ME 411 / ME 511

Biological Frameworks for Engineers

Class Organization

- HW1 assigned. Due Fri Oct 4.

- Read Pgs 7-9, 107-110 in Phillips et al. (if you have it)
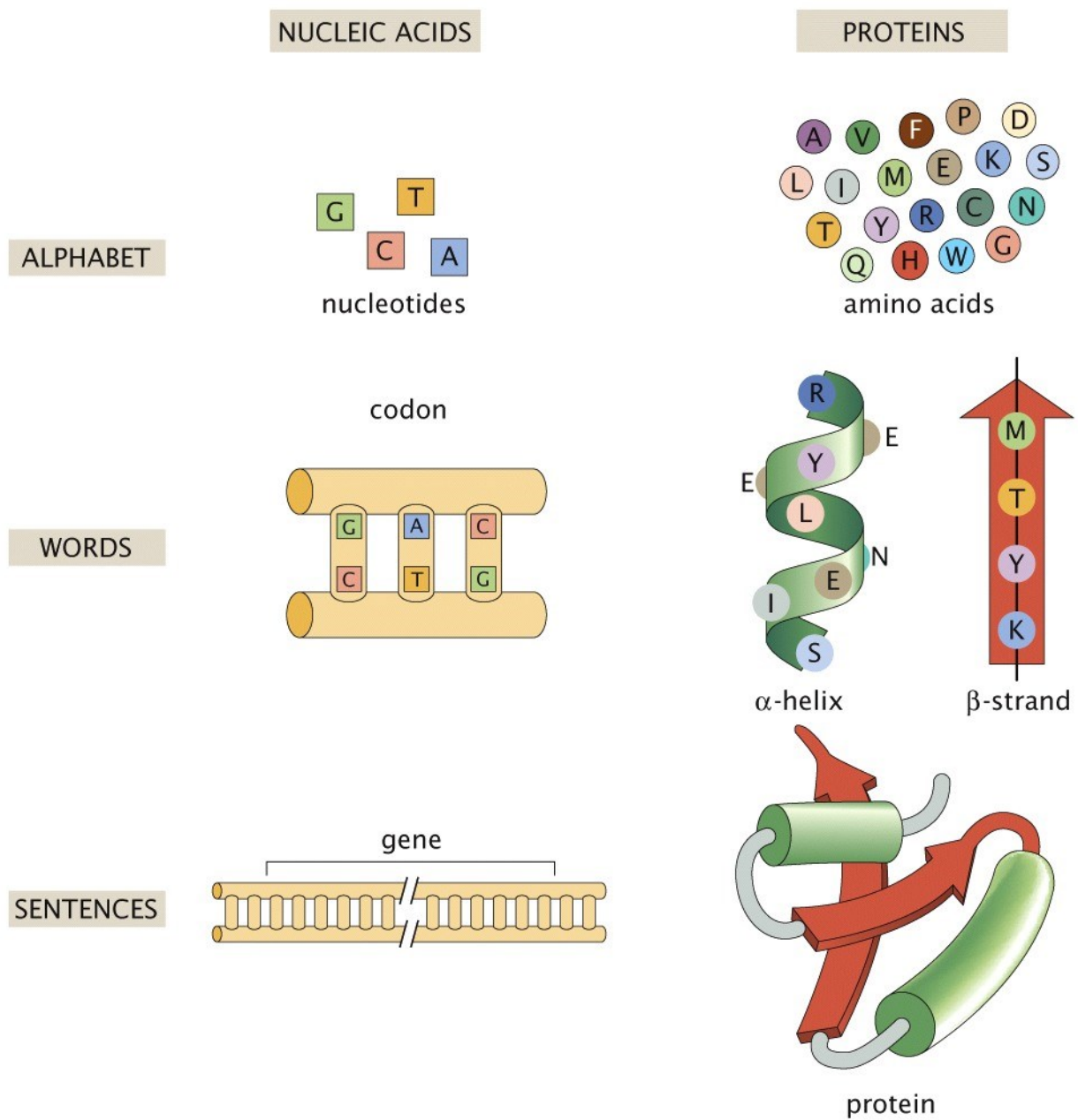
ME 411 / ME 511

Information Handling

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NUCLEIC ACIDS

PROTEINS

ALPHABET

nucleotides

amino acids

WORDS

codon

α-helix

β-strand

SENTENCES

gene

protein

Figure 1.2 Physical Biology of the Cell, 2ed. (© Garland Science 2013)

