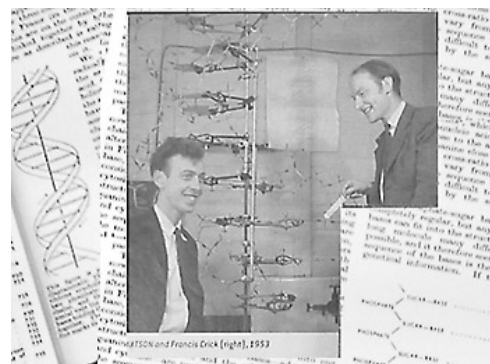


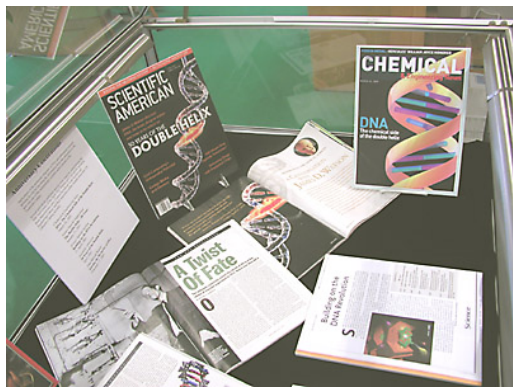
DNA's Double Helix: 50 Years of Discoveries and Mysteries An Exhibit of Scientific Achievement

Introduction

The April 25, 1953 issue of the journal, *Nature* (vol. 171, no. 4356) may be the most important journal issue ever published. Its table of contents provides a modest descriptive title of "Molecular Structures of Nucleic Acids," by J.D. Watson and F.H.C. Crick; Dr. M.H.F. Wilkins, Dr. A.R. Stokes and H.R. Wilson; Rosalind E. Franklin and R.G. Gosling." The three, including the legendary paper by James Watson and Francis Crick, "[A Structure for Deoxyribose Nucleic Acid](#)," dramatically changed biology, biochemistry, and genetics research. The publishers of the journal, *Nature* published [a special issue commemorating the 50th anniversary](#) of this discovery ([another point of access to the special issue](#)). The other papers in this landmark issue of *Nature* are "[Molecular Structure of Deoxyribose Nucleic Acids](#)" by Dr. M.H.F. Wilkins, Dr. A.R. Stokes and H.R. Wilson and "[Molecular Configuration in Sodium Thymonucleate](#)" by Rosalind E. Franklin and R.G. Gosling.



DNA research, which has dominated the fields of biology, genetics, and biochemistry for more than half a century, has its origins the mid-19th Century. Friedrich Miescher discovered DNA in 1869, calling it nuclein (from its presence in the cell nucleus). *Chemical Heritage*, the magazine published by the Chemical Heritage Foundation, issued a special cover feature on Miescher's discovery, "Friedrich Miescher: The Man Who Discovered DNA," (vol. 21, no. 2, Summer 2003). A subscription to this journal is pending for the Science and Engineering Library. There is no online production of this magazine by CHF, only its [Table of Contents](#) for the current issue (the covers of back issues and bibliographic data for each issue is available).



[Albrecht Kossel](#) identified DNA as a nucleic acid in 1881 and provided its present chemical name. Kossel's work would be rewarded in 1910 as the recipient of the first Nobel Prize (Physiology or Medicine) for research on DNA (see below for a comprehensive list). The race to determine the molecular structure of DNA was hotly contested in the late 1940s and early 1950s. This work and subsequent research defining DNA's role for encoding the information from one generation to the next was one of the monumental scientific achievements of the Twentieth Century. The Valley Library's Special Collections at Oregon State University compiled a noteworthy collection of works in their Web site, [Linus Pauling and the Race for DNA: A Documentary History](#) describing the inter-laboratory intrigue that accompanied the search for a chemical structure for DNA in the late 1940s and into the 1950s.

James F. Crow (geneticist, University of Wisconsin) provides additional insights on the search for DNA's chemical structure in an article, "[Was there life before 1953?](#)" published in the April 2003 issue of *Nature Genetics* (vol. 33, p. 449-450). He writes:

"... If [Linus] Pauling had been able to travel to London in 1951 he would probably have been shown the famous X-ray picture that gave Jim Watson the crucial hint. The greatest chemist of his time would surely have realized the significance and might have deduced the structure as quickly as Watson and Crick did. But Pauling was kept from traveling outside the United States because he had been accused of Communist sympathies. Is it possible that Watson and Crick owe their priority to Joe McCarthy? It's a thought too horrible to contemplate."

Library Exhibit



The SEL exhibit showcased the original Watson and Crick article in *Nature* and the "other" lesser-known Watson and Crick article published in *Nature* on May 30, 1953, where the future Nobel Laureates provided a more explicit article, "[Genetic Implications of the Structure of Deoxyribonucleic Acid.](#)" (*Nature*, vol. 171, no. 4361, p. 964-967). Here they concluded that their "proposed structure for deoxyribonucleic acid may help to solve one of the fundamental biological problems-the molecular basis of the template needed for genetic replication."

