

Practical Biology

DNA writing paper: an educational aid in A-level biology

Elizabeth Burns

A series of diagrams to show genetic material at different scales is provided. These can each be used as a decorative margin for a sheet of writing paper as well as a teaching aid

Introduction

Molecules are at the heart of biology, and yet they are possibly one of the most intimidating and alien concepts confronting a young person. Therefore, rather than gloss over these apparently difficult topics fundamental to biology, perhaps we should tackle this 'chemophobia' at a younger age in a more positive manner. The problem is not the molecules themselves, but the perceived foreign language they present to young people. By increasing familiarity, some of these fears can be eroded, and a young mind kept open for the future.

One of the best ways of increasing familiarity is to make molecules fun. Molecules offer many teaching possibilities since so many scientific principles can be hung on visual models. Most students will enjoy the welcome break of a few pictures during a theoretical lesson.

DNA is the keystone of modern biology and one of the easiest molecules for students to enthuse about, since most are already familiar with it from the media. Therefore, they are less afraid to confront this complicated molecule.

Materials and method

Chromosome and DNA writing paper (figures 1–8) not only offers familiarity, but can also be used to make students think about DNA in context. The following exercise requires students to actively identify the components of DNA, and understand how it is packaged to make a chromosome. It enables them to connect molecular genetics, via information from the electron microscope, to nuclear material as seen under the light microscope.

The eight illustrations can be photocopied on to four sheets of A4 paper and cut to A5 size for use as writing paper. The eight different A5 sheets should be given out in a random order with a separate list of labels (figure 9).

First, the students must put the illustrations in order. The initial and final diagrams are already numbered, so they can work up from the DNA components building a picture of the features and sequential coiling of DNA into a chromosome during mitosis or meiosis. Second, once the order has been checked, the sheets can be labelled in pencil so that they can be corrected.

The teacher could convert each sheet with appropriate labels to an overhead transparency to be used to check the students' results.

The author

Elizabeth Burns is currently a biology undergraduate at the University of York. Any correspondence should be sent to Kekewich, Little Dowgate, Leverington, Wisbech, Cambs. PE13 5DL.

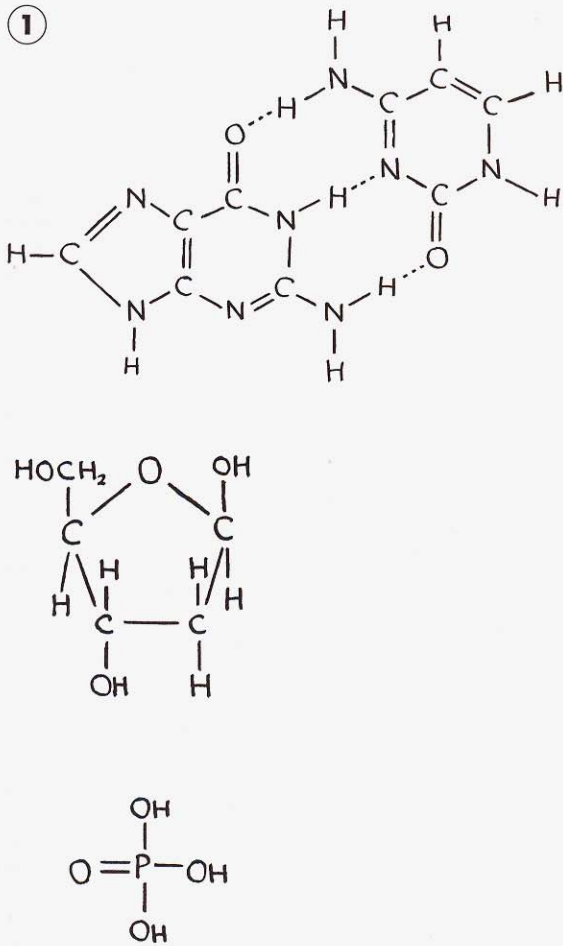


Figure 1 DNA components.

