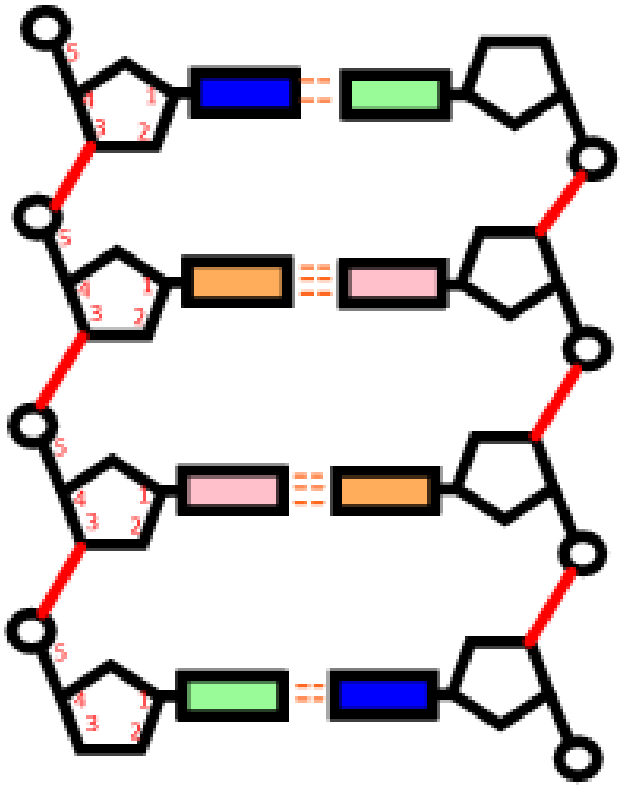
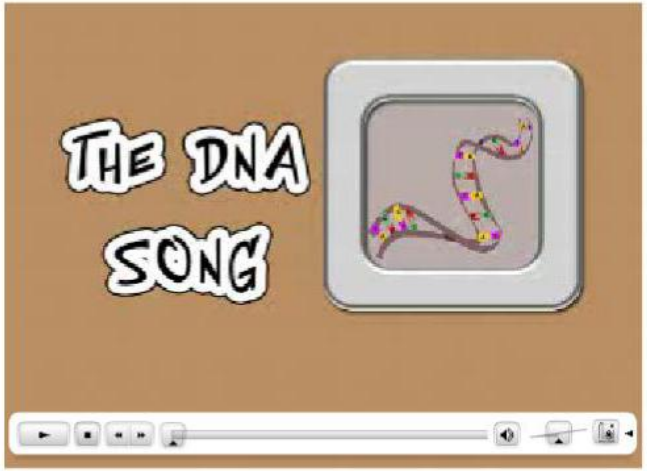


DNA Structure

Hip-hip hooray for DNA!



http://www.youtube.com/watch?v=xnT_OuAYfvY

DNA!

DNA- *deoxyribonucleic acid*:
the recipe book for all the functions
in a living organism - the code for life

How was the structure of DNA discovered?

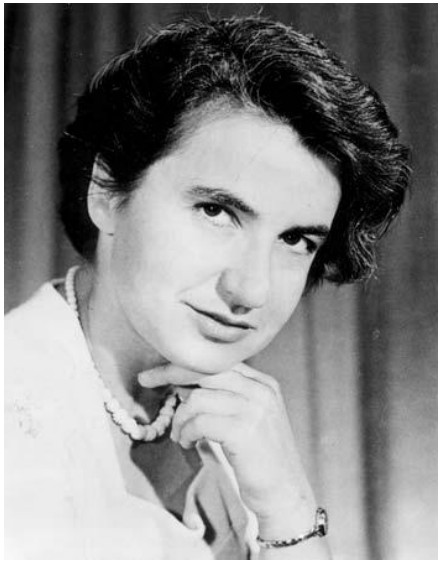
http://www.youtube.com/watch?v=sf0YXnAFBs8

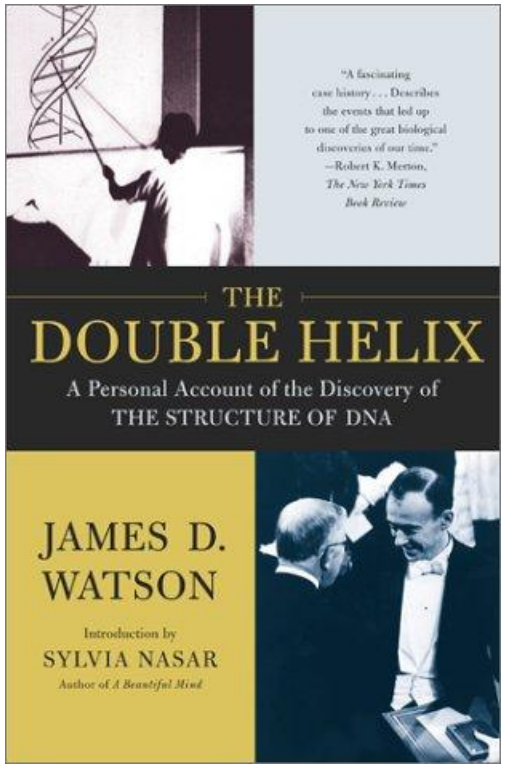
How is the discovery of DNA an example of:
- cooperation?
- competition?
- internationalism?

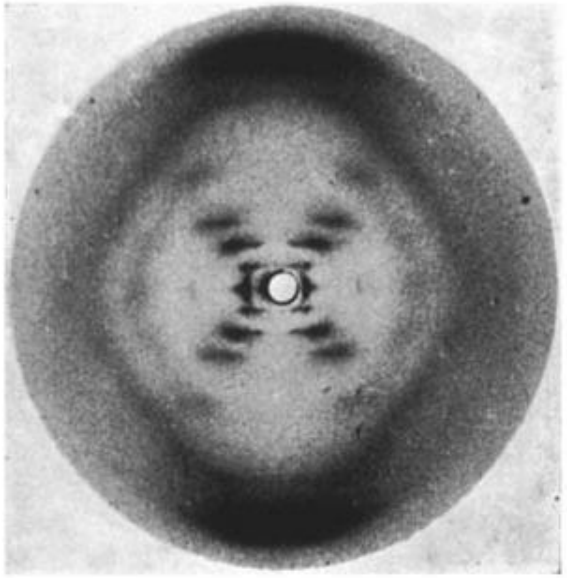
- A DNA Rap: https://www.youtube.com/watch?v=wdhL-T6tQco
- Chargaff: https://www.youtube.com/watch?v=HvJlnujmYcg
- & https://www.youtube.com/watch?v=Nbhx94MyYkk
- https://www.youtube.com/watch?v=sf0YXnAFBs8

