



Texas Education Agency and Austin Community College

Biotechnology Online Continuing Education Project

Module 2. Applications of DNA Technology Resource Page

This module is part of a series of online instruction designed to help high school teachers to bring to their courses a biotechnology perspective on biosciences, math, health sciences, and agriculture. These online instructional modules are self-paced and free to all Texas high school teachers to participate. Information updates about these online course modules are available at www.austincc.edu/biotech/teaproject and teachers may register for CPE credit at <http://biotech.mindflash.com> from April 20 – August 15, 2009. The following animations, videos, and online resources are used in the second module, listed here for teachers who may wish to incorporate them in their high school courses.

Module 2. Applications of DNA Technology	Resources Used
Objective 2.1. Recombinant DNA technology	<p>“Agarose Gel Electrophoresis of Nucleic Acids” animation by the Dolan DNA Learning Center (see more below under “Supplemental Resources”). http://www.dnalc.org/ddnalc/resources/electrophoresis.html</p> <p>“Restriction Enzyme On an Agarose Gel” animation by Thinkwell, who offers curricula, activities, and animations online for replacement of textbooks in education in math and science fields (www.thinkwell.com). Inquiries about Thinkwell is available from Connie Hundley, Thinkwell Academic Consultant, at connieh@thinkwell.com or by phone toll-free at 1-888-416-8880 x115. http://207.207.4.198/pub/flash/4/4.html</p> <p>“Restriction Enzyme Animation” animation from McGraw-Hill Higher Education, <i>Biology</i> (8th edition, 2008) by Peter H Raven, George B. Johnson, Kenneth A. Mason, Jonathan Losos, and Susan Singer (see more below under “Supplemental Resources”). http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter16/animations.html</p> <p>“Griffith’s Transformation Experiment” animation from Norton Books, a publisher of college textbooks for science and math instruction. This animation comes from their introductory biology textbook for nonmajors, <i>Discover Biology</i>, (4th ed.) by Michael L. Caine, Carol Kaesuk Yoon, & Anu Singh-Cundy. This textbook stands out from more traditional nonmajors biology textbooks by it emphasis on applying concepts to students’ world and experiences. Each chapter opens with a story that engages student interest, which is revisited at the end of the chapter to demonstrate how core concepts are involved in understanding. “Biology on the Job” boxes in the textbook show how biological literacy can help in careers not always thought to be related to biology. Student resources include over 200 engaging animations. http://nortonbooks.com/college/biology/animations/ch12a01.htm</p> <p>“Gene Cloning” animation from McGraw-Hill Higher Education, <i>Biology</i> (8th edition, 2008) by Peter H Raven, George B. Johnson, Kenneth A. Mason, Jonathan Losos, and Susan Singer (see more below under “Supplemental Resources”). http://highered.mcgraw-hill.com/classware/ala.do?isbn=0072965819&alaid=ala_1032442&showSelfStudyTree=true</p> <p>“DNA Sequencing” from McGraw-Hill Higher Education, <i>Biology</i> (8th edition, 2008) by Peter H Raven, George B. Johnson, Kenneth A. Mason, Jonathan Losos, and Susan Singer (see more below under “Supplemental Resources”). http://highered.mcgraw-hill.com/classware/ala.do?isbn=0072965819&alaid=ala_1032449&showSelfStudyTree=true</p>

