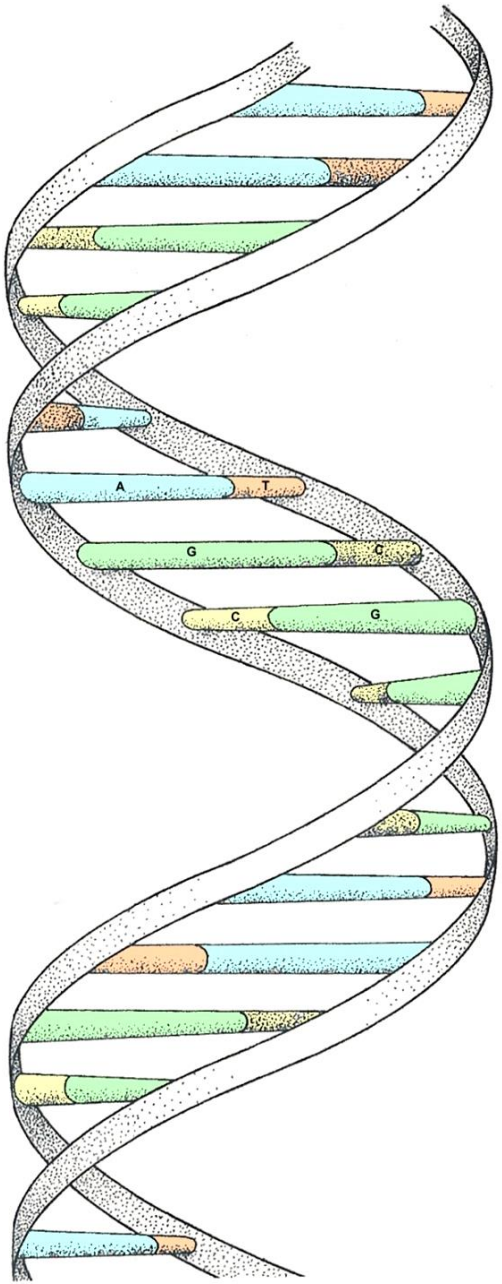
What can you tell me about DNA?

DNA and Replication

DNA

Credit for discovery of DNA is given to Watson & Crick



DNA

DNA stands for **deoxyribose nucleic acid**

This chemical substance is present in the nucleus of all cells in all living organisms – both eukaryotic (in nucleus) and prokaryotic (in cytoplasm).

DNA controls all the chemical changes which take place in cells

The kind of cell which is formed through differentiation (muscle, blood, nerve etc) is controlled by DNA

The kind of organism which is produced (buttercup, giraffe, herring, human etc) is controlled by DNA

DNA carries genetic information and codes for the traits of all organisms

Your turn:

Where is DNA found in eukaryotes?

Where is DNA found in prokaryotes?

DNA molecule

DNA is a very large molecule made up of a long chain of sub-units

The sub-units are called **nucleotides**

Each nucleotide is made up of

a sugar called **deoxyribose**

a **phosphate** group **-PO_4** and

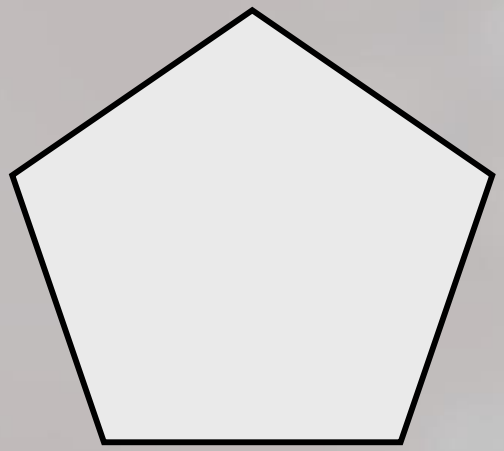
an **organic nitrogeneous base**

Ribose & Deoxyribose

Ribose is a sugar, like glucose, but with only five carbon atoms in its molecule

Deoxyribose is almost the same but lacks one oxygen atom

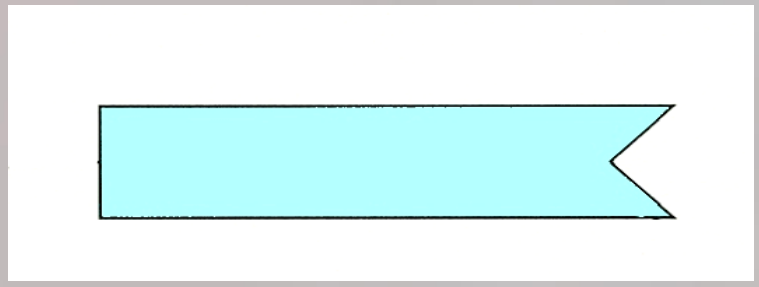
Both molecules may be represented by this symbol:



The bases

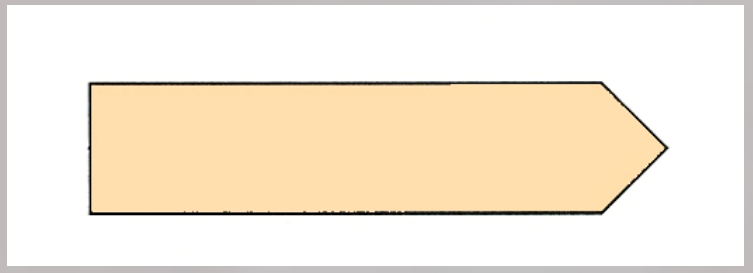
The most common organic bases are

Adenine



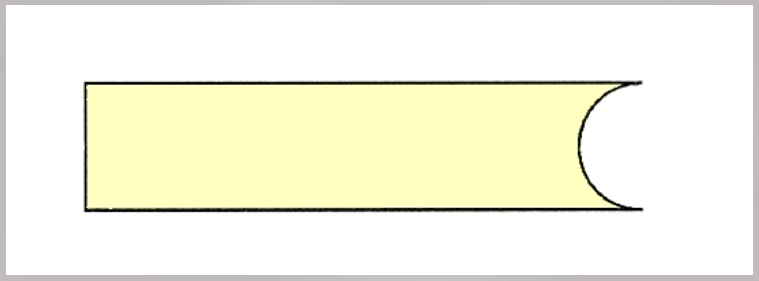
(A)

Thymine



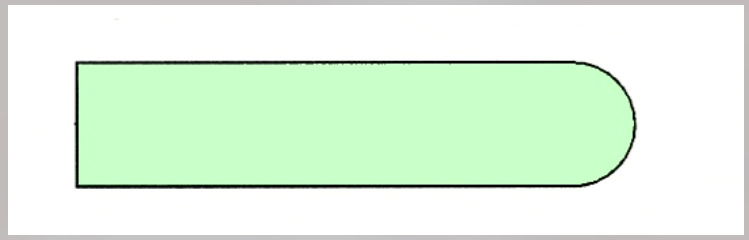
(T)

