Brazilian actions to promote physiology learning and teaching in secondary and high schools

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Brazilian actions to promote physiology learning and teaching in secondary and high schools. Adv Physiol Educ 40: 253–256, 2016; doi:10.1152/advan.00032.2016.—Members of the Education Committee of the Brazilian Society of Physiology have developed multiple outreach models to improve the appreciation of science and physiology at the precollege level. The members of this committee act in concert with important Brazilian governmental strategies to promote training of undergraduate students in the teaching environment of secondary and high schools. One of these governmental strategies, the Programa Institucional de Bolsas de Iniciação à Docência, a Brazilian public policy of teaching enhancement implemented by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) since 2007, represents a well-articulated public policy that can promote the partnership between University and Schools (7). Furthermore, the Program “Novos Talentos” (New Talents)/CAPES/Ministry of Education is another government initiative to bring together university and high-level technical training with the reality of Brazilian schools. Linked to the New Talents Program, in partnership with the British Council/Newton Fund, CAPES recently promoted the visit of some university professors that coordinate New Talents projects to formal and informal educational science spaces in the United Kingdom (Science, Technology, Engineering, and Mathematics, Brazil-United Kingdom International Cooperation Program) to qualify the actions developed in this area in Brazil, and one of us had the opportunity to participate with this.

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THE BRAZILIAN PRECOLLEGE EDUCATIONAL SYSTEM (basic education, as called in Brazil) is organized in three main levels, as show in Fig. 1. The activities related here were developed with students and teachers from secondary and high school. Activities such as thematic weeks/months, workshops, and continuing education courses provide theoretical and practical experiences for students and teachers. These activities are often implemented through university-school collaborations, involving teachers and students of universities and public and private schools. Here, we describe some examples of actions stimulated by the Education Committee of the Brazilian Society of Physiology (SBFis) to improve physiology teaching and learning in schools. These actions were developed through 2011–2015 to promote physiology teaching and understanding in different parts of Brazil, more specifically in Feira de Santana (Bahia), Ribeirão Preto (São Paulo), and Uruguaiana (Rio Grande do Sul) (Fig. 2) and reflect the view of the Education Committee of SBFis in how best to improve physiology teaching and learning in schools.

Actions with Students

Thematic weeks/months. Thematic weeks/months provide good strategy to promote science dissemination and popularization. Different regions of Brazil have implemented outreach based on these national and international models.

NATIONAL WEEK OF SCIENCE AND TECHNOLOGY. The National Week of Science and Technology (NWST) is an October national campaign that is sponsored and promoted by the Brazilian Ministry of Science and Technology. Activities mobilize and engage the population, especially children and young people, in science and technology. The goal is to awaken interest in how science impacts their life and careers.

BRAIN AWARENESS WEEK. Brain Awareness Week (BAW) is a global campaign that aims to increase public awareness toward the progress and benefits of brain research. The campaign is organized by the DANA Foundation, and, during a specific week of March, actions are developed in different parts of the world.

PHYSIOLOGICAL UNDERSTANDING WEEK. Physiological Understanding (PhUn) Week is organized annually by the American Physiological Society. It comprises a set of activities that have as the main objective to increase students’ interest in physiology and increase their understanding about the presence and relevance of physiology in their daily life. Activities in Brazil are held in parallel with the United States PhUn Week each year in November.

BREAST CANCER AWARENESS MONTH. Breast Cancer Awareness Month (BCAM) is a health campaign globally organized every October to increase the awareness of causes, prevention, diagnosis, treatment, and cure of breast cancer.

The BAW, NWST, and PhUn thematic events have been held since 2012 in Uruguaiana in the state of Rio Grande do Sul, in the south of Brazil (Fig. 2). The activities include four schools per year, with the participation of ~400 students and 10 teachers per year per event, reaching >3,000 students. The BAW and NWST, as well as the BCAM campaign, have been held since 2013 in Feira de Santana, in the state of Bahia in the north of Brazil (Fig. 2). Each year, seven public secondary schools of the municipality participated. These events were directed at public school students and consisted of lectures,
meetings, health fairs, bulletin boards, and displays of physiology models. The set of activities demonstrate how science works and how it impacts daily life. Practical and hands-on activities were the preferred activities, and they were focused on neuroscience/neurophysiology and physiology as well as science in general. In the practical activities, students could:

- Develop insights into how the brain and whole body are organized by means of anatomic pieces
- Better understand how scientific research is conducted, including exposure to equipment used in different types of investigation, including in vitro and animal research
- Discuss the significance of science in general, and of brain research and physiology specifically, in different context settings
- Conduct quick experiments to visualize physiological responses, such as, for example, heart rate, ventilation, blood saturation, and other alterations, that occur in response to physical exercise
- Discuss behaviors that can contribute to physical and cognitive health, such as physical exercise
- Relate scientific knowledge to their daily life events and their school curricula
- Explore science as a possible career

These activities, based on a participative educational process, emphasized interdisciplinary work to strengthen physiology teaching in schools and have had positive results (2, 5, 6, 9). The process of participative training in thematic weeks expands the possibilities for physiology learning by promoting interactions between academic and community environments.

Workshops in high schools. The teaching of physiology deserves attention at all grade levels. In high school, the classes given to students often barely touch on scientific explanations and the students in this phase have difficulties, especially with the terminology of physiology. With this in mind, an educational workshop named “Journey to the Giant Cell” was proposed, developed, and implemented in a public school of Feira de Santana, Bahia, Brazil, in 2014. The workshop was conducted in three main stages and involved students at all grade levels. First, high school students crafted cell organelles, preferably using recycled materials. They then constructed a three-dimensional model of a eukaryotic cell (plant or animal). After the cell was constructed, it was displayed to the school community. In all stages, the students involved studied and discussed cell physiology concepts related to the contents of their theoretical classes.

The exposition was visited by 98 students from the first grade of secondary education of the school. The degree of satisfaction of the exposition of the visitors was evaluated through a Lickert scale questionnaire. Seventy percent of the students that visited the exposition reported an enthusiasm to study cell physiology, and 65% said that this activity was important to increase their comprehension of some physiology concepts. Hence, we conclude that developing the workshop in school is an interesting way to stimulate broader interest in physiology.

Workshop for high school students in a physiology congress. The transition from the end of high school and the beginning of academic activities in a university is a time of change in a student’s life. During the last year of high school and pre-university courses, the preparation of students is intense and very much focused on the topics of the main tests for entry to the best public universities in the country. The motivation of the students to enter a university is high, and such admission is desirable. However, even when counting with the support of professional pedagogical and psychological staff, many students do not have an accurate understanding of the challenges that they will face once they are admitted to a university.

The Education Committee of SBFis decided to address this gap by organizing an event with high school students similar to that of the American Physiological Society, which takes place during the Experimental Biology meeting. There, teachers and students of high schools have the opportunity to interact with scientists, professors, and students of United States universities and abroad. Our main goal in Brazil was to offer high school students the opportunity to experience a scientific congress where the participants are, at every moment, discussing scientific data, raising hypotheses, and thinking about experiments on how to test them.

In 2013, our Brazilian Physiology Congress was held in Ribeirão Preto in the state of São Paulo (Fig. 2), and we organized such an event that was sponsored by the SBFis and AD Instruments. Four schools from the city, two private and
two public ones, were randomly chosen. School principals received an official letter inviting teachers and students to attend the event and explaining the objectives of the workshop. We asked them to contact teachers and students interested in biological and health sciences. Eighty students were invited, 20 students from each school.

The workshop was organized in two stages. The first stage consisted of theoretical and practical activities (4 h) on the Sunday morning before the Congress Opening Ceremony. This stage was initiated with a class (50 min) on neuromuscular and cardiorespiratory systems. The class was designed and presented in a way that students could interact with each other and with the teacher. It was a dynamic class with several questions directed to the students so that they could think about concepts related to the presented themes and to enable them to understand the practical applications of such knowledge in their daily life. Next, students were divided into groups of 10 for the second stage. With the help of equipment and technical staff of AD Instruments, students could measure blood pressure, peripheral pulse, respiratory rate, respiratory volumes, and neuromuscular reflexes.