The [1962 Nobel Prize for Physiology or Medicine](#), "for their discoveries concerning the molecular structure of nucleic acids and its significance for information transfer in living material," was presented to:

- o [Francis Harry Compton Crick](#)
Institute of Molecular Biology
Cambridge, United Kingdom
- o [James Dewey Watson](#)

Harvard University
Cambridge, Massachusetts, USA

- o [Maurice Hugh Frederick Wilkins](#)
University of London
London, United Kingdom

Nobel Prizes Involving (directly or indirectly) DNA (1)

Beginning in 1910 research on DNA has directly or indirectly been responsible for 19 Nobel Prizes. The Noble Prize site provides links to all of the Nobel Prizes in all categories. The information includes various forms of press releases, biographical sketches of the award winners, and copies of the various speeches made by the Nobel Presentation Committee and the award winner(s). The links below are to the individual award's site.

- o [1910 Physiology or Medicine](#)
Albrecht Kossel
chemical composition of nucleic substances
- o [1936 Chemistry](#)
Petrus J.W. Debye
analysis of molecular structure by X-ray diffraction, providing the tools necessary to discern the chemical structure of complex molecules like DNA
- o [1954 Chemistry](#)
Linus Pauling
nature of the chemical bond in complex molecules, e.g. proteins
- o [1959 Physiology or Medicine](#)
Severe Ochoa and Arthur Kornberg
biological synthesis of ribonucleic acid (RNA) deoxyribonucleic acid (DNA)
- o [1962 Physiology or Medicine](#)
Francis H.C. Crick, James D. Watson, Maurice H.F. Wilkins
molecular structure of nucleic acids and "its significance for information transfer in living material."
- o [1968 Physiology or Medicine](#)
Robert W. Holley, Har Gobind Khorana, Marshall W. Nirenberg
mechanism of the genetic code and its role in protein synthesis
- o [1972 Chemistry](#)
Christian B. Anfinsen, Sanford Moore, William H. Stein
chemical structure and catalytic activity of ribonuclease in protein synthesis
- o [1978 Physiology or Medicine](#)
Werner Arber, Daniel Nathans, Hamilton O. Smith
discovery of restriction enzymes and their application in molecular genetics
- o [1980 Chemistry](#)
Paul Berg, Walter Gilbert, Frederick Sanger
recombinant DNA determination of base biochemistry of nucleic acids sequences in nucleic acid-protein interactions
- o [1982 Chemistry](#)
Aaron Klug

- crystallographic electron microscopy and implications for nucleic acid- protein interactions
- [1983 Physiology or Medicine](#)
Barbara McClintock
discovery of mobile genetic elements and their role in genetic transposition
- [1985 Chemistry](#)
Herbert A. Hauptman (2), Jerome Karle
development of a direct method for determination of crystal structures and implications for structural and molecular biology
- [1989 Chemistry](#)
Sidney Altman
catalytic properties of RNA Thomas Cech
- [1992 Physiology or Medicine](#)
Edmond H. Fischer, Edwin G. Krebs
regulatory functions of protein phosphorylation
- [1993 Physiology or Medicine](#)
Richard J. Roberts, Philip A. Sharp
discovery of split genes
- [1993 Chemistry](#)
Kary B. Mullis, Michael Smith
NA-based chemistry methods: Polymerase Chain Reaction (PCR); oligonucleotide site-directed mutagenesis in protein chemistry
- [1994 Physiology or Medicine](#)
Alfred G. Gilman, Martin Rodbell
discovery of G-proteins and their function in cell biology
- [1999 Physiology or Medicine](#)
Gunter Blobel
localization and transport of proteins in cells
- [2001 Physiology or Medicine](#)
Leiand H. Hartwell, R. Timothy Hunt, Paul M. Nurse
mechanisms of regulation in the cell cycle, including DNA replication
- [2002 Physiology or Medicine](#)
Sydney Brenner, R. Robert Horvitz, John E. Sulston
"genetic regulation of organ development and programmed cell death," including degradation of DNA

