Views of RNA on the World Wide Web

Over the past few years, new network information systems have led to a phenomenal growth in the use of the Internet. However, in spite of the existence of Internet search engines it is still a problem to find the resources one needs. For those scientists interested in RNA, and its diverse biological roles, the RNA World website has been set up[1], which collects RNA-related Internet resources. It provides links to databases of sequences, secondary structures, and coordinates and images of three-dimensional structures to other web tools, software, books, tutorials, meetings and to the RNA prototype newsgroup archive. A few entries are given in Box 1.

One of the resources within the RNA World site is the Image Library of Biological Macromolecules[2,3]. It contains currently more than 4500 images of about 350 biopolymers including all RNA structures available from the Protein Data Bank (PDB) and from the Nucleic Acid Database (see Box 1 for URLs). For the structural biologist, sophisticated molecular graphics packages such as InsightII[4], Sybyl[5] or MidasPlus[6] are the preferred working tools for visualising biological macromolecules. However, Internet-based image archives can contribute to a better dissemination of visual information on biopolymer structures, especially for the large community outside structural biology. In addition to the Image Library, other large image archives have been developed which provide either automatically generated standard representations (PDB[7], Molecules R US[8]) or nonstandard images (Swiss-3D-Image[9]). Accessing the images in the Image Library requires nothing more than a standard web browser. Each entry consists of a text file with general information, various molecular structure images in mono and stereo representations (GIF format) and colour coded distance plots (GIF, PostScript, PDF formats). The distance plots are a useful addition to the structure images. They display the distribution of distances between representative atoms of the biopolymer residues of a particular structure. A search option scans filenames and the text files. Mixed rendering, labelling and colouring techniques are extensively used. The images were generated on a 48 cm monitor and are, therefore, relatively large when displayed within a web browser. The best way to overcome this problem is to use separate viewers which are able of resizing images, like LviewPro (PC) or JPEGView

(MAC)[10]. They can be started either automatically from the browser or separately after saving the image.

An increasing number of images is also available in the new Virtual Reality Modelling Language (VRML) format, which enables one to rotate, zoom or translate the molecular structures shown on the images without having available a molecular graphics software. However, this requires VRML viewers that are becoming standard parts of the most recent versions of web browsers, such as Netscape Navigator Gold and Microsoft Internet Explorer 3.0. Alternatively, VRML viewers can be obtained from sources such as The VRML Repository[11]. We recommend that you try the viewers available at this site. Anybody who is aware of RNA web sites that are not yet accessible via the RNA World is requested to contact the author.

References

1 http://www.imb-jena.de/RNA.html

2 http://www.imb-jena.de/IMAGE.html

3 Sühnel, J. (1996) *Comput. Appl. Biosci.* 12, 227-229

4 http://www.msi.com/info/products/InsightII.html

5 http://www.tripos.com/products/sybyl.html

6 http://cgl.ucsf.edu/midasplus.html

7 http://www.pdb.bnl.gov/

8 http://molbio.info.nih.gov/cgi-bin/pdb/

9 http://expasy.hcuge.ch/sw3d/sw3d-top.html

10 http://dspace.dial.pipex.com/town/parade/ow72/viewer/viewer.htm

11 http://www.sdsc.edu/vrml/

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Box 1. RNA web resources related to sequences, secondary and three-dimensional structures

Three-dimensional structures and images

Protein Data Bank	(http://www.pdb.bnl.gov/; http://www2.ebi.ac.uk/pdb/)
Nucleic Acid Database	(http://ndbserver.rutgers.edu:80/; http://ndbserver.ebi.ac.uk:5700/NDB/)
RiboWeb Project	(http://www-smi.stanford.edu/projects/helix/ribo3dmodels/index.html)
Image Library of Biological Macromolecules	(http://www.imb-jena.de/IMAGE.html)
Electron micrographs of plant viruses	(http:www.res.bbsrc.ac.uk/plantpath/virusems/fastindex.html)
Visulization of viruses	(http://www.bocklabs.wisc.edu/virusviztop.html)

Sequences and secondary structures

Berlin database of 5S rRNA and 5S rRNA gene sequences	(http://www-srs.caos.kun.nl/srs/srsc?-id+810542608_193.174.235.99+-info+BERLIN)
GenCANS RDP classification system	(http://diana.uthct.edu/~nih/cans/gencans_rdp.html)
Haemophilus influenza RNA genes	(http://www.tigr.org/docs/tigr-scripts/hi_scripts/rna.spl)
Higher plant mitochondrial tRNA genes	(ftp://ftp.ebi.ac.uk/pub/databases/plmitrna/)
Ribosomal Database Project	(http://rdp.life.uiuc.edu/)
Ribosomal RNA mutation database	(http://www.fandm.edu/Departments/Biology/Databases/RNA.html)
RNA secondary structures	(http://pundit.colorado.edu:8080/)
RNA modification database	(http://medstat.med.utah.edu/RNAmods/RNAmods.html)
Rnase P database	(http://jwbrown.mbio.ncsu.edu/RNaseP/home.html)
rRNA aligned sequences and secondary structures	(http://rrna.uia.ac.be/)
Signal recognition particle database	(http://pegasus.uthct.edu/SRPDB/SRPDB.html)
Small RNA database	(http://mbcr.bcm.tmc.edu/smallRNA/smallrna.html)
tRNA and tRNA gene sequences	(ftp://ftp.ebi.ac.uk/pub/databases/trna/)
uRNA database	(http://pegasus.uthct.edu/uRNADB/uRNADB.html)
Viroid and viroid-like RNA sequences	(http://callisto.si.usherb.ca/~jperra/)
tRNAscan (search for tRNA genes in a genomic sequence)	(http://genome.wustl.edu/eddy/tRNAscan-SE/)