DNA polymerase   primase
                  helicase

REPLICATION

DNA

DNA

DNA template

RNA polymerase

DNA   TRANSCRIPTION

RNA message

mRNA

growing
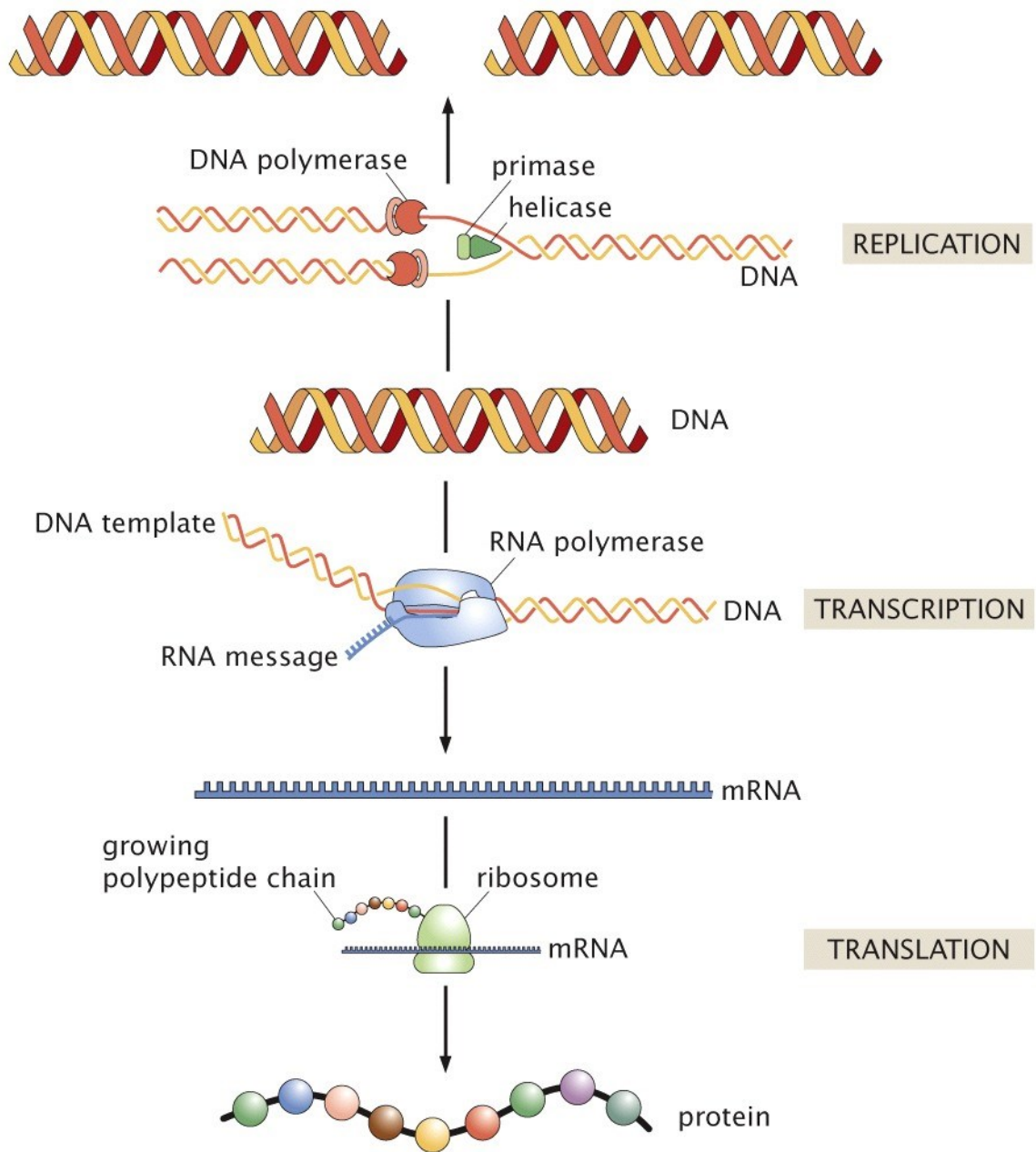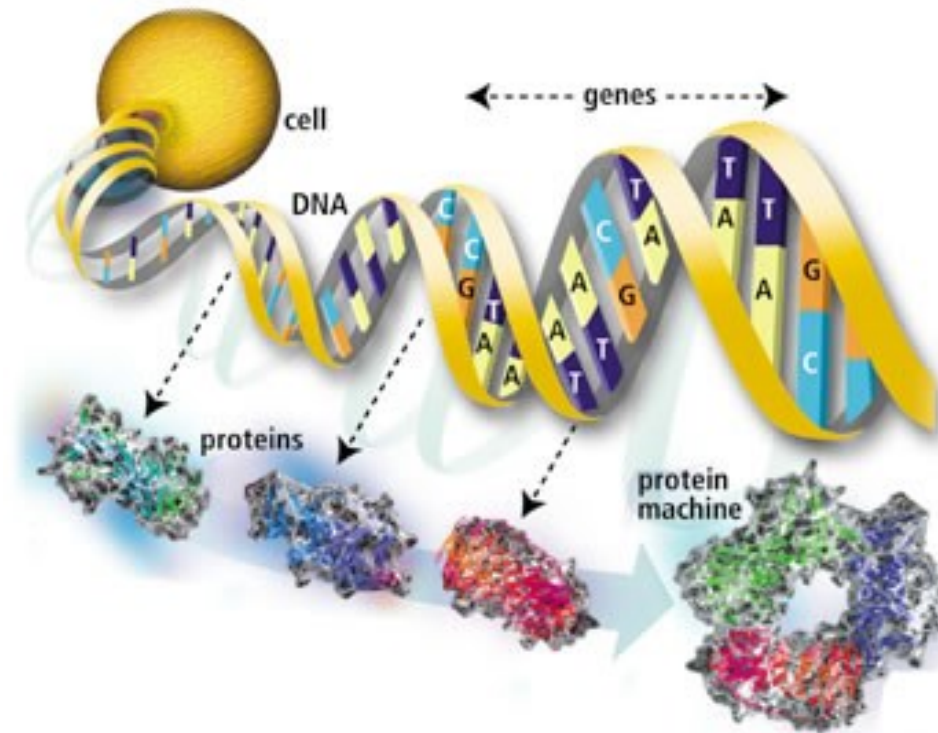polypeptide chain   ribosome