There's more to the story…

- Watson & Crick
- Linus Pauling
- Franklin & Wilkins
- Chargaff



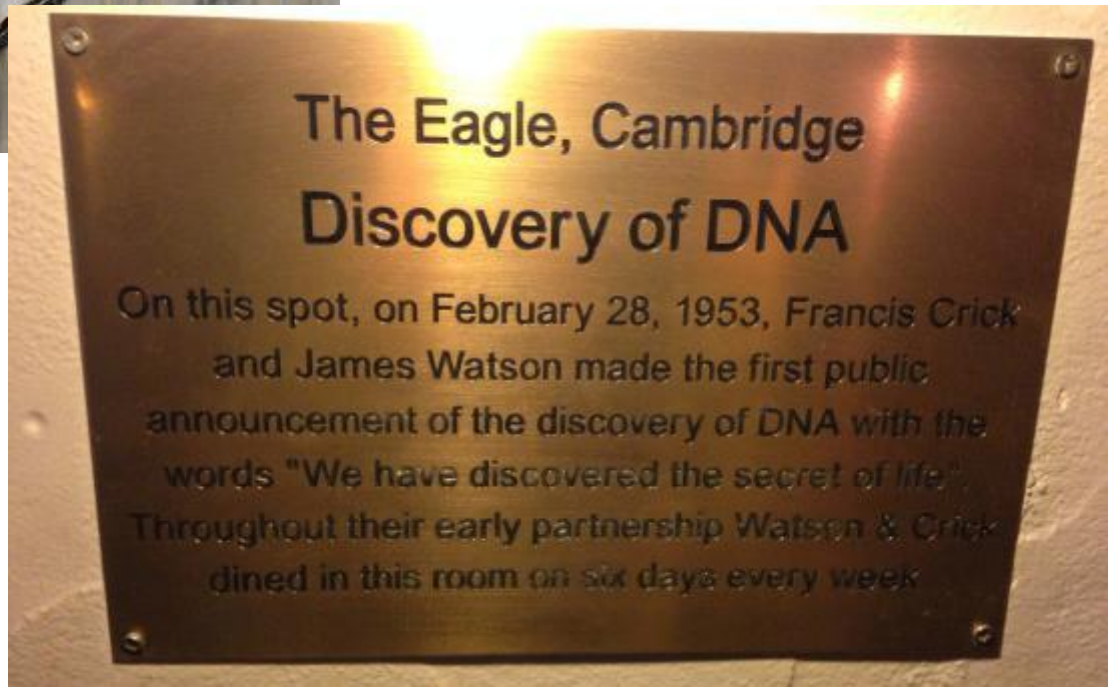




Film: "The Secret of Photo 51"

https://www.youtube.com/watch?v=0tmNf6ec2kU

Science Teacher Tourism…



Some key points about the structure of DNA:

http://www.youtube.com/watch?v=qy8dk5iS1f0

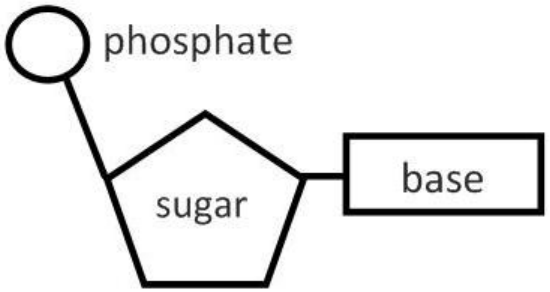
DNA is a double-helix: it has two strands that twist around each other.

Each strand is made of single units called nucleotides.

It has a sugar-phosphate backbone.

Bases join the two strands by hydrogen bonds. These bases are cytosine, guanine, adenine and thymine.

A nucleotide:

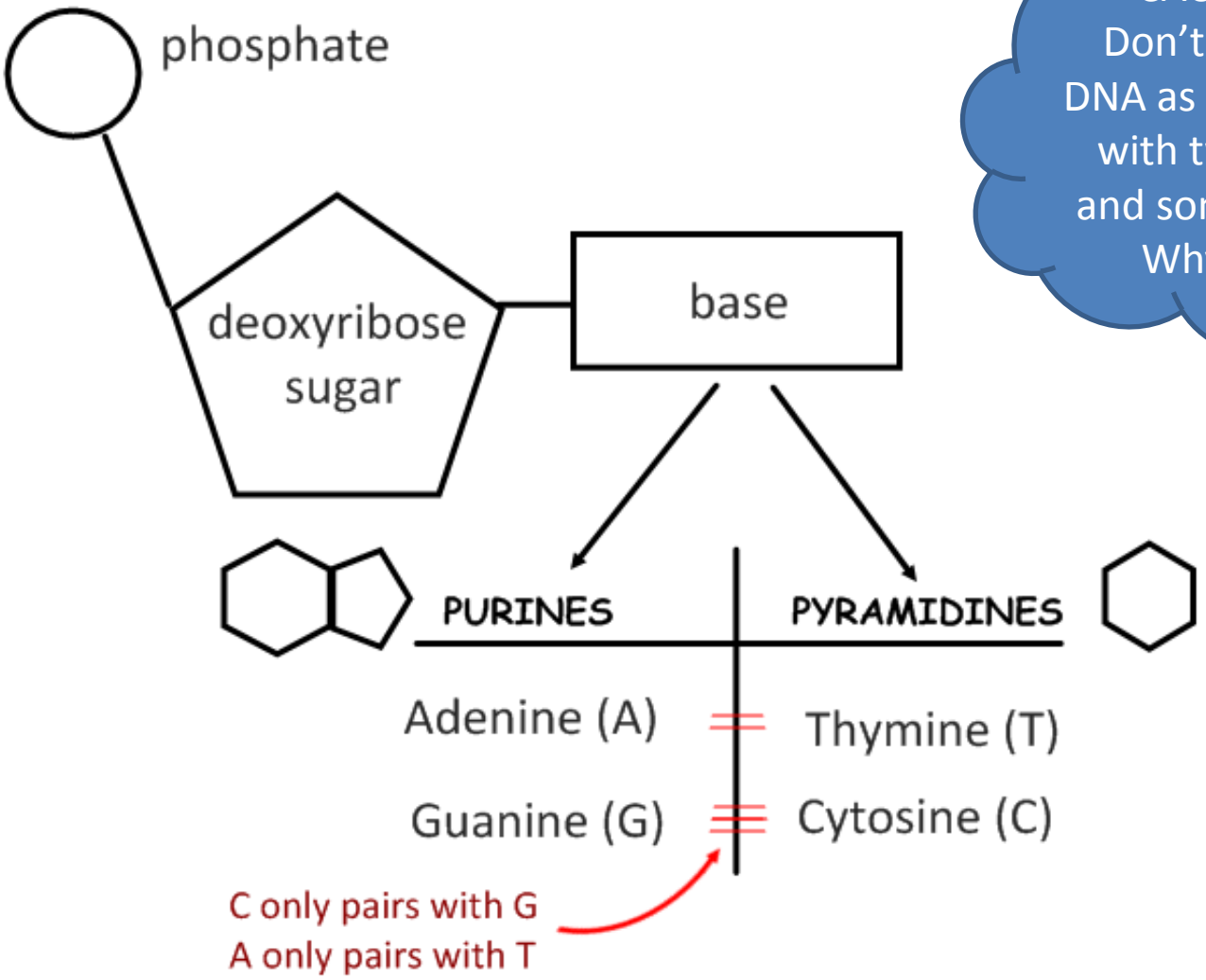


Complementary base pairing is a key idea in genetics: C pairs with G, T with A.

Each strand of DNA can be millions of base-pairs in length and is coiled up to make chromosomes.

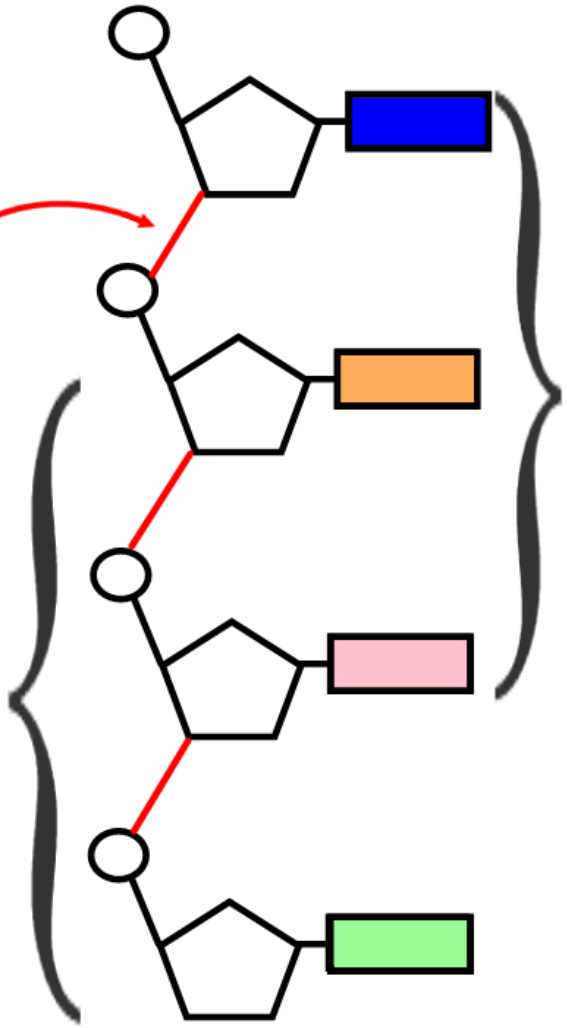
Remember? Our 4th Macromoleule!

A nucleotide: the single unit in DNA



CAUTION!
Don't think of DNA as a "ladder" with two sides and some rungs!
Why not?

A strand of nucleotides is joined by covalent bonds

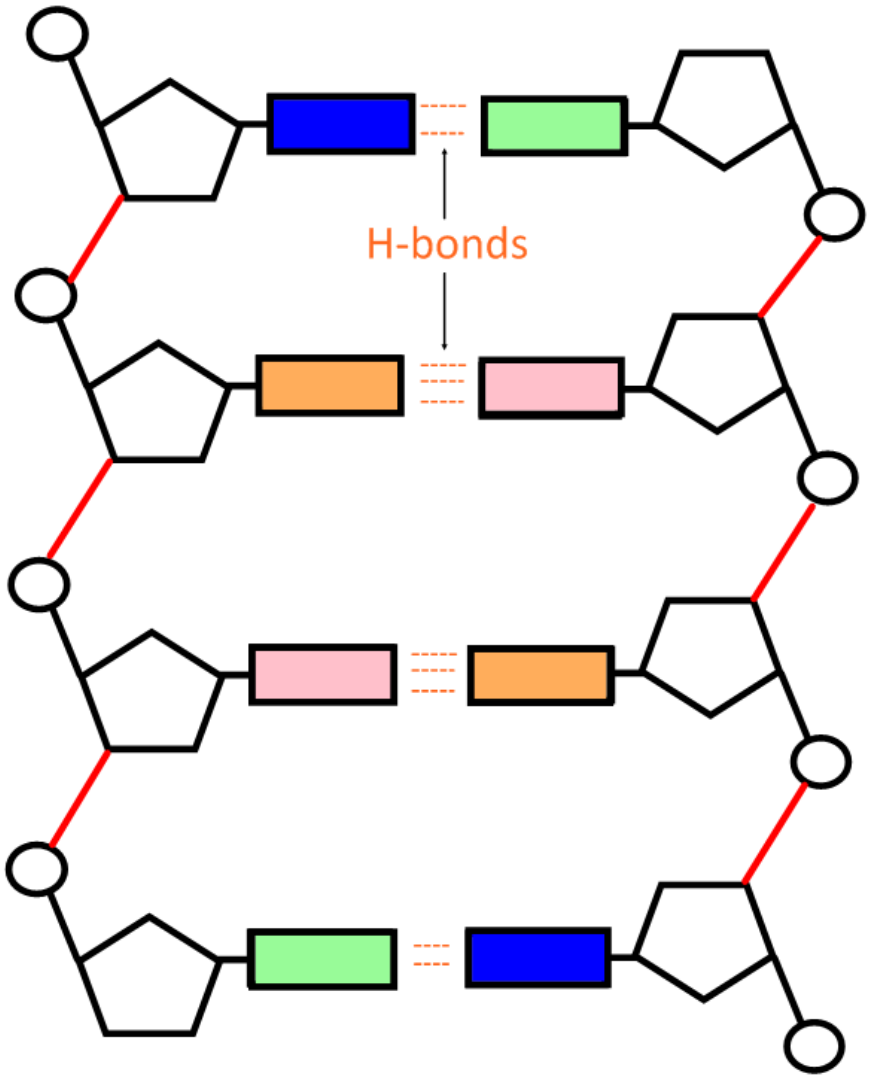


The sequence of bases makes up the genetic code.