Special Journal Issues

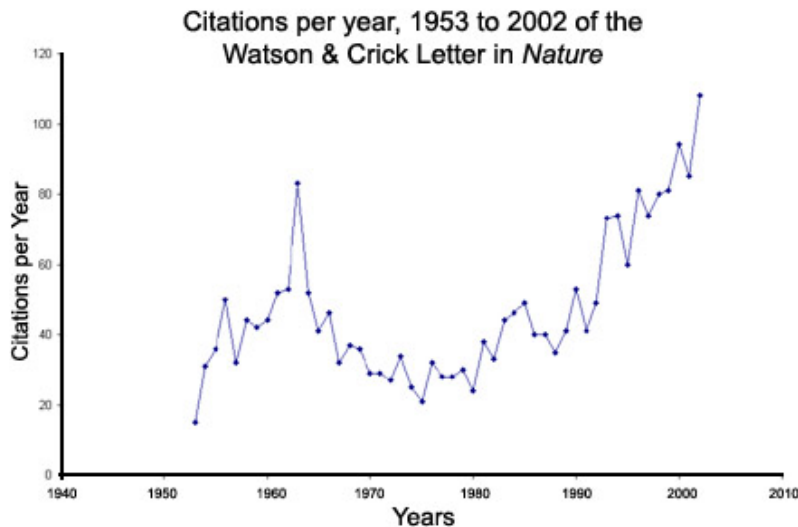
Several prominent periodicals published special cover issues to commemorate the occasion of the 50th Anniversary of the April 1953 article written by Watson and Crick including those depicted here and also found in the SEL Journal Collection (see Current Periodicals in the Science and Engineering Library and their respective online formats from their UB Libraries Catalog records):

- [Time](#)
Special Report
Solving the Mysteries of DNA
February 17, 2003
- [Scientific American](#)
50 Years of the Double Helix
April 2003
- [Chemical & Engineering News](#)
DNA: The Chemical Side of the Double Helix
March 10, 2003
- [Nature](#) Special Supplement
The Double Helix-50 Years
January 23, 2003
- [Science](#)
Building on the DNA Revolution
11 April 2003
- [Nucleic Acids Research](#)
February 15, 2003, vol. 31, no. 4
- [Bio-IT World](#)
Unraveling the Future

Each of these special issues provides insights regarding the work of Watson and Crick and other DNA researchers. They provide a perspective for how their collective efforts stimulated subsequent studies in molecular and structural biology leading to the deciphering of the complete human genome. Most provide links to other DNA sites for teaching purposes and general interest. If seeking DNA cover art, the covers of the journal, [Nature Genetics](#), typically features DNA in some artistic rendition.

Giving Credit Where Credit is due...

Since 1961, Dr. Eugene Garfield (founding President of the [Institute for Scientific Information](#), ISI) has developed new means of tracking the use of scientific literature. The Cited Reference Search was one of the most significant and led to the publication prototype of the [Science Citation Index](#) in 1961, the National Institutes of Health-funded experimental database. Genetics Citation Index. The Cited Reference Search allows one to obtain a list of journal articles or other documents citing a particular previously published work. Garfield's column, "Current Comments," in the weekly issues of the ISI publication. Current Contents, featured many commentaries on information use and bibliometrics (such as citation analyses). These essays now appear in book form as, *Essays of an Information Scientist* (Lockwood Z7405 .C E8). Free registration required for Garfield's essays online at www.garfield.library.upenn.edu/essays.html. Garfield has written 54 essays where the Watson and Crick paper was mentioned or used as an example (he wrote 211 essays where DNA was mentioned).



The Watson and Crick paper has been cited nearly 2400 times since 1953.(3) Garfield noted a particularly interesting "[obliteration phenomenon](#)" with the slow decline of citations to the Watson and Crick 1953 *Nature* paper. This phenomenon is apparent in the steady decline in the citedness of the Watson & Crick paper after 1962 (the year in which Watson and Crick received their Nobel Prize). Garfield attributes this decline to the incorporation of the original concept or research "into the common wisdom of the field." In short, the Watson and Crick Model of DNA became so routine and commonplace that their discovery was quickly absorbed into the knowledge-base of science. So complete was this incorporation, others no longer needed to cite the original work. Garfield also provides an interesting essay more fully exploring the bibliometric rubric of scientific obliteration.(4)

A sample of Garfield's DNA essays include the following titles:

- o [The Double Helix 40 Years Later: Joshua Lederberg's Personal Commentary About Its Impact on Basic Research](#)
- o [Highly Cited Articles. 39. Biochemistry Papers Published in the 1950s](#)
- o [The Articles Most Cited in the SCI from 1961 to 1982. 7. Another 100 Citation Classics: The Watson-Crick Double Helix has its turn](#)