Cytosine



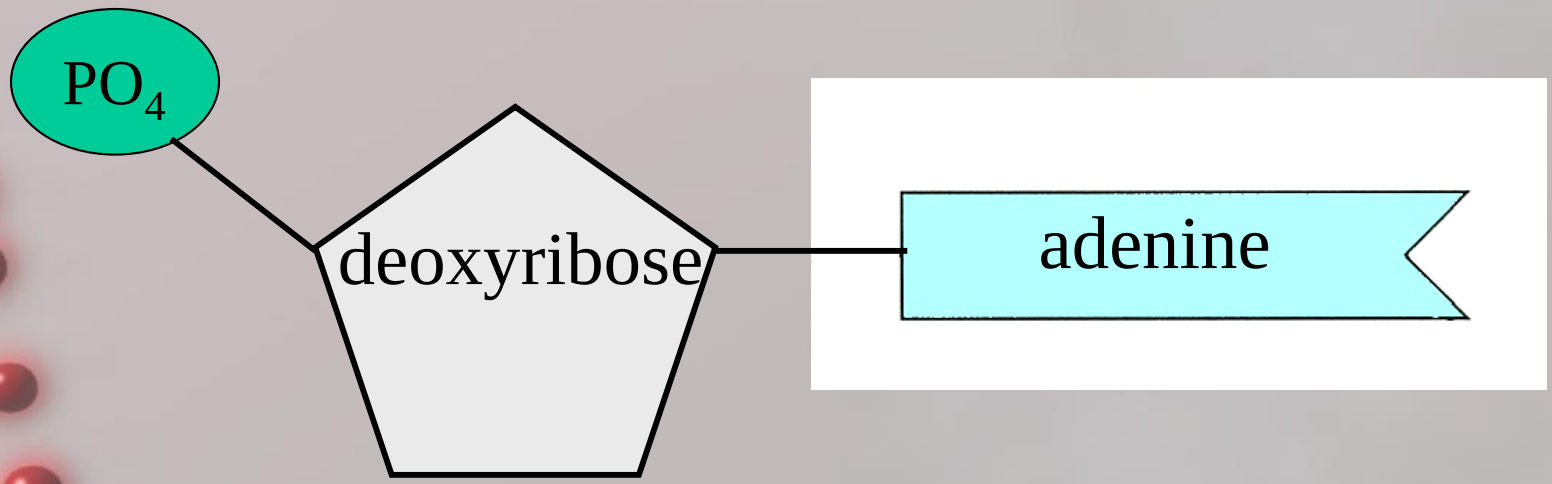
(C)

Guanine



(G)

Nucleotide

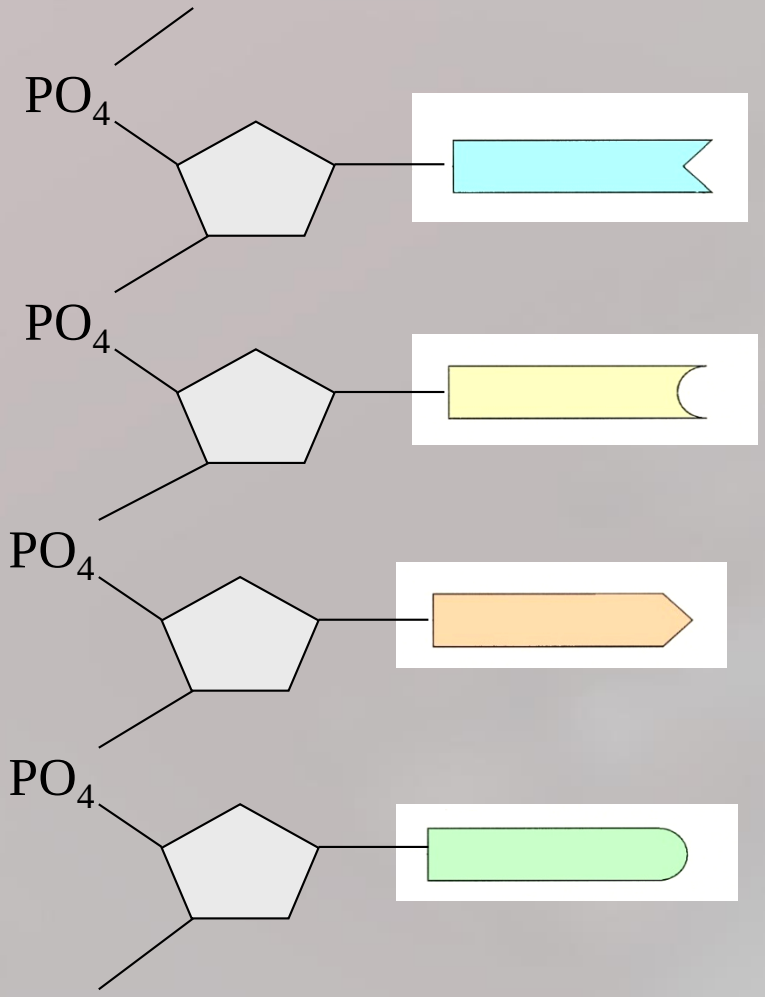


The deoxyribose, the phosphate and one of the bases combine to form a nucleotide

Your turn:

What are the three parts of a nucleotide?