mRNA   TRANSLATION

protein

Figure 3.12 Physical Biology of the Cell, 2ed. (© Garland Science 2013)
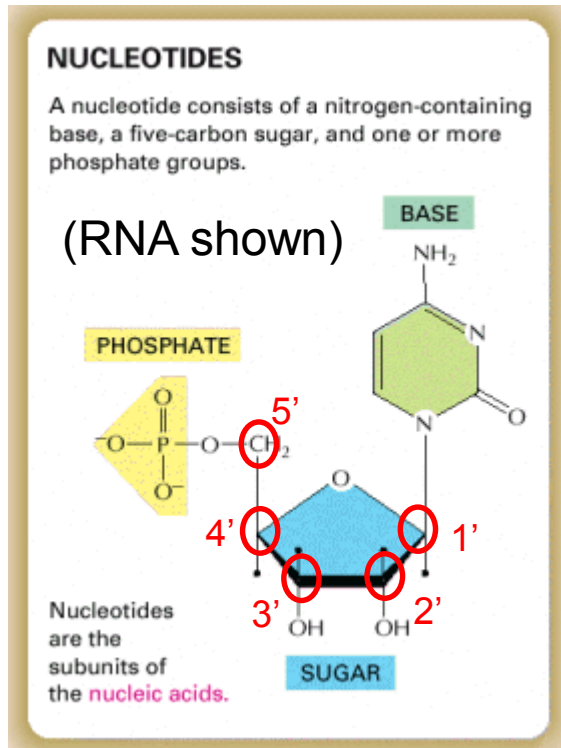
Deoxyribonucleic Acid

DNA is a polymer of nucleotides that encodes the sequence of amino acid in proteins through a template called messenger RNA

Nucleotides

Consists of a nitrogen base, 5-carbon sugar, and a phosphate from the *5' end* of the sugar.