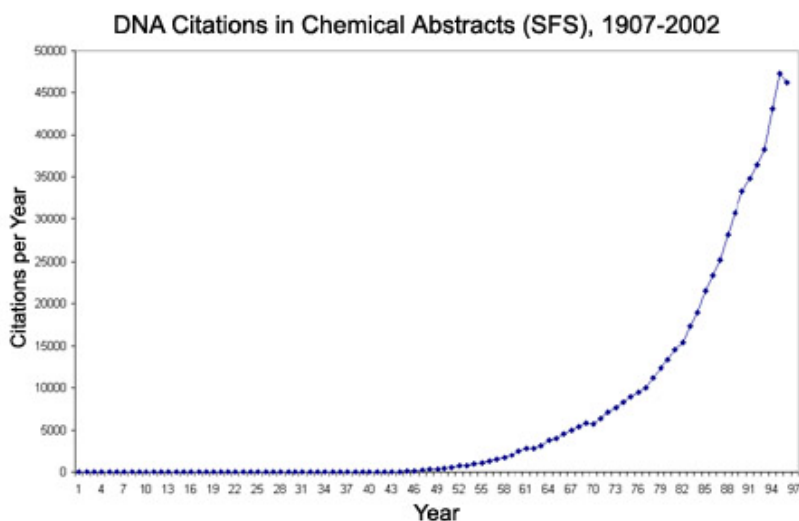
However, what Dr. Garfield did not have at the time was a crystal ball that would predict new aspects and interpretations of DNA's chemical structure and its implications related to laboratory automation and the subsequent research in recombinant DNA and the abilities to analyze gene sequence data leading to the deciphering of the entire human genome (almost) by the year 2003. These discoveries stimulated acknowledgment of the Watson and Crick Model of DNA's structure and resulting increased citedness of their original paper.

Another footnote in the history of DNA is that of a bibliographic omission (Garfield has described such "[bibliographic](#)

negligence " as a "serious transgression" in the ethical attribution of previous research (5) and the need to maintain " citation vigilance " as a means to preserve the acknowledgment of previous research through literature citations) in the original Watson and Crick Nature papers. In 1944, Oswald Avery, Maclyn McCarty and Colin MacLeod were researching DNA at the Rockefeller Institute Hospital (now Rockefeller University). They proved that DNA was the material responsible for inheritance--not a protein, as had been the prevailing thoughts on the chemical nature of inheritance. Their papers, " Studies of the Chemical Nature of the Substance Inducing Transformation of Pneumococcal Types. Induction of Transformation by a Deoxyribonucleic Acid Fraction Isolated from Pneumococcus Type III, " (*Journal of Experimental Medicine* , vol. 79, p. 137-158, 1944) and " Studies of the Chemical Nature of the Substance Inducing Transformation of Pneumococcal Types II. Effect of Desoxyribonuclease on the Biological Activity of the Transforming Substance, " (*Journal Experimental Medicine* , vol. 83, p. 89-96, 1946) were **never** cited by Watson and Crick in their 1953 Nature papers.

Nobel Laureate Joshua Lederberg (Rockefeller University) in 1994 called the work of these Rockefeller Institute researchers, "The pivotal discovery of 20th -century biology."

According to an editor's note appearing in an article, " Discovering Genes Are Made of DNA " written by McCarty (the lone surviving member of that Rockefeller Institute team) in a special 50th anniversary edition of the journal *Nature* (vol. 421, no. 6921, p. 406, 23 January 2003), "Their [Avery, McCarty, and MacLeod] discovery was greeted initially with skepticism, however, in part because so many scientists believed that DNA was too simple a molecule to be the genetic material. And the fact that McCarty, Avery, and MacLeod were not awarded the Nobel Prize is an oversight that, to this day, still puzzles."



Tracking the legacy of publications about DNA is not a difficult task, when one is able to use the special features of today's online bibliographic databases. Since 1907 (the first publication of Chemical Abstracts), more than 600,000 citations have been archived in this reference source. The exhibit includes a graph showing the number of items indexed in Chemical Abstracts per year. In the most recent years, more than 40,000 items per year are published! Of the total number of documents cited in 1999-2002 in Chemical Abstracts, more than 75 percent are journal articles and reviews.

The Stories and Works of DNA Researchers

The publication of James Watson's 1968 autobiographical account of efforts to find the chemical structure of DNA, *The Double Helix: A Personal Account of the Discovery of the Structure of DNA* (UB Libraries' Holdings: Lockwood: QD341.A2 W315, Undergraduate: QD341.A2 W315; Health Sciences: QU 55 W339d) was one of the first general interest or popular works written on DNA. *Double Helix* is also the title of a video produced by the BBC-TV (UB Libraries Holdings: Lockwood: Videocassette VHS V12111.VHSQP624.D69).

The significance of this general and popular format of a scientific topic had tremendous impact in helping to increase our understanding of DNA and genetics. Watson would also write one of the leading textbooks in the field, *Molecular Biology of the Gene* , in 1965 with the latest edition appearing in an expanded two-volume 4th edition in 1987 (UB Libraries Holdings: Health Sciences: QH431 W36, QH 605 W339m, QH 506 M7191; Science and Engineering: QH506 .W4, QH506 .M6627). *DNA: The Secret of Life* (SEL QH437 W387 2003) written by Watson with Andrew Berry is a 446-page non-technical popular work written specifically for the 50th anniversary of the deciphering of DNA's chemical structure. It is a lavishly illustrated work providing the scientist and nonscientist with an in-depth look at DNA's past, present, and future.

