

CHEMISTRY AND THE INTERNET

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CHEMISTRY AND THE INTERNET

Introduction

You have no doubt heard it said that society has passed from the age of the Industrial Revolution to the Information Age. While there are many who dispute this assertion, it does appear that the advent of the Internet (NET) is changing the way science, and chemistry in particular, is being practiced. Whatever its future the NET has opened the door to easy access to all sorts of chemistry related material. The purpose of this exercise is to introduce some useful sources of this information. This will include some prime sources for guidance in pursuing careers in science and related fields.

The NET consists of a network of millions of computers from all over the world that are able to communicate with one another. Terms that are used in connection with the NET are:

- servers (or host computers): these provide the information
- clients: these computers read the information (for example, the computer you are using)
- a node: each computer that is connected to the NET
- Internet Protocol (IP) address: each node has an IP address. These are assigned by the Internet Service Provider when your computer signs on to its service.
- Domain Name System (DNS): This is the name you will usually see associated with a node. These consist of at least two alphanumeric words separated by a decimal point. The second part of the name gives an indication of the affiliation of the host computer. Sometimes a code for the country is added. Some examples are:

American Chemical Society	<i>gopher.acs.org</i>
The White House	<i>www.whitehouse.gov</i>
The Environmental Protection Agency	<i>www.epa.gov</i>
New York Public Library Public Library	<i>www.nypl.org</i>

Some domain names used to designate affiliation are:

<i>.com</i>	commercial	<i>.edu</i>	education
<i>.org</i>	non-profit organization	<i>.gov</i>	government

Some domain names that designate countries are

<i>.us</i>	United States (usually the host country doesn't carry its country domain)	<i>.ca</i>	Canada
<i>.ar</i>	Argentina	<i>.uk</i>	United Kingdom

NET OPERATIONS

The operations one performs on the NET can be divided into seven parts *

1. Remote Log-in (Telnet)

This is a process that allows you to access another computer usually at some other location such as a library. This may also be used to participate in group conversations on a bulletin board system (BBS). Often a password is required. You can access the Library of Congress information system by typing *telnet://locis.loc.gov*. The Iowa Student Computer Association, a very large, publicly accessible bulletin board, can be accessed by typing *telnet://bbs.isca.uiowa.edu*.

2. File Transfer Protocol (FTP)

This is used to transfer or download a program or file to your computer. This will not be discussed here.

3. Electronic Mail (E-Mail)

This enables you to send messages (mail) via computer. You need the recipient's account name and domain name separated by an @. This will not be discussed here.

4. Usenet News

This is similar to a BBS but consists of several thousand newsgroups. That is people discussing some common topic if interest. These newsgroups are hierarchical with short strings of letters identifying them. For example *http://www.news2mail.com/sci/chem/analytical.html* identifies a science newsgroup interested in analytical chemistry. People can post their comments and read the comments of others that have been posted. These are usually erased after a few days. This will not be discussed any further here.

5. Gopher

This is a method of presenting sets of interrelated documents on the NET. It does not require a log-in and it is possible to select items from a gopher site that will automatically link to a completely different gopher site. Gopher allows you to transfer forwards and backwards. Gopher searching is provided by Iona.

6. Hypertext Documents and the World Wide Web (WWW)

In hypertext links with other documents are imbedded in the text and indicated by underlining them or making them a different color. These often

contain images, sound, and animation which may require special programs called “plug-ins” to run.

These hypertext documents constitute the World Wide Web (WWW). These documents are introduced into a web page using the hypertext mark-up language (HTML). The WWW and NET are often used interchangeably.

7. Custom Applications

Some examples of special applications that exist are programs designed to retrieve information such as those that check the current time from an atomic clock, or obtain and display current weather information.

** Adapted from Chemistry on the Internet. A student's Guide, 1997-1998, by Thomas Gardner, Prentice Hall, Upper Saddle River, NJ 07458.*

EVALUATING INTERNET RESOURCES⁺

Purpose

- Does the web page match your specific needs ? (e.g., is it too technical or written for a special audience).