The bases are 'read' in groups of three.

These triplets are used to send instructions in the cell: to switch genes on and off, to make proteins and enzymes.

DNA is a double strand of polynucleotides.



The sugar-phosphate backbone is on the outside, the bases are on the inside.

The strand is held together by hydrogen bonds between the bases.

A only pairs with T. G only pairs with C.
This is called complementary base pairing.

The two strands run in opposite directions.
This is called anti-parallel.

DNA twists into a double-helix, held by more hydrogen bonds.

http://science.nhmccd.edu/biol/bio1int.htm#dna

antiparallel strands of polynucleotides

5' (5-prime)
the end nearest
carbon number 5

3' (3-prime)

H-bonds

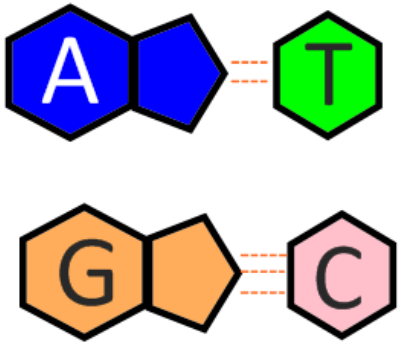
covalent bonds link
carbon 3 and 5

3' (3-prime)
the end nearest
carbon number 3

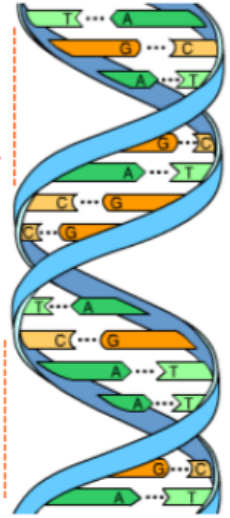
5' (5-prime)

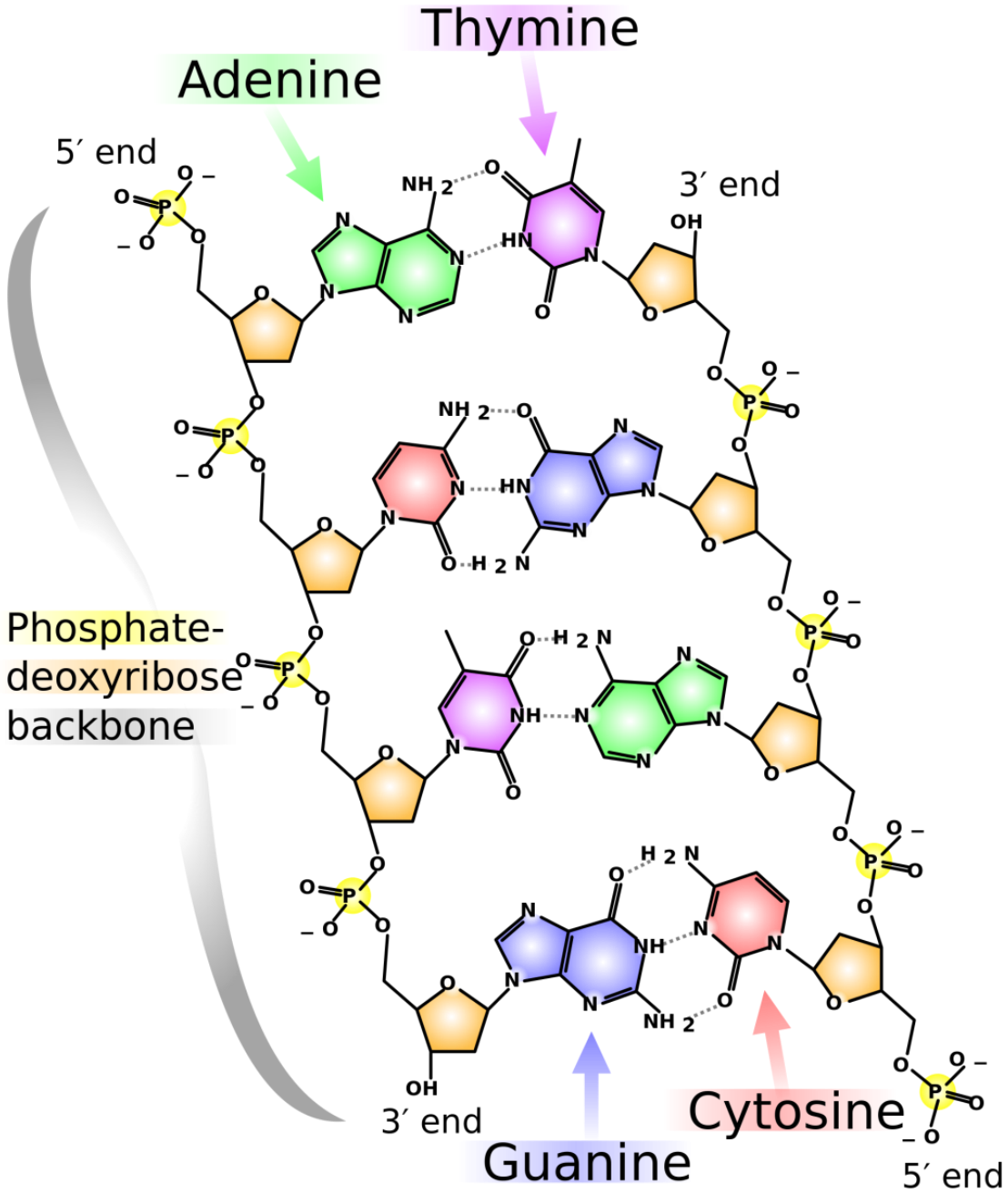
A purine must base-pair
with a pyramidine:

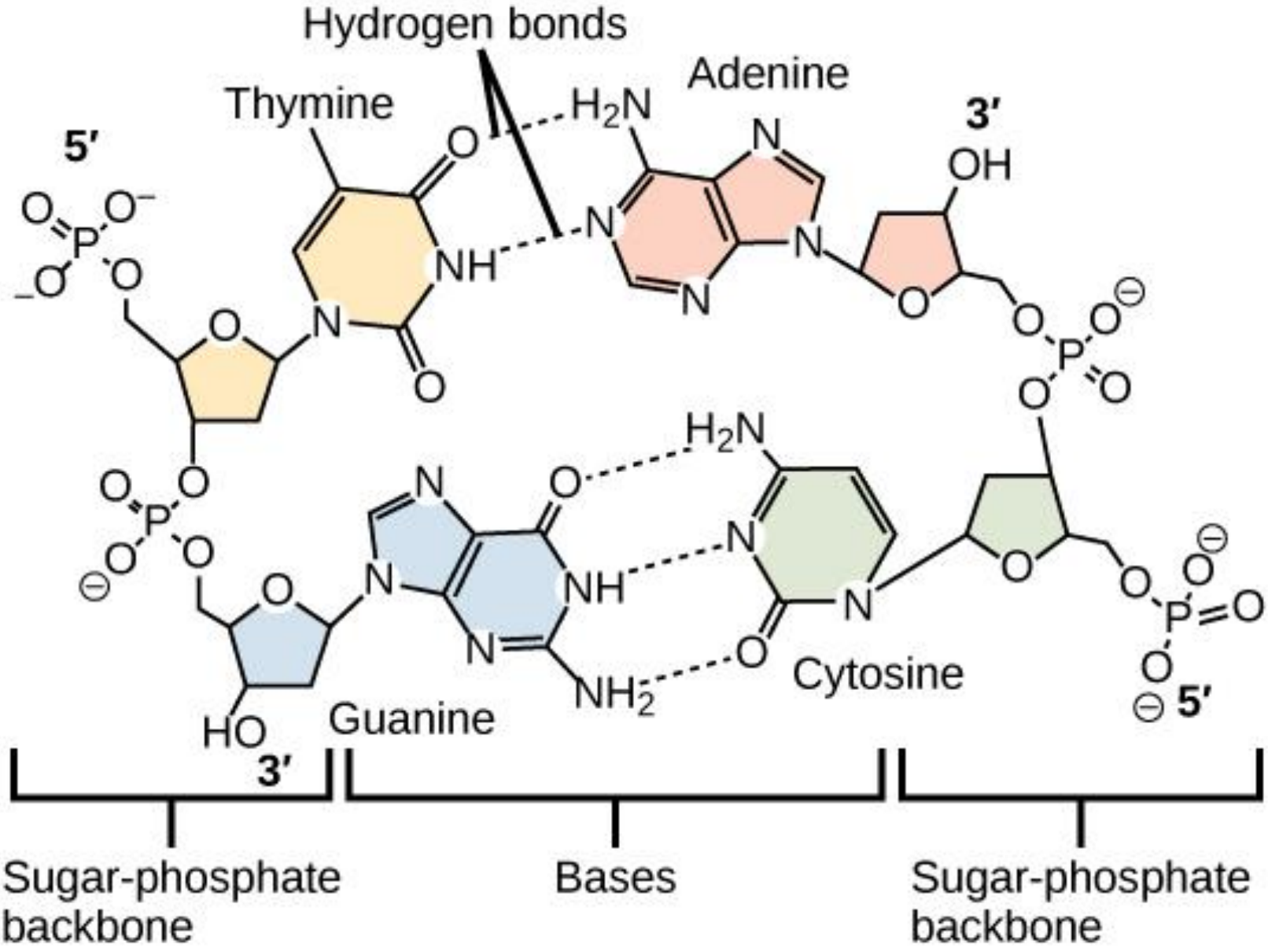
purines pyramidines



Hydrogen bonds
also hold the
structure of the
double helix




Thymine
Adenine
5′ end
3′ end
Phosphate-
deoxyribose
backbone
3′ end
Guanine
Cytosine
5′ end

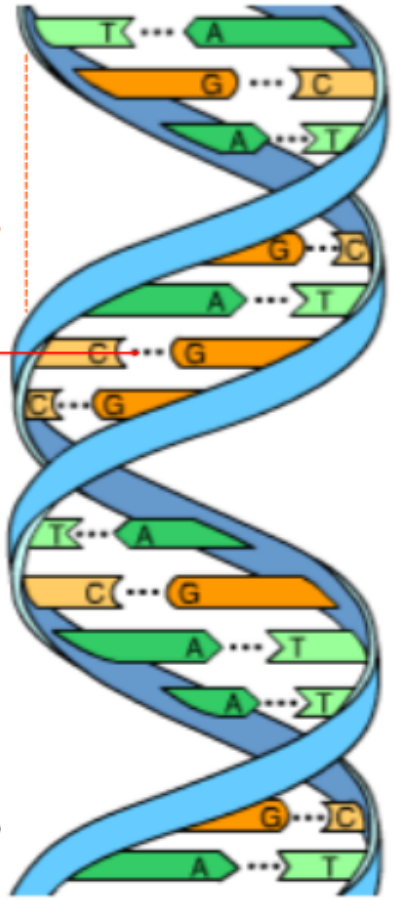

Hydrogen bonds
Thymine
Adenine
5′
3′
Guanine
Cytosine
3′
5′
Sugar-phosphate backbone
Bases
Sugar-phosphate backbone

How is the double helix structure maintained?

