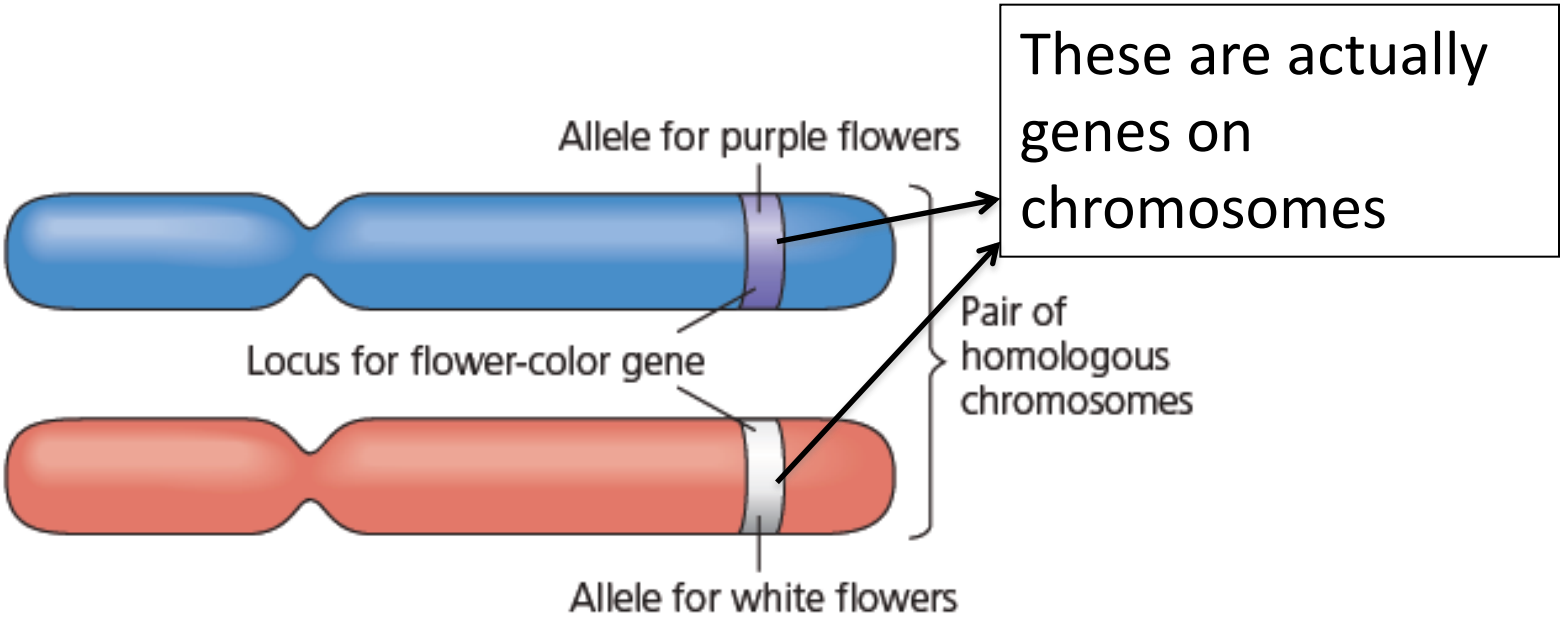
Lecture 3

- Continuing on Mendel's laws of Genetics

- What are the molecular mechanisms underlying Mendel's results? Genetic material DNA

Quick revisit of Genetics terminology!

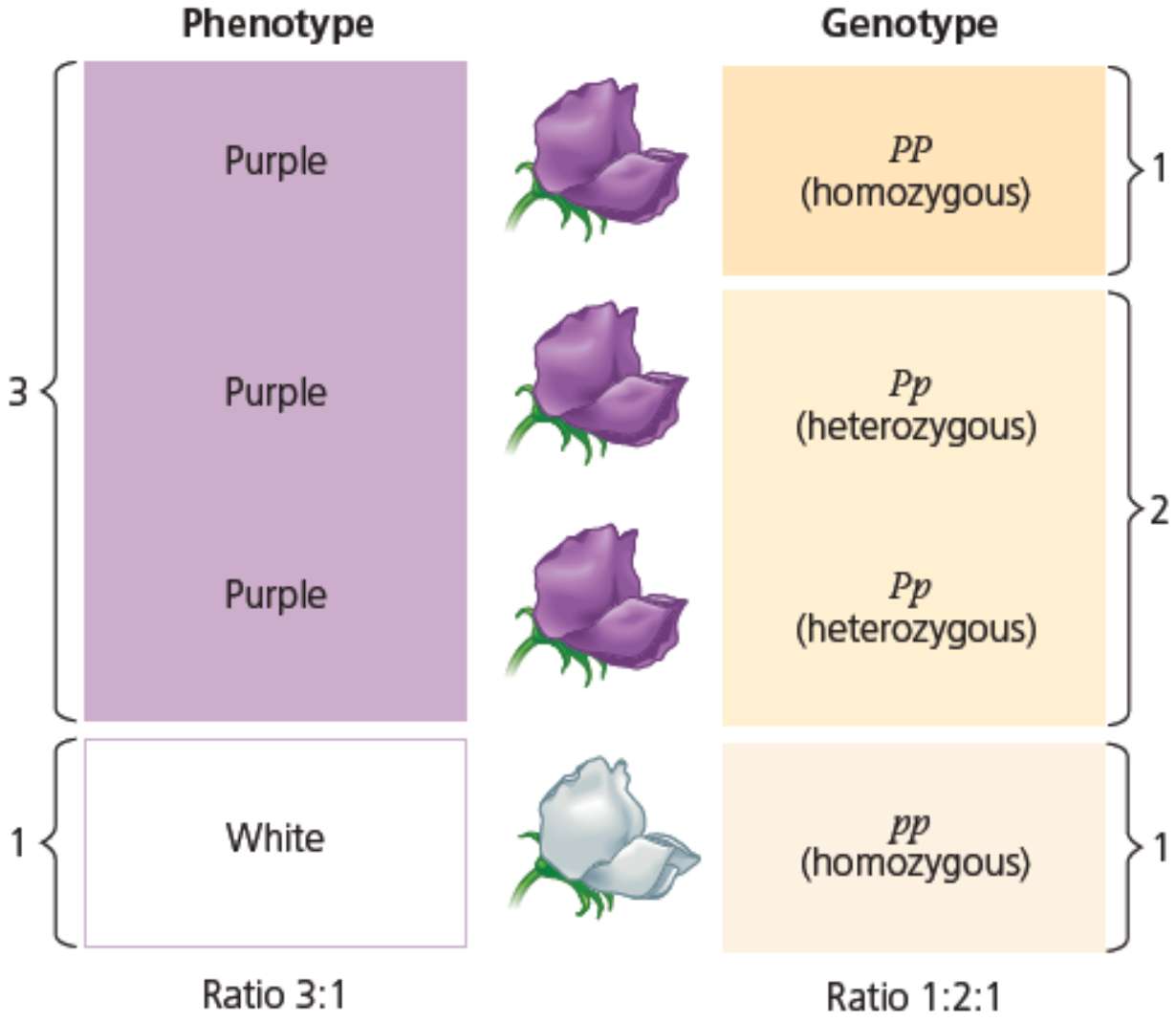
- Alternative variations of genes account for variation ---- called alleles.



