

Hands-on diatoms for children: The “Schülerlabor NatLab”

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INTRODUCTION

During the recent years informal science laboratories, in which children and young adults can experience hands-on science activities, have been founded all over Germany. These out-of-school learning locations have been established by companies, research institutes, universities, and science museums and can be seen as a response to the declining number of students enrolling in “hard” sciences such as chemistry, physics and mathematics. They hope to spark children’s interest in science.

Unlike schools, informal science laboratories are able to offer hands-on activities and an authentic scientific environment. NatLab, one of the two informal science laboratories of the Freie Universität Berlin, is located in the department of biology, chemistry and pharmacy. This is the perfect place for school children and their teachers to meet students and researchers in their natural habitat and helps them to acquire a realistic and modern view of science. NatLab covers topics that are related to the school subjects of biology and chemistry in high school (grade 11 to 13) and to science education in primary schools (5th and 6th grade). All Teachers are expected to attend a training course, where they get to know the scientific background of the experiments and learn to perform the experiments themselves. Thus they gain the competence to prepare the visit in school and to also deal with questions that might arise afterwards. Trained teachers have the right to visit NatLab with their classes and to attend workshops that are guided by scientists and university students.

Given that only a small percentage of primary school teachers have received a scientific education, they need supplemental support to be able to teach science. At present NatLab is offering two courses for primary schools. The first one is an introduction to chemistry. The second course is entitled “Life in a drop of water” and deals with the subject of microbial life, which includes diatoms and living cultures of *Paramecium caudatum* Ehrenb. and *Euglena spirogyra* Ehrenb.

MATERIAL & METHODS

Preparation of permanent slides: For demonstration purposes a sample of *Cladophora* associated diatoms was taken from the urban part of river Spree (Berlin-Kreuzberg, October 2005). Organic compounds were removed by oxidation with 30% hydrogen peroxide and valves were mounted onto glass slides using Naphrax. Specimens contain more than 50 centric and pennate diatom species.

Microscopy: For workshops and courses, NatLab has a set of 15 Leitz Laborlux student microscopes offering brightfield illumination and magnifications from 35x to 400x. A Zeiss Axiostar microscope with photo tube and attached JVC GZ-MC500 camera and 20“ LCD is used for demonstrations. It has also proven indispensable as teaching aid for physically handicapped children.

For use in posters and overhead transparencies DIC photographs of diatom valves were taken with a Canon EOS 1D mounted on a Zeiss Photomikroskop III. Video footage of living diatoms was shot using a Sony DXC 9100P attached to a Zeiss IM 405 inverted microscope.

Species identification: Photos and slides of diatom valves were sent to Botanic Museum and Botanical Garden Berlin-Dahlem for identification. Images are now part of the AlgaTerra information system (Jahn & Kusber 2007).

