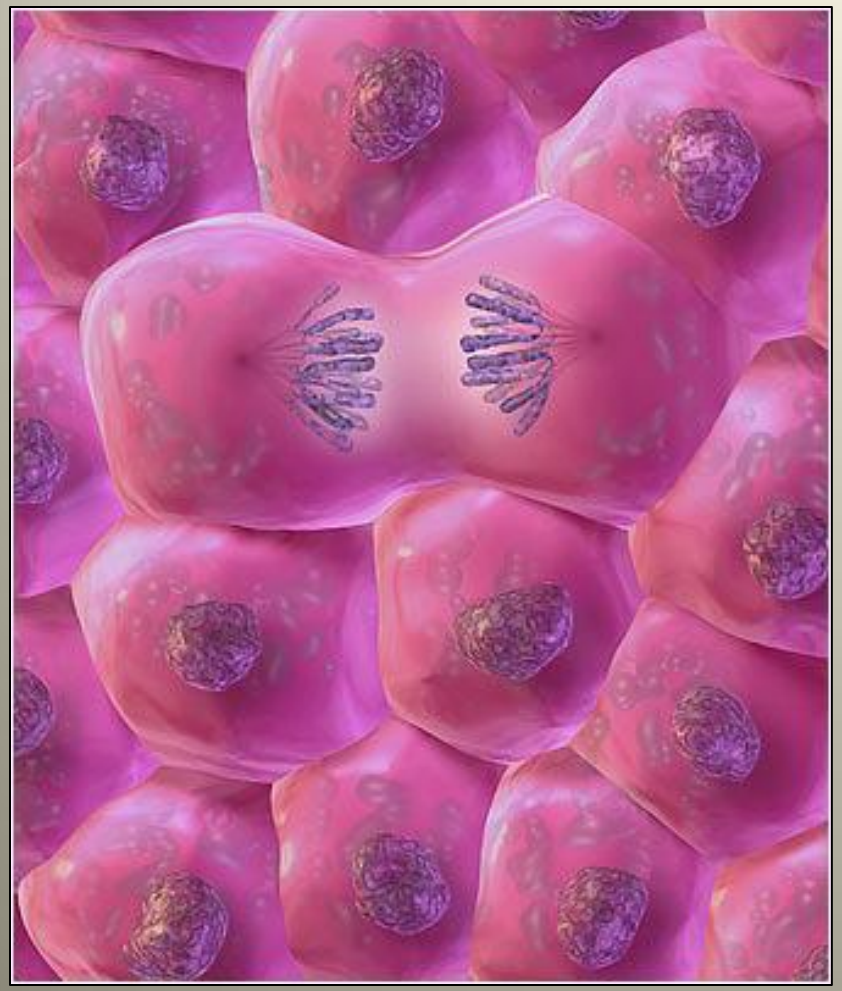
Mitosis/Asexual
Meiosis / Sexual
REPRODUCTION

DNA

ASEXUAL REPRODUCTION involves only one parent. The new organism develops from cells of the parent.

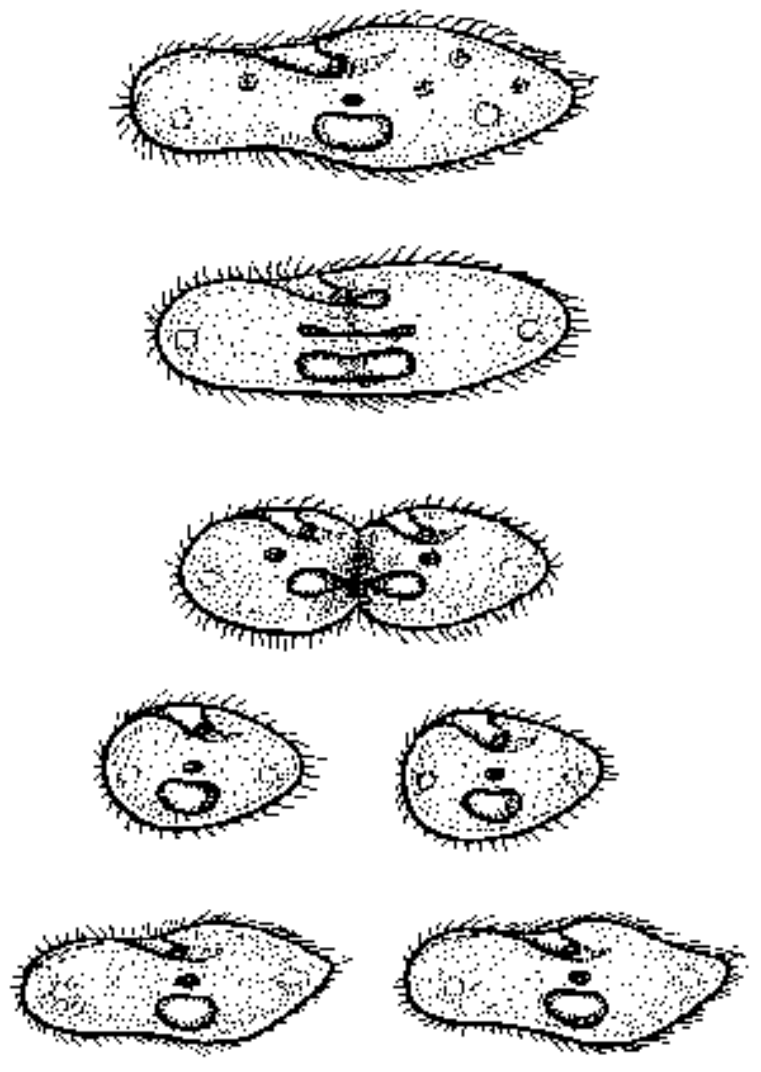
In SEXUAL REPRODUCTION there are two parents. Each contributes a specialized cell to the new generation.