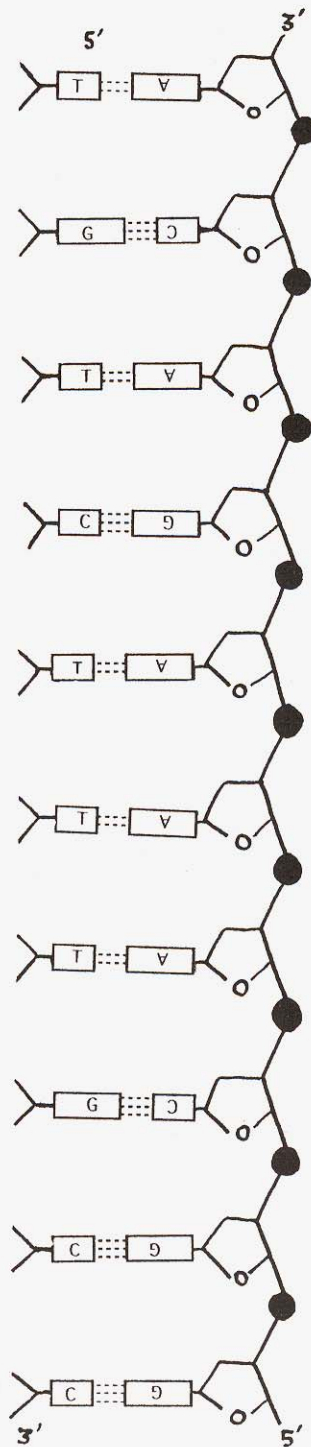


Figure 2 DNA.

These pages can be photocopied (enlarge to a suitable size)

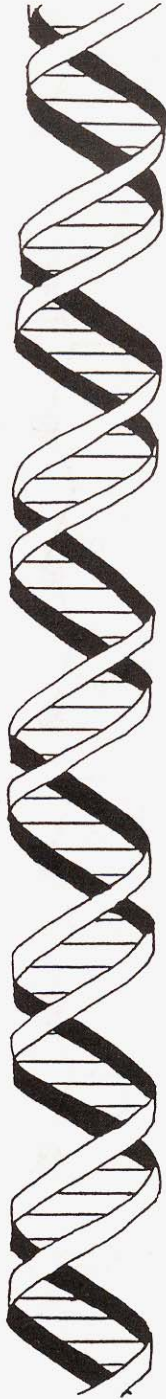


Figure 3 DNA double helix.



Figure 4 Nucleosomes in 'bead-on-a-string' form of chromatin.



Figure 5 Chromatin fibre of packed nucleosomes.



Figure 6 Extended section of chromosome.



Figure 7 Condensed section of chromosome.

8



Figure 8 Metaphase chromosome.

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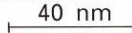
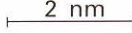
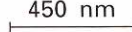
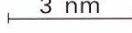

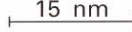
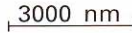
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|---|--|--|--|
| <p>1. <i>DNA components:</i>
 Hydrogen bonds
 Phosphate
 Purine base: Guanine
 Pyrimidine base: Cytosine
 Sugar: Deoxyribose</p> | <p>1 nm</p>  | <p>5. <i>Chromatin fibre of packed nucleosomes:</i>
 DNA double helix
 Nucleosome: DNA and histone
 Protein: Histone</p> | <p>40 nm</p>  |
| <p>2. <i>DNA:</i>
 Hydrogen bonds
 Phosphate
 Purine base: Guanine, Adenine
 Pyrimidine base: Cytosine, Thymine
 Sugar: Deoxyribose</p> | <p>2 nm</p>  | <p>6. <i>Extended section of chromosome:</i>
 Looped chromatin fibre
 Nucleosomes</p> | <p>450 nm</p>  |
| <p>3. <i>DNA double helix:</i>
 Deoxyribose-phosphate
 backbone
 Position of purine-pyrimidine
 base pairs</p> | <p>3 nm</p>  | <p>7. <i>Condensed section of chromosome:</i>
 Looped and coiled chromatin
 fibre</p> | <p>700 nm</p>  |
| <p>4. <i>Nucleosomes in 'bead-on-a-string' form of chromatin:</i>
 DNA double helix
 DNA wrapped round core
 histone protein
 Nucleosome: DNA and histone
 Protein: Histone</p> | <p>15 nm</p>  | <p>8. <i>Metaphase chromosome:</i>
 Centromere
 Packaged chromatin fibre
 Two daughter chromatids</p> | <p>3000 nm</p>  |

Figure 9 Labels for the components and sequential coiling of DNA.