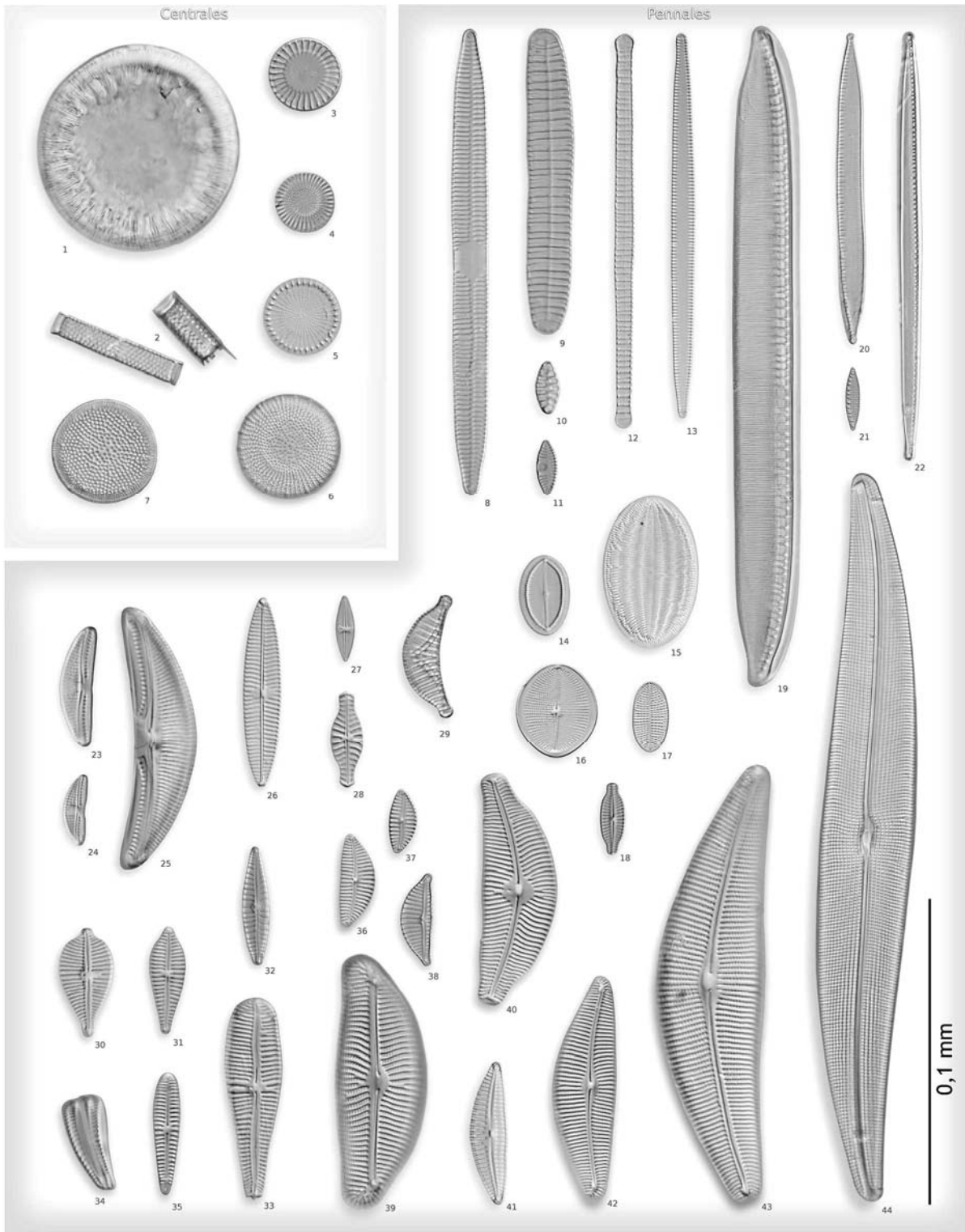


Fig 1. Poster of diatoms for class room use. 1. *Ellerbeckia arenaria*. – 2. *Aulacoseira granulata*. – 3. *Cyclotella meneghiniana*. – 4. *Cyclostephanos dubius*. – 5. *Stephanodiscus hantzschii*. – 6. *Stephanodiscus berolinensis*. – 7. *Actinocyclus normanii* f. *subsalsus*. – 8. *Ulnaria ulna*. – 9. *Diatoma vulgare*. – 10. *Staurosira martyi*. – 11. *Fragilaria vaucheriae*. – 12. *Diatoma tenue*. – 13. *Tabularia tabulate*. – 14. *Cocconeis placentula*. – 15. *Cocconeis* sp. – 16. *C. pediculus*. – 17. *Cocconeis* sp. – 18. *Karayevia kolbei*. – 19. *Nitzschia sigmoidea*. – 20. *Nitzschia* sp. – 21. *N. amphibia*. – 22. *Nitzschia* sp. – 23. *Amphora copulata*. – 24. *A. pediculus*. – 25. *A. ovalis*. – 26. *Navicula tripunctata*. – 27. *Luticola goeppertiana*. – 28. *Hippodonta capitata*. – 29. *Epithemia sorex*. – 30. *Gomphonema augur*. – 31. *G. pseudoaugur*. – 32. *G. parvulum*. – 33. *G. truncatum*. – 34, 35. *Rhoicosphenia abbreviata*. – 36. *Encyonema* sp. – 37. *Cymbella leptoceros*. – 38. *Encyonema ventricosum*. – 39. *E. prostratum*. – 40. *Cymbella tumida*. – 41. *C. leptoceros*. – 42. *C. compacta*. – 43. *C. aspera*. – 44. *Gyrosigma acuminatum*. (for details see Jahn & Kusber 2007).