Sugar
Ribonucleic acid (RNA)
Deoxyribonucleic acid (DNA)

Nitrogen Bases
G: Guanine   (Purine)
A: Adenine   (Purine)
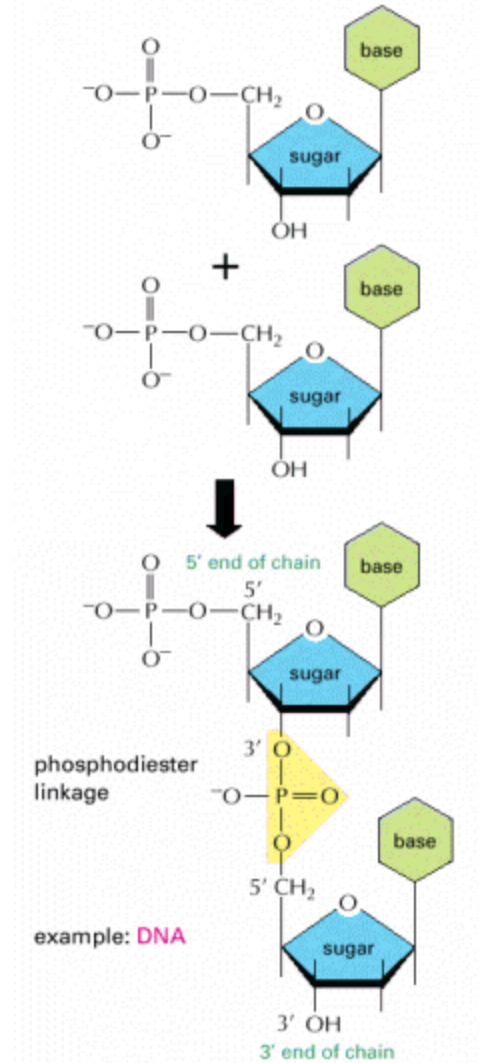T: Thymine   (Pyrimidine)
C: Cytosine   (Pyrimidine)
U: Uracil   (Pyrimidine)

DNA Polymerization

A nucleic acid strand has a pentose-phosphate backbone.

A phosphodiester bond connects the 3' end of one nucleic acid with the 5' end of the next *mer*.

(DNA shown)