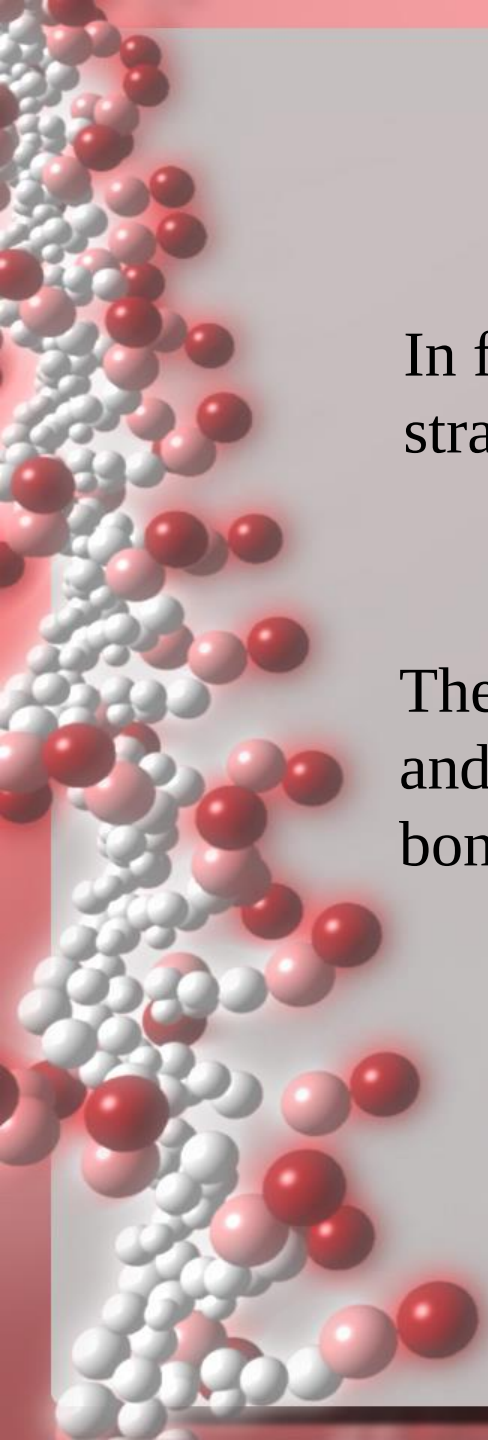
Joined nucleotides



sugar-phosphate backbone

+ bases

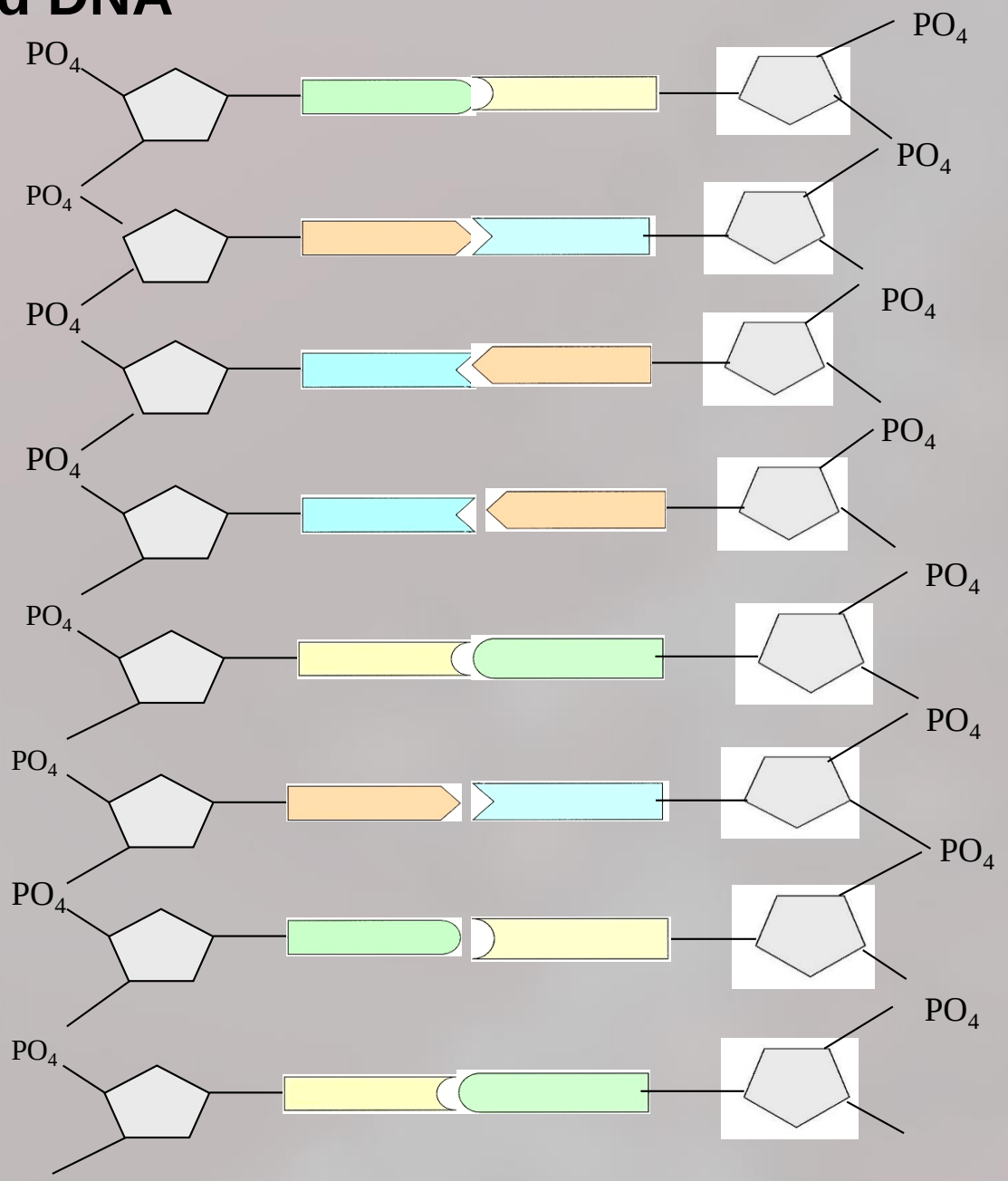
A molecule of DNA is formed by millions of nucleotides joined together in a long chain



In fact, the DNA usually consists of a double strand of nucleotides

The sugar-phosphate chains are on the outside and the strands are held together by Hydrogen bonds between the bases

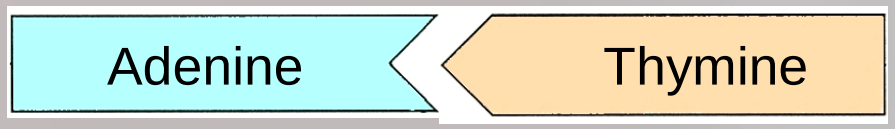
2-stranded DNA



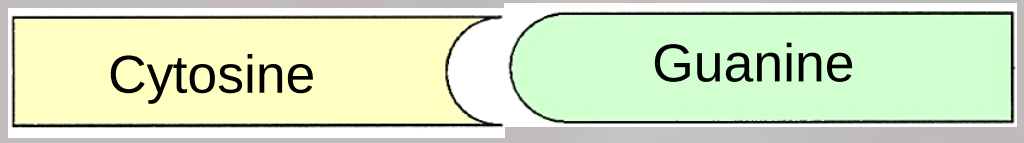
Bonding 1

The bases always pair up in the same way (Chargaff's Rule)

Adenine forms a bond with Thymine



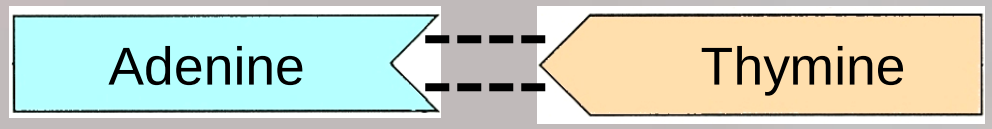
and Cytosine bonds with Guanine



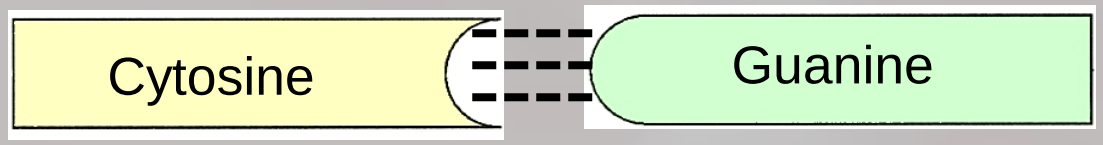
Bonding 1

The bases are held together by hydrogen bonds.

