SPORE* SERIES WINNER

Resources for Anyone Interested in the Brain

Games, information, and discussions with scientists bring neuroscience knowledge to all hands.

Eric H. Chudler

The high incidence of neurological and mental illness in our society makes it likely that children will know someone who has been affected by a disease or disorder of the nervous system. For example, 50 million people in the United States are affected by neurological illnesses and it costs more than $460 billion to treat these individuals (*1*). The high economic and emotional costs of these disorders make it imperative that we understand the implications of these issues and communicate this to the public, as a knowledgeable public can make healthier life-style choices that may reduce the burden of these conditions. Moreover, a science-literate electorate may support and advocate for biomedical research.

With these issues in mind, the "Neuroscience for Kids" Web site (http://faculty.washington.edu/chudler/neurok.html) was created in 1997 with the primary goal to help children, adolescents, teenagers, and their teachers learn about the nervous system. Neuroscience for Kids was initiated with development of the Web site and evaluation of the Web site's efficacy in changing attitudes about science and increasing knowledge about neuroscience. Although the title of the site includes the word "Kids," the resource can be used by the general public as an introduction to the field of neuroscience.

Early construction of the Web site was a collaborative effort between research neuroscientists and middle school science teachers. Scientists translated recent research papers into simple language or provided ideas for experiments, activities, and demonstrations. Middle school teachers reviewed this work to ensure readability, style, and content before the material was made public. Teachers also wrote articles, lesson plans, and experiments that were reviewed by researchers for scientific accuracy. Care has been taken to align the materials with the AAAS *Benchmarks for Science Literacy* (*2*) to increase the acceptance of the resource by classroom teachers (*3*). The goal has been to develop a storehouse of materials to motivate precollege students to learn more about science.

University of Washington Brain Awareness Week Open House participant.

Neuroscience for Kids has always been focused on content rather than on the latest browser enhancements. This approach was taken because students and teachers are often prohibited from downloading software from the Internet onto school or personal computers. Since its inception, Neuroscience for Kids has undergone substantial changes to improve its navigation and visual appeal. Since 2002, videos have been added to the site, including the BrainWorks television program (*4*) and Flash animations to illustrate concepts. Nevertheless, it is impossible to please everyone, and the extensive depth of the site sometimes makes materials difficult to find.

The content-rich environment of Neuroscience for Kids offers users hundreds of individual Web pages to explore at their own pace as they learn about neuroscience. The resource can be used for research; students and teachers can find basic information about neuroanatomy, neurophysiology, neuropharmacology, the senses, sleep, mental and neurological illness, neuroscience methods, blood supply, and language. Visitors can interact with online activities and demonstrations illustrating a variety of neuroscientific concepts. For example, a set of interactive visual illusions allows students to manipulate figures and background images as they explore their own perceptions (http://faculty.washington.edu/chudler/chvision.html).

Many students use Neuroscience for Kids to locate ideas for local and regional science fairs. In addition to providing science fair project ideas, the Web site has suggestions and best practices for the development of project hypotheses, data collection, data analysis, and visual displays.

A unique feature of Neuroscience for Kids is the "Neuroscientist Network" that consists of a group of 19 neuroscientists from different institutions. Through e-mail, students and teachers can ask these neuroscientists questions about neuroanatomy, neurophysiology, the educational requirements to become a neuroscientist, and careers in neuroscience. Responses are sent back through personal e-mail messages and posted to the Web site for others to read.

Offline games, demonstrations, and quizzes permit users to learn in an entertaining environment and to extend their learning beyond the Web site. Many of the activities and demonstrations include open-ended questions that encourage students to perform their own experiments. For example, in an activity using Benham disks, students are presented with classic pattern designs, but are then asked to view the patterns in different lighting conditions, to change the pattern design, and to spin the disks in different directions and speeds. These investigations are designed to help students inquire independently or in groups and to develop their own hypotheses about what they experience.