<p>Objective 2.2. Analyzing DNA molecules</p>	<p>“RFLP” animation from McGraw-Hill Higher Education, <i>Biology</i> (8th edition, 2008) by Peter H Raven, George B. Johnson, Kenneth A. Mason, Jonathan Losos, and Susan Singer (see more below under “Supplemental Resources”). http://highered.mcgraw-hill.com/olc/dl/120078/bio20.swf</p> <p>“Southern Blot” animation from McGraw-Hill Higher Education, <i>Biology</i> (8th edition, 2008) by Peter H Raven, George B. Johnson, Kenneth A. Mason, Jonathan Losos, and Susan Singer (see more below under “Supplemental Resources”). http://highered.mcgraw-hill.com/sites/0072556781/student_view0/chapter14/animation_quiz_5.html</p> <p>“PCR” animation from McGraw-Hill Higher Education, <i>Biology</i> (8th edition, 2008) by Peter H Raven, George B. Johnson, Kenneth A. Mason, Jonathan Losos, and Susan Singer (see more below under “Supplemental Resources”). http://highered.mcgraw-hill.com/classware/ala.do?isbn=0072965819&alaid=ala_1032451&showSelfStudyTree=true</p> <p>“Geneology” animation by animation from the <u>Genetics Learning Center</u> at the University of Utah (see more below under “Supplemental Resources”). http://learn.genetics.utah.edu/content/extras/molgen/mutation_haploptype.html</p>
<p>Objective 2.3. Therapeutic proteins</p>	<p>“Column Chromatography” animation on You Tube http://www.youtube.com/watch?v=Z54ec_G12QE&feature=related</p> <p>“SDS-PAGE” animation from the W.H. Freeman publisher of one of the most popular college biochemistry textbooks, <i>Biochemistry</i> (5th ed.) by Jeremy Berg, John Tymoczko, and Lubert Stryer. This textbook is an older edition, and is available free-of-charge at the National Center for Biotechnology (www.ncbi.nlm.nih.gov). http://bcs.whfreeman.com/biochem5/cat_040/ch04/ch04xd02.htm</p>
<p>Module 2 Project</p>	<p>How is Biotechnology Used in Your Field of Interest?</p> <p>Option #1: Find an article or story related to your field:</p> <ol style="list-style-type: none"> www.sciencedaily.com (a daily source of research news, with a searchable archive) http://www.austincc.edu/deslac/staff/biotechactivitiesstaff.html (a list of biotechnology stories compiled by the Austin Community College faculty of the English for Speakers of Other Languages – ESOL – Department) <p>Option #2: Use one of the stories below:</p> <ol style="list-style-type: none"> R&D: Products in the Pipeline. http://www.gene.com/gene/pipeline/status/ (a list of therapeutic proteins in development by the biotechnology company Genentech) Biotech Drugs. http://www.signonsandiego.com/news/business/biotech/20070713-9999-1b13generics.html (a biotechnology business article from the online version of the Sand Diego <i>Union-Tribune</i>) Plants: hydroponics. http://quest.nasa.gov/smores/background/mcclain-scott.html (a NASA article about studying plant growth) ARS USDA: http://www.ars.usda.gov/research/research.htm http://www.ars.usda.gov/is/np/ha/han19.htm (This is the gateway to news and educational resources offered by the Agricultural Research Service of the USDA.) Antibodies in vegetables. http://www.accessexcellence.org/WN/SUA01/vaccines.php (an article about the use of plants to produce therapeutic proteins and vaccines) Cancer. http://bio.org/ (This is the gateway to a searchable database maintained by the Biotechnology Industry Organization) Animals. http://www.ca-biomed.org/csbr/students.php (This is the “Student Arena” site for the California Biomedical Research Association) Telomeres. http://websites.afar.org/site/PageServer?pagename=IA_b_tel_5_role (This

	<p>article is provided by the American Federation for Aging Research. They have a searchable archive of research news on how telomeres relate to the aging process.)</p> <p>h. Cancer and DNA repair. www.appliedbiosystems.com/biobeat/index.jsp?articleId=58df04ea-7696-8b26-092c1fa5a45b179a&type=1 (a research summary provided by the biotechnology company Applied Biosystems)</p> <p>i. CSI (Crime Scene Investigators) forensics. http://www.cci.ca.gov/faq.html#g1 (This website is maintained by the California Criminalistics Institute, a unit of the California Department of Justice Bureau of Forensic Services which provides specialized forensic science training.)</p> <p>j. Mutation medicine: http://www.genomenewsnetwork.org/articles/2004/07/29/lungcancerdrug.php (a brief article provided by the Genome News Network, published online by the J. Craig Ventor Institute of Maryland. GNN provides a searchable archive of news on genomics research, as well as resources for educators and students.)</p> <p>k. Nanotechnology. www.newscientisttech.com/channel/tech/nanotechnology/dn6597 (The <i>New Scientist</i> is an online archive of over 76,000 review articles that has a searchable index that is free to the general public.)</p> <p>l. Nanotechnology. http://e-drexler.com/p/04/03/0325nanoMeanings.html (K. Eric Drexler, PhD, a key researcher of nanotechnology and nanosystems, maintains this website for the education of the general public on nanosystems.)</p>
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SUPPLEMENTAL RESOURCES FOR MODULE 2: APPLICATIONS OF BIOTECHNOLOGY

There are many excellent online tutorials, animations, videos, and interactive activities that can be used to learn concepts important in biotechnology education. These are our favorite sites that are entertaining, yet comprehensive and cutting-edge.