DNA Structure

<u>*1953*</u>: Watson and Crick proposed the double-helix structure of DNA*

- Right-handed, Anti-parallel
  - 5' / 3' → 3' / 5' (Strands run opposite)
- Base pairs on the inside
  - A • T has two H-bonds
  - G • C has three H-bonds
- Dimensions
  - 2.0 nm wide
  - 3.4 nm length per turn
  - 10 base pairs per turn
- Grooves
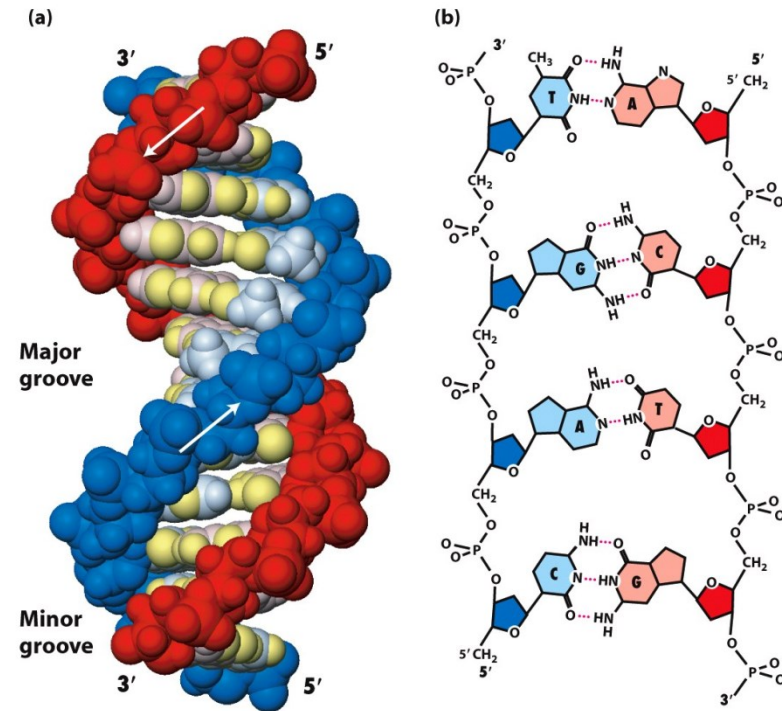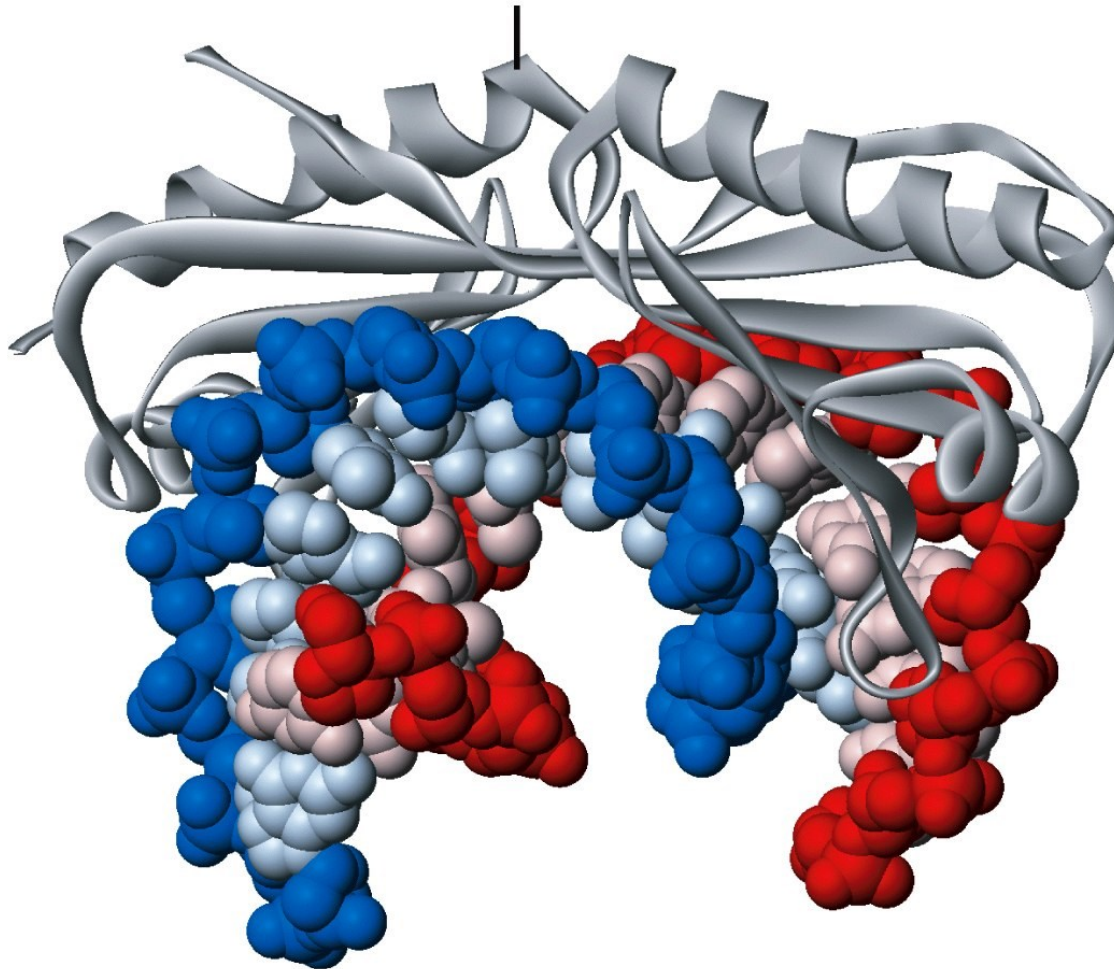 - Major: 2.2 nm wide (protein docking)
  - Minor: 1.2 nm wide

Figure 4-3
Molecular Cell Biology, Sixth Edition
© 2008 W. H. Freeman and Company

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* using Maurice Wilkins and Rosalind Franklin's X-ray diffraction data.

It's Bend-y!

TATA box–binding protein

Flexibility arises because H-bonds run perpendicular and not parallel to long axis