- Each pea plant harbors 2 copies of a gene

- Dominant allele has the effect but recessive has not

Phenotype vs. genotype



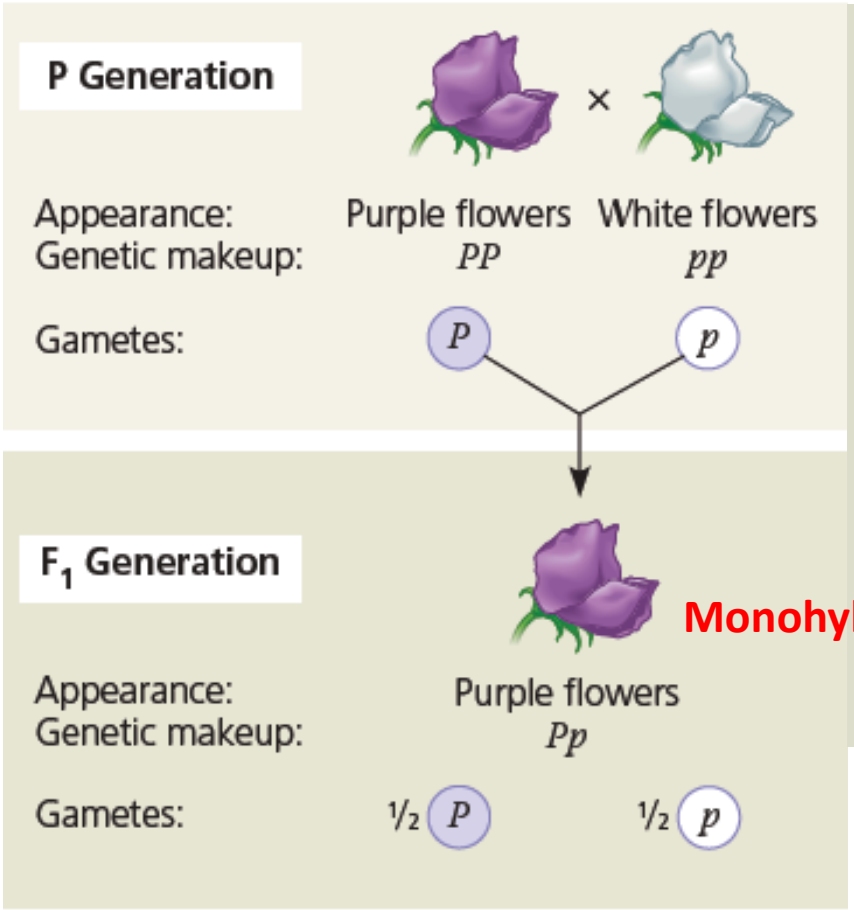
Identical alleles:
Homozygous

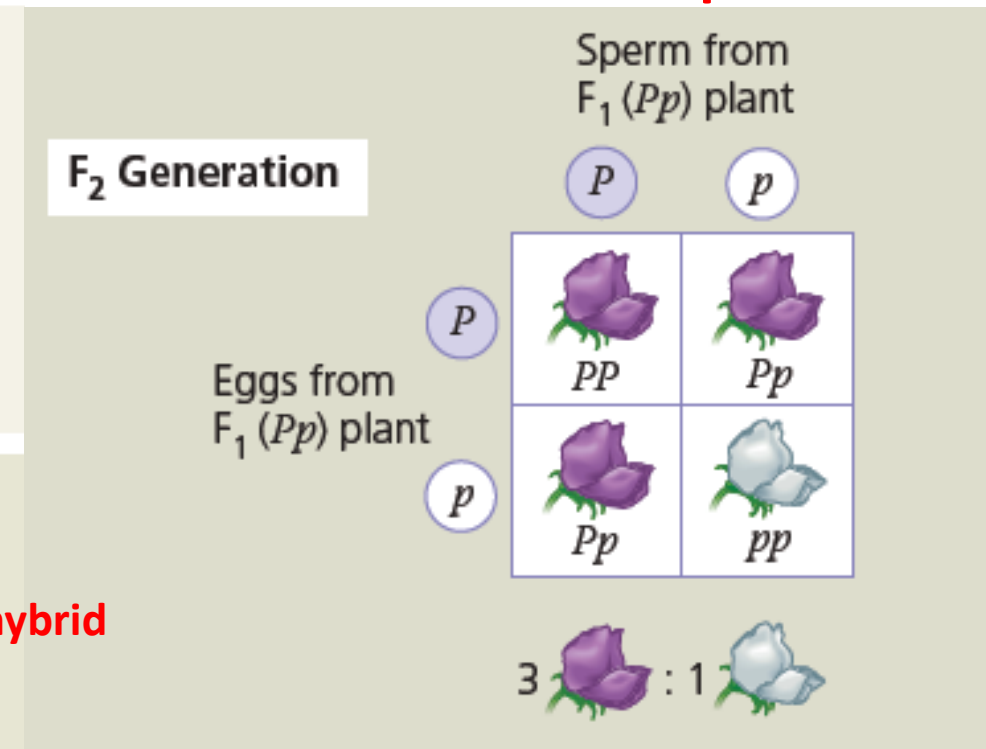
Different alleles:
Heterozygous

Mendel proposed a reason for the 3:1 ratio

- Law of segregation -- Two units (called alleles today) for a heritable traits separate from each other during gamete formation and end up in different gametes

