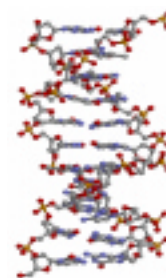


modelling dna

Model-making can help scientists to understand the structure and function of DNA and proteins. Physical models, such as those which helped James Watson and Francis Crick to reveal the structure of DNA, have been largely replaced by computer-generated images. Much of the software and necessary structure data is available free-of-charge from scientific and educational World Wide Web sites.



PDB ID: 1D66

Computer modelling

RASMOL is a 3-D molecular modelling programme for *Macintosh*, *Windows*, *UNIX* and *VMS* operating systems. It was written by Roger Sayle and can be downloaded free-of-charge from the **RASMOL** Web site (<http://www.umass.edu/microbio/rasmol>).

The programme is small enough to fit on a single floppy disc. It is a good idea to print out **RASMOL**'s 40-page manual (which comes with the programme), as although **RASMOL** is easy-to-use, to make the most of it you will need to use the commands described in the manual.

Molecules can be depicted in seven different forms (wireframe, spacefill, ball-and-stick, ribbon, cartoon, sticks, stereoscopic) and coloured, highlighted and labelled in many ways (for example, to show the general motifs that comprise a protein). It is easy to rotate molecules and zoom in on parts to examine their structures in detail.

Structures

Once you have installed **RASMOL**, you will need to obtain some molecular structure data. An excellent source is the Protein Data Bank (<http://www.rcsb.org/pdb/>) and its mirror sites around the world.

This database of thousands of molecular structures can be searched in various ways *e.g.*, by entering the name of a molecule as a keyword. Selecting the name of a molecule from the list of structures retrieved will enable you to display the selected file within your Web browser or to download it to your computer. Save the structure data as a text file, then launch **RASMOL**.

To view the molecule you have downloaded, open it from within **RASMOL**'s 'FILE' menu. *Note: Protein Data Bank and Nucleic Acid Database IDs are given alongside many of the molecular figures in this booklet.*

useful web sites

RASMOL's own Web site (with simple instructions, a discussion list and other resources) can be found at: <http://www.umass.edu/microbio/rasmol>. This site also has details of **RASMOL**'s stable-mate, **CHIME**, which enables 3-D models to be incorporated into Web pages.

There are several tutorials on molecular structure at this site, plus instructions for creating your own Web pages that incorporate **CHIME** models.

The Nucleic Acid Database is held at Rutgers University, New Jersey (USA): <http://ndbserver.rutgers.edu/NDB/ndb.html>. You can also find the amazing Musical Nucleic Acid Atlas here!

Structures for modern/cell biology—the **CHIME** plug-in is needed to view these interactive structures: <http://info.bio.cmu.edu/courses/biochemMols/BuildBlocks/Molecules.html>.

Physical models

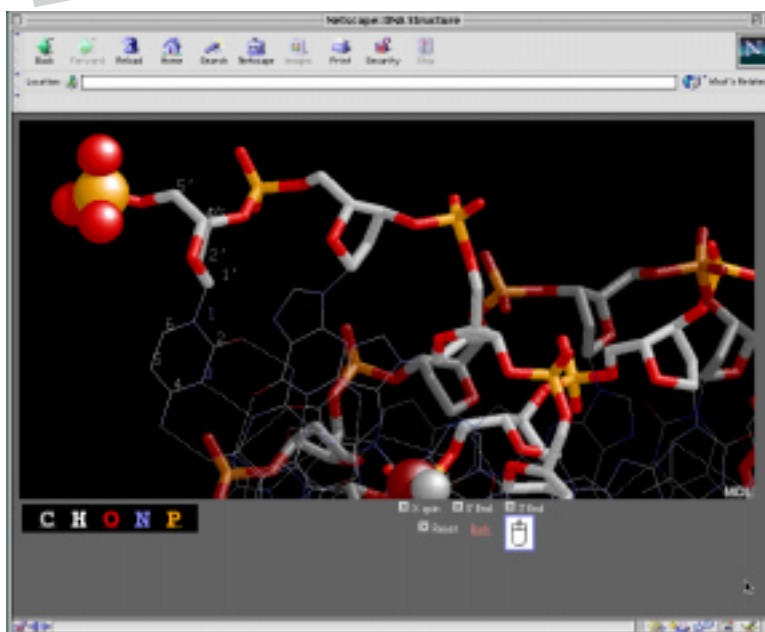
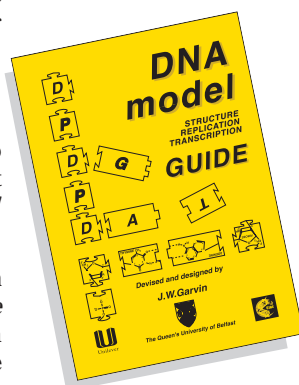
Wilbert Garvin, formerly of the Queen's University of Belfast, has designed a 2-dimensional jigsaw-like DNA model kit for use in schools. The model can be used to learn about the structure and function of DNA. The component parts, which are made of robust coloured plastic, are reversible, providing both a simple and an 'advanced' model.

The kit comprises sufficient parts for use by a whole class and comes with a comprehensive guide with instructions for teachers and students. This includes some overhead projector masters.

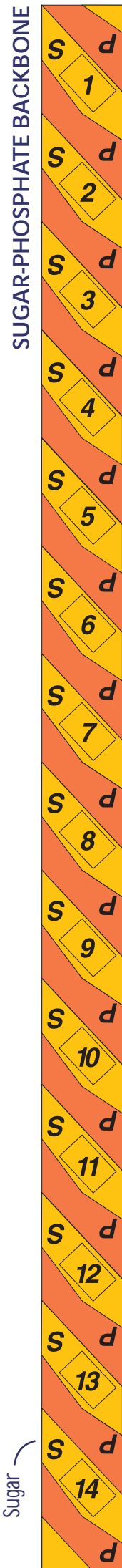
An *Adobe Acrobat*® (PDF) file of the instruction manual that accompanies the model can be downloaded from the EIBE web site: <http://www.reading.ac.uk/EIBE>

This manual is available in several languages.