Description
<p>The Dolan DNA Learning Center website (www.dnalc.org) at the Cold Springs Harbor Laboratory has won the “Science Website of the Year” from <i>Scientific American</i> for years in a row for its tutorials, animations, interactive activities, videos, lectures, and classroom laboratory exercises. Their curricular offerings in modern genetics & molecular biology are geared for the high school and community college level.</p> <p>Their Resources directory (http://www.dnalc.org/ddnalc/resources/) lists these tutorials:</p> <p>“DNA from the Beginning” about classical and modern genetics</p> <p>“DNA Interactive” about DNA replication, mRNA transcription, protein translation, biotechnology applications, genomic studies, and the history of eugenics. This tutorial includes over 200 video clips and animations and has 15 lesson plans that can be downloaded for use in high school and community college classrooms.</p> <p>“Inside Cancer”, a multimedia guide to cancer biology that explores modern concepts from molecular and cellular biology that help with cancer diagnosis, prevention, and treatment. An instructors’ wiki is available for exchange of lesson plans that use this site. Content alignment to local and national standards is also available.</p> <p>“Your Genes, Your Health” offers animations on genetic disorders, their causes, their inheritance patterns, their diagnosis, their treatments, and their exact pathology.</p> <p>The Dolan DNA Learning Center Resources directory also offers laboratory exercises:</p> <p>“Genetic Origins” provides laboratory for isolating DNA sequences for analysis of mitochondrial point mutations and a VNTR insertion sequence analysis. Followup exercises in bioinformatics can be used to</p>

determine our relationship to the extinct Neandertal man and the patterns of human migrations in prehistoric times.

“Greenomes” provides laboratory and bioinformatics exercises to introduce students to modern plant genetics and genome research.

“Silencing Genomes” provides a laboratory project that contributes to research studies in RNAi gene silencing in the roundworm, *C. elegans*.

“Dynamic Gene” provides bioinformatics exercises in locating and annotating gene sequences.

The Dolan DNA Learning Center Resources directory is also the gateway to their Biology Animations Library. (<http://www.dnalc.org/dnalc/resources/animations.html>)

The Howard Hughes Medical Institute offers a science education site (<http://www.hhmi.org/resources/educators/>) that offers excellent educational resources for health & biosciences, modern genetics & molecular biology that includes:

“Biointeractive” (<http://www.hhmi.org/biointeractive/click/index.html>)

Virtual labs, animations, and other interactive resources, including DNA Replication and Transcription & RNA translation animations (<http://www.hhmi.org/biointeractive/dna/animations.html>)

Lectures on Science (<http://www.hhmi.org/biointeractive/lectures/>)

Includes topics on infectious and genetic diseases, neurobiology, molecular biology, and evolution

Ask a Scientist (www.askascientist.org/)

If you've got a question about medicine, human biology, animals, biochemistry, microbiology, genetics, or evolution, you can pose your question and some of the top scientists in the country will provide you with an answer. Also offered is guidance in science fair projects and careers in science.

The **Genetics Learning Center at the University of Utah** (<http://teach.genetics.utah.edu/gslc/>) delivers educational materials on genetics, bioscience and health topics, providing resources for K-12 teachers and higher education faculty. In addition to their animations and interactive activities, lesson plans and materials are also available that meet national and many states' education standards for science and health. Their Learn Genetics website (<http://learn.genetics.utah.edu>) is one of the most widely-disseminated education sites in the world. In 2007, it received over 7.1 million unique visits from over 180 countries.

McGraw Hill Higher Education (www.mhhe.com) publishes some of the most popular college-level freshman biology textbooks, as well as more advanced textbooks in genetics and molecular biology. They generously provide their Online Learning Center animations,

The animations that support biotechnology education best comes from *Biology* (8th edition, 2008) by Peter H Raven, George B. Johnson, Kenneth A. Mason, Jonathan Losos, and Susan Singer (ISBN-13 9780073227399). Featuring the latest in cutting edge content reflective of the rapid advances in biology, this textbook serves biotechnology education well. The animations that cover the topics that are the most relevant to biotechnology education can be found in the quizzes from Chapters 14 – 17 (www.mhhe.com/raven8).