Francis Crick provided his autobiographical account of the DNA molecule two decades later with, *What Mad Pursuit: A Personal View of Scientific Discovery* (UB Libraries Holdings: Undergraduate: QH31 C85 A3; Health Sciences: WZ 100 C928). *Crick's 1981, Life Itself: Its Origin and Nature* (UB Libraries Holdings: Health Sciences: QH325 C928L) and *Of Molecules and Men* (UB Libraries Holdings: Health Sciences: QH 331 C9; Undergraduate: QH331 C9), are more

philosophical accounts of molecular biology and genetics and their implications in other disciplines and walks of life.

Rosalind Franklin: The Dark Lady of DNA (UB Libraries Holdings: Undergraduate: QH506 F72 M33) by Brenda Maddox, is a recent (2002) biography of the researcher who worked with Maurice Wilkins (1962 Nobel Laureate) and provided the now famous Photograph 51 used by Watson and Crick to finalize their double helix structure of the DNA molecule. Maddox also provided an article on Franklin in the special 50th Anniversary issue of *Nature*, [The Double Helix and the "Wronged Heroine"](#) (vol. 421, 407-408, 23 January 2003) For decades Franklin's contributions to the efforts related to Watson and Crick's work has been the source of much controversy and debate (see Franklin's 1975 biography, *Rosalind Franklin and DNA*, [UB Libraries Holdings: Health Sciences: WZ 100 F833s; Undergraduate: QP26 F68 S29] by Arme Sayre).

Additional recent articles on Franklin are found in "The Double Helix and the 'Wronged Heroine,'" by Brenda Maddox in *Nature* (vol. 421, no. 6921, p. 407-8, 23 January 2003) and Lynne Osman Elkin's, "Rosalind Franklin and the Double Helix," in *Physics Today* (vol. 56, no. 3, p. 42-48, March 2003). Both periodicals are found in the SEL Collection. To commemorate the 50th Anniversary of the chemical structure of DNA the Public Broadcast System (PBS) produced a Nova Presentation, [The Secret of Photo 51](#), which is available from PBS affiliate WGBH, producers of the Nova Series.

Passing on DNA Information from One Generation to the Next

Providing a legacy of research results is one of the primary functions of scientific and technical literature. Just as the coded sequences within the chemical structure of DNA pass on information from one generation to another, so does our accumulation of scientific and technical literature pass on information from one generation to the next. The [Books in Print](#) database indicates nearly 1,000 entries (6) for books identified by the single search term, "DNA." (7) Of those more than 340 are out of print and hopefully residing on library shelves, where they will be read and used again. The [WorldCat](#) database reveals nearly 3,000 book entries retrieved by the search term, "DNA." An explosion of books (as well as in journals, dissertations, reports, and...) is taking place as data and information in the new fields of bioinformatics, genomics, proteomics, and other "...omics" disciplines are created.

The UB Libraries maintain active collection development activities to assure researchers, students, and administrators have the most current and most relevant resources at their disposal. The UB Libraries Catalog provides subject-search results for: "bioinformatics" (24 entries/48 by keyword), "genome" or "genomics" (349/422 by keyword), "proteome" or "proteomics" (17/32 by keyword), nucleic acids (243/290 by keyword), and "DNA" (576 as subject term). The SEL DNA Exhibit features a number of selected titles of books found in SEL reflecting continued interest in the subject of DNA in the "post-Genomics Era" or the "Era of the New Biology" (bioinformatics, genomics, and proteomics). Other UB Library resources for studying DNA, such as reference books, bibliographic databases, and Web compilations are highlighted.

Finding DNA in BISON

Locating books, journals, reports, videos, and other items in the UB Libraries related to DNA is not as simple as one might think. There are a number of ways to search the holdings of all the libraries via [BISON](#) the UB Libraries Catalog. "DNA" is the established Library of Congress subject heading for retrieving items on the molecule. Searching the name of the chemical, "deoxyribonucleic acid," reveals only a few items and would be necessary only if one needs a comprehensive and exhaustive search of all of the UB Libraries records.

Connecting to the BISON Catalog provides a number of searching options including Author, Title, Keyword or Subject Heading. Along the bottom of the screen are links to five other ways to search BISON, including Keyword Search and Command Search options.

Both of these searching options allow for more complicated searches. The Keyword Search option broadens the ability to search for keywords, words in titles, and allows for increased Boolean operations. The Command Search provides searching capabilities by coded commands, including the ability to search or browse by Call Number. To avoid a number of false hits in the number of items retrieved, it is suggested NOT to truncate the term, "DNA."

Users are reminded of the Boolean operators for expanding and narrowing search strategies, such as searching "DNA AND biochem?" as keywords to retrieve items that also are related to the biochemistry or biochemical aspects of DNA. This capability can be more rigorously exploited in a Keyword Search setting.