All cells arise from other cells by CELL DIVISION.



MITOSIS is a type of cell division that results in the formation of two new cells that are genetically identical to each other.

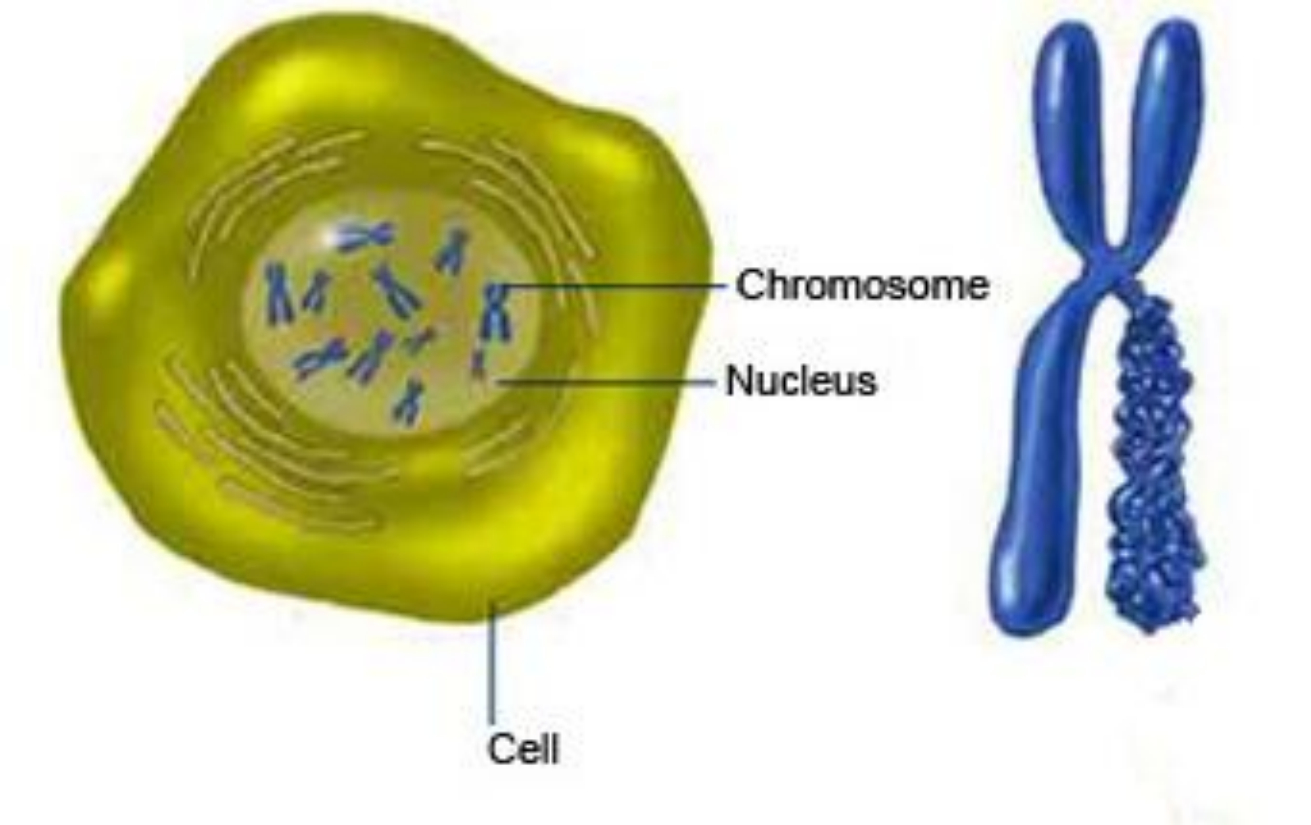
During mitosis, two important things occur:



1. the DNA replicates

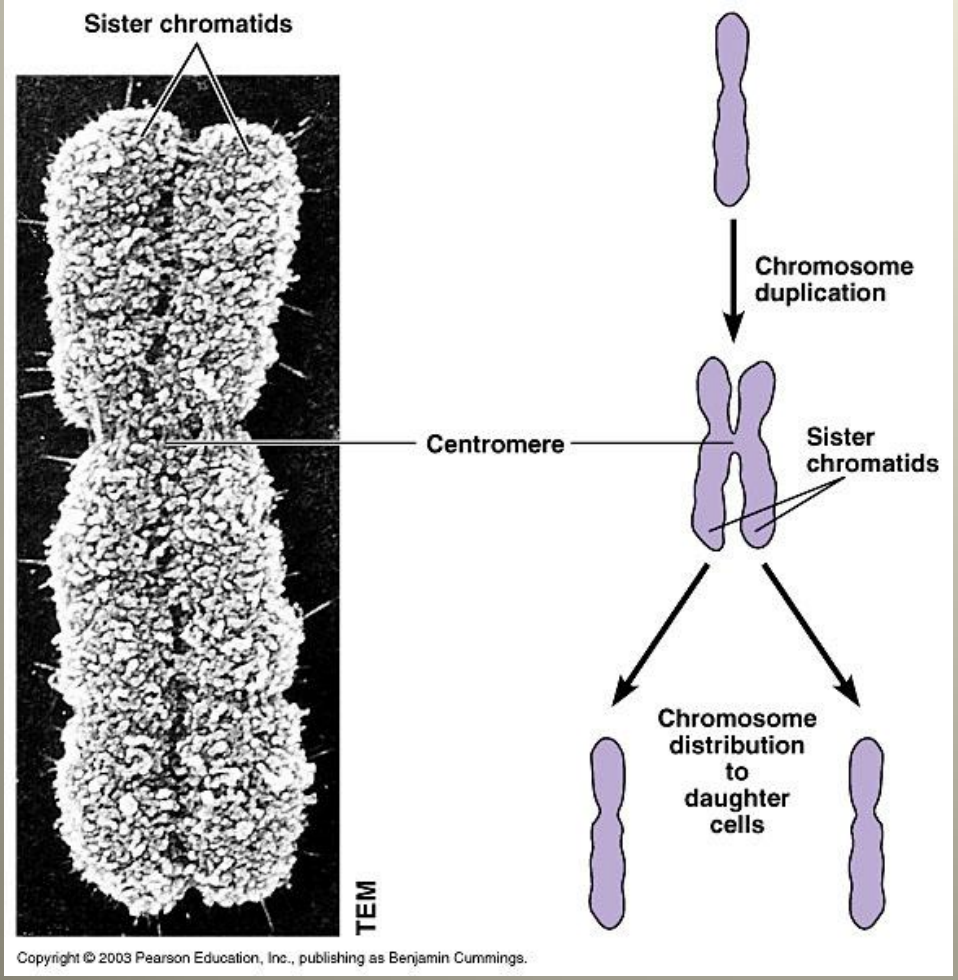
2. the cytoplasm divides, forming two cells.

Inside the nucleus, the hereditary material DNA is found in the chromosomes.



Each species has a characteristic number of chromosomes.

Before cell division begins, the DNA is copied, forming two identical strands of genetic material.



One strand is distributed to each of the two new cells that form when the cell divides.

A cell passes through FIVE STAGES during cell division:

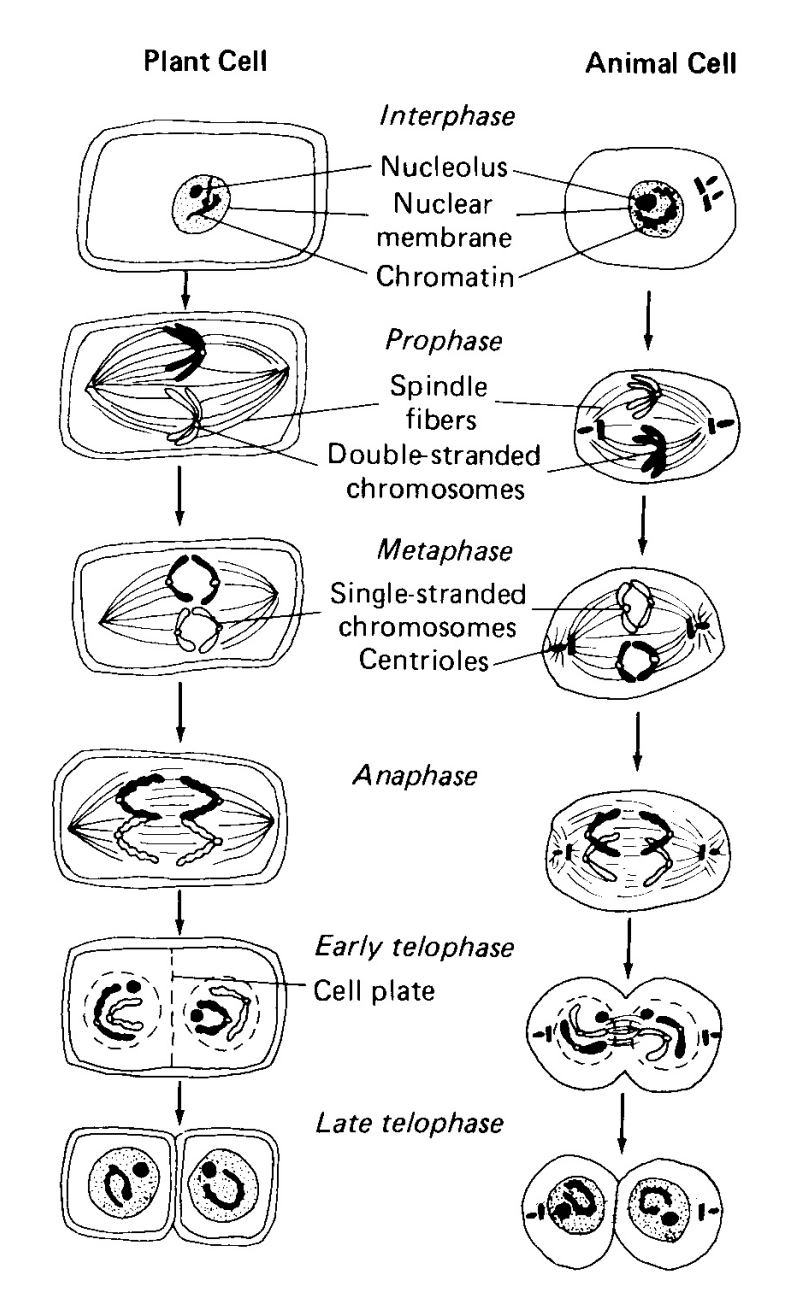
Interphase

Prophase

Metaphase

Anaphase

Telophase



I

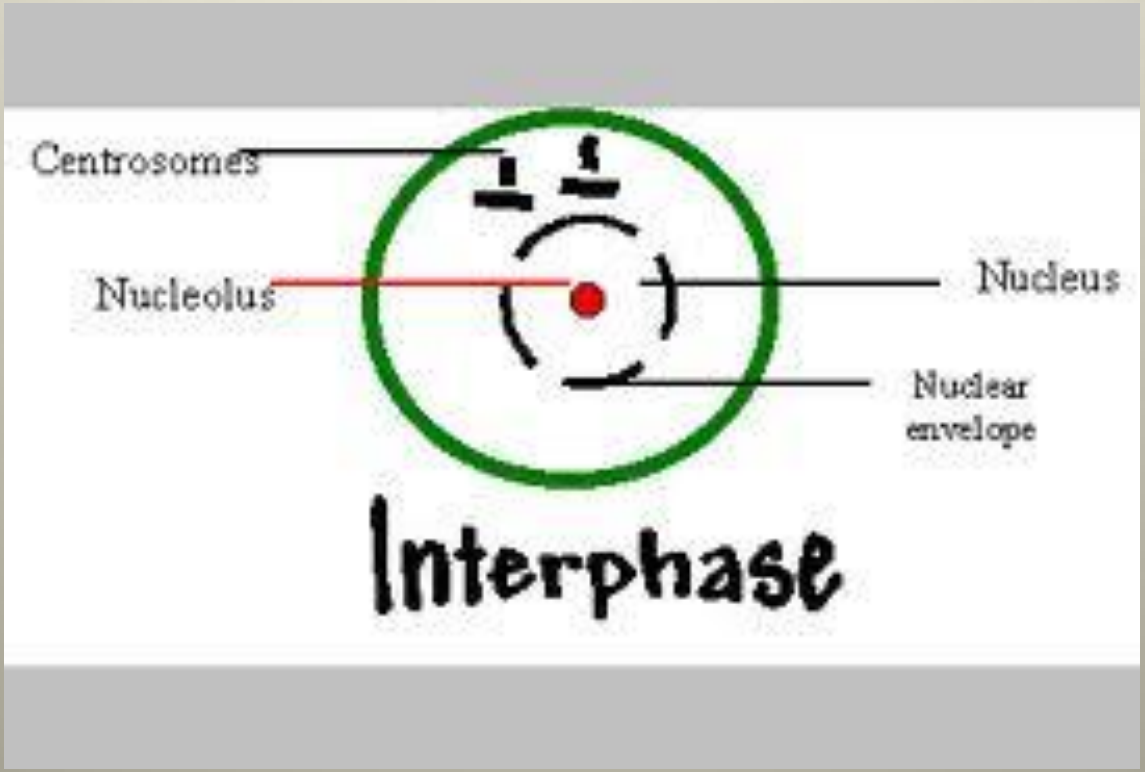