Source

- Is the author/producer identifiable
- Does the author/producer have expertise on the subject as indicated on a credentials page. You may need to trace back in the URL (internet address) to view a page in a higher directory with background information
- Is the sponsor/location of the site appropriate to the material shown in the URL for example .edu, .gov, .com
- Is there a provision for submission of questions or comments

Content

- Don't take the information at face value
- Web sites are rarely reviewed or refereed as are scholarly journals and books
- Look for
 - point of view
 - evidence of bias
- the source of the information should be clearly stated, whether original or borrowed from elsewhere
- Determine if the content covers a specific time period or aspect of the topic, or strives to be comprehensive
- Use additional print and electronic sources to complement the information provided
- Look to see if
 - the site has been updated recently, as reflected in the date on the page
 - Material contained on the page is current
- Are the links relevant and appropriate
- Don't assume that the linked sites are the best available. Be sure to investigate additional sites on the topic

Style and functionality

- Is the site laid out clearly and logically with well organized subsections
- Is the writing style appropriate for the intended audience
- Is the site easy to navigate (clearly labeled *Back*, *Home*, *Go To Top* icons/links; internal indexing links on lengthy pages)
- Do the links to remote sites all work
- Is a search capability offered if the site is extensive

⁺ Adapted from a web page by Trudi Jacobson, Coordinator of User Education Programs, and Laura Cohen, Network Services Librarian, SUNY, Albany (<http://www.albany.edu/library/internet/evaluate.html>)

NOTE: IF YOU ARE NOT ABLE TO ACCESS ANY OF THE URLs LISTED TRY CUTTING AND PASTING THEM INTO YOUR BROWSER

The following are Web sites that have been evaluated and are recognized as being reliable.

- Librarians Internet www.lii.org (accessed 10/27/09)
- Infomine <http://infomine.ucr.edu> (accessed 10/27/09)
- Academic Info <http://www.academicinfo.net/subsci.html> (accessed 10/27/09)

INFORMATION ABOUT SPECIFIC WEB SITES

(Some of these may be appropriate for more than one classification.)

1. Career Information

1.1 <http://www.iona.edu/> (accessed 10/27/09)

An excellent resource which describes a wide variety of career options among which are biochemistry, chemical sales, chemical information specialists, environmental chemistry, forensic chemistry, and medicinal chemistry.

It provides information about careers in science related to chemistry. Descriptions of educational requirements, nature of the work, etc. are included.

This is an extensive resource which includes hints on job searching, interviewing, resume preparation, job postings and much, much more.

Choose

Undergraduate Programs
Chemistry Department
American Chemical Society – ACSWeb
Careers
What Chemists Do

1.2 <http://www.nationalacademies.org> (accessed 10/27/09)

Choose **Career Guides**

This is a site maintained by the National Academy of Sciences. You will be presented with a choice of a number of publications which can be read online

1.3 <http://pubs.acs.org/cen/index.html> (accessed 10/27/09)

This gives access to the American Chemical Society's journal, Chemical and Engineering News which has many articles for the lay public. There are often articles about careers and career trends in chemistry.

1.4 <http://www.iona.edu/studentlife/career/> (accessed 10/27/09)

A description of the extensive career support services offered by the Iona College Gerri Ripp Center for Career Development.

1.5 http://www.nap.edu/openbook.php?record_id=5129 (accessed 10/28/09)

Careers in Science and Engineering: A Student Planning Guide to Grad School and Beyond

A searchable guide

1.6 <http://science.education.nih.gov/LifeWorks> (accessed 10/28/09)

Explore health and medical science careers

2. Health Information

2.1 <http://epa.gov> (accessed 10/27/09)

This database, maintained by the U.S. government, has all sorts of information regarding the environment. For example you can obtain a list of the chemicals most frequently disposed of by industry, or a list of the top ten companies, in a particular state, with respect to generation of waste as well as information specific to any locality in the U.S.. All of this is a consequence of the effort to make such information widely accessible to local communities.

2.2 <http://toxnet.nlm.nih.gov> (accessed 10/27/09)

This site includes 14 toxicology databases covering thousands of chemicals including literature references and the Hazardous Substances Data Bank.

2.3 <http://www.ilpi.com/msds/search.html> (accessed 10/27/09)

Search for Manufacturer Safety Data Sheets (MSDS).

2.4 <http://www.ilpi.com/msds/ref/index.html> (accessed 10/27/09)

This site has a Glossary of terms used in the MSDS.