Figure 4-5
Molecular Cell Biology, Sixth Edition
© 2008 W. H. Freeman and Company
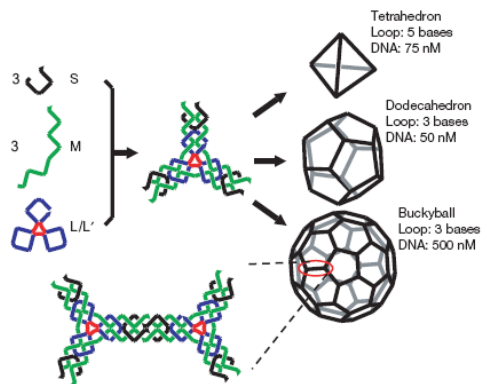
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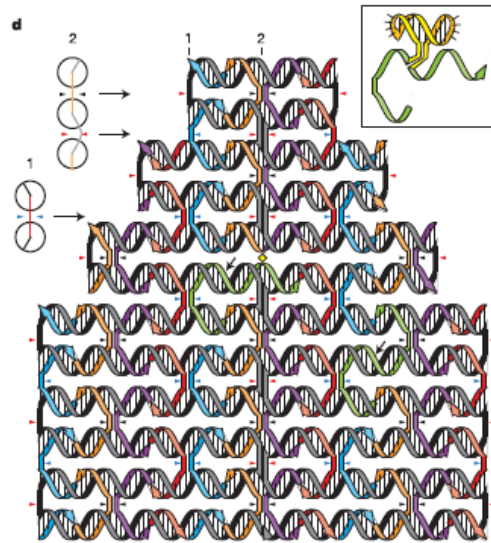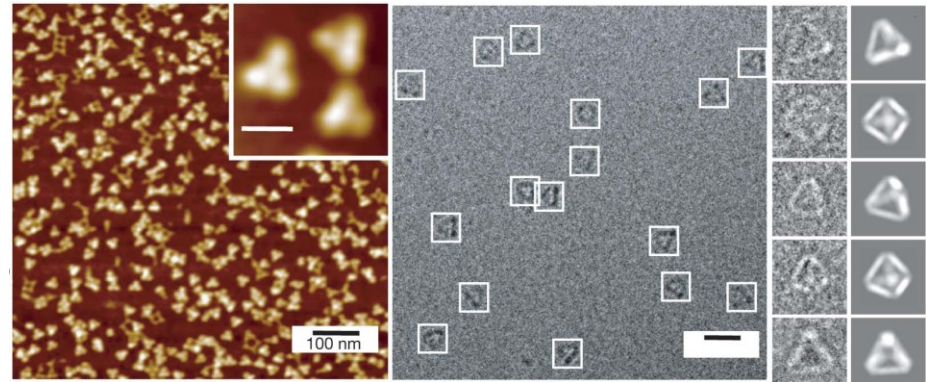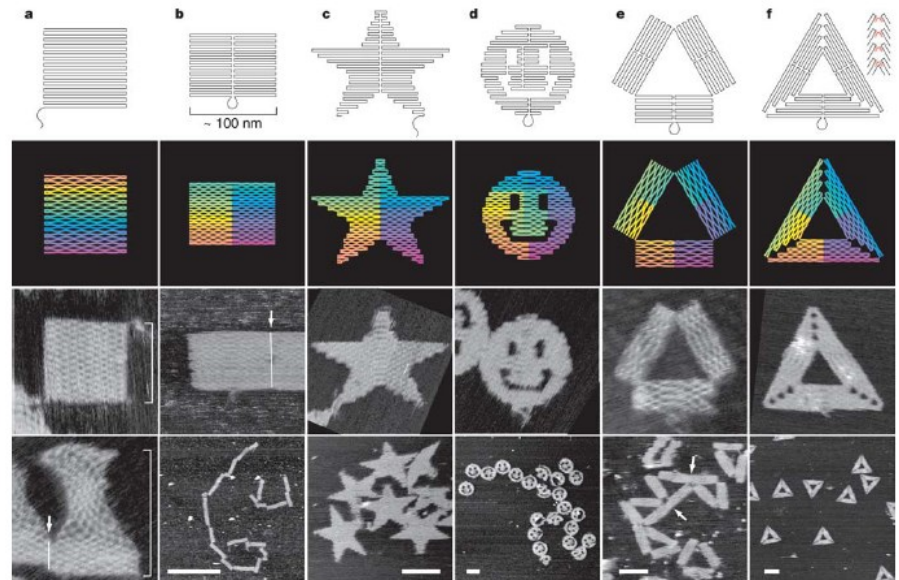
It's Constructable!

Figure 1 | Self-assembly of DNA polyhedra. Three different types of DNA single strands stepwise assemble into symmetric three-point-star motifs (tiles) and then into polyhedra in a one-pot process. There are three single-stranded loops (coloured red) in the centre of the complex. The final structures (polyhedra) are determined by the loop length (3 or 5 bases long) and the DNA concentration.

Hw 1…

Explore information handling in

Replication (DNA → DNA)

Transcription (DNA → RNA) & Translation (RNA → Proteins)