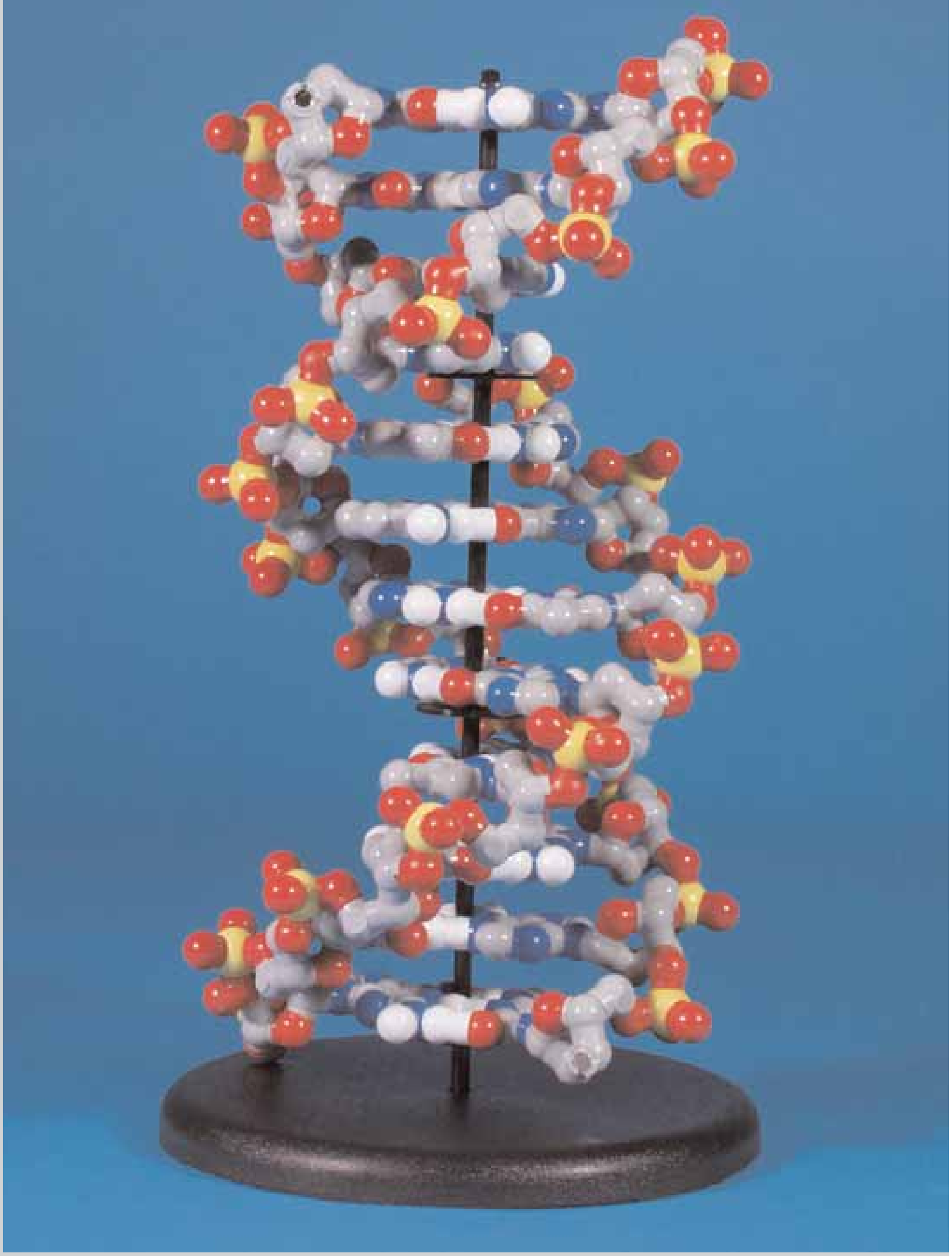
3-D Molecular Designs

...where molecules become real™

The DNA Discovery Kit©

Three Frequently Asked Questions



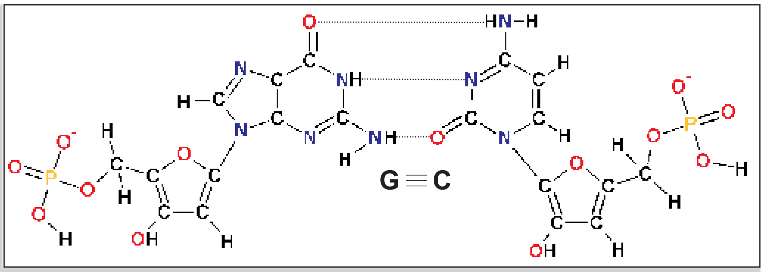
Photos by Sean Ryan

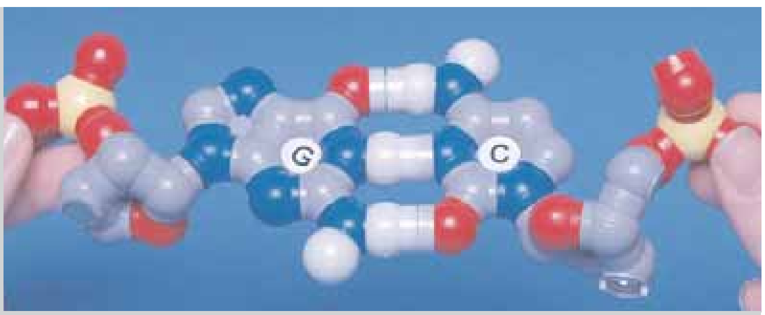
Three Frequently Asked Questions

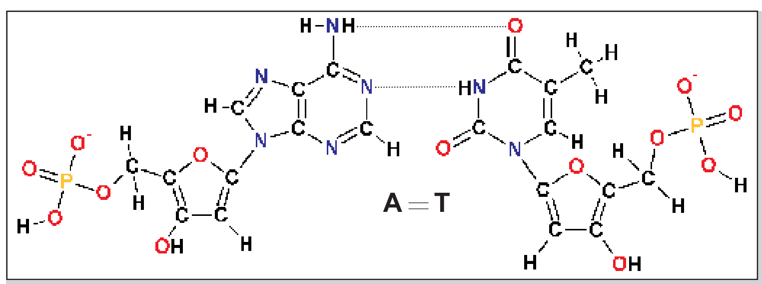
How do these models compare with the chemical drawings of nucleotides in my textbook?

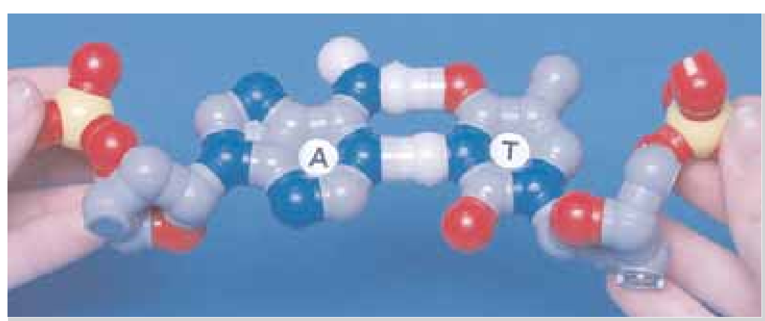
As your students become familiar with DNA's phosphate groups, deoxyribose groups and bases, by handling the models, the 2-D drawings of DNA's chemical structure will be more meaningful.