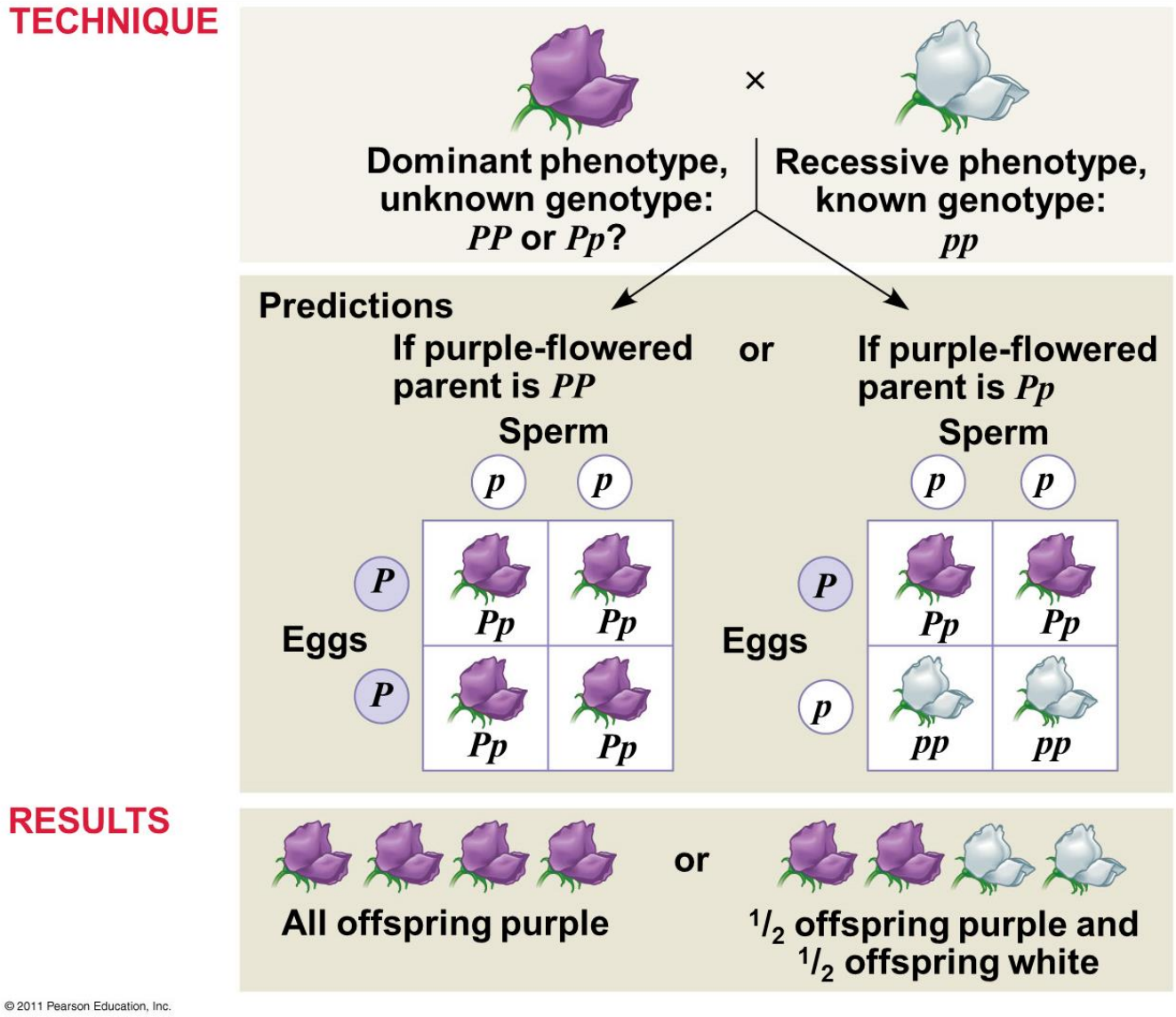
Punnett square





F_2 plants – a cross between 2 monohybrids

Q. How can we tell the genotype of an individual with the dominant phenotype?



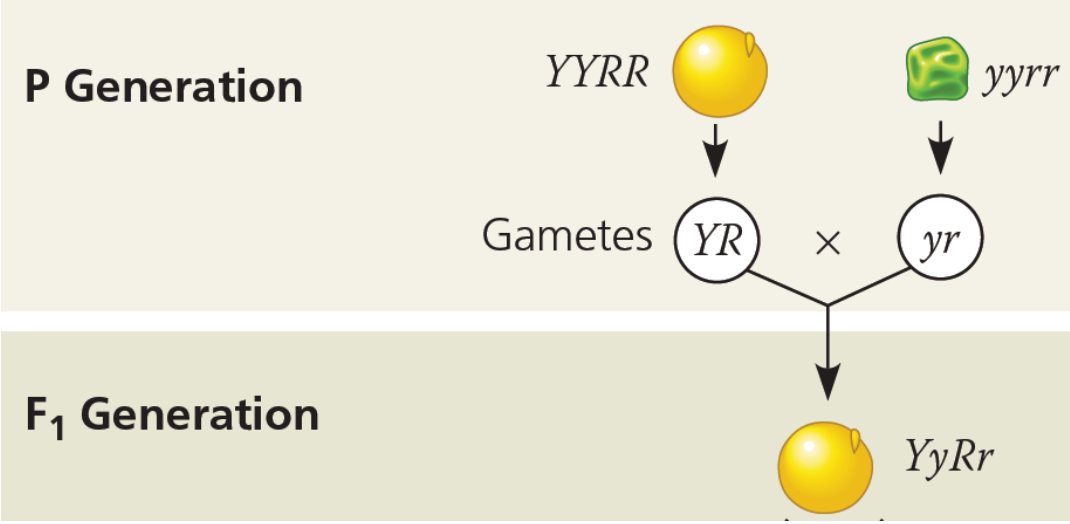
Law of independent assortment

- 2 traits were simultaneous studied e.g.

Seed color	Yellow	×	Green
Seed shape	Round	×	Wrinkled

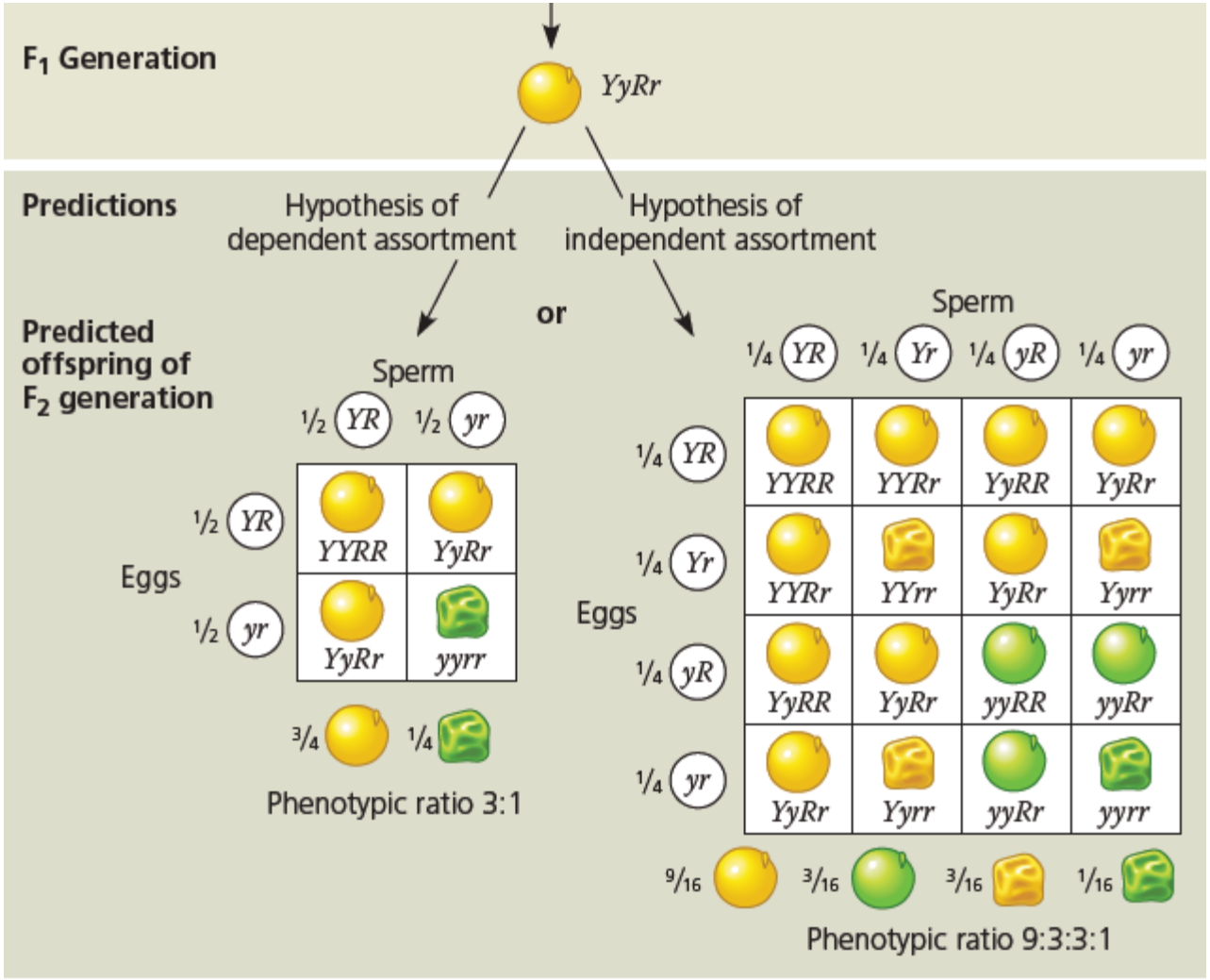
Dominant (*YYRR*)

Recessive (*yyrr*)



Dihybrid

Results of dihybrid cross



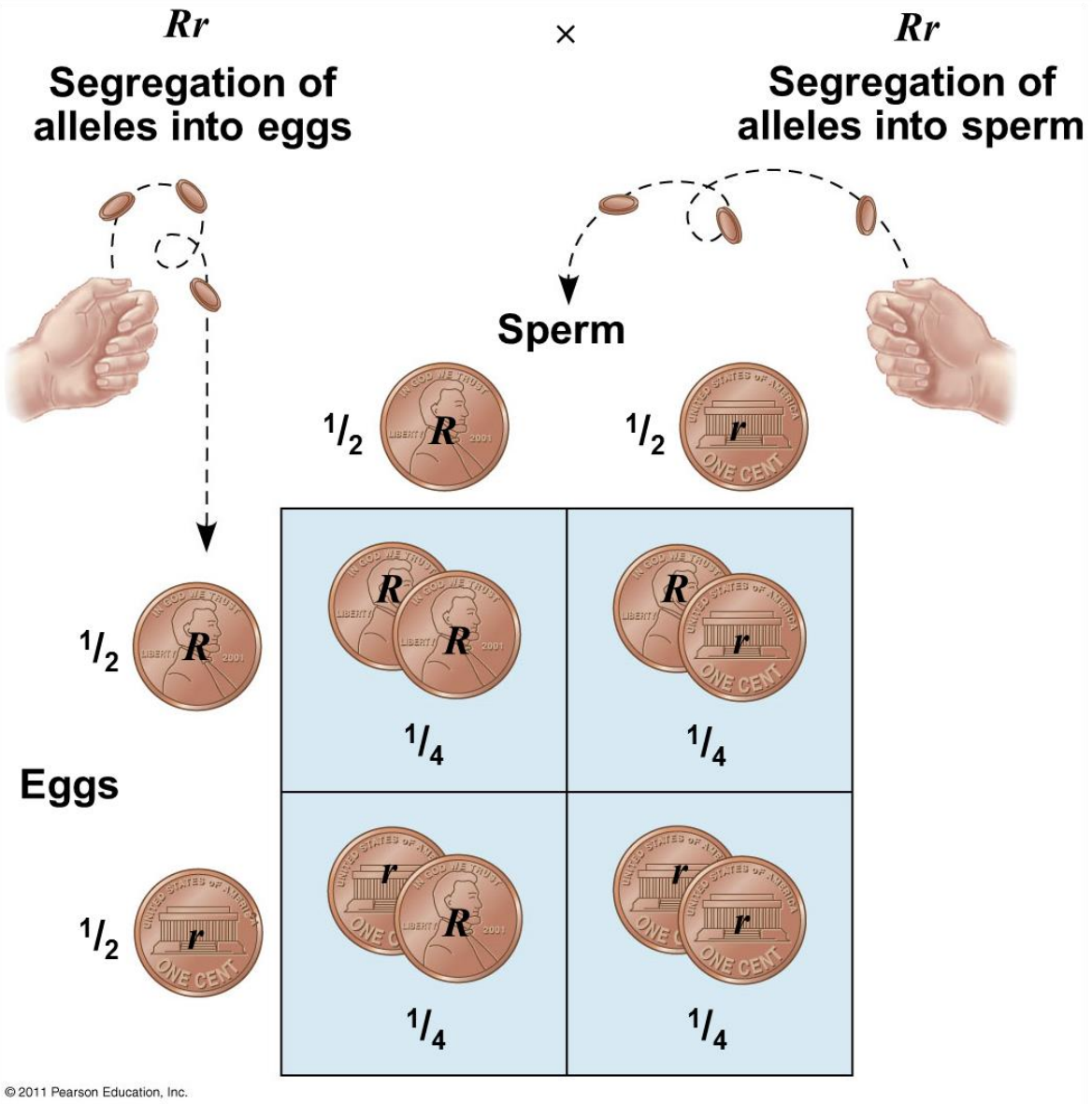
Law of independent assortment :