Adenine forms a double H bond with Thymine



and Cytosine forms a triple H bond with Guanine



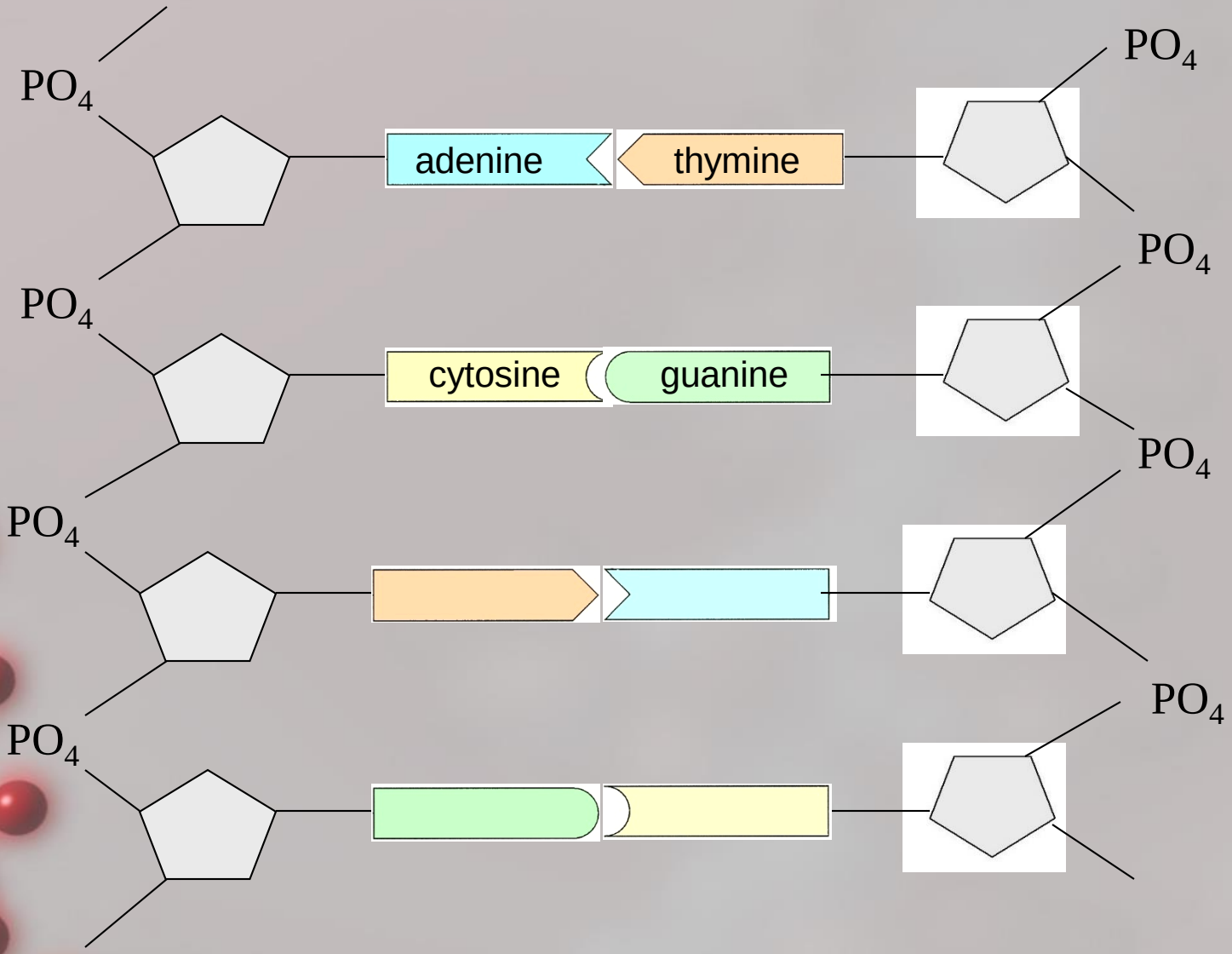
The amounts of the four bases on DNA (A,T,C,G) in a body or somatic cell:

A = 30.1%
T = 30.1%
G = 19.9%
C = 19.9%

Your turn:

An organism's DNA contains 15% Adenine, 15% Thymine, how much guanine and cytosine is in the DNA?

Bonding 2


PO4
PO4
adenine
thymine
PO4
PO4
cytosine
guanine
PO4
PO4
PO4
PO4

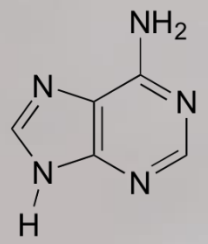
Bonding 3 – This page for PreAP only.

Purines and Pyrimidines.

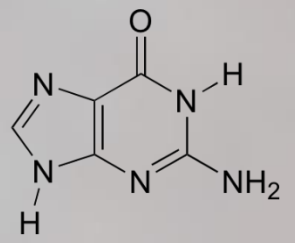
Adenine and Guanine are purines. They are the larger bases and have two rings.

Adenine

Guanine



adenine

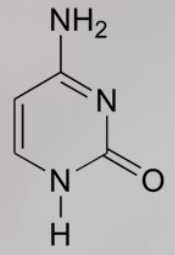


guanine

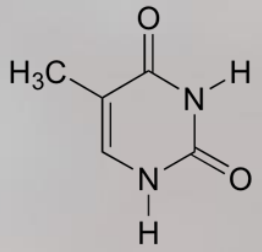
Thymine and Cytosine are pyrimidines. They have only one ring.

Cytosine

Thymine



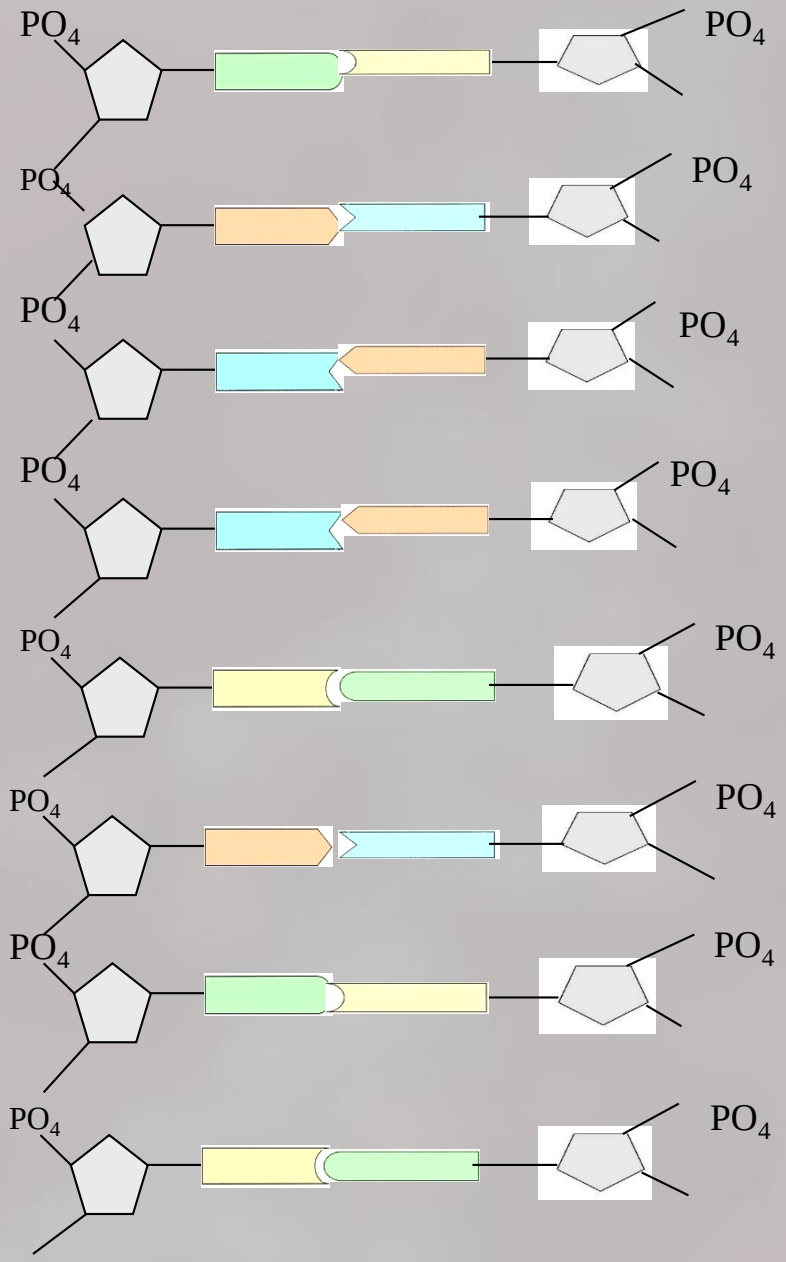
cytosine



thymine

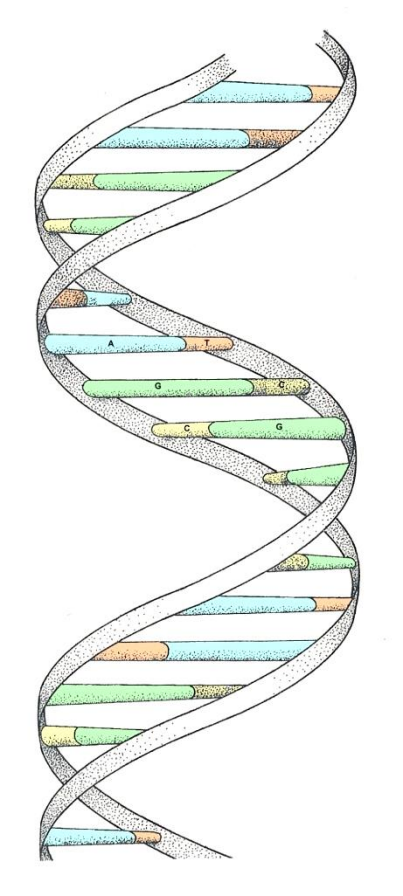
Double-stranded DNA

The genetic code is carried in the nitrogen bases, it's important DNA is copied correctly.



