

RESOURCES

WWW GUIDE

Biotechnology education for school-age students*Dean Madden*

An increasing number of universities, science centers, and biotechnology companies provide educational resources on the Web aimed specifically at school-age students. This material does not consist merely of information, but includes directions for practical activities, role-plays and debates, and computer simulations.

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As one might expect from its preeminence in biotechnology and the enthusiasm with which its schools have embraced the Internet, the majority of sites are currently based in the United States. One of the first and still one of the most comprehensive sites was established by Genentech under its Access Excellence program at <http://www.gene.com:80/ae/>. Access Excellence is regularly revised, providing articles on contemporary issues, numerous detailed suggestions from working teachers, and a wide range of well-structured links to additional resources.

However, a key problem with this and similar sites in the US is that they often describe practical protocols that are forbidden under the stringent regulations covering genetic modification that apply within the European Union. The examples given and contexts described nearly always relate to the US alone, which can cause problems of understanding. Finally, many US sites fail to address the concerns of European teachers and students where environmental and ethical issues are involved. Recently, more European sites aimed at the school audience have been developed, and the range of issues covered has widened.

A sampler of biotechnology education Web sites aimed at schools and colleges*Cold Spring Harbor Laboratory DNA Learning Center*<http://darwin.cshl.org/>

High school protocols developed at Cold Spring Harbor Laboratory's DNA Learning Center are used throughout the world. A key resource at the center's Web site is the Biology Animation Library, which includes Shockwave files with simulations of PCR, Southern blotting, and cycle sequencing.

European Initiative for Biotechnology Education<http://www.eibe.reading.ac.uk:8001>

The EIBE is a European Commission-funded program that seeks to promote skills, enhance understanding, and facilitate informed public debate through improved biotechnology education in schools and colleges. A variety of materials aimed at 16- to 19-year-old students can be downloaded as Adobe Acrobat (PDF) files in several languages.

European Federation of Biotechnology Task Group on Public Perceptions of Biotechnology<http://www.kluyver.stm.tudelft.nl/efb/tgppb/home.htm>

The EFB is an association of nonprofit European technical and scientific societies. The EFB Task Group Briefing Papers are concise, authoritative documents discussing key areas of biotechnology, intended for decision makers and communicators such as journalists, politicians, and teachers rather than the general public. Current titles include: Patenting in Biotechnology; Biotechnology in Food and Drinks; Applications of Human Genetic Research; Environmental Biotechnology; Dealings with the Media; and What's what in Biotechnology. They are available in many European languages and can be downloaded in PDF format.

Glaxo Wellcome<http://www.glaxowellcome.co.uk>

RASMOL is a free molecular modeling program available from the Glaxo Wellcome site. With RASMOL, several types of projections of proteins and nucleic acids are possible (e.g., ball-and-stick, space filling, ribbon, etc.). Structure data for use with RASMOL is available from the Brookhaven Protein Data Bank or its mirror sites: <http://www2.ebi.ac.uk/pdb-bin/pdbmain>.

Murray, bacterium and actor<http://www.demon.co.uk/scotcal/murray/index.html>

Scotcal's innovative computer software teaches students about bacterial growth by letting them gain experience in total and viable counting before progressing to the real challenge: designing a series of growth experiments that will help them to answer questions posed in the Report section of the program. After designing an experiment, students must analyze the results before designing the next. The site has a trial version of the software plus information about the structure of bacterial cells and their growth—the latter being presented as a day in the life of Murray, bacterium and actor.

National Centre for Biotechnology Education<http://www.ncbe.reading.ac.uk/>

The NCBE Web site includes practical protocols that can be downloaded in PDF format, describing work with enzymes, microorganisms, plant tissue culture, and DNA gel electrophoresis. A microbial fuel cell featured here can be used to study respiration in yeast. There are several feature articles, including "Genetics and the Understanding of Life," that was produced for the XVIIth International Congress of Genetics. An animated (Shockwave Flash) and up-to-date version of this publication will soon be available from the NCBE's site.

Novo Nordisk A/S<http://www.novo.dk>

Novo Nordisk has a well-designed and highly informative Web site coupled with a "virtual laboratory" in which users can "clone" lipase, human growth hormone, and insulin in microorganisms. Be warned that the lab uses Shockwave files that may take some time to download.

Science and Plants for Schools<http://www-saps.plantsci.cam.ac.uk/>

SAPS works with teachers and scientists to develop new resources to promote and support lively and interesting classroom work in plant science and molecular biology. Their ever-expanding site features practical worksheets, a bulletin board, a database of questions-and-answers, abstracts from educational journals, and longer feature articles on plant science.