Each pair of alleles segregates independently of each other pair of alleles during gamete formation

The laws of probability govern Mendelian inheritance

- Both laws reflect the rules of probability
- Monohybrid crosses also follow multiplication and addition rules

- You are the result of a genetic lottery!



What are the molecular mechanisms underlying Mendel's results?

Genetic material

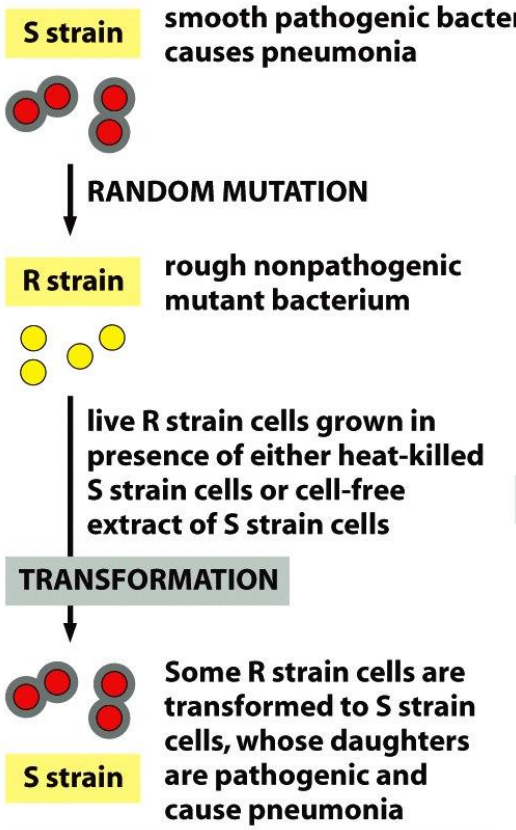
DNA

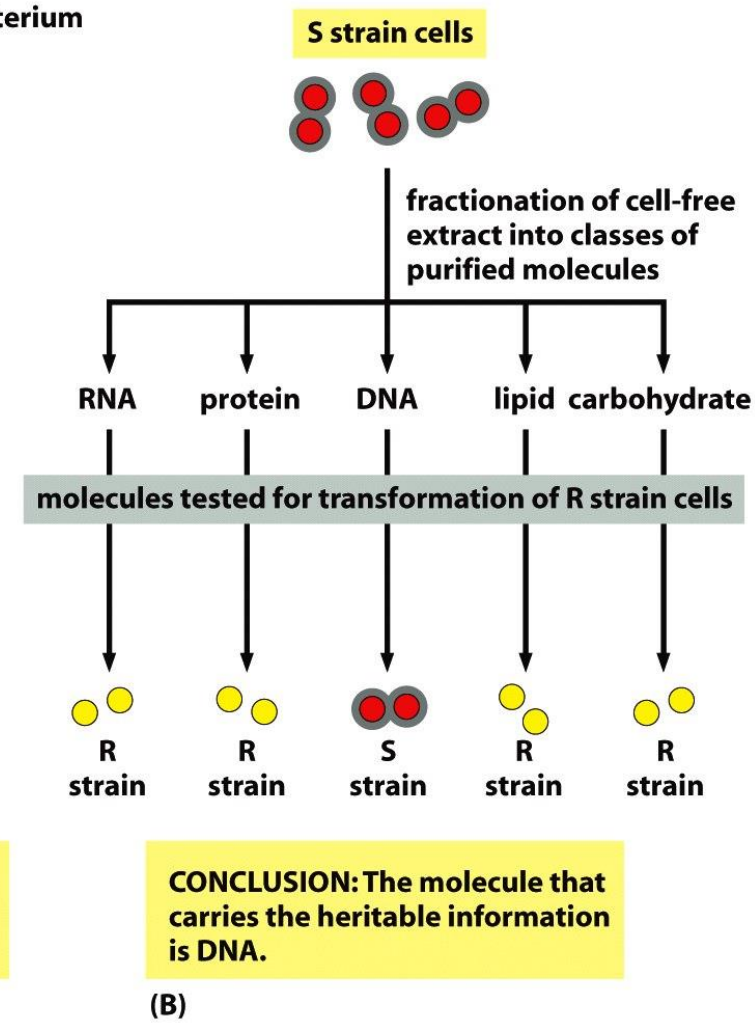
Molecular basis of inheritance: exciting scientific detective story

- What is the molecular basis of Mendel's heritable factors and Morgan's genes?

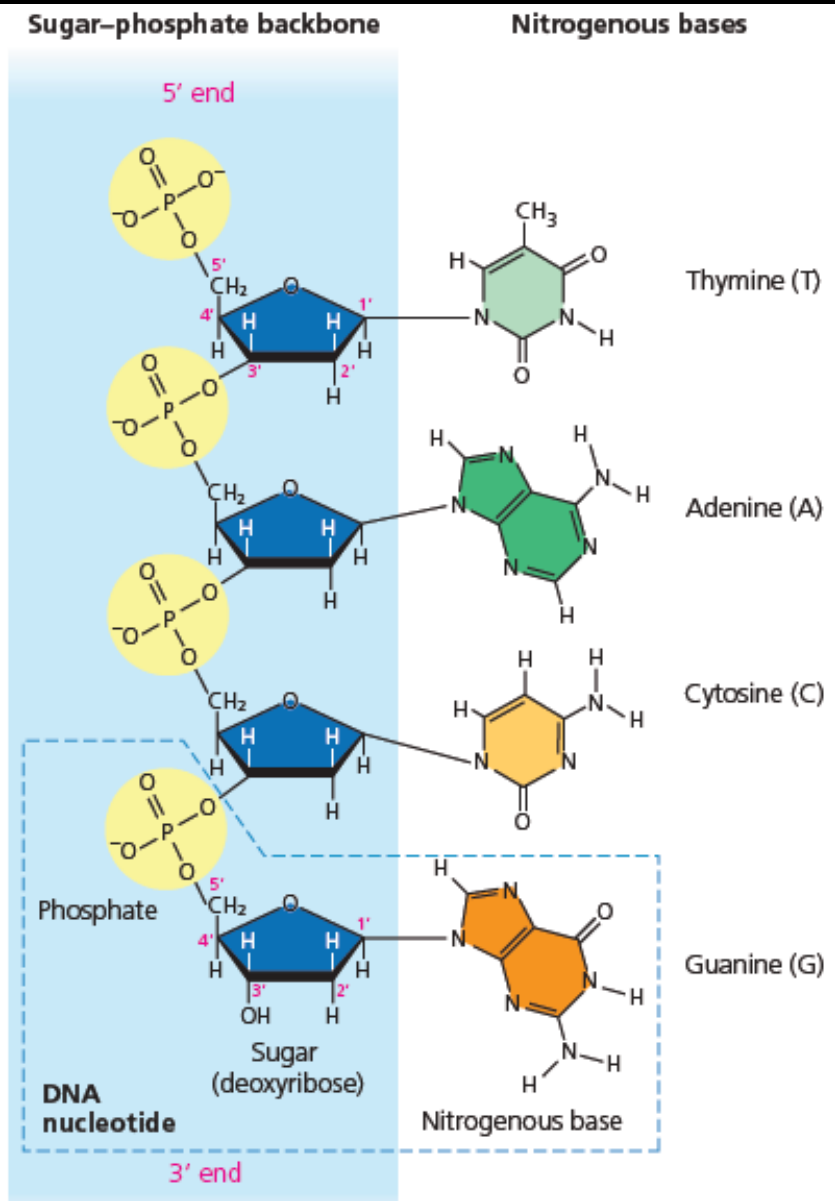
- These are deoxyribonucleic acid (DNA)

