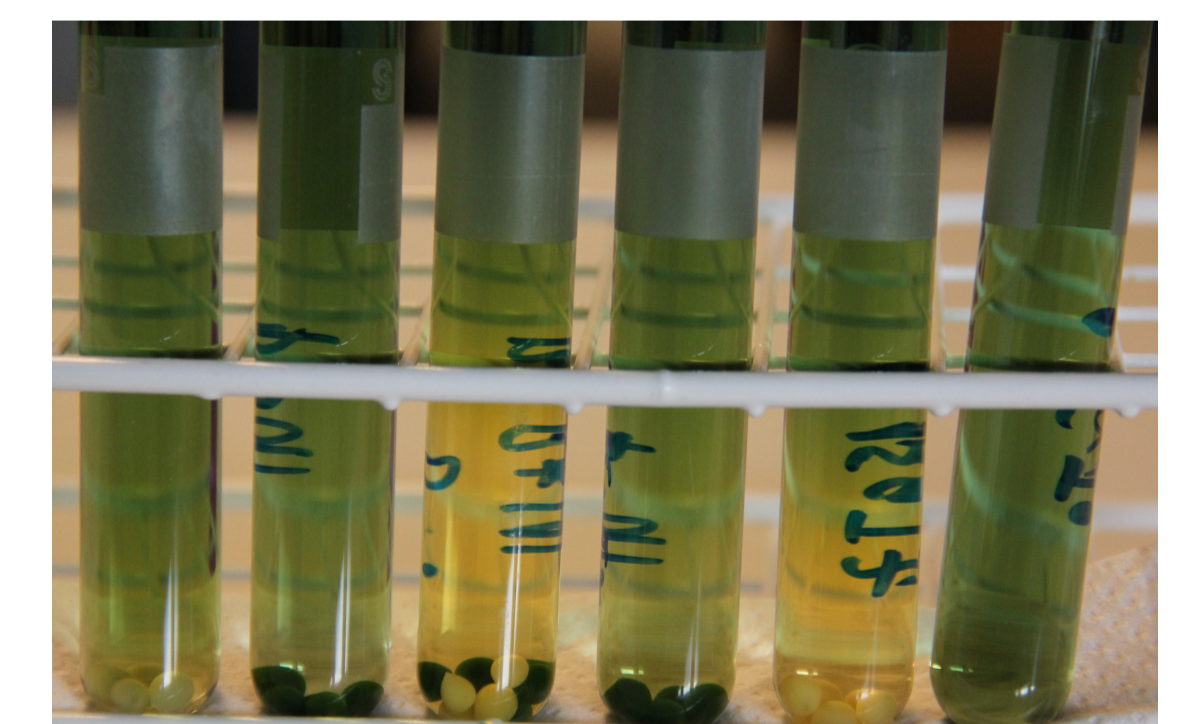
Phytoplankton, bacteria, sediments and enzymes immobilised in alginate are used in hands-on experiments to demonstrate several topics like oxygen production and nutrient uptake by microalgae and the role of enzymes produced by bacteria in some steps of the nutrient cycles.



Pupils immobilising bacteria and phytoplankton in alginate beads



Materials required for immobilising yogurt bacteria



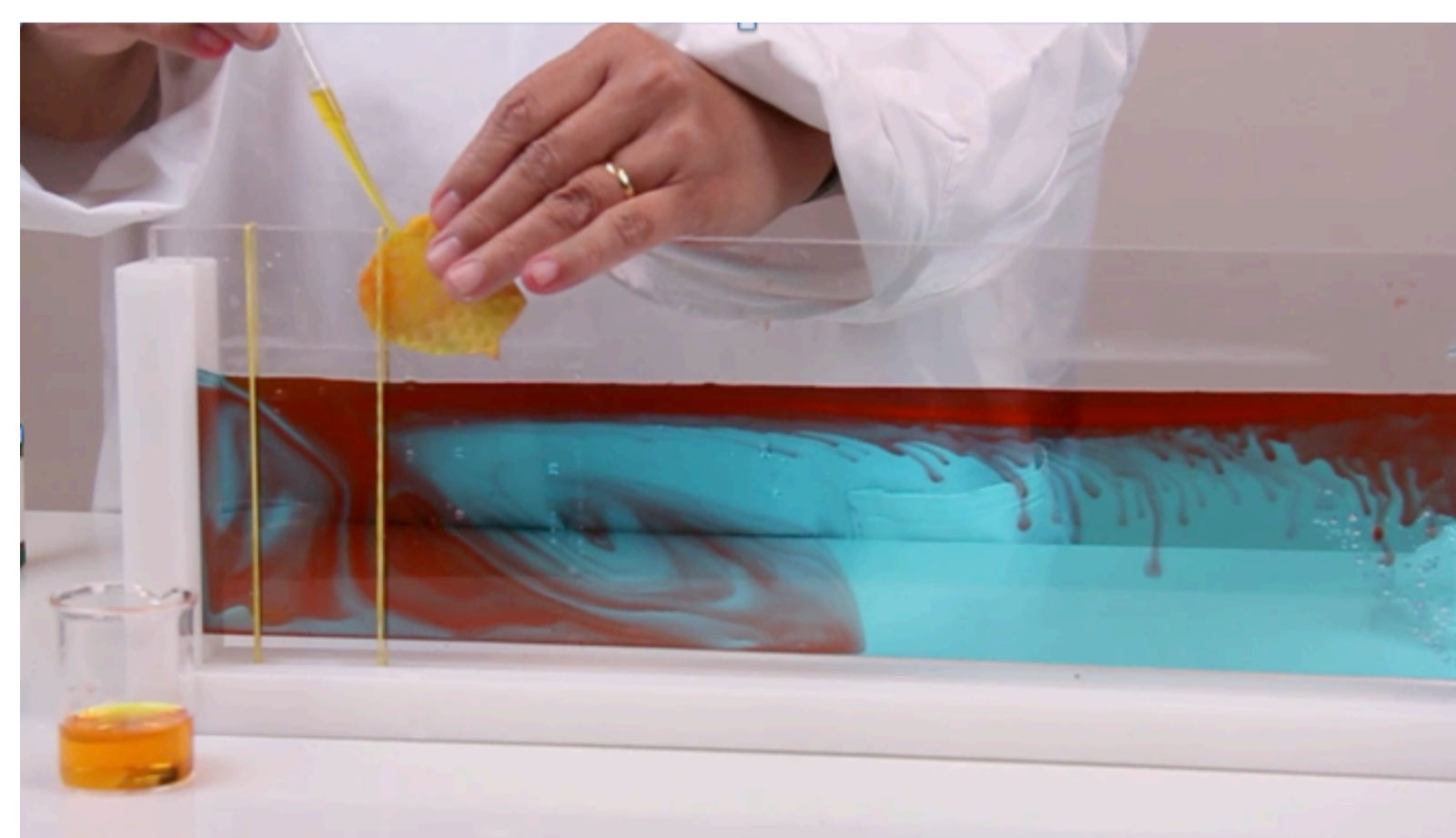
Sample experiment using immobilised bacteria and phytoplankton