When your students compare the models with the chemical drawings in textbooks, it is important that they understand that most of the hydrogen atoms have been eliminated from the models in order to more clearly reveal the underlying structure. A direct comparison of the physical models with a typical chemical drawings of the nucleotide structures is provided below.









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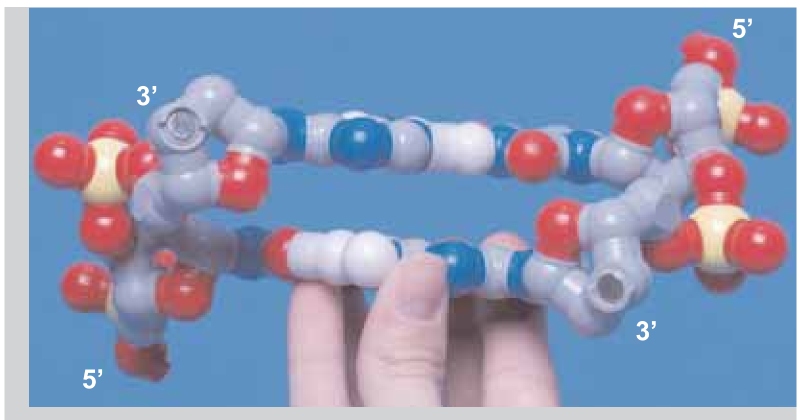
How does the model show that the two strands of DNA are anti-parallel?