The activities were conducted simultaneously and supervised by the teachers. For optimal learning during the activities, all questions posed by students were discussed in the group. At the end of this step, during lunch time, students continued the discussions of activities. After lunch, the student groups were taken to a 3-h guided tour of the poster session of the Congress. During the visit, students were accompanied by teachers from their school and members of the Education Committee. In front of randomly chosen posters, the dynamics of the workshop were explained to the poster presenters, and the presenters were asked to talk to the group of students about their work at an appropriate level of knowledge. After the poster presentation, two important points could be observed: first, there was curiosity and interest of the students in the topics and results presented, and, second, the students appreciated the difficulty of the poster presenters to communicate their work appropriately to high school students.

At the end of the day, all students joined again in a closing session to finish the workshop with final discussions on both technical and general aspects. The main aim of this workshop was to have the students experience how scientific research in physiology is done, using physiological phenomena that are presented theoretically in their schools. The class and the guided visit to the posters raised students’ curiosity and stimulated them to create hypotheses and to explain phenomena in a way that could make them understand the role of scientists.

**Actions With Teachers**

**Continuing education courses.** Although performing intermittent activities with school students is an excellent strategy to promote science dissemination and popularization, a more continuous activity is necessary to promoting the interest of students in physiology and science in general. Long-term results require a partnership with school professionals that are permanently in the school environment, such as directors, coordinators, and teachers. Continuing education courses for this audience provides another important route to promote physiology in schools. In this respect, we have developed such courses in both Uruguaiana and Feira de Santana in the last 3 yr.

**NEUROSCIENCE APPLIED TO EDUCATION COURSE.** Knowledge of how the brain works and what factors can affect the brain during learning can promote an effective teaching-learning process. Consequently, physiologists in Uruguaiana developed a course that focused on the importance of neuroscience and neurophysiology concepts for education. The two first editions of the course (2013–2014) involved 40 h of theoretical and practical activities, and the last edition (2015) was a more compact edition of 15 h. The course involved 30 teachers in each edition. During the activities, the themes addressed included neuroanatomy, neurophysiology, nervous system development, neuroplasticity, learning and memory, attention, emotion, executive functions, the neurobiological process of reading, numbers processing by the brain, intelligence, learning disabilities, and the relationship between neuroscience and education. At the end of the course, teachers reported that they considered themselves able to include the topic of brain neurophysiology in their classes and that the course activities contributed to improving their teaching.

**USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES AND EXPERIMENTATION IN SCIENCE AND PHYSIOLOGY TEACHING COURSE.** A second continuing education course, also organized in Uruguaiana, was offered in 2012 (a 60-h course focusing on physiology) and as a short edition in 2015 (a 15-h edition focusing on science in general). This course trained teachers to use experimentation and information and communication technologies in physiology and science teaching and included possibilities for critical creative and responsible use of these tools. The course emphasized the effects of strategies, such as hands-on activities, experimentation, and information and communication technologies in the teaching-learning process in the light of scientific knowledge about the functioning of the brain. At the end, teachers stated that the course stimulated them to adopt methodologies that promote innovation and knowledge acquisition, manipulation of scientific equipment, the exploration of alternative educational opportunities, and the ability to perform experiments (1, 3, 4, 8).

**PHYSIOLOGY AND ENVIRONMENTAL HEALTH COURSE.** This course, with 4 h/wk for 10 wk, was developed in Feira de Santana and examined the use of innovative initiatives to teach physiology and its relationships with other fields of health science, such as anatomy and parasitology. The activities involved the participation of eight teachers of public secondary schools, focusing on creative and interdisciplinary studies in physiology, in several basic active learning techniques. Participative teaching methods were used, including experimentation, group discussions, video presentations of data, construction of educational games, working with models, demonstrations, judging, practical activities, and others. The actions were accomplished in small groups (3 teachers each). The results of the course were throughout positive, since all teachers of secondary schools reported that they felt able to work with basic active learning techniques and that they would begin to implement the new teaching methods in their classrooms.
**Perspectives**

The Education Committee members of the SBFis have worked to implement active approaches to physiology teaching, promoting physiology within the context of university-school cooperation and introducing innovative initiatives for physiology teaching and learning in Brazilian schools. Efforts have been made and will continually being made by the members of the Education Committee of SBFis to innovate in physiology teaching not only in the university but also in schools.

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**AUTHOR CONTRIBUTIONS**


**REFERENCES**