Evidence that DNA is the genetic material (by Griffith, Avery, McCarty and Macleod)





Chemical composition of DNA



Chain of nucleotides linked by phosphodiester bridges:

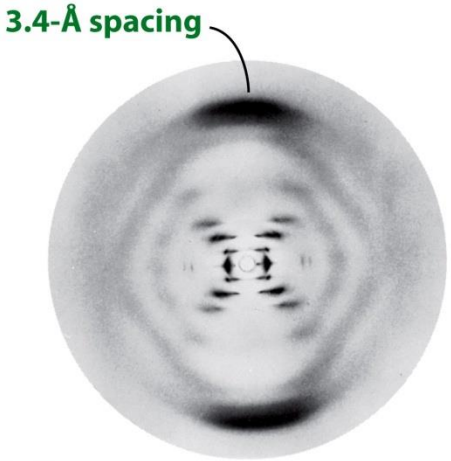
Polymer of sugars, phosphates, nitrogenous bases in water

Hunt to elucidate the structure of DNA

Linus Pauling's hypothesis

- Three chains, twisted around each other in ropelike stands

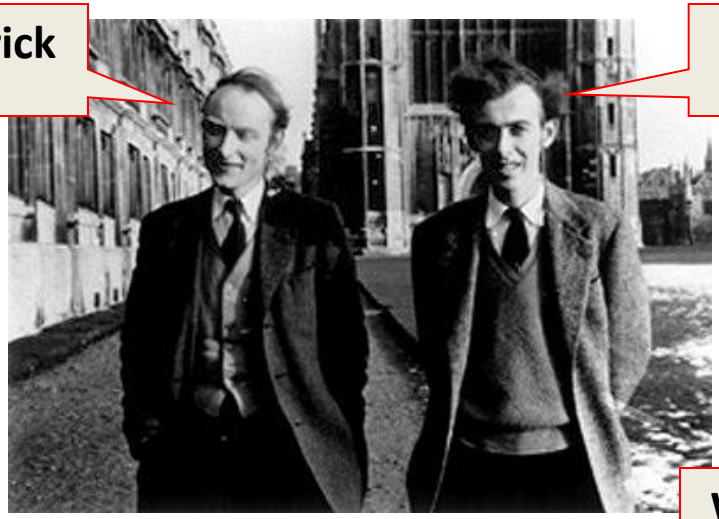
Maurice Wilkins'/Rosalind Franklin's X ray crystallographic data



- Nucleotides are 3.4 Aº apart in the chain
- Structure repeats at 34 Aº intervel

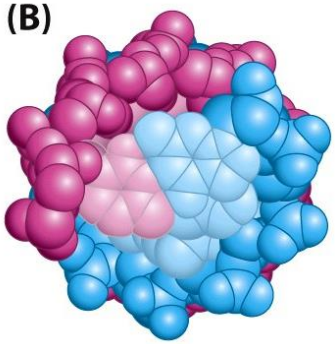
Erwin Chargaff's rule : %A = %T and %G = %C

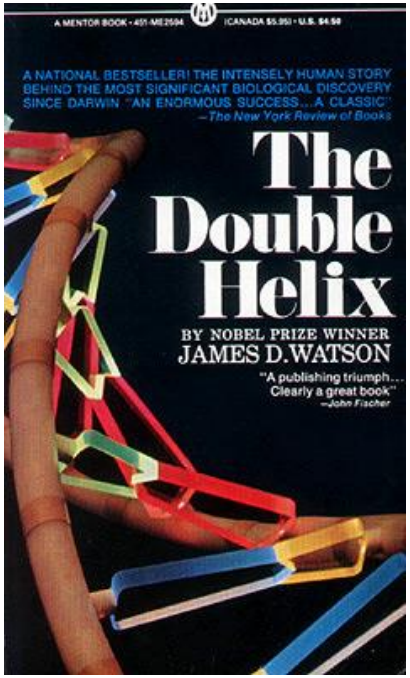
A great discovery: Elucidation of DNA double helix