One powerful feature of this model is that it clearly demonstrates that the two strands of DNA are running in opposite directions. Look at the photo shown below, and focus on the red oxygen atom found in the two deoxyribose groups. Notice how the oxygen of the deoxyribose on the left is below the plane of the base pair, while the oxygen of the deoxyribose on the right is above the plane. This is a clear indication that the “polarity” of the nucleotides in the two strands are opposite each other.



Now focus your students attention on the phosphate groups from each nucleotide. Again, one of these phosphates will be below the plane of the base pair while the other will be above the plane. And since the phosphate group is attached to the 5’carbon of the deoxyribose group, the DNA chain on the right of the double helix shown in the photo above is said to run 5’ to 3’ from the top of the photo to the bottom — while to other strand is running 5’ to 3’, from the bottom to the top.

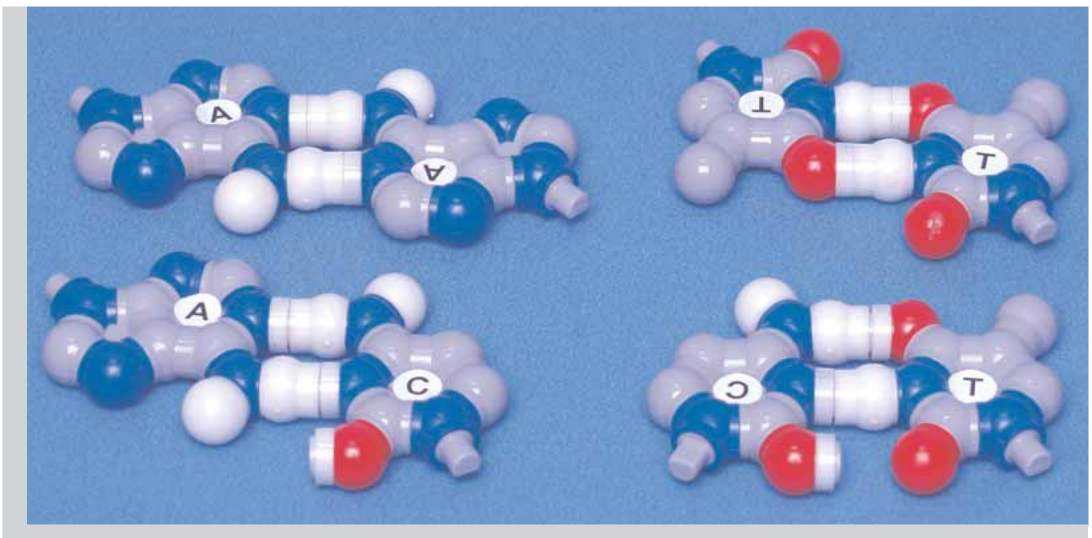
Three Frequently Asked Questions

Can *incorrect* base pairs be formed with the model pieces?

Yes, non-standard base pairs (other than the A - T and G - C that form the double helix) can be formed by this model — just as these base pairs can form in solution with *real* nucleotides.

Four of these non-standard base pairs are shown below. However, these non-standard base pairs are not compatible with double helical DNA, for two reasons. Base pairs formed with two purines or two pyrimidines will have a different *diameter* than standard A - T and G - C base pairs that consist of one purine paired with one pyrimidine. Therefore, the non-standard base pairs shown below cannot be assembled into a double helical model with a uniform diameter.

Encourage your students to discover these non-standard base pairs -- and then determine for themselves why these base pairs are not consistent with the model proposed by Watson and Crick.



For the non-standard hydrogen bonded base pairs to form, the polarity of the two strands of DNA must be parallel, <u>not anti-parallel</u>. Therefore, notwithstanding the problem with the diameter of these non-standard base pairs (see above paragraph), it is not possible to accommodate these parallel base pairs in the Watson-Crick model of DNA.