The paired strands are coiled into a spiral called

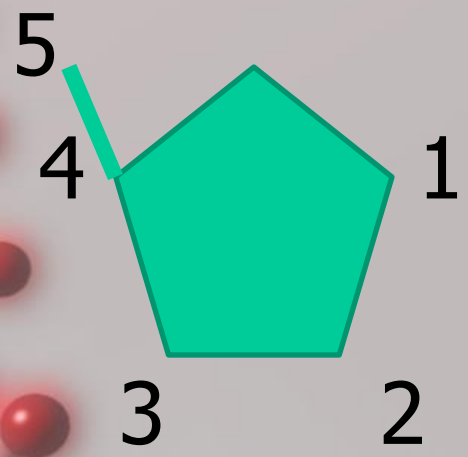
A DOUBLE HELIX

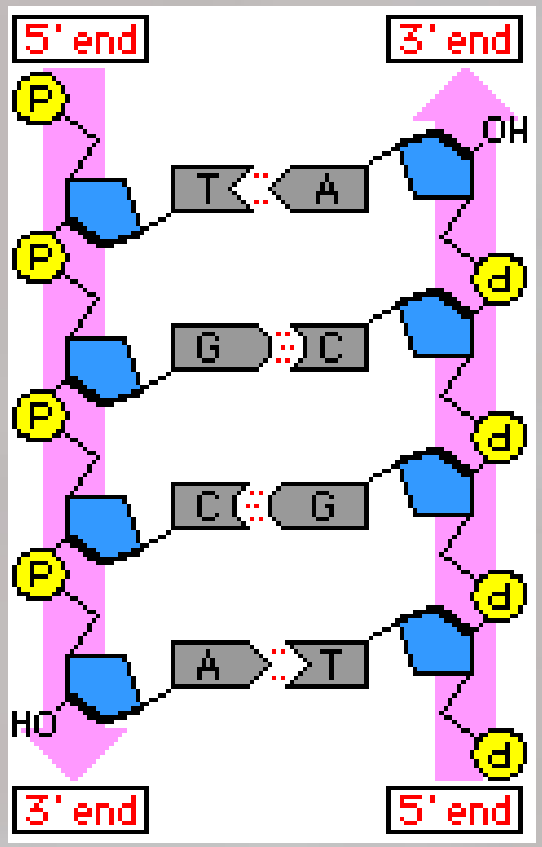


Anti-parallel

- One side is 3′ to 5′, the other is 5′ to 3′

Deoxyribose sugar has 5 carbons:

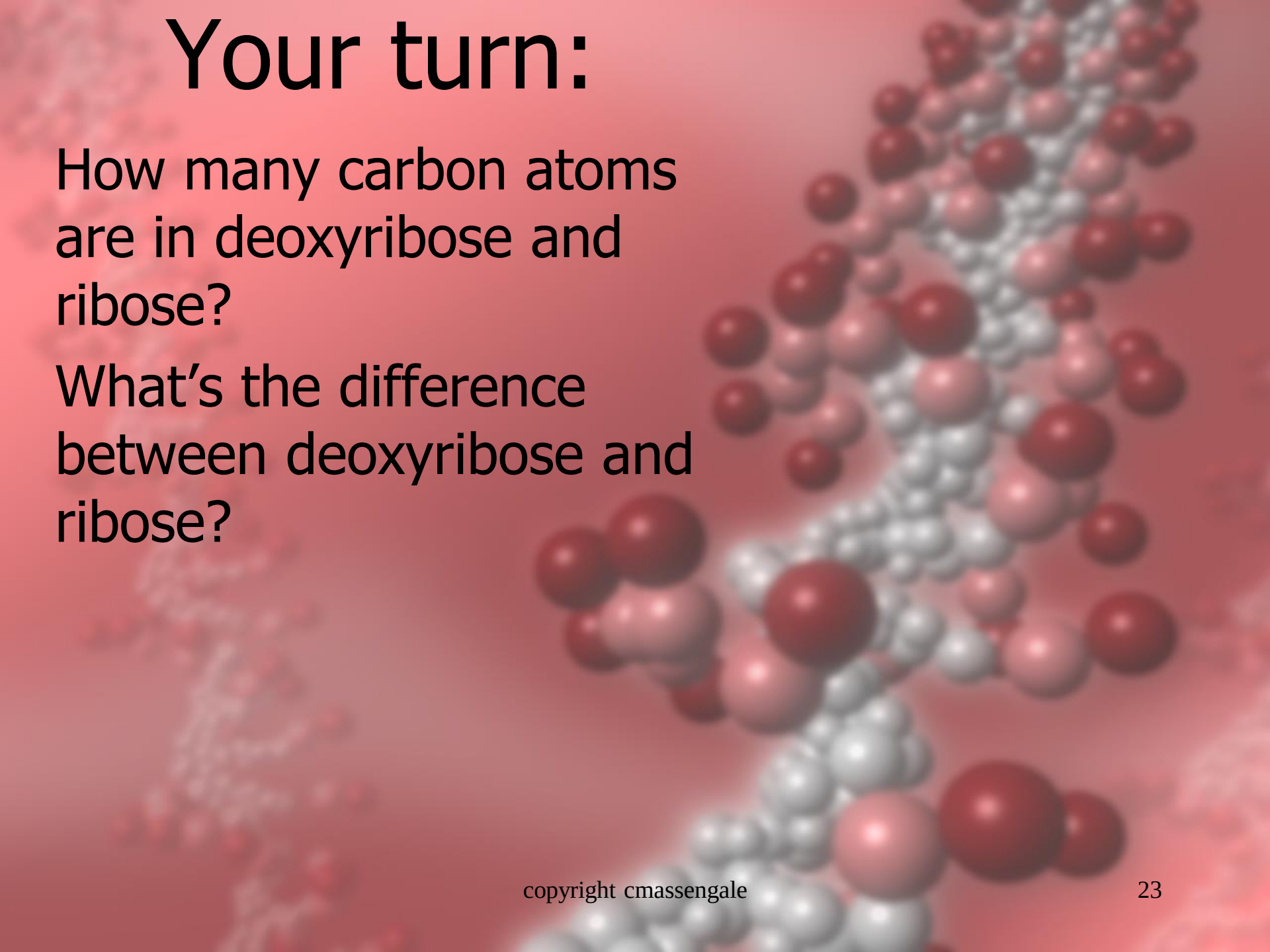




Your turn:

How many carbon atoms are in deoxyribose and ribose?

What's the difference between deoxyribose and ribose?