2.5 <http://chemfinder.camsoft.com/>

For each included substance this site provides the

- formula
- molecular weight
- boiling point
- water solubility
- synonyms for the name
- melting point
- flash point
- specific gravity
- vapor density
- chemical abstract registry number
- evaporation rate
- extensive references for additional information

2.6 <http://hazard.com/msds/> (accessed 10/27/09)

This provides an entry to the Safety Information Resources, Inc. (SIRI MSDS) archive, a collection of material safety data sheets as well as toxicological reports provided by manufacturers.

These data sheets generally provide the following information:

- CAS number
- Synonyms
- Chemical properties
- First aid measures
- Accidental release information
- Exposure limits
- Ecological information
- Disposal considerations
- Exposure controls and personal protection
- Regulatory information
- Physical properties
- Potential health effects
- Fire fighting measures
- Handling and storage information
- Stability and reactivity
- Toxicological information (acute and chronic)
- Transport information

2.7 <http://www.epa.gov/iris/> (accessed 10/27/09)

“IRIS is a database of human health effects that may result from exposure to various substances in the environment.” It is created and maintained by the U.S. Environmental Protection Agency and its Office of Research and Development, National Center for Environmental Assessment. The information provided represents a consensus reached by the EPA health scientists and the office of Research and Development. When a chemical is selected the following options are provided:

- I.A. Reference dose for chronic oral exposure (RfD)
- I.B. Reference concentration for chronic inhalation exposure (RfC)
- II. Carcinogenicity assessment for lifetime exposure
- VI. Bibliography
- VII. Revision history
- VIII. Synonyms

2.8 <http://www.state.nj.us/health/eoh/rtkweb/> (accessed 10/27/09)

The stated purposes of this site are to:

- Give public employees information about what hazardous substances are located at their workplace and how to work with these hazardous substances safely
- Help firefighters, police and other emergency response personnel to adequately plan for and respond to hazardous substances safely

- Provide data for monitoring and tracking hazardous substances in the workplace and the environment

Fact Sheets are available and provide the following information:

- Physical properties
- A hazard summary
- Synonyms
- Workplace exposure limits
- Handling, storage, and emergency procedures
- Workplace controls and practices
- The reason the substance is listed
- Acute and chronic health effects

2.9 <http://sis.nlm.nih.gov/chemical.html> (accessed 10/28/09)

Database of over 380,000 chemicals, synonyms, structures, regulatory list information, and links to other databases

2.10 <http://science.howstuffworks.com/> (accessed 10/28/09)

Science explains and demystifies the world through the objective of gathering and analyzing data. Explore the natural world, engineering, space, military technology, physics and even supernatural phenomena.

2.11 <http://www.liv.ac.uk/Chemistry/Links/links.html> (accessed 10/28/09)

Links for Chemists is an index of chemistry resources on the web. This site is the copyright of The University of Liverpool, Department of Chemistry. We hope you will abide by our fair-use guidelines whilst using this index.

3. Environment

3.1 <http://www.gcrio.org/> (accessed 10/27/09)

This is a site maintained by the United Nations Environmental Programme World Meteorological Organization. It provides answers some of the most commonly asked questions about climate change such as

1. Has the world warmed ?
2. Are human activities contributing to climate change ?
3. What human activities contribute to climate change ?
4. How do we know that the atmospheric build-up of greenhouse gases is due to human activity ?
5. What climate changes are projected ?
6. How reliable are predictions of future climate ?

7. Are recent extreme weather events, like the large number of Atlantic hurricanes in 1995 due to global warming ?
8. Why do human-made greenhouse gases matter when water vapor is the most potent greenhouse gas ?
9. Why should a few degrees of warming be a cause for concern ?
10. Why can't ecosystems just adapt ?

3.2 <http://www.scorecard.org/> (accessed 10/27/09)

This is a Web site created by and maintained by The Environmental Defense Fund. As reflected by the information provided, this organization is focused on evaluating environmental hazards and providing the public with relevant information. The initial screen provides the following options:

- Potential sources of land contamination
- Hazardous air pollutants
- Criteria air pollutants
- Chemical releases from manufacturing facilities
- Animal waste from factory farms
- Setting environmental priorities chemicals as well as links to Web sites where additional information can be obtained.

3.3 <http://globalchange.gov/> (accessed 10/27/09)

A government Web site providing information about global change research projects.