The keyword phrase "DNA AND periodicals" provides a list of 24 serial titles (journals, newsletters, magazines, etc.) covering DNA.

To locate reference works in BISON, use the appropriate subject terms and subheadings. Enter the term followed by two (2) hyphens (-) and the type of reference work you are seeking (e.g., dictionaries, encyclopedias, etc.):

- Biochemistry-dictionaries (14 items identified)

- o Genetics-encyclopedias (9)
- o Expand your search for reference works by using keywords. Again, enter the term and the type of reference work you want, except this time replace the two hyphens with the Boolean operator AND:
- o Biochem? AND dictionar? (30)
- o Genetic? AND director? (40)
- o DNA AND encycloped? (3)

SEL Reference Books

- o *Biotechnology: Vol. 1. Biological Fundamentals, Vol. 2 Genetic Fundamentals and Genetic Engineering, Vol. 5b Genomics and Bioinformatics*
UGL/SEL Ref TP2482 B5465
- o *The Dictionary of Gene Technology, 2nd Ed.*
UGL/SEL Ref QH506 .K333 2001
- o *Encyclopedia of Analytical Chemistry*
UGL/SEL Ref QD71.5 E52 2000
- o *Encyclopedia Computational Chemistry*
UGL/SEL Ref QD39.3 .E46 E53 1998
- o *Encyclopedia of Life Sciences*
UGL/SEL Ref QH302.5 .E53 2002
(Also available through UB Libraries Web subscription)
- o *Encyclopedia of Molecular Biology*
UGL/SEL Ref QH506 C74 1999, v.1-v.4
- o *Facts on File Science Library: Genetics and Cell Biology*
UGL/SEL Ref QH440.2 G455 2003 vol 1.(Genetics) vol. 2 (Cell Biology)
- o *Genomes and Databases on the Internet: A Practical Guide to Functions and Applications*
UGL/SEL Ref QH447 .R36 2002
- o *Nature Encyclopedia of the Human Genome*
UGL/SEL Ref QH447 E53 2003 v.1 - v.5
- o *Using the Biological Literature: A Practical Guide*
UGL/SEL Ref QH303.6 .D38 2002

Databases for DNA

The UB Libraries provide access to over 150 reference and bibliographic databases. From the [Libraries' Home Pag](#), select [Resources by Subject](#), where you will find resources organized by discipline. Select a subject and link to any of the databases. A partial listing of databases in which DNA information can be found is provided below.

Online Encyclopedias (Full-text)

- o [Access Science](#) (McGraw-Hill Encyclopedia of Science and Technology)
- o [Encyclopedia of Life Sciences](#) (general and scholarly articles, news, and essays)
- o [Oxford Reference Online](#) (full-text access to subject encyclopedias, dictionaries, and reference works)
- o [Ullmann's Encyclopedia of Industrial Chemistry](#) (detailed articles on chemical technology including biotechnology and pharmacy science)

Bibliographic Databases

- o [AB I/Inform Global](#) (business related research and news from 1971 on)
- o [AGRICOLA](#) (agricultural and life sciences, botany, plant science, and forest science from 1970 on)
- o [BIOSIS Previews](#) (enhanced version of Biological Abstracts with new search capabilities for Gene Names and Biosequences, 1990 on)
- o [Compendex Plus](#) (Engineering Index enhanced all aspects of engineering and applied sciences, 1980 on)
- o [EMBASE: Drugs and Pharmacology](#) (drug and pharmacology-related research, 1991 on)
- o [Factiva](#) (news and business information, including biotechnology, bioinformatics, and related disciplines)
- o [INSPEC](#) (physics, computer technology, and information technology, 1969 on)
- o [MEDLINE](#) (biomedical research and clinical studies, from 1966 on)
- o [SciFinder Scholar](#) (five Chemical Abstracts Service databases and [MEDLINE](#), with links to GenBANK records for biosequences, coverage of Chemical Abstracts is for 1907 on)
- o [Web of Science](#) (Science Citation Index, Social Sciences Citation Index, and the Arts and Humanities Citation Index;

allows for cited reference searching, 1973 on)

Journal Publishers' Pages

- [ACS Journals](#) (American Chemical Society)
 - [Cambridge Journals Online](#)
 - [IEEE Xplore](#)
 - [Oxford University Press Online Journals](#)
 - [RSC Journals](#) (Royal Society of Chemistry)
 - [Science Direct](#) (Elsevier Science)
 - [University of Chicago Press Journals](#)
 - [Wiley InterScience Journals](#)
-

Education and Research at UB

A number of interdepartmental and inter-institutional research centers provide substantial expertise, facilities, and technical support for the disciplines studying DNA at the University. From the Center of Excellence in Bioinformatics to the most recently created Laboratory for Molecular Visualization and Analysis are featured for their role in stimulating and sustaining the creative forces on these new frontiers of science here at the University at Buffalo.