Your turn:

Write a DNA strand that will pair with this DNA strand:

3’ ATT CGG AGC 5’

Replication

Before a cell divides, the DNA strands unwind and separate

Each strand makes a new partner by adding the appropriate nucleotides

The result is that there are now two double-stranded DNA molecules in the nucleus

So that when the cell divides, each nucleus contains identical DNA

This process is called **replication**

Your turn:

During what phase in interphase does DNA replicate?

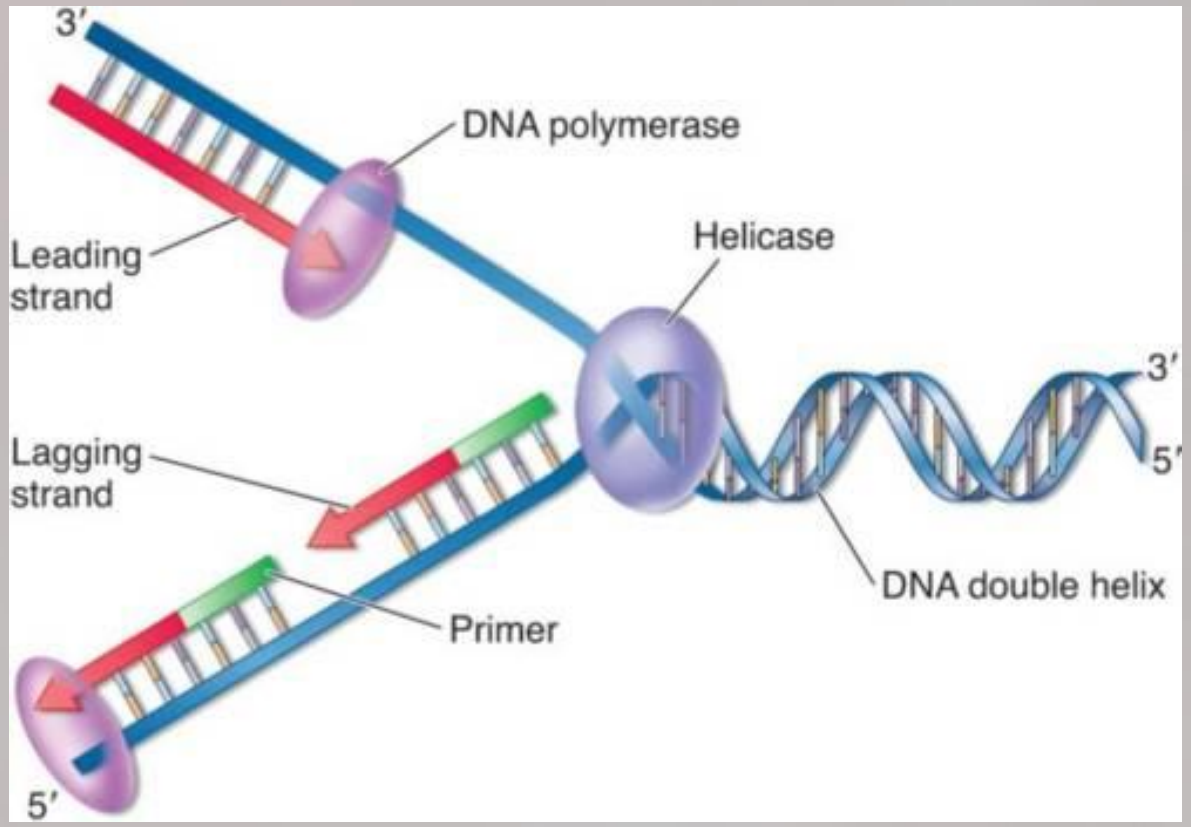
INTERPHASE

Your turn:

What is the significance of DNA replication in cells, why does it happen?

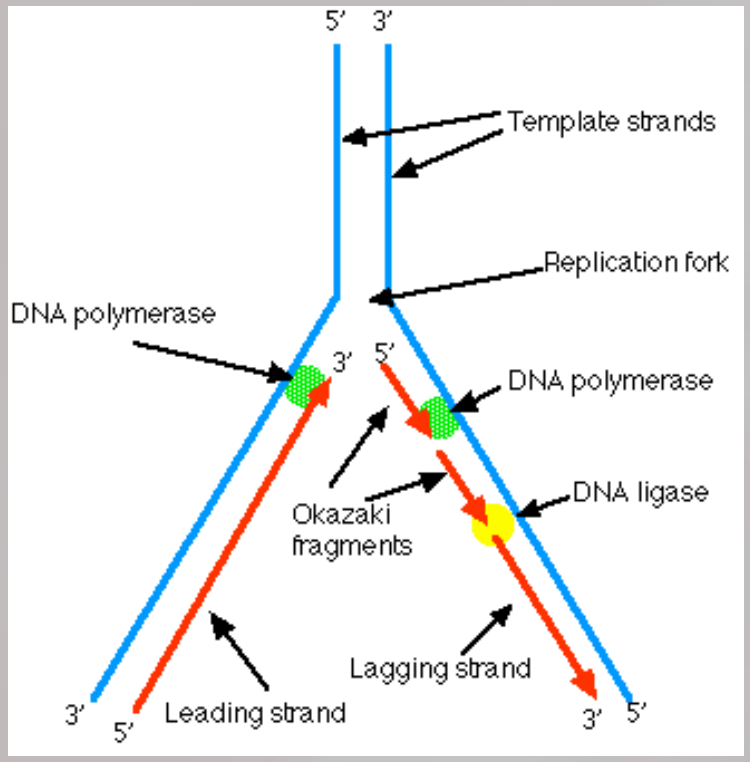
Enzymes Involved in Replication

- An enzyme, Helicase, unzips DNA
- DNA polymerase adds new nucleotides.



Leading and Lagging Strand - This page for PreAP only.

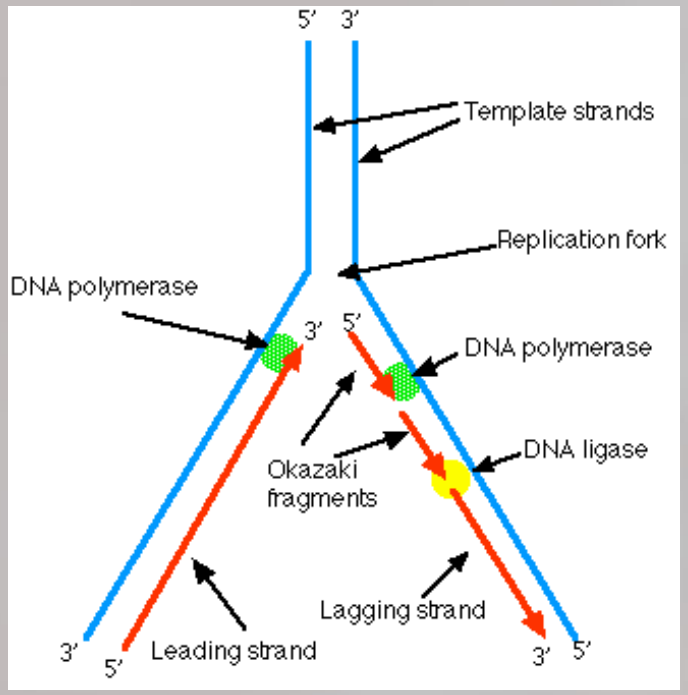
- DNA polymerase adds new nucleotides continuously down the leading strand because it separates at 3′ end.