3.4 <http://www.epa.gov/opptintr/chemfact/> (accessed 10/27/09)

In this site "...EPA has developed information summaries on selected chemicals to describe how you might be exposed to these chemicals, how exposure to them might affect you and the environment, what happens to them in the environment, who regulates them, and whom to contact for additional information."

3.5 <http://www.epa.gov/pesticides/food> (accessed 10/27/09)

The EPA provides information about regulation of, susceptibility to, types of, and health problems associated with pesticides.

3.6 <http://www.rtk.net>(accessed 10/27/09)

The Right-to-Know Network (RTK NET), a service provided by [OMB Watch](#), provides free access to numerous environmental databases. With the information available on RTK

NET, you can identify specific factories and their environmental effects, and assess the people and communities affected.

4. Periodic Table

4.1 <http://www.webelements.com/webelements/scholar/index.html> (accessed 10/27/09)

This is a portal to a huge amount of information. Choose the **Periodic Table** and **WebElements.com** after accessing the site. This site provides an up to date periodic table. By clicking on an element one obtains:

- its standard state
- Debye temperature
- melting temperature
- effective nuclear charge
- ionic radius
- radii
- where discovered
- critical temperature
- discoverer
- hydride boiling temperature
- superconduction temperature
- boiling temperature
- bond enthalpies
- electronegativities
- size of the valence shell orbital
- meaning of the name
- date of discovery
- color
- hydride melting temperature
- fluoride melting temperature

4.2 http://www.chemsoc.org/viselements/pages/periodic_table.html (accessed 10/27/09)

Visual Elements

Visual Elements, sponsored by the RSC, is chemsoc's stunning periodic table uniting chemistry and digital art in an exciting collaborative project.

The Visual Elements web site provides a unique graphical interpretation of the chemical elements, making the [periodic table](#) fun and interesting. Computer generated images, animations and a soundtrack inspired by the elements are combined with detailed scientific data for the 109 elements currently officially recognised by IUPAC. The site also includes the unique [Periodic Landscapes](#) - 3D panoramas derived from trends and relationships within the Periodic Table: view static images or even fly-through the landscapes in the online movies!

Downloads for PCs and Macs include screen savers and wallpapers. Send your friends an [electronic postcard](#) to tell them about your fascinating visit to the Visual Elements web site at www.chemsoc.org/viselements

Take a look at the [chemsoc timeline](#) - an exciting exploration of key events in the history of science with a particular emphasis on chemistry. Using stunning images, it's the fun way to explore scientific history.

4.3 <http://antoine.frostburg.edu/chem/senese/101/index.shtml> (accessed 10/27/09)

- Common Compound Library
A searchable database of over 800 common compound names, formulas, structures, and properties
- Common Notes
Hyperlinked notes and guides for first semester general chemistry.
- Features: Featured articles and tutorials.
- Resources
A searchable, annotated database of over 400 general chemistry Web resources.
- Toolbox: Interactive graphing, popup tables, and calculators.
- Tutorials
Index of self-guided tutorials, quizzes, and drills on specific topics.
- Answers to questions
Answers to general chemistry questions that you forgot to ask.
- Frequently asked questions
Answers and hints for over 400 frequently asked questions.
- Glossary
A searchable, crosslinked collection of over 1000 chemical terms; now with audio pronunciations.
- Trivia quiz: 45 randomly selected trivia questions.
- Chemistry Exam Survival Guide
Skills checklists and online self-grading examinations.

4.4 <http://www.periodicvideos.com/#> (ACCESSED 10/28/09)

Tables charting the chemical elements have been around since the 19th century - but this modern version has a short video about each one.

We've done all 118 - but our job's not finished. Now we're updating all the videos with new stories, better samples and bigger experiments.

Plus we're making films about other areas of chemistry, latest news and occasional adventures away from the lab.

5. Physical and Chemical Properties

5.1 <http://webbook.nist.gov/> (accessed 10/27/09)

A tremendous resource operated by the National Institute of Standards and Technology.