DIDACTIC APPROACH

In Berlin up to 4th grade, the subject “Sachkunde” is taught, which includes topics concerning both science and social sciences. In the grades 5 and 6, “science” is taught, a subject which was introduced in 2005 as a result of reducing the number of school years from 13 to 12 years in total. Science subjects that have been taught in secondary schools are now part of the primary school curriculum. Within this new curriculum is the topic “World of the small and world of the large”, in which the children have to learn about microscopy and about what live within probes of water and mud. Since most primary schools in Berlin do not own the microscopes necessary for studying the multitudes of living creatures in water probes the course “Life in a drop of water” was developed to supplement what has to be taught in school.

During their two hour visit to NatLab, children have the opportunity to examine protozoa and algae under a microscope. They usually work together in groups of two, but all participants have to write down their observations individually. Later the research teams get together to compare their results. In doing so they become familiar with three basic steps of scientific work: observation, recording and discussion.

The organisms at hand include living cultures of *Paramecium caudatum* and *Euglena spirogyra*, so that the children can see how different microbes move. They also realise that different microbes can look and behave differently. The third object to explore is a permanent slide containing diatom valves.

These slides turned out to be excellent subjects for children to investigate. Diatoms are probably the best suited protist group to visualize the diversity of unicellular life. Since the mounted diatom valves do not move, permanent slides are easy to look at and to draw. While protozoa such as *Paramecium* are sometimes perceived as “squirmy” and appalling, most children feel that diatoms are “beautiful”.



Fig 2. Children investigating diatoms.

Additional teaching materials have been prepared for the discussion of diatom biology in class. These include a collection of texts, overhead transparencies, a poster of diatom valves and a video DVD showing cell motility. The media provided highlight some of the amazing and unexpected features found in protist cells. It is shown that diatoms cells have no limbs or sense organs, yet some of them move around and are capable of building extremely complicated species-specific silica structures. They also serve as an example of autotrophic, plant-like organisms that clearly do not belong to the green plants. The course book provides plenty of background information about the role of diatoms in aquatic ecosystems. Most teachers are unaware that diatoms have been found to be the major source of oxygen on our planet. A lot of food for thought.

DISCUSSION

Research on the impact of informal science laboratories has just begun, but the first studies indicate that the science laboratories can indeed inspire and increase the interest in science (Engeln & Euler 2004; Kohse-Höinghaus et al. 2004, Brandt 2005). The majority of children visiting the laboratories enjoy their stay. They particularly like doing hands-on experiments, being challenged, the authenticity, and the work within teams. About 50 % of the children not only enjoy, but also value the visit and more than 30 % would like to learn more about the subject area which was presented. The positive influence of such a visit is not short term, but can still be measured after 3 months.

Like the children, teachers evaluate the visit positively. They observe an increase of interest in the classroom, especially in children that normally underperform. Most primary teachers would like to be able to teach science subjects in their classroom, but feel intimidated, since most of them never studied a science subject. They depend on proper training and good teaching materials to be up to that task. Hence a number of laboratories are offering teacher training. In addition, more and more informal science laboratories assist students pursuing teaching certification, thus influencing future teachers.

NatLab has received three awards: two awards from “Lernort Labor” (2005, 2006) and an award from the Robert Bosch Foundation (2006). “Lernort Labor” is a project supported by the Bundesministerium für Bildung und Forschung to investigate the role of science laboratories. With the money from the first “Lernort Labor” award, NatLab was able to finance equipment needed for the primary school experiments. Money from the second “Lernort Labor” award was used to integrate pre-service training of primary teachers into the work of NatLab and to develop material that can be loaned to teachers to prepare the visit or to continue to work on the topic of the NatLab visit afterward.

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