Pick

My

Apple

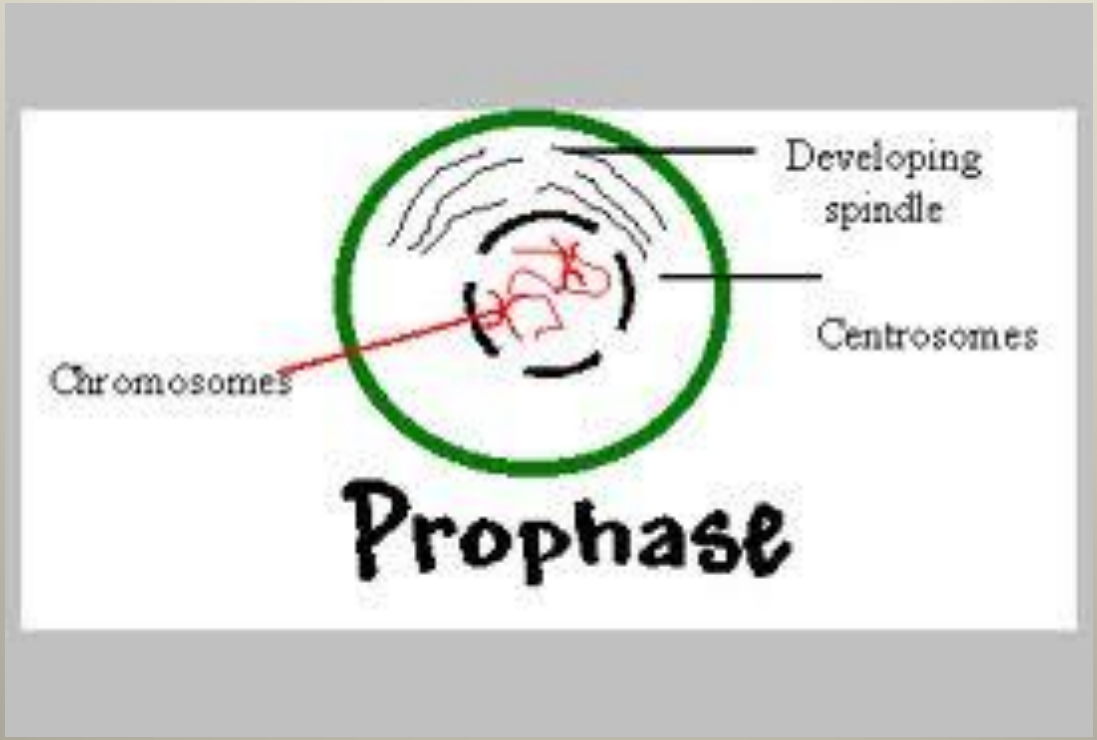
Tree

The cell spends most of its life in the non-dividing phase, INTERPHASE.