Educational programs from the UB undergraduate biology class, [Evolutionary Biology](#), to comprehensive graduate programs in DNA research and molecular biology. Abu's research and education programs that involve the study of DNA and related biomolecules are highlighted in the SEL exhibit:

- [Center for Advanced Molecular Biology and Immunology](#)
- [Center for Molecular Mechanisms of Disease & Aging](#)
- [Center for Drug Discovery and Experimental Therapeutics](#)
- [Center for Excellence in Bioinformatics](#)
- [Graduate Group in Chemical Biology](#)
- [Graduate Group on DNA Replication](#)
- [Graduate Group in Evolutionary Biology and Ecology](#)
- [Graduate Group on DNA](#)
- [Hauptman-Woodward Medical Research Institute, Inc. \(HWI\)](#)
- [Laboratory for Molecular Visualization and Analysis](#)
- [Roswell Park Cancer Institute](#)
- [Structural Biology Center](#)

Research is an integral part of the University at Buffalo. Professor of Biology [Paul Gollnick](#) provides an illustration of his research here at UB demonstrating the elegance, simplicity, and the complexities of protein synthesis at the molecular level. The DNA molecule provides the information code for the sequence of the RNAs (ribonucleic acids), which in turn transcribe the code for the blueprint for constructing proteins from amino acids. The Trp RNA-binding attenuation protein (TRAP) is an important regulatory protein in *Bacillus* bacteria. The SEL Exhibit features a 2003 rendition of a September 1999 Nature cover showing the crystal structure of TRAP from *Bacillus stearothermophilus*, surrounded by a 53-base RNA molecule. The abstract and cover description from the 16 September 1999 Nature article are provided here:

Model of the structural events during transcription attenuation control of the *Bacillus subtilis* trp operon. The 11-subunit TRAP protein is shown in a ribbon model with 11 bound L-tryptophan molecules shown as van der Waals spheres. The bound RNA molecule is shown in ball-and-stick models including a 26-nucleotide A-form stem-loop at the 3' end, which represents the transcription termination hairpin. (Alfred Antson, York Structural Biology Laboratory, York University, York England and Paul Gollnick, [Department of Biological Sciences](#), University of Buffalo. Nature 401, 235-242, 1999). Abstract and graphic representation are provided by Dr. Paul Gollnick, Professor, [Department of Biological Sciences](#), University at Buffalo. The [TRAP figure and legend](#) from the Nature article is provided in full-text format via the OVID Technologies site and can be found simply by navigating this portal to the desired issue.

"Trp RNA-binding attenuation protein (TRAP) is an important regulatory protein governing tryptophan synthesis in *Bacillus* sp. Bacteria. The crystal structure of TRAP from *B. stearothermophilus*, in complex with a 53-base RNA Molecule, is reported this week. RNA protein complexes are central to many biological processes, yet few such structures been determined in this sort of detail. Details of the RNA-protein interaction revealed in the TRAP complex include the arrest of the RNA segment by encircling I (the ball-and-stick models on the cover) around a protein disk." Source: "Cover Story," Nature [vol. 401, no. 6750, p. ix, 16 September, 1999](#)

Library Web Guides

UB Librarians routinely compile special resource guides on specific topics. Fred Stoss, Biological Sciences Librarian has compiled [Genomics Research and Bioinformatics](#), as an introduction to these new and exciting fields in The New Biology. Christy Hightower, Engineering Librarian in the Science and Engineering Library at the University of California Santa Cruz, published an article, [Science and Technology Sources on the Internet: Guide to Selected Bioinformatics Internet Resources](#) in the Winter 2002 (no. 33) issue of the online journal, [Issues in Science and Technology Librarianship](#). As mentioned above the Valley Library's Special Collections at Oregon State University compiled a noteworthy collection of works in their Web site, [Linus Pauling and the Race for DNA: A Documentary History](#) describing the inter-laboratory intrigue that accompanied the search for a chemical structure for DNA in the late 1940s and into the 1950s. The Baker Library at Harvard University has compiled another useful online resource guide, [INDUSTRY GUIDES: Biotechnology & Pharmaceuticals](#).

DNA in the News

The Exhibit also features two free-standing posters. The first is a discussion on public access and use of news and media accounts of science, which explain the background and benefits of scientific research and the implications that research results may hold for the public good. In the case of DNA research public good has tremendous implications for medical, pharmaceutical, and agricultural benefits.

The SEL DNA Exhibit provides a brief discussion of the role of science in the news media as an important link in the chain of scientific communication. Public access and use of news and media accounts of science provides the R&D community with a certain level of societal or cultural support of the research process and the implications that research results may hold for the public good. It is assumed that access to sound information resources will lead the public to a better understanding and acceptance of theoretical and applied research. However, an accurate, unbiased account of factual reporting of science news is rare, if not non-existent.