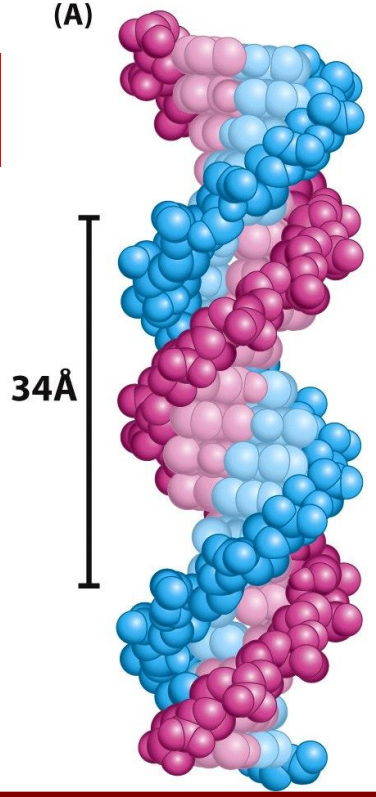


Watson-Crick Model of Double-Helical DNA

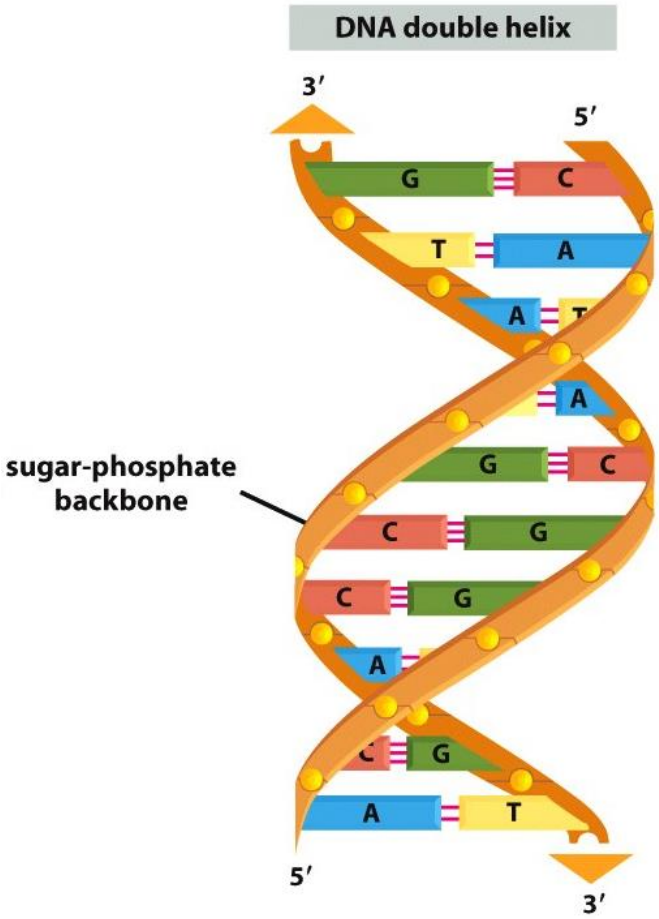
1962 Nobel Prize

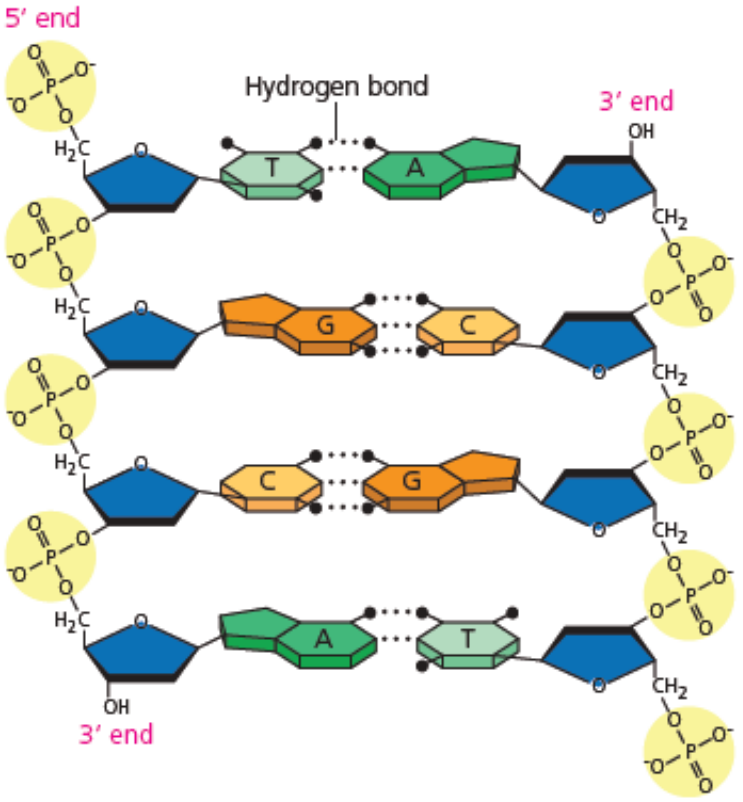


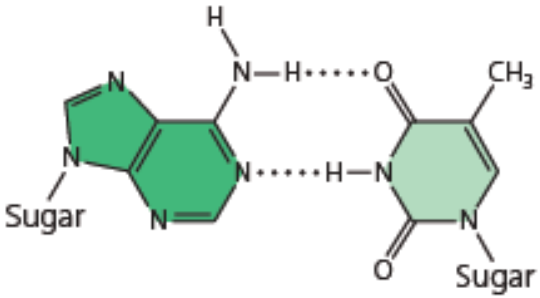


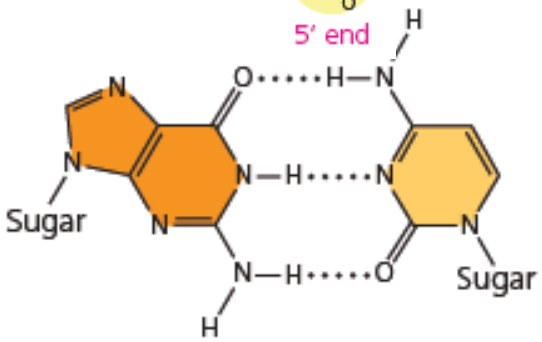


Features of the structure of DNA



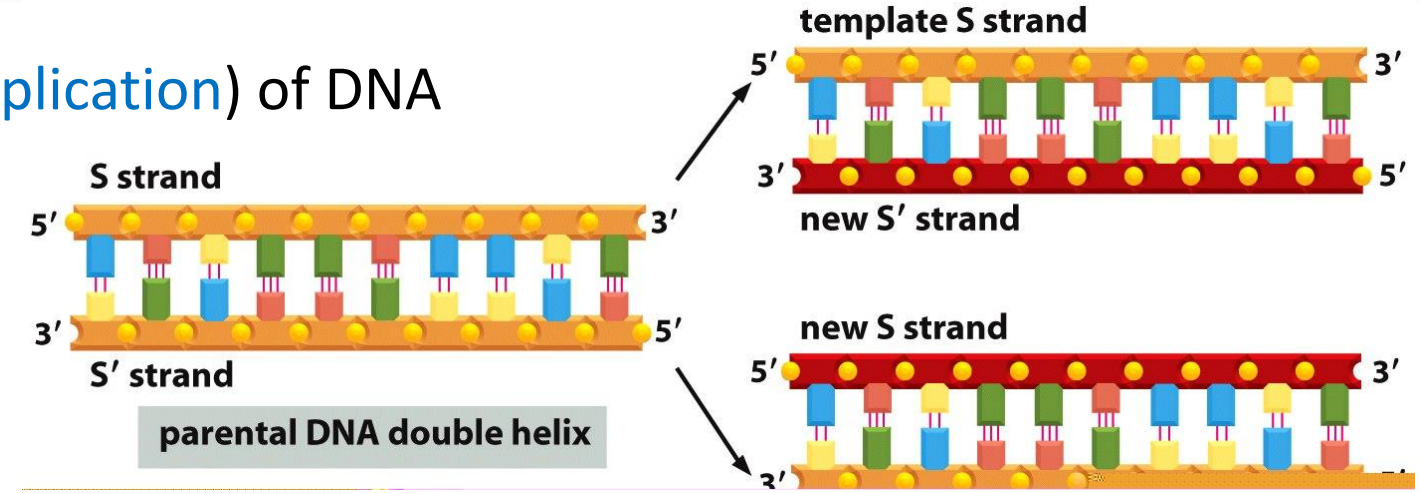


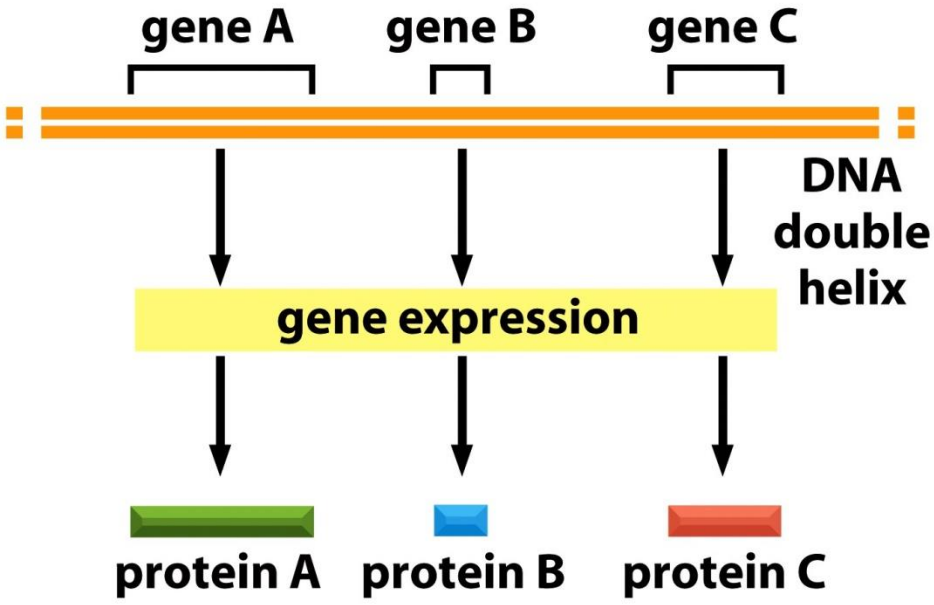




DNA and heredity: DNA is passed to offspring and it carries information to give phenotypes