Students and teachers can also send free neuroscience-related postcards by e-mail (see the figure on page 1649) or request a monthly, electronic Neuroscience for Kids newsletter. The newsletter is sent to about 9600 people (students, teachers, school administrators, and scientists) with information about new additions to the Web site. It also includes upcoming events, such as television programs and museum exhibits, book reviews, interesting

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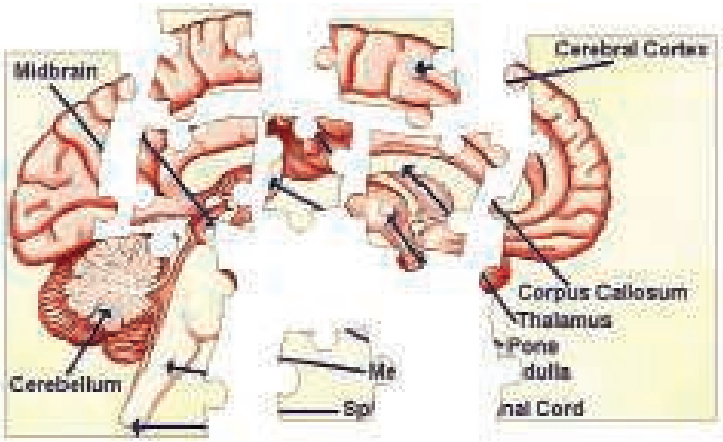
trivia about the brain, and current popular magazine articles about the nervous system.

The effectiveness of Neuroscience for Kids for changing student attitudes about science and for improving neuroscience content knowledge was evaluated by distributing the Web site (on compact disk) and pre- and post-use questionnaires to 52 teachers and about 3794 middle school students in public and private schools across the United States. Analysis of the responses from students demonstrated that student content knowledge about neuroscience concepts improved significantly after the use of Neuroscience for Kids, but student attitudes toward science, as measured with the Scientific Attitude Inventory SAI II (*5*) remained unchanged (*6*). Further studies are warranted to determine how classroom visits by scientists, laboratory tours, and other informal learning experiences in addition to online resources affect students' content knowledge and attitudes about science.



Postcard jigsaw puzzle. A partially completed jigsaw puzzle of a midsagittal section of the human brain. Users piece together the puzzle and then can send an e-mail link to the puzzle to others.

Neuroscience for Kids has been accessed by people from more than 150 different countries. About 150 million files (e.g., Web pages, PDFs, graphics, animations, Flash applications) and 770 GB of information are downloaded from the Web site each year. Portions of the Web site have been translated into Spanish, Slovene, Chinese, Portuguese, Italian, Korean, Dutch, Japanese, and Turkish, and materials translated into Arabic, Hebrew, and Hindi are planned for 2010. Neuroscience for Kids is ranked highly in both Google and Yahoo search engines: For example, the search term "neuroscience" results in hits to Neuroscience for Kids pages in two of the top 10 returns in Google and one of the top 25 returns in Yahoo; "brain" results in the 11th return in a Google search (*7*).

The creation and maintenance of online scientific education materials are not without challenges. Bench scientists have to balance responsibilities in the laboratory with those of developing educational resources. Science outreach and public education are not usually recognized or rewarded by universities and may sometimes be actively discouraged. They rarely influence faculty tenure and promotion decisions, and grants that are available for these projects often are accompanied by low indirect-cost rates. These factors reduce the motivation of scientists to undertake such endeavors and create an academic culture that discourages public engagement (*8*).

Some organizations are working to change this culture. In addition to *Science*'s SPORE award, the Science Educator Award and the Next Generation Award, two awards established by the Society for Neuroscience, are other examples that recognize senior and junior faculty members, and pre- and postdoctoral trainees who contribute to public education. To succeed in shifting the culture of academia to be more welcoming of public education will require financial and administrative support from the top levels of academic institutions. Scientists have many opportunities for community engagement. For example, through Brain Awareness Week (BAW), an international campaign established and supported by the DANA Alliance for Brain Initiatives and the Society for Neuroscience to celebrate education and outreach about the brain, researchers visit neighborhood schools, invite students into laboratories, and present public lectures (see the figure on page 1648). Over the course of its 15-year history, BAW has involved 2600 partners (i.e., universities, kindergarten through 12th-grade schools, hospitals, patient support groups, museums, government agencies, service organizations, and professional associations) in 76 countries (*9*).

Neuroscience for Kids seeks to spark curiosity about science in young students and to encourage them to pursue careers in neuroscience. Concerted efforts by scientists, educators, administrators, and parents may entice young scholars into the mysteries of the nervous system, teach them to ask questions, and give them the confidence to seek answers.

About Dr. Chudler

Eric H. Chudler is a research associate professor in the departments of Bioengineering and of Anesthesiology & Pain Medicine at the University of Washington in Seattle. Chudler's research interests focus on cortical and basal ganglia mechanisms of nociception and pain and on how the cerebral cortex and basal ganglia process information from multiple sensory systems. In addition to his research, Chudler is the director of education and outreach for University of Washington Engineered Biomaterials where he manages several programs for precollege students and for research training opportunities for undergraduate students.

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