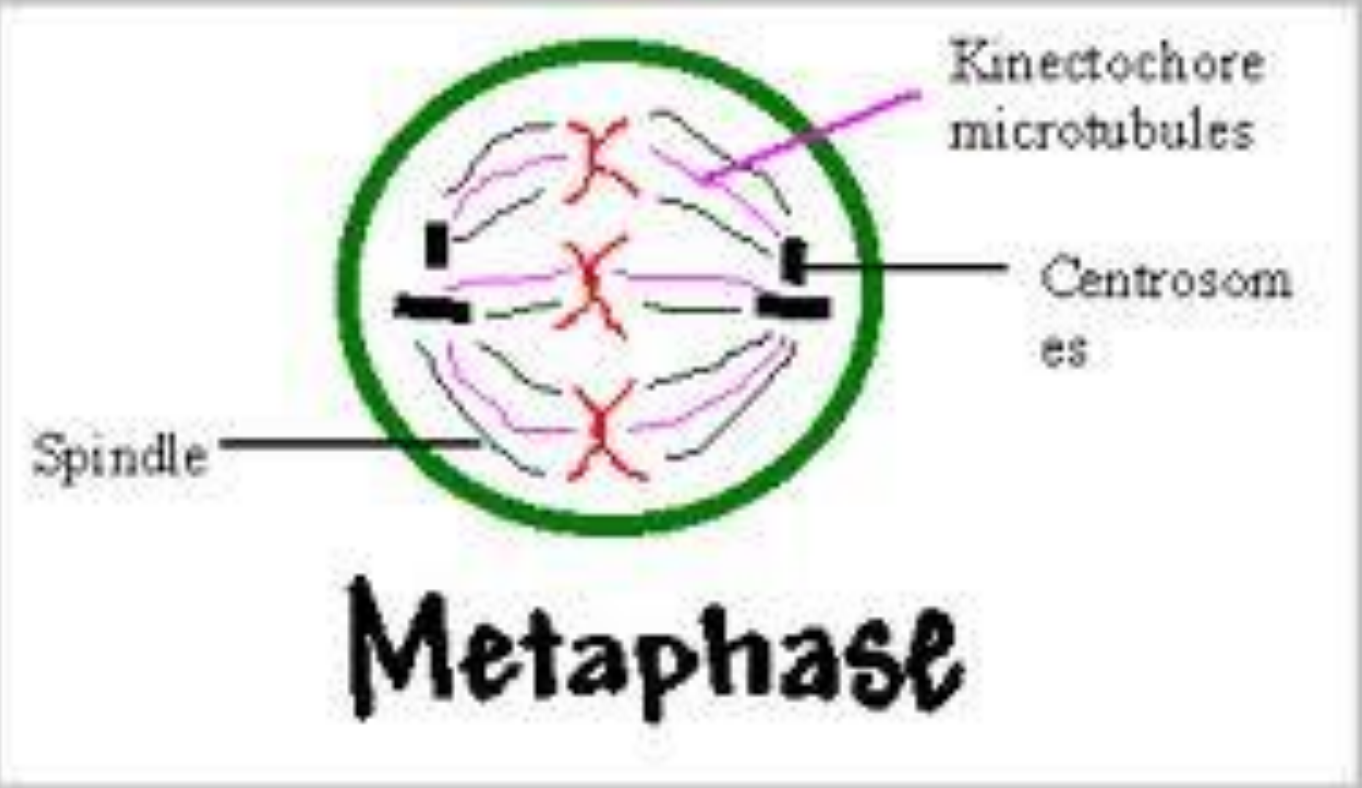
During interphase, the cell carries on its life processes including DNA synthesis for the replication of chromosomes.

During PROPHASE, the cell prepares for cell division.

