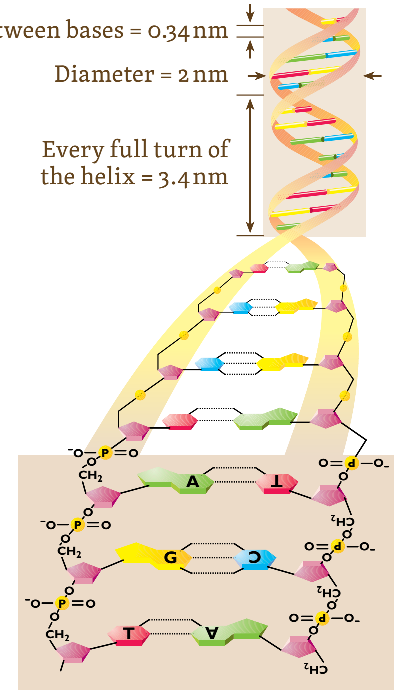
2. A model of DNA

Equipment and materials

Equipment
- Scissors
- Bodkin or strong needle, for punching holes through card
- OPTIONAL: Sharp craft knife and cutting board

Materials
- Nucleotide templates, copied onto thin card
- Glue for sticking paper
- Drinking straws
- Fine string or strong sewing thread



Structure of the DNA double helix.

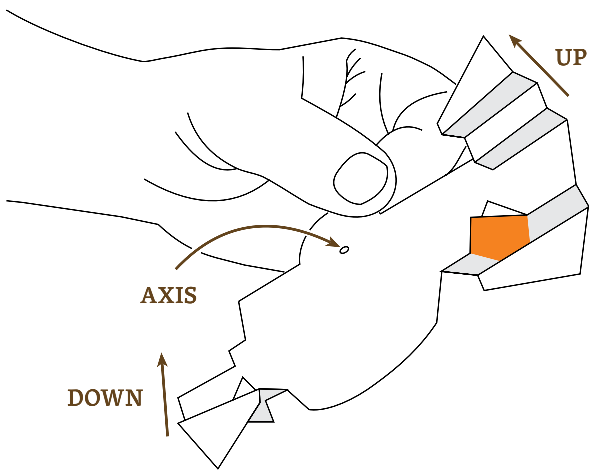
Instructions

1. Obtain several copies of the nucleotide templates printed on card. Ten nucleotide pairs are required for a complete turn of the double helix. To see the major and minor grooves in the double helix clearly, the model must have *at least 16* nucleotide pairs.

2. Cut out the nucleotide pairs around the thicker, outer lines. Make two small cuts into the card by the phosphate groups where indicated. OPTIONAL: Use a sharp craft knife to make cuts above the deoxyribose molecules where shown.

3. Carefully punch a small hole in each cut-out where shown. This will be the axis of the DNA model through which the string will be threaded. *Do not make these holes too big!*

4. Fold the sugar-phosphate 'backbones' where indicated by dotted lines. These folds must be made in the directions shown below. *Take care not to make a left-handed DNA helix.*



Phosphate groups on the left side fold DOWN, phosphates on the right fold UP.

5. Cut 25 mm lengths of drinking straw. You will need one less piece of straw than you have nucleotide pairs.

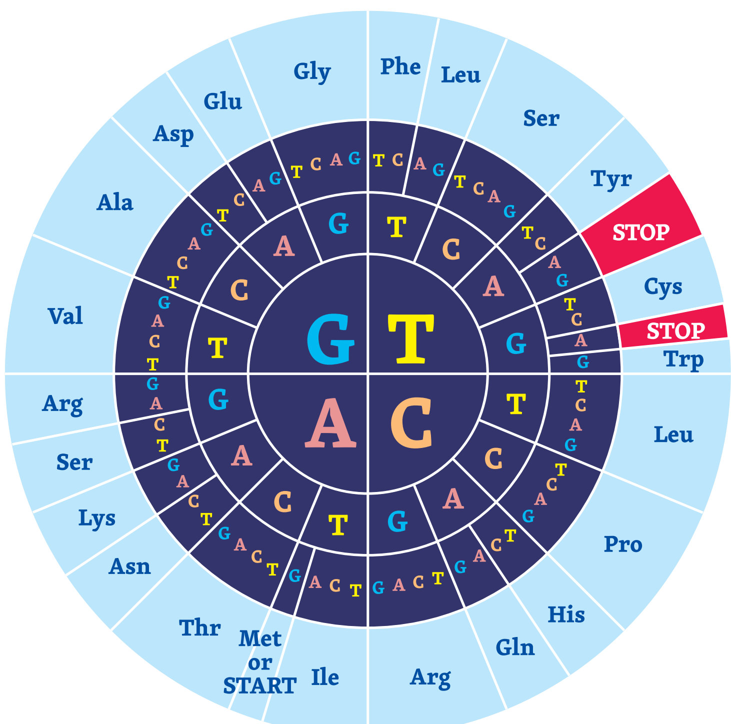
6. Glue the phosphate group on one cut-out onto the deoxyribose on the next. Do the same with the opposite sugar–phosphate strand. Remember that the sugar-phosphate chains run in opposite (anti-parallel) directions. The orientation of the letters on the card should help you to assemble the model correctly.

7. Hold a piece of drinking straw between the holes in the cut-outs, and thread the string through them.

8. Repeat steps 5–8 for as many nucleotide pairs as desired.

9. Cut out the two discs and glue the two sides together onto the string at the bottom of the model. The weight of the discs will help the model to hang vertically.

   Note that the genetic code on the disc is the **DNA** code: it shows which groups of three bases (codons) correspond to each amino acid. It is also possible to have a version of the code showing which triplets in **messenger RNA** (mRNA) correspond to each amino acid.



The Genetic Code indicates the amino acids that are encoded by each group of three DNA bases. There are also 'start' and 'stop' codons that control the synthesis of each polypeptide chain. To decipher this chart, start at the centre and read outwards.

Amino acid codes

The three-letter and single letter codes for the 20 amino acids that are found in proteins. Computer software often uses the single-letter codes to represent the different amino acids, rather than the three-letter codes.

Ala	**A**	Alanine
Arg	**R**	Arginine
Asp	**D**	Aspartic acid
Asn	**N**	Asparagine
Cys	**C**	Cysteine
Glu	**E**	Glutamic acid
Gln	**Q**	Glutamine
Gly	**G**	Glycine
His	**H**	Histidine
Ile	**I**	Isoleucine
Leu	**L**	Leucine
Lys	**K**	Lysine
Met	**M**	Methionine
Phe	**F**	Phenylalanine
Pro	**P**	Proline
Ser	**S**	Serine
Thr	**T**	Threonine
Trp	**W**	Tryptophan
Tyr	**Y**	Tyrosine
Val	**V**	Valine