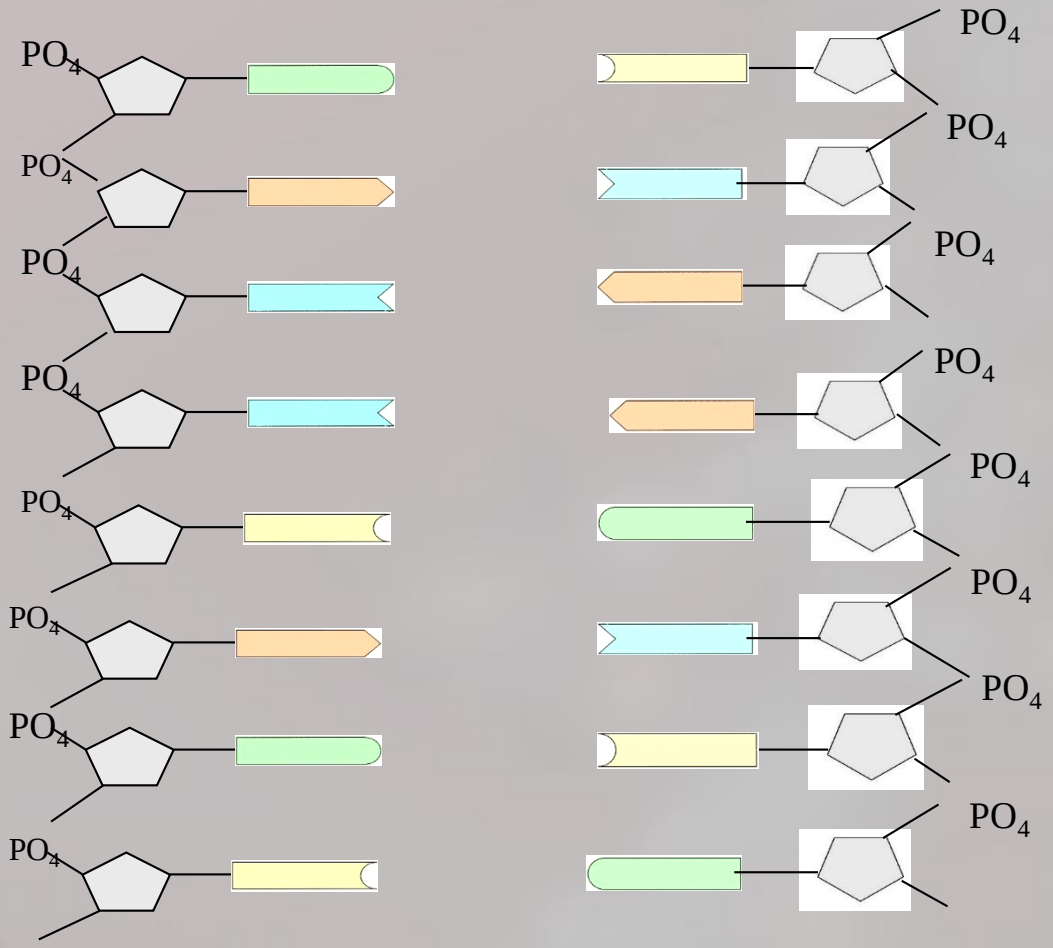
Leading and Lagging Strand

This page for PreAP only.

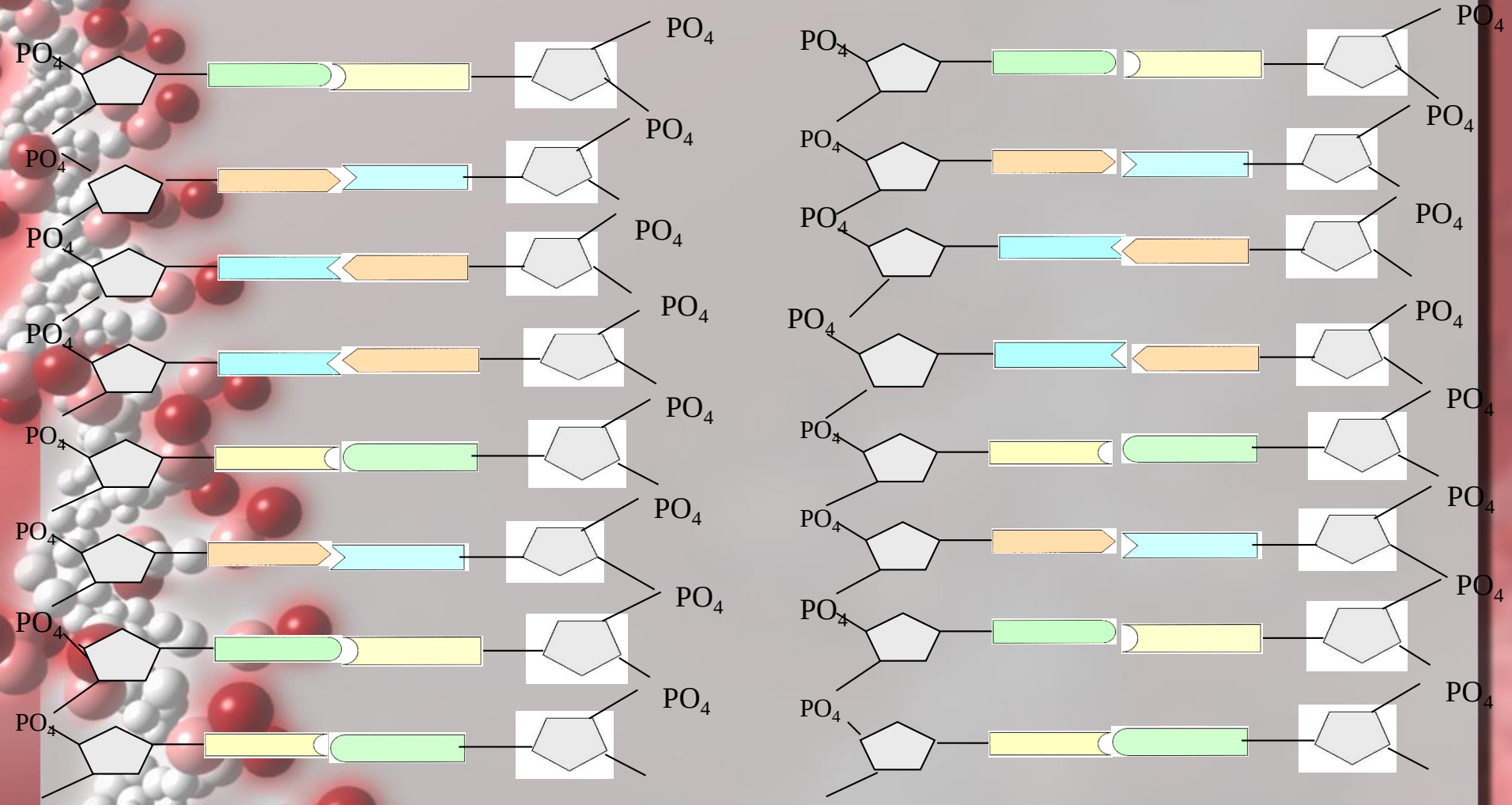
- On the other strand DNA is still copied from 5′ to 3′, so it must be replicated in segments. This strand is the lagging strand.