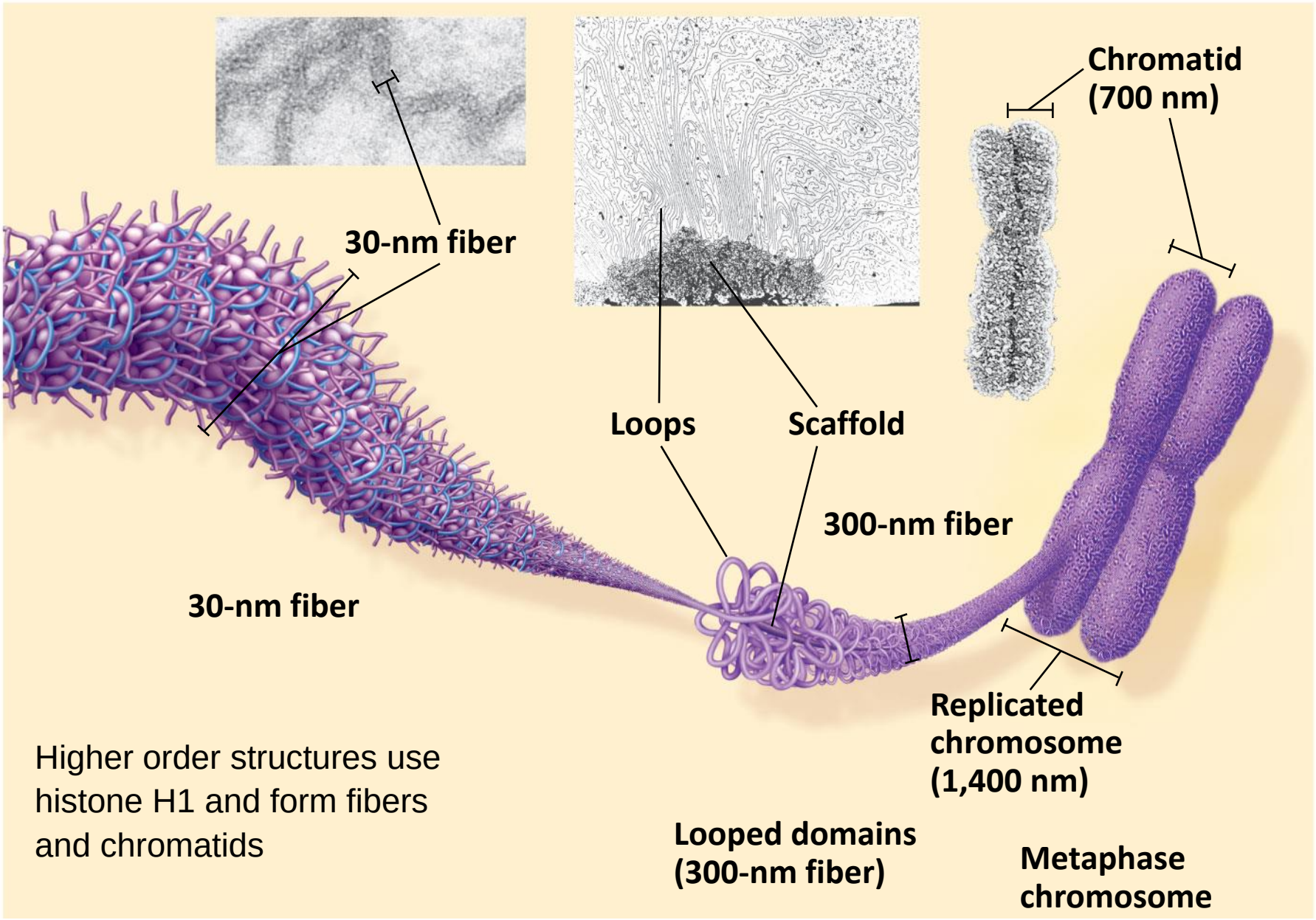
Duplication (replication) of DNA





Genes on DNA: You will learn a lot more about this in the next lecture.

Eukaryotic genomes are organized into chromosomes



Higher order structures use histone H1 and form fibers and chromatids

The structure of DNA gives us simple rules

Viruses have genetic material that can be (1) single-stranded DNA, (2) single-stranded RNA, (3) double-stranded DNA or (4) double-stranded RNA.

One of the major differences between DNA and RNA is that there is a uracil (U) in place of the thymine (T).

There is an outbreak of a new disease in the hostels where affected people have severe cough, cold-symptoms, high fever and their skin turns yellow. You have isolated a new virus that causes this strange disease and obtained the following information after analyzing it's genetic material:

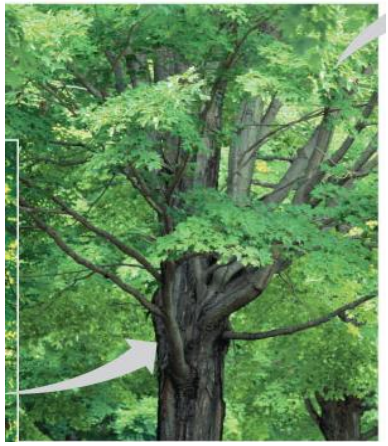
%A = 53 %C = 13 %G = 25 %T = 9

Which of the four (see the first sentence) possible classes of viruses could this be and why?

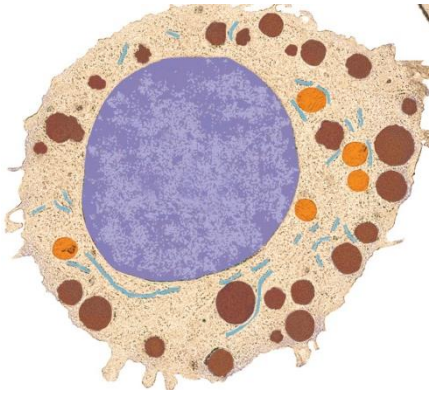
So far we learnt….

Biosphere

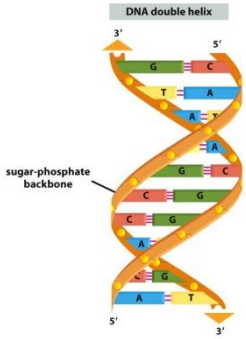
Individual



Cell (&Nucleus)



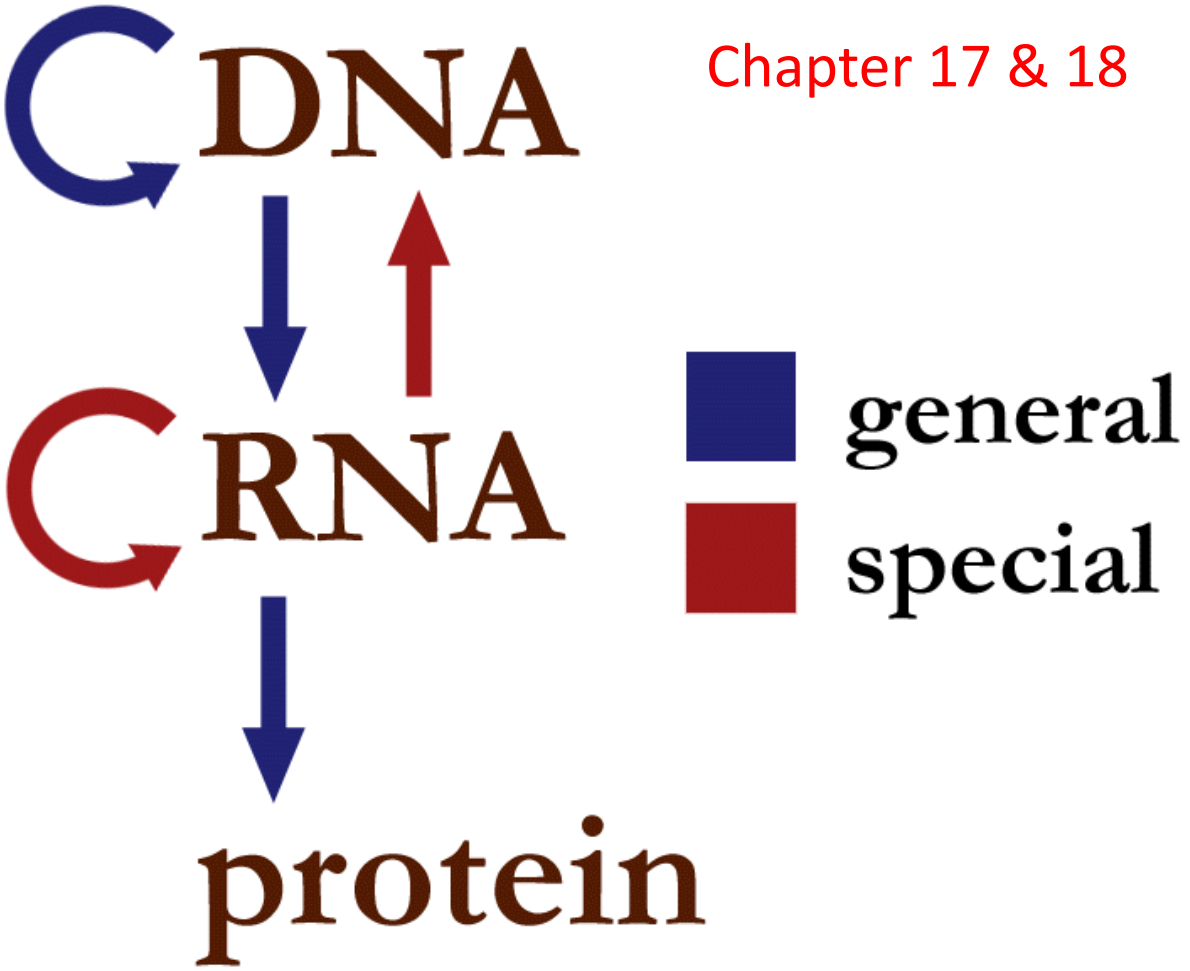
Hereditary material (DNA)



Imagine the future…..

