Additional DNA Resources

GENERAL WEBSITES

It is impossible, of course, to list all of the useful DNA-related websites, but here are a few of the most comprehensive. We also list below a few sites that relate the study of DNA and genetics to other areas of the curriculum. Each of these sites has extensive links to educational resources.

The National Center for Biotechnology Information Home Page
http://www.ncbi.nlm.nih.gov/
This is a comprehensive website with access to GenBank, free literature, molecular databases, and genome resources for multiple species. Multiple free textbooks can be accessed and simultaneously searched through this site.

Human Genome Project Websites
http://www.ornl.gov/sci/techresources/Human_Genome/home.shtml
http://www.genome.gov/
http://www.doegenomes.org/

The RCSB Protein Data Bank
http://www.rcsb.org/pdb/
The worldwide repository for the processing and distribution of 3-D biological macromolecular structure data.

Bioinformatics
http://www.vg-bio.com/
This is a very large collection of bioinformatics, genomics, proteomics, biotechnology, and molecular biology links.

Nobel Prize
http://nobelprize.org/

Dolan DNA Learning Center, Cold Spring Harbor Laboratory
http://www.dnalc.org/home.html

DNA Interactive, from the Dolan DNA Learning Center
http://www.dnai.org/index.htm

CROSS-CURRICULAR CONNECTIONS TO DNA AND GENETICS

Social Issues

http://www.ornl.gov/sci/techresources/Human_Genome/elsi/elsi.shtml

This also a comprehensive site that discusses the many ethical, legal, and social issues arising out of the human genome project and advances in molecular genetics. This includes issues related to privacy, reproduction, health and the environment, and clinical testing. A survey of these areas will lead students to understand the large impact genetics will have on society. Students should realize that understanding the structure of DNA and the variation within the human genome is not an isolated piece of knowledge, and that this understanding will help them make informed decisions in many areas of their lives.

Music

It would be hard to improve on the relationship between genes and music as described by Dr. M. A. Clark, so we have provided a brief out-take from his website below (Genetic Music: An Annotated Source List, http://whozoo.org/mac/Music/Sources.htm). This website contains many links to music generated from both protein and DNA sequences.

> In his landmark book Godel, Escher, Bach, Douglas Hofstadter comments on similarities between genes and music. The analogy is explicit in the following quote (Vintage Books Edition, 1980, p. 519).
>
> - Imagine the mRNA to be like a long piece of magnetic recording tape, and the ribosome to be like a tape recorder. As the tape passes through the playing head of the recorder, it is "read" and converted into music, or other sounds...When a "tape" of mRNA passes through the "playing head" of a ribosome, the "notes" produced are *amino acids* and the pieces of music they make up are *proteins*.
>
> Hofstadter also discusses how meaning is constructed in protein and in music (p. 525):
>
> - Music is not a mere linear sequence of notes. Our minds perceive pieces of music on a level far higher than that. We chunk notes into phrases, phrases into melodies, melodies into movements, and movements into full pieces. Similarly, proteins only make sense when they act as chunked units. Although a primary structure carries all the information for the tertiary structure to be created, it still "feels" like less, for its potential is only realized when the tertiary structure is actually physically created.
>
> ***The individuals and teams described below have taken advantage of the multiple biochemical and biophysical properties of both DNA and proteins to make the genetic patterns of these macromolecules audible. As Hofstadter first suggested, music is a natural medium for expressing the complex patterns of proteins and their encoding DNAs. Both consist of a linear sequence of elements whose real meaning lies in their combinations.***

Dr. Clark's home site is http://whozoo.org/mac/Music/, which will lead you to other interesting pages, including:

A Protein Primer: A Musical Introduction to Protein Structure

http://whozoo.org/mac/Music/Primer/Primer_index.htm

This page contains an introduction to amino acids and protein structure using music. A specific musical scale based on the amino acids is introduced, and musical compositions based on the proteins calmodulin, B-globin, and Huntington Disease protein can be accessed and played. The relative position of hydrophobic and hydrophilic amino acids in proteins, protein secondary structure and the divergence of proteins between species is discussed and incorporated into the music.

Protein Music Samples

http://whozoo.org/mac/Music/samples.htm

This page contains additional samples of protein music. Of particular interest is the beta-globin sample by John Dunn that begins with a human voice declaring the beta-globin amino acid sequence followed by the assigned tone. The voice gradually diminishes as the music dominates.

Music From DNA and Protein by Algorithmic Arts

http://algoart.com/music.htm

Art

The *Mona Lisa* of Modern Science

http://monod.biomath.nyu.edu/index/course/hw_articles/nature8.pdf

An interesting article that reviews how the structure of DNA has permeated all aspects of society, including, art, music, cinema, music, and advertising.

Art Gallery at Genome News Network

http://www.genomenewsnetwork.org/categories/index/culture/art.php?s=0&n=15

This is a very large gallery of biological art. One favorite is the double helix made out of shopping carts!

GA (Genetic Art) Computer Program

http://www.cim.mcgill.ca/~dudek/ga.html

This program uses an evolution-like process to incrementally improve a drawing. It was originally written by the author to teach his children about evolution.

Nanobiotechnology: DNA Motors and Computers

DNA Computing.

http://news.nationalgeographic.com/news/2003/02/0224_030224_DNAcomputer.html

A computer using DNA and enzymes may be 100,000 times faster than current computers that use silicon chips.

DNA Computing at HowStuffWorks

http://computer.howstuffworks.com/dna-computer.htm

This is an introductory article about DNA computing. For additional information see links at the end.

DNA Motors

http://www.trnmag.com/Stories/2003/042303/DNA_motor_keeps_cranking_042303.html