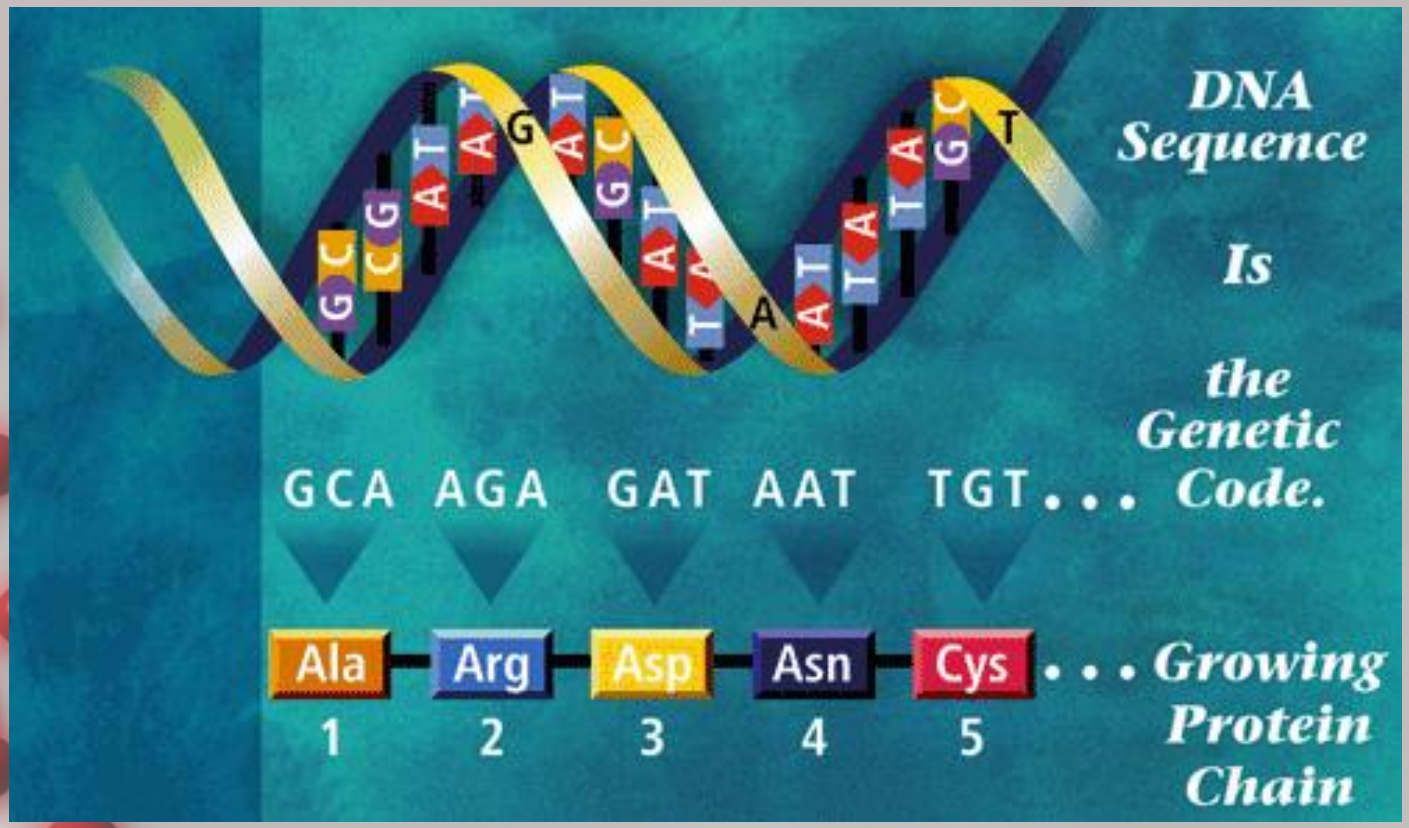
The original strand separates when helicase breaks the bonds



DNA polymerase adds nucleotides to each old strand to form two identical strands



Every three bases codes for a protein that builds your traits! So it's the bases that carry the genetic code! They also have the code to synthesize enzymes from organic molecules to help you build and break down products and substrates.



Your turn:

What determines the traits of an organism?

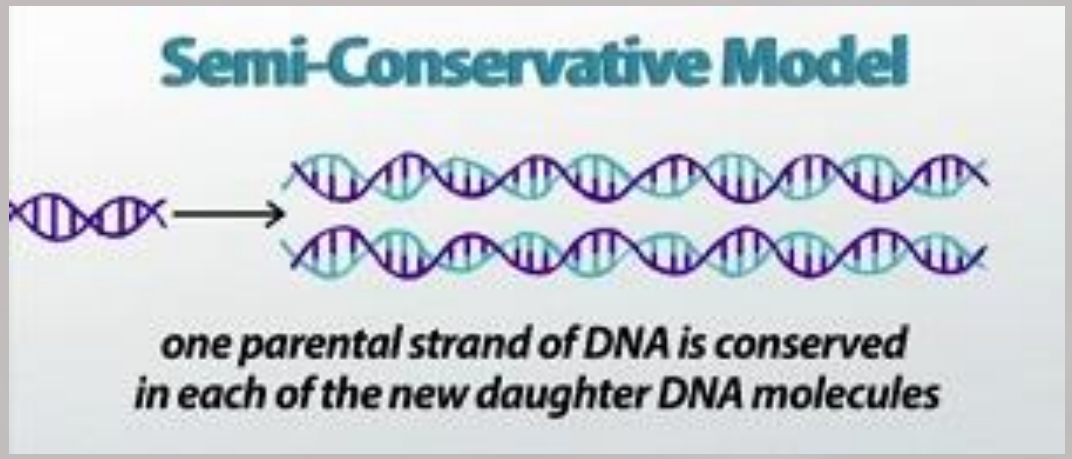
Your turn:

DNA has the code to synthesize enzymes

from what?

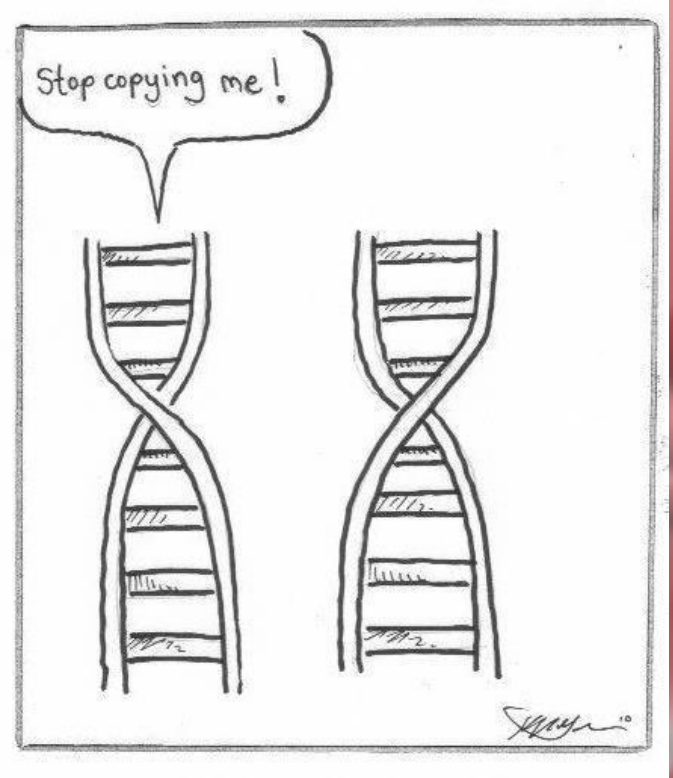
Semiconservative Model of Replication

- The new DNA consists of 1 PARENTAL (original) and 1 NEW strand of DNA



Proofreading New DNA

- DNA polymerase initially makes about 1 in 10,000 base pairing errors
- Enzymes proofread and correct these mistakes
- The new error rate for DNA that has been proofread is 1 in 1 billion base pairing errors



[Amoeba Sisters DNA Replication]