Hydrogen bonds hold adjacent sections together

Hydrogen bonds hold complementary base pairs together

Complementary base pairing ensures that mistakes are not made when copying or transcribing DNA



Sugar-phosphate backbone is hydrophilic so is positioned on the outside

Nitrogenous bases are very reactive so are protected on the inside

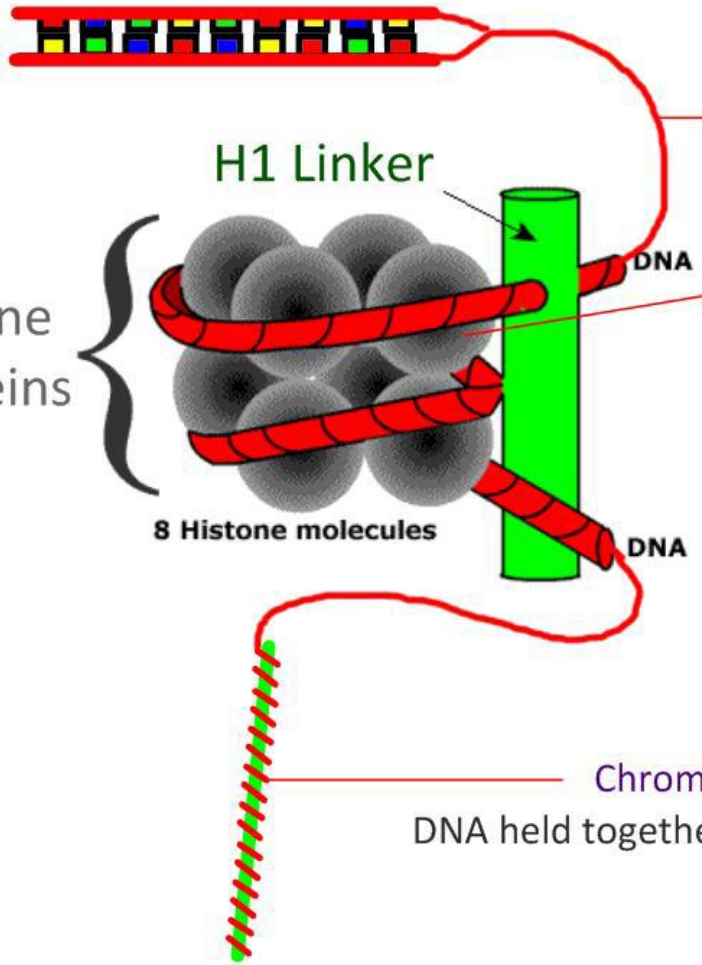
Polynucleotides are anti-parallel: they run in opposite directions

http://science.nhmccd.edu/biol/bio1int.htm#dna

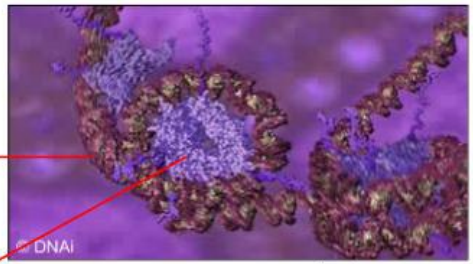
A good Resource for this unit…

- http://learn.genetics.utah.edu/content/basics/

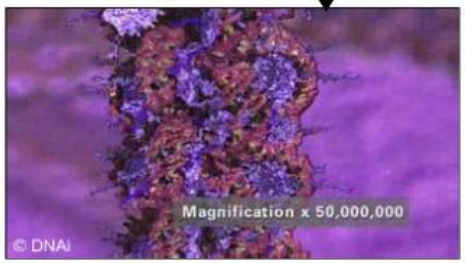
Nucleosomes hold the DNA together to form the 'frame' of chromosomes:



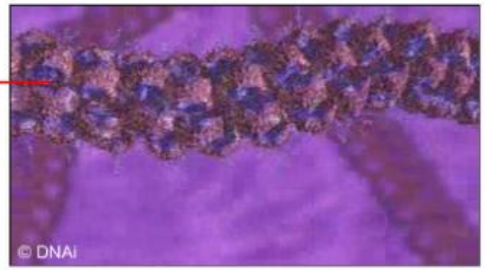
DNA wraps twice around each nucleosome before moving to the next one.



packing



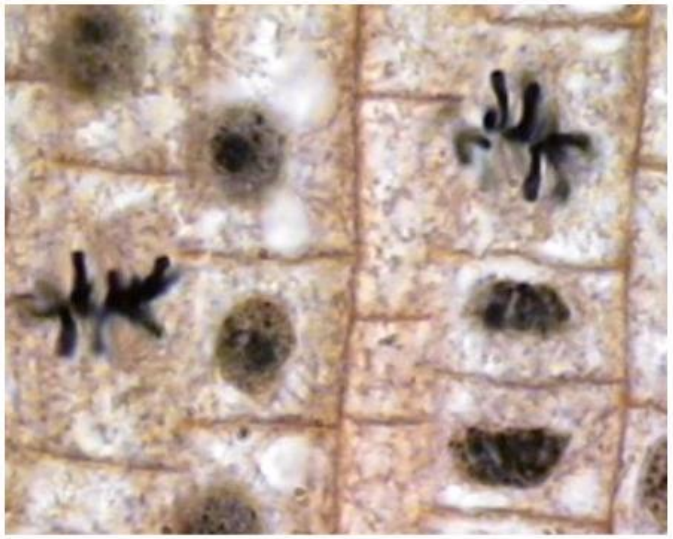
supercoiling



Chromosome:
DNA held together by nucleosomes

http://www.dnai.org/text/mediashowcase/index2.html?id=564

Histone proteins allow the DNA to be SUPERCOILED



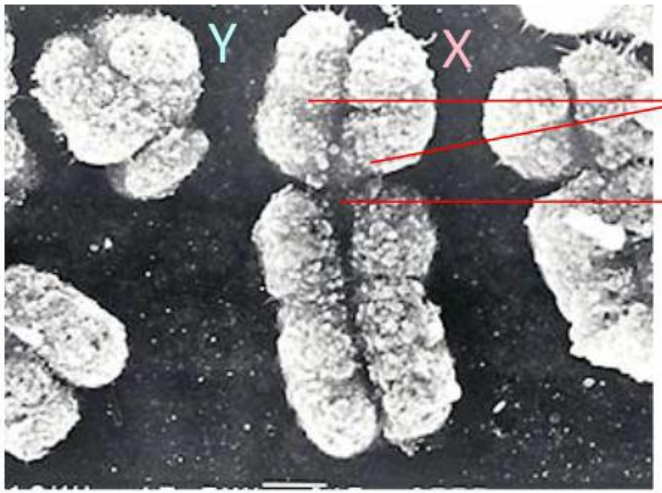
Which phases of mitosis do you recognise in this slide? It is easy to see them, because the DNA has been supercoiled to make division easier

http://www.lima.ohio-state.edu/biology/images/metaphase.jpg

15,000 x more dense, so takes up less space in the nucleus

Supercoiled sections of genes cannot be expressed (cannot be opened up for transcription)

Supercoiling allows control over which genes are expressed: to express a gene, the region of the chromosome must be uncoiled.