You can search for

- **Thermochemical data for over 7000 organic and small inorganic compounds:**
 - Enthalpy of formation
 - Enthalpy of combustion
 - Heat capacity
 - Entropy
 - Phase transition enthalpies and temperatures
 - Vapor pressure
- **Reaction thermochemistry data for over 8000 reactions.**
 - Enthalpy of reaction
 - Free energy of reaction
- **IR spectra for over 16,000 compounds.**
- **Mass spectra for over 15,000 compounds.**
- **UV/Vis spectra for over 1600 compounds.**
- **Gas chromatography data for over 27,000 compounds.**
- **Electronic and vibrational spectra for over 5000 compounds.**
- **Constants of diatomic molecules (spectroscopic data) for over 600 compounds.**
- **Ion energetics data for over 16,000 compounds:**
 - Ionization energy
 - Appearance energy
 - Electron affinity
 - Proton affinity
 - Gas basicity
 - Cluster ion binding energies
- **Thermophysical property data for 74 fluids:**
 - Density, specific volume
 - Heat capacity at constant pressure (C_p)
 - Heat capacity at constant volume (C_v)
 - Enthalpy
 - Internal energy
 - Entropy
 - Viscosity
 - Thermal conductivity
 - Joule-Thomson coefficient
 - Surface tension (saturation curve only)
 - Sound speed

5.2 <http://www.chem.ox.ac.uk/mom/default.html> (accessed 10/27/09)

MOLECULES OF THE MONTH

Vignettes of many interesting chemicals (e.g., viagra, DDT, taxol) with virtual reality images.

6. Polymers

6.1 <http://www.pslc.ws/macrog.htm> (accessed 10/27/09)

This is a site that provides a comprehensive introduction to the field of polymers. It is divided into five levels of increasing difficulty (familiarity with the structural theory of organic chemistry is assumed beginning at the second level):

- (a) Polymers are everywhere (everyday uses)
- (b) Polymers Up Close and Personal (individual resins)
- (c) How They Work (structure-property relationships)
- (d) Makin' Polymers (synthesis)
- (e) Getting Polymers to Talk (instrumental analysis)

7. Mathematics

7.1 <http://physics.nist.gov/cuu/Constants/> (accessed 10/27/09)

Values of basic constants and conversion factors

7.2 <http://www.unc.edu/~rowlett/units/index.html> (accessed 10/27/09)

An excellent Dictionary of Units of Measurement that will convert almost anything into anything else.

8. Journals

8.1 <http://pubs.acs.org> (accessed 10/27/09)

Scientists generally communicate with one another by publishing their results in scientific journals. The better journals referee these articles. This means, before publication, the articles are reviewed by several experts in the field. The American Chemical Society (ACS) is the prime publisher of chemistry related journals. Currently all 26 of its journals are available on-line for a fee.

8.2

http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_SUPERARTICLE&node_id=1355&use_sec=false&sec_url_var=region1 (accessed 10/28/09)

Global Challenges/Chemistry Solutions is a series of podcasts describing some of the 21st Century's most daunting problems, and how cutting-edge research in chemistry

matters in the quest for solutions. This sweeping panorama of global challenges includes dilemmas such as providing a hungry, thirsty world with ample supplies of safe food and clean water; developing alternatives to petroleum to fuel society; preserving the environment and assuring a sustainable future for our children; and improving human health. An ongoing saga of chemistry for life — chemistry that truly matters— Global Challenges debuts in June and continues through December. Subscribe at iTunes or listen and access other resources here.

8.3 www.sciencenow.org (accessed 10/27/09)

This site provides primary research articles as well as general news items related to science. At the present time one must be a subscriber to Science Online in order to use it.

9. General Information (for example, news about current issues in science and technology)

9.1 <http://www.pbs.org/science/> (accessed 10/27/09)

This site is maintained by the Public Broadcasting System. It has a great deal of information about topics in science and technology including information about careers in various fields.

9.2 <http://www.nasa.gov> (accessed 10/27/09)

A rich source of many types of information related to space exploration.

9.3. www.madsci.org (accessed 10/27/09)

Experts will answer questions about science. The site also offers a tour of the Visible Human and describes experiments you can try at home.

9.4 <http://www.quackwatch.com/> (accessed 10/27/09)

This site is operated by Stephen Barrett, M.D. who describes it as “Your Guide to Health Fraud, Quackery, and Intelligent Decisions.”