Scenario # 1: Your genetic test says you are worthy of the IITs. How can your DNA result in traits like intelligence?

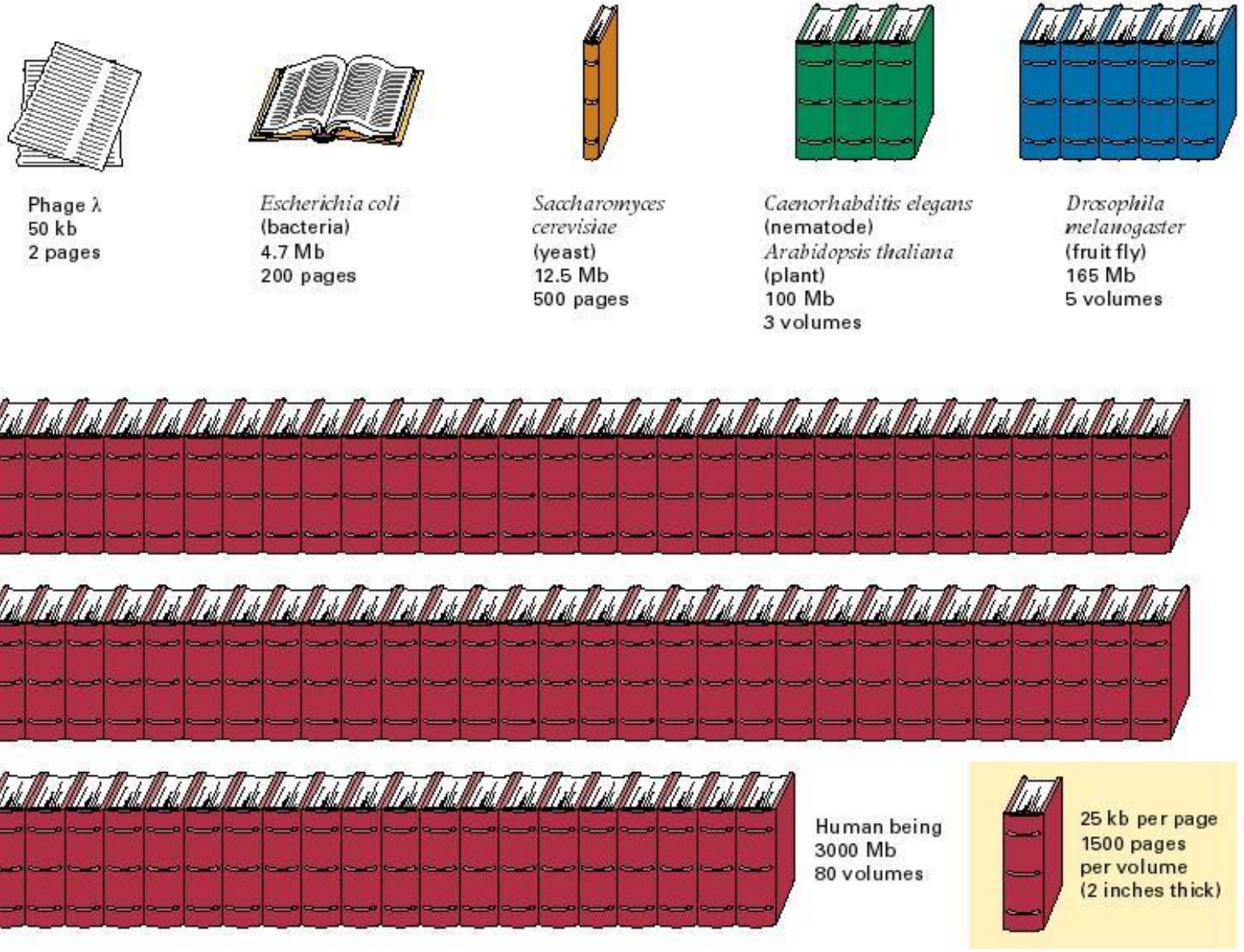
From genes to proteins & regulation of gene expression



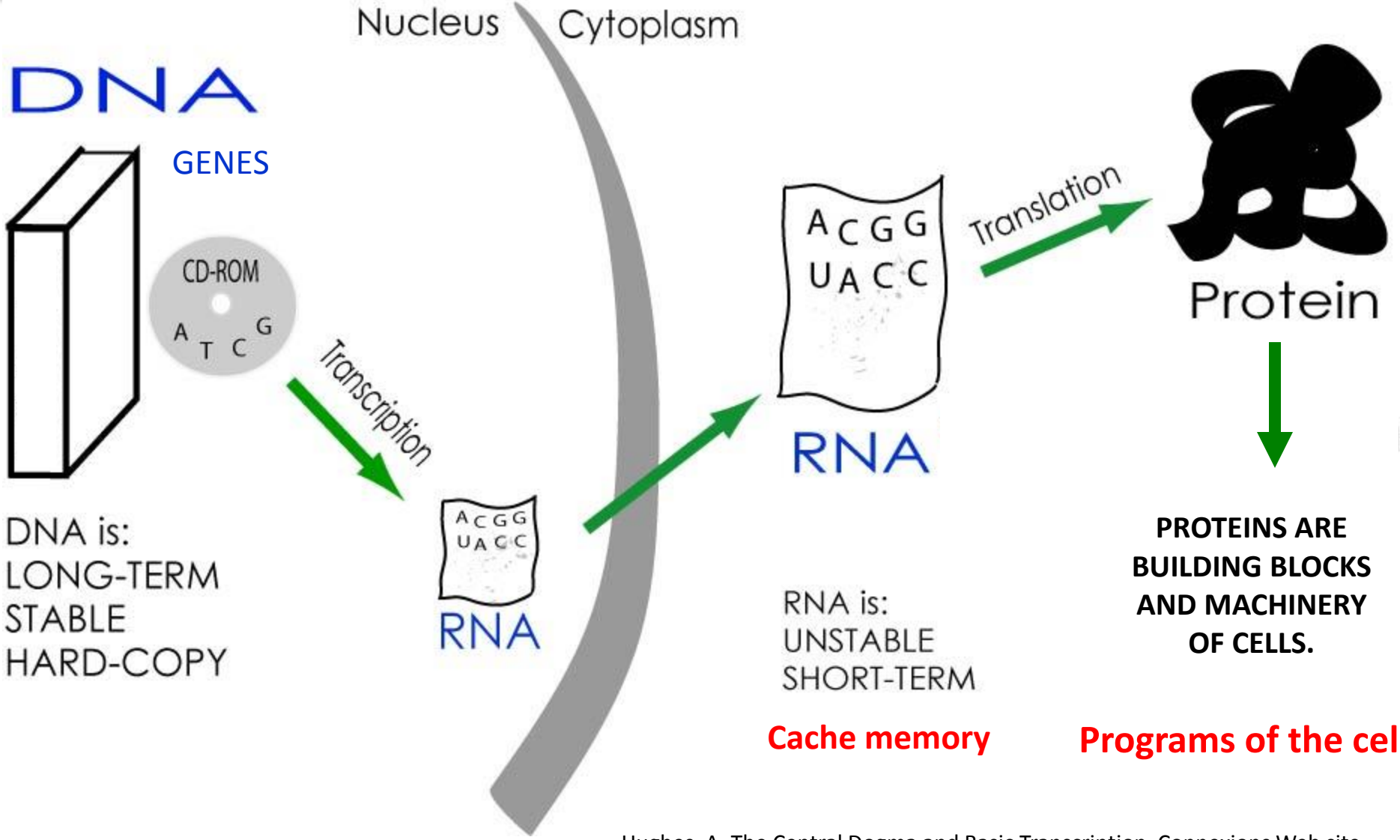
Chapter 17 & 18

Central Dogma

Concept : Eukaryotic genomes can be thought of as instruction manuals



Eukaryotic genomes can be thought of as instruction manuals



Hughes, A. The Central Dogma and Basic Transcription, Connexions Web site. http://cnx.org/content/m11415/1.5/, Jul 27, 2003.