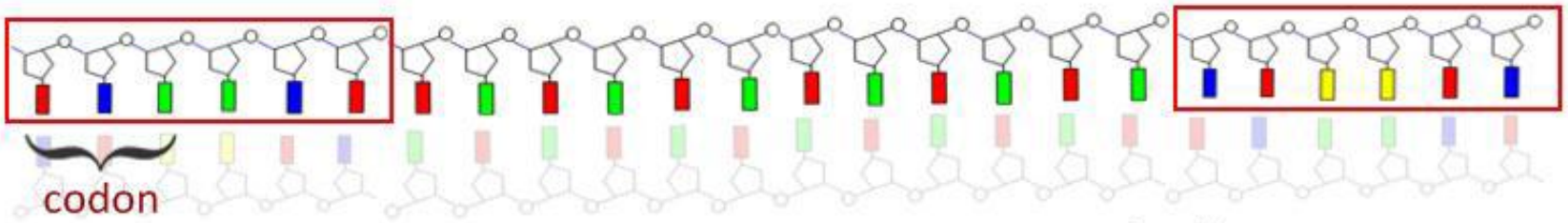
This SEM image shows supercoiled X and Y chromosomes in metaphase. The sister chromatids have not separated yet.

http://www.indigo.com/software/gphpcd/em24.jpg

The sequence of bases on DNA makes up genes.

Genes are heritable factors that control specific characteristics.

Nuclear DNA contains *single-copy genes* and regions of *highly repetitive sequences*.



Single Copy Genes

1.5% of genome makes polypeptides
Each codon (3 bases) codes for one amino acid

3% codes for 'on/off' gene switches

Within each eukaryotic genes there are:

EXONS (coding regions)

INTRONS
(non-coding regions which are edited out)

First Letter	Second Letter: T	Second Letter: C	Second Letter: A	Second Letter: G	Third Letter
T	TTT, TTC: Phe; TTA, TTG: Leu	TCT, TCC, TCA, TCG: Ser	TAT, TAC: Tyr; TAA: Stop; TAG: Stop	TGT, TGC: Cys; TGA: Stop; TGG: Trp	T C A G
C	CTT, CTC, CTA, CTG: Leu	CCT, CCC, CCA, CCG: Pro	CAT, CAC: His; CAA, CAG: Gln	CGT, CGC, CGA, CGG: Arg	T C A G
A	ATT, ATC, ATA: Ile; ATG: Met	ACT, ACC, ACA, ACG: Thr	AAT, AAC: Asn; AAA, AAG: Lys	AGT, AGC: Ser; AGA, AGG: Arg	T C A G
G	GTT, GTC, GTA, GTG: Val	GCT, GCC, GCA, GCG: Ala	GAT, GAC: Asp; GAA, GAG: Glu	GGT, GGC, GGA, GGG: Gly	T C A G

http://www.illc.uva.nl/~seop/entries/information-biological/

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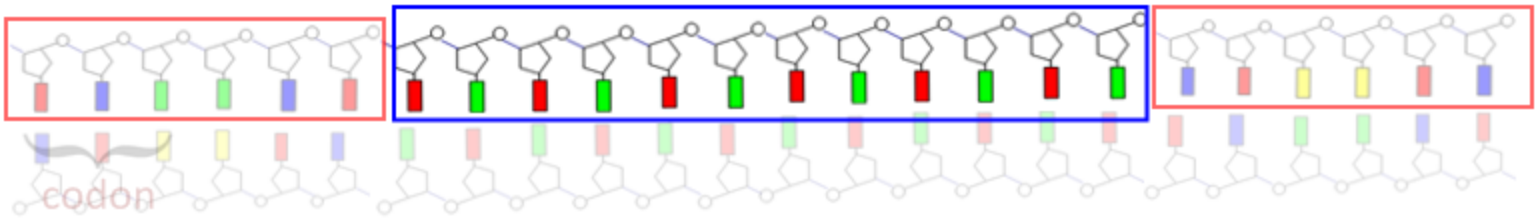

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Within each eukaryotic genes there are:

EXONS (coding regions)

INTRONS
(non-coding regions which are edited out)

Highly Repetitive Sequences

Makes up about 5-45% of the genome

Once called 'junk' DNA

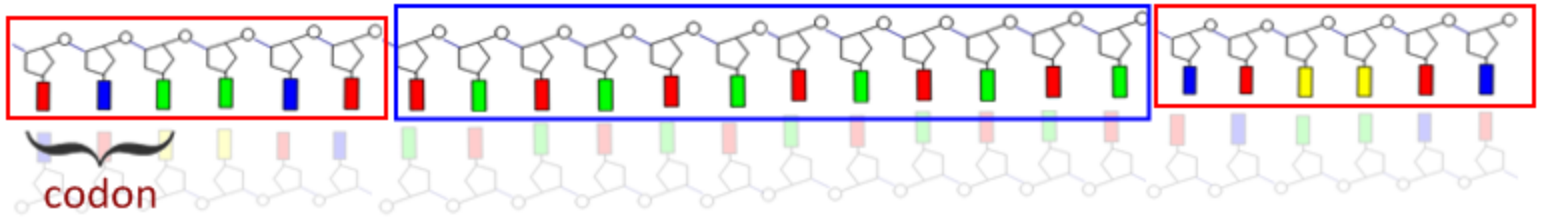
Also known as satellite DNA, each repeated sequence can be 5-300 base pairs.

HRSs are used in genetic fingerprinting.
This is because they accumulate mutations rapidly
(they do not affect phenotype, so are not selected against)

The sequence of bases on DNA makes up genes.