News stories represent the most popular means for the public to learn about scientific and technical achievements and the ramifications of research stimulate and sustain improved quality of life indicators. It is from news resources, print and broadcast, from which public opinion is cast. It is from public opinion that much of our government policies regarding scientific and technical research is formulated, and the news media provides the source of information molding public opinion.

A poster of three covers of Time magazine and recent full-page articles on DNA from USA Today (February 24, 2003) and the New York Times (February 25, 2003) highlight this important section of the DNA Exhibit which also provides additional news-related resources available to UB's faculty, administrators, students and staff.

Time Magazine Covers devoted to DNA

- o [January 11, 1999](#)
The Biotech Century ? Say farewell to the century of physics, in which we split atoms and turned silicon into data. Ring in the century of the gene
- o [Jul 3, 2000](#)
The Men Who Mapped the Genome: Backing away from their often bitter rivalry, J. Craig Venter and Dr. Francis Collins are celebrating the completion of a project that will ultimately transform medicine more than vaccines and antibiotics combined. But can the new detente repair Venter's cranky reputation?
- o [January 15, 2001](#)
The Future of Drugs ? Now that our DNA has been decoded, the search for better, faster and more effective medications begins in earnest
- o [February 17, 2003](#)
Solving the Mysteries of DNA (framed or unframed [cover available for purchase](#))

The Science and Engineering Library of the Arts and Sciences Libraries maintains a Web site, [Science in the News](#), a collection of selected science and engineering news sources, including the following broad categories of news types:

- o Newspapers
- o Newsletters
- o News Magazines
- o Popular Magazines
- o Science News in the Science and Engineering Library
- o Science News in Undergraduate Library
- o News Databases
- o Other Online Sources

The Exhibit also features two free-standing posters. The first is a discussion on public access and use of news and media accounts of science, which explain the background and benefits of scientific research and the implications that research results may hold for the public good. In the case of DNA research public good has tremendous implications for medical, pharmaceutical, and agricultural benefits. A second poster shows the 2001 partial map of the human genome published in a special 15 February 2001 issue of Nature. Nature created a special [GenomeGateway](#) to assist researchers, educators, teachers, students and others interested in the science and technology related to the Human Genome and other genomic topics. The Human Genome was updated to near completion this year. Additional information on the [Human Genome Project](#) is available from Oak Ridge National Laboratory, which is part of the U.S. Department of Energy's [Genomes to Life Program](#) and the [National Human Genome Research Institute](#), which is part of the National Institutes of Health. Additional wall posters are found on the posts adjacent to the SEL DNA Exhibit.

A 5-foot ball-and-stick model of DNA From [Zome Tools](#), Inc.-- [ZOME DNA](#)) is also featured in the exhibit, which was compiled, written, and planned by SEL Associate Librarian, Frederick W. Stoss (MS Zoology, MLS). Ruth Oberg, new tile, in SEL and Kimberly Wagner, Conservation Technician in the UB Libraries' Center for Book Preservation provided technical assistance and support for this exhibit.

Footnotes:

- o &' Research on DNA has directly or indirectly been responsible for 19 Nobel Prizes (12 for Physiology or Medicine and 7 for Chemistry; the 1936 Chemistry Prize is listed because of its importance in providing an analytic tool essential for the description of DNA's molecular structure). For more information about DNA and its role in genetics and molecular biology, see the [Nobel e-Museum on DNA-RNA-Protein](#), For additional information about the Nobel Prizes and their recipients go to the Nobel Prize in [Chemistry](#) site <http://www.nobel.se/chemistry/> or the Nobel Prize in [Physiology or Medicine](#) site <http://www.nobel.se/medicine/> and "click" on the Laureates section to find more about each year's award through press releases, biographies, Nobel lectures, interviews, etc.
 - o &0' Distinguished Research Scientist at the [Hauptman-Woodward Medical Research Institute](#), formerly The Medical Foundation of Buffalo.
 - o &1' Garfield, Eugene. 1977. [Highly Cited Articles. 39. Biochemistry Papers Published in the 1950s](#), essay. *Current Contents*, #25, June 20, 1977, In: *Essays of an Information Scientist*, E. Garfield. vol. 3, p. 147-154, 1977-1978.
 - o &2' Garfield, Eugene. 1975. [The "Obliteration Phenomenon" in Science-and the Advantage of Being Obliterated!](#) essay, *Current Contents*, #51/52, December 22, 1975, In: *Essays of an Information Scientist*, vol. 2, p. 396-398, 1974-1976. 3 E. Garfield, ["Bibliographic Negligence: A Serious Transgression,"](#)
 - o &3' *The Scientist*, 5 [23]: 14, Nov. 25. 1991.
 - o &4' Duplicate retrievals included
 - o &5' DNA terms modified by restricting items containing the truncated terms, "gene+ or biol+ or biochem+ or molecu+ ". Again, duplicate retrievals are included in the final total.
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