The production of Wilbert Garvin's model kit was jointly supported by Unilever and EIBE, the European Initiative for Biotechnology Education.



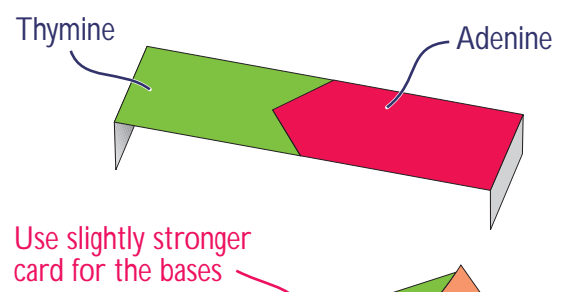
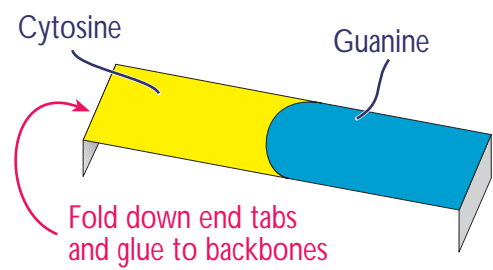
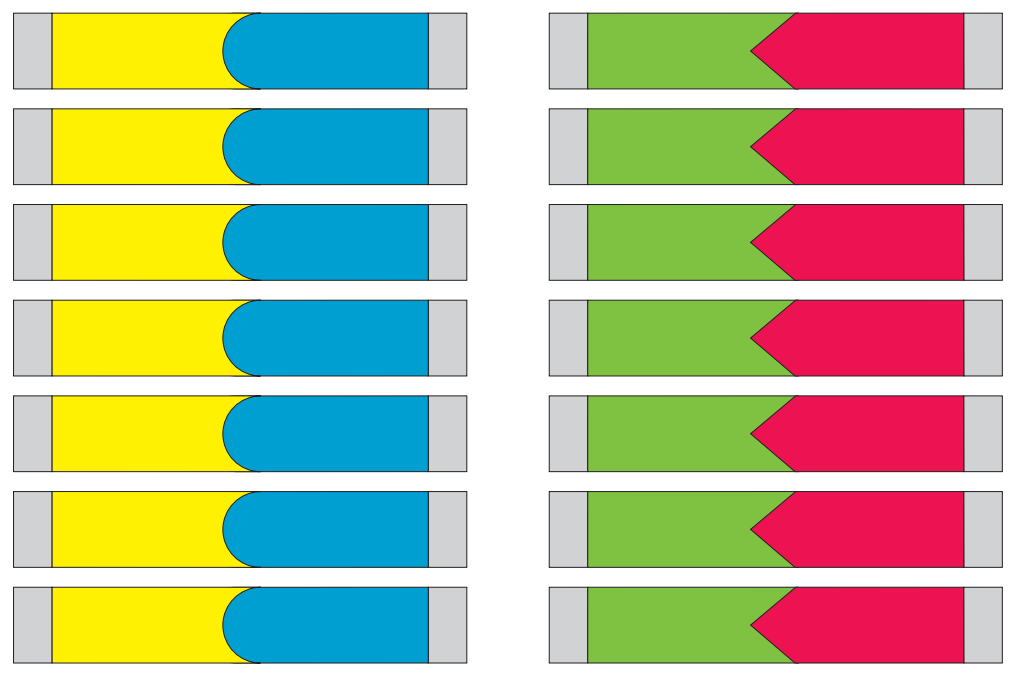
▲ The **CHIME** plug-in can be used to view molecular structures within the Netscape Web browser. The frame above comes from a complete suite of animated, interactive **CHIME** pages designed to help students learn about the structure of DNA. It can be viewed or downloaded entirely (for viewing off-line) from: <http://www.umass.edu/microbio/rasmol>



Phosphate

Sugar

BASE PAIRS



DNA

BASES

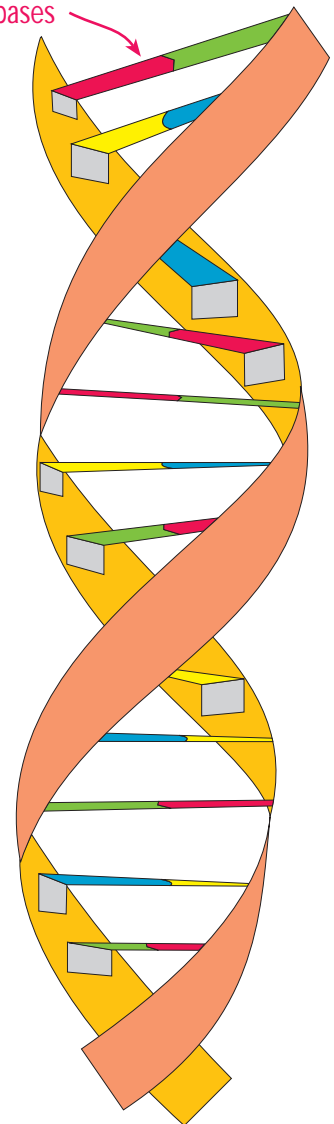
Adenine

Thymine

Guanine

Cytosine

LABEL
Fold and glue sides together



INSTRUCTIONS

- Print this page onto card
- Cut out the pieces and glue them together
- Hang the label from the bottom of the model