9.5 <http://www.nypl.org/research/sibl/> (accessed 10/27/09)

Whether you're looking for timely business information or tracking scientific journals and research, The Rohatyn Center at SIBL offers a range of global information at no cost to users. Information may be downloaded at no charge, but there are charges for printing. Staff are available to make resource recommendations, and give one-on-one assistance. Free training classes teach database search strategies and techniques. Click on "Free Public Training Classes" on the SIBL Home page to see the class schedule.

9.6 <http://ask.nypl.org/> (accessed 10/28/09)

Chat with a librarian. Available Monday to Friday 10 am to 5 pm EST.

9.7 [Ask a question via e-mail](#) (accessed 10/28/09)

Available 24 hours a day, 7 days a week. Call Telephone Reference at 212-340-0849.
Available Monday to Saturday 9 am to 6 pm EST.

9.8 <http://lii.org/file/about> (accessed 10/27/09)

The Librarian's Index to the Internet is an annotated subject directory of more than 7,300 Internet resources selected and evaluated by librarians.

9.9 <http://www.chemspy.com/> (accessed 10/27/09)

- Database

ChemSpy.com helps you to find chemistry and chemical engineering related terms, definitions, synonyms, acronyms and abbreviations. Also search forms for finding MSDS/safety data, scientific publications in over 20,000 different journals, physical data of chemical compounds, worldwide patents are available.

- Latest News

Supplies the latest news from the chemical industry, the plastics industry, engineering, the oil and gas industry, bio technology, the pharma industry environmental issues and, finally, the metals industry.

- Portal

Each category contains a link to a more detailed list of resources made by specialists in their field.

- Tutorials

ChemSpy.com links you to comprehensive tutorials in the field of chemistry and chemical engineering.

10. Instrumentation

10.1 <http://www.spectroscopynow.com> (accessed 10/27/09)

The free access spectroscopy portal has become the definitive spectroscopy resource on the internet, offering a wealth of valuable information, resources and services.

It covers:

- Mass Spectrometry
- NMR
- Infrared
- Raman Spectroscopy
- MRI
- X-ray Spectrometry
- Chemometrics
- Atomic Spectroscopy
- Ultraviolet
- Proteomics

11. Genetic Engineering

11.1 <http://ghr.nlm.nih.gov/ghr/page/Home> (accessed 10/27/09)

The Genetics Home Reference, the National Library of Medicine's web site for consumer information about genetic conditions and the genes or chromosomes responsible for those conditions.

11.2 www.ornl.gov/hgmis(accessed 10/27/09)

This site's objective is to make the human genome project accessible to the general public. It includes a technical section on gene mapping and sequencing, the impact of genetics on medical therapies, a student primer on molecular genetics, and a library of articles covering ethical, legal and social issues. One can ask questions and receive responses.

11.3 <http://www.dnalc.org/> (accessed 10/27/09)

Dolan DNA Learning Center at Cold Spring Harbor. The source for timely information about genes in education.

11.4 <http://www.doegenomes.org/> (accessed 10/27/09)

Genome programs of the U. S. Department of Education Office of Science.

11.5 <http://gslc.genetics.utah.edu/> (accessed 10/27/09)

[A University of Utah site helping people understand how genes affects their lives and society.](#)

12. Online Learning Resources

12.1

<http://www.learner.org/resources/series61.html?pop=yes&volid=652906&pid=793#>
(Accessed 10/28/09)

Join with experts to observe chemistry in action and learn the laws and principles of this dynamic field. Computer technology and special effects place students in a front-row seat to observe many processes, even those that are too dangerous or impractical to experience directly. Working industrial and research chemists of all backgrounds serve as role models. *The World of Chemistry* is appropriate for students taking high school or college chemistry, from introductory to advanced levels, and is easily applicable to different

teaching approaches. It includes physics and Earth science components, and is also valuable for teachers seeking to review the subject matter.

13. Humor

13.1 <http://www.twinkiesproject.com/> (accessed 10/27/09)

This web site should appeal to everyone. At this point you are probably hungry. Perhaps you would like some refreshment. You have perhaps eaten a Twinkie sometime in your life. Maybe more than one. However, you probably are not aware of the amazing properties of this substance.

Try some of the options on this site and find out about Twinkies and intelligence, radiation, gravity, solubility, density, electrical properties and reaction with oxygen

13.2 <http://www.privatehand.com/flash/elements.html>

“The Elements” created by Tom Lehrer circa 1955.