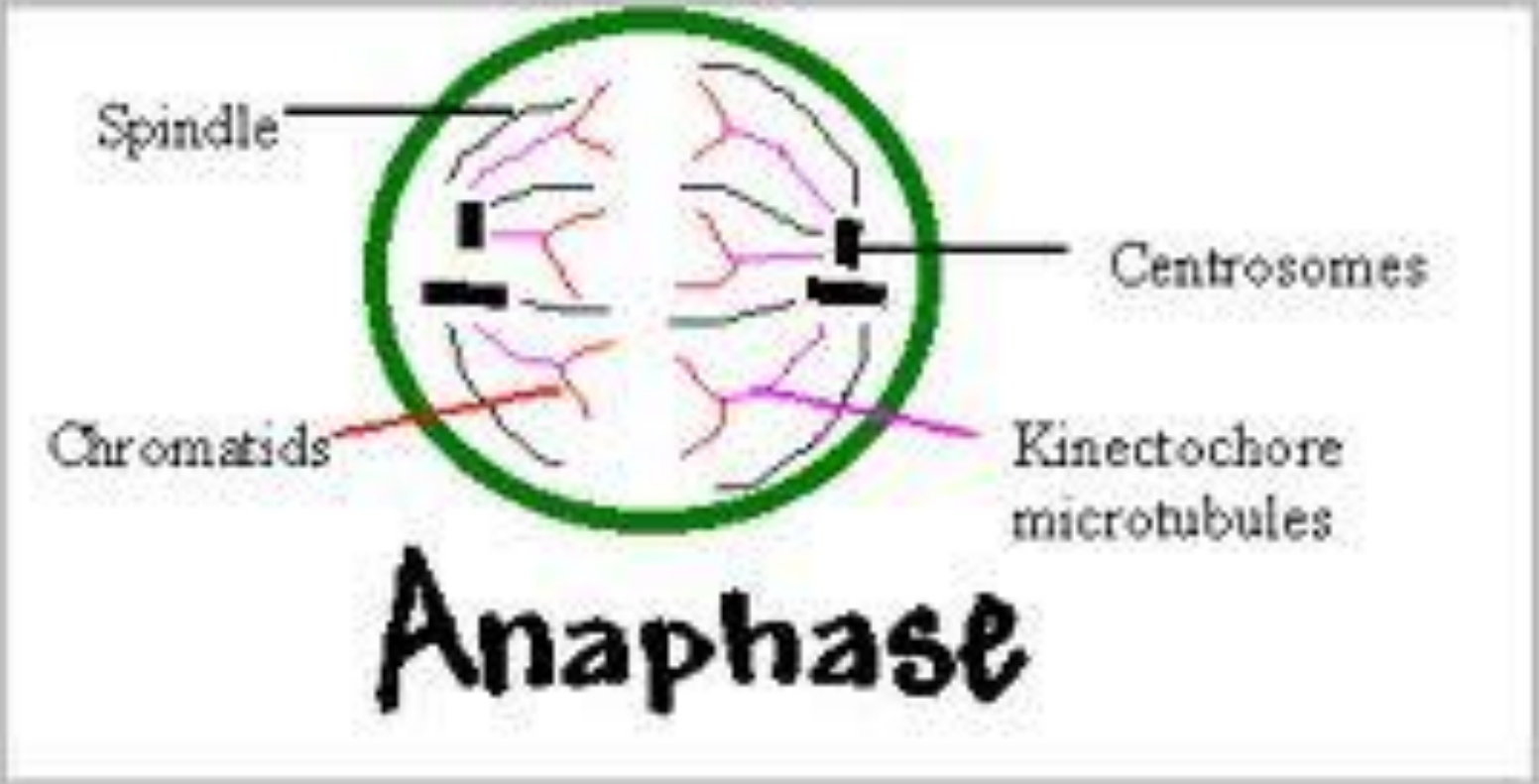


The chromatin condenses into chromosomes.
The nuclear membrane breaks down.
The centrioles move to opposite poles in the cell.

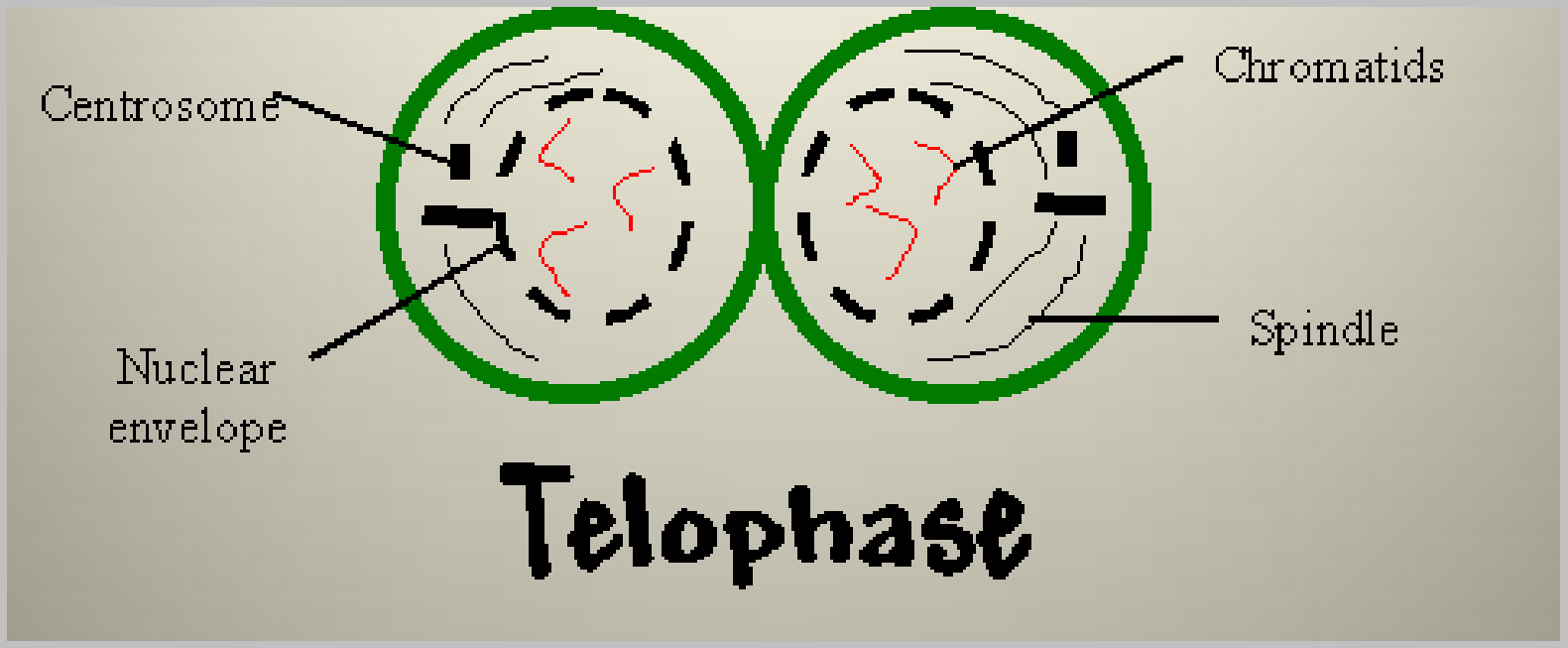
During METAPHASE, the chromosomes line up in the center of the cell along the equator.