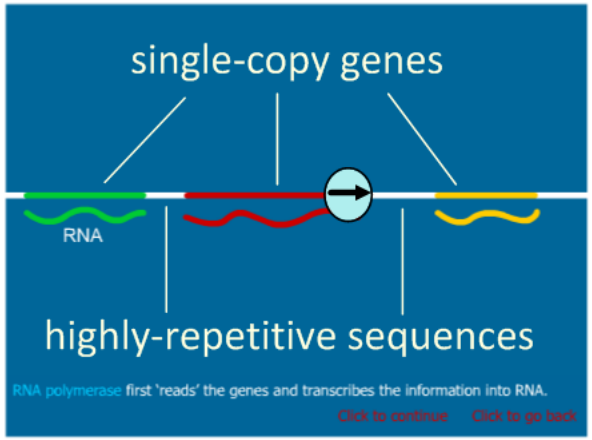
Genes are heritable factors that control specific characteristics.

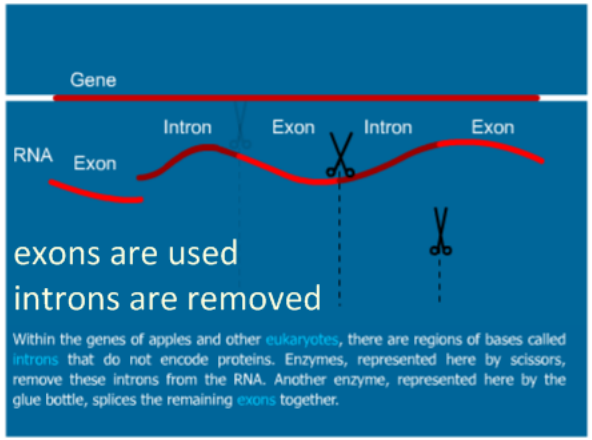
Nuclear DNA contains *single-copy genes* and regions of *highly repetitive sequences*.



Single Copy Genes

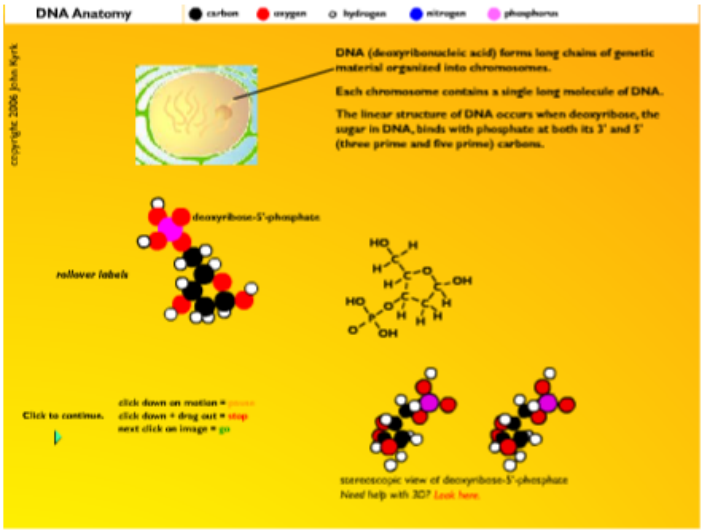
Highly Repetitive Sequences





http://www.four-h.purdue.edu/apple_genomics/flash/movie3.swf

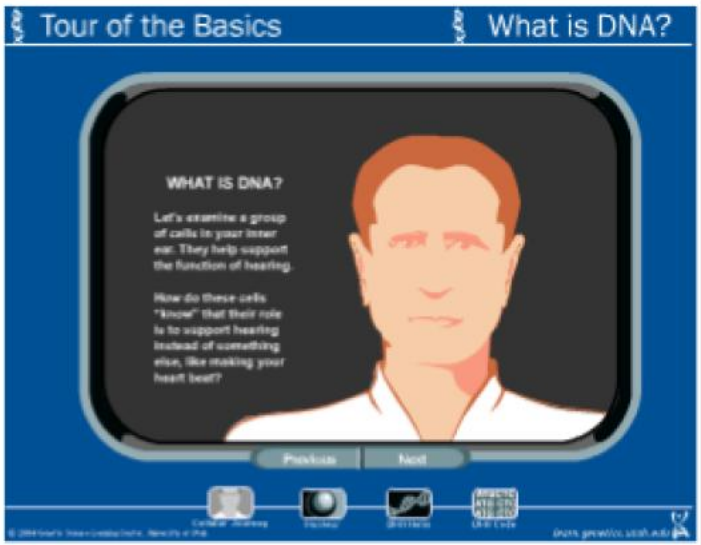
More DNA resources:



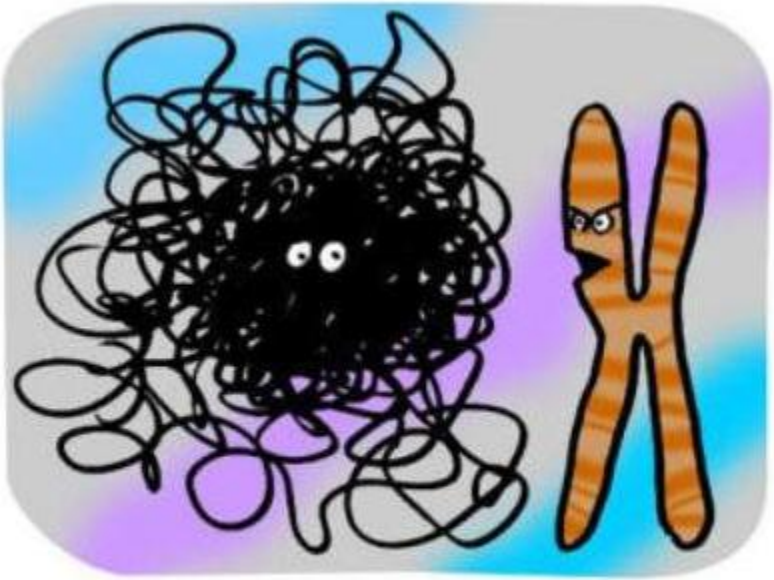
http://www.johnkyrk.com/DNAanatomy.html

Match the pairs (Nobel Prize):

http://nobelprize.org/educational_games/medicine/dna_double_helix/readmore.html



http://learn.genetics.utah.edu/content/begin/tour/



Dude, mitosis starts in five minutes...
I can't believe you're not condensed yet.