## Oxygen Transport Experiments

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



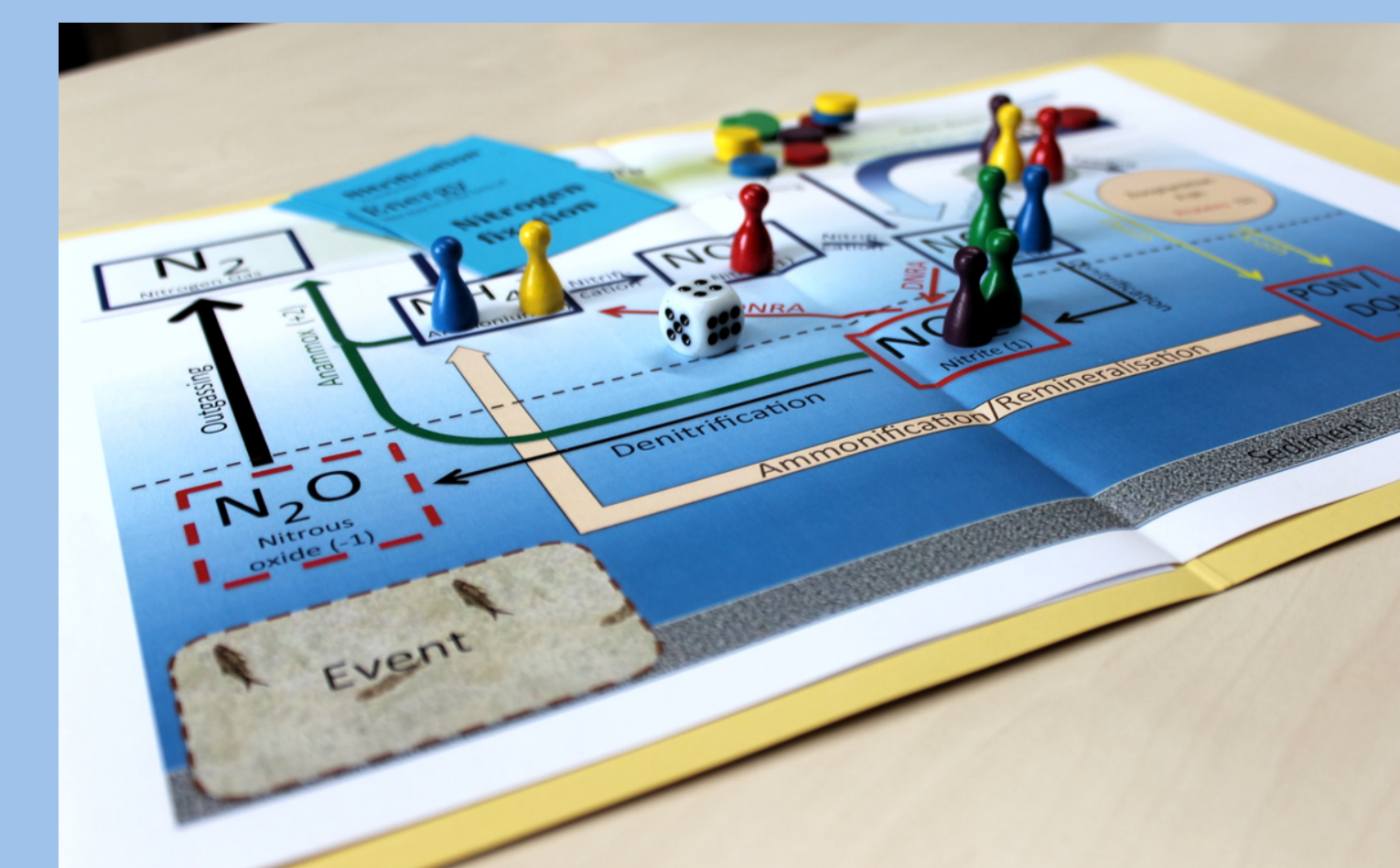
Simulating vertical oxygen distributions



Simulation of deep water formation by thermal convection

## 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.