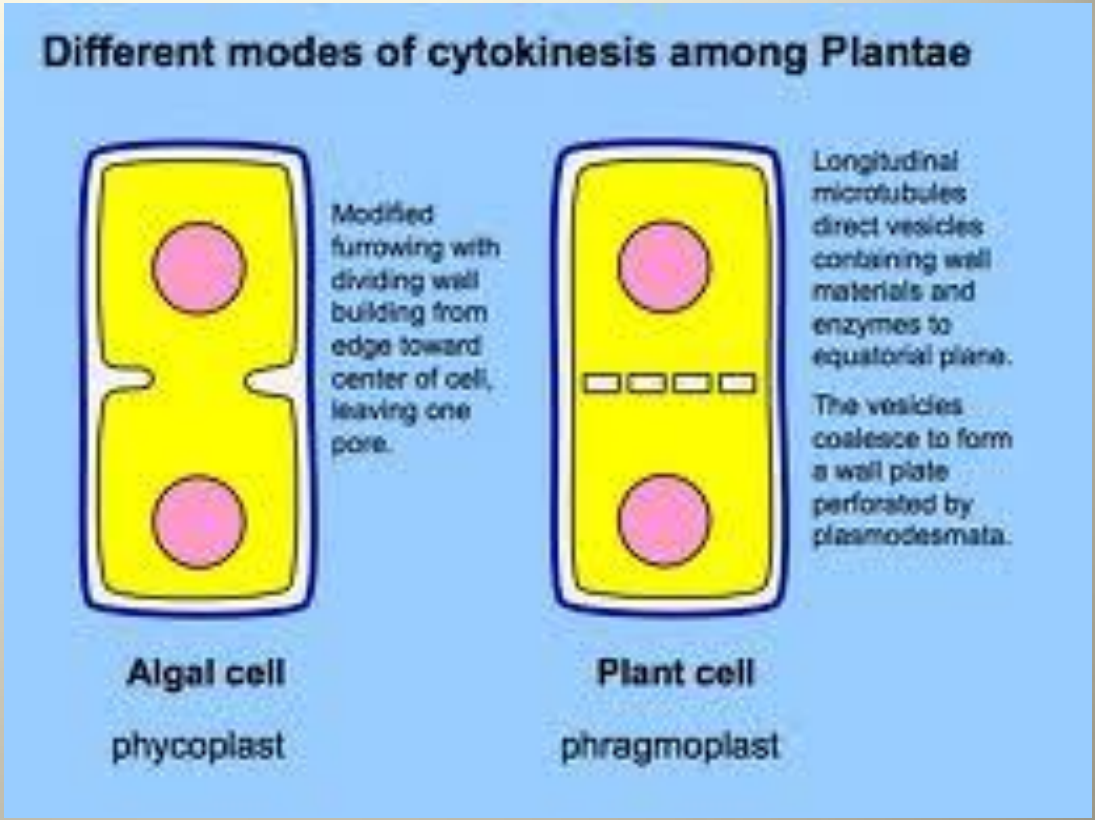
During ANAPHASE, the chromosomes split at the centromeres, and move into two groups.



During TELOPHASE, the cell completes the nuclear division.



The chromosomes unwind to form chromatin.
Two new nuclear membranes form.



In plant cells, a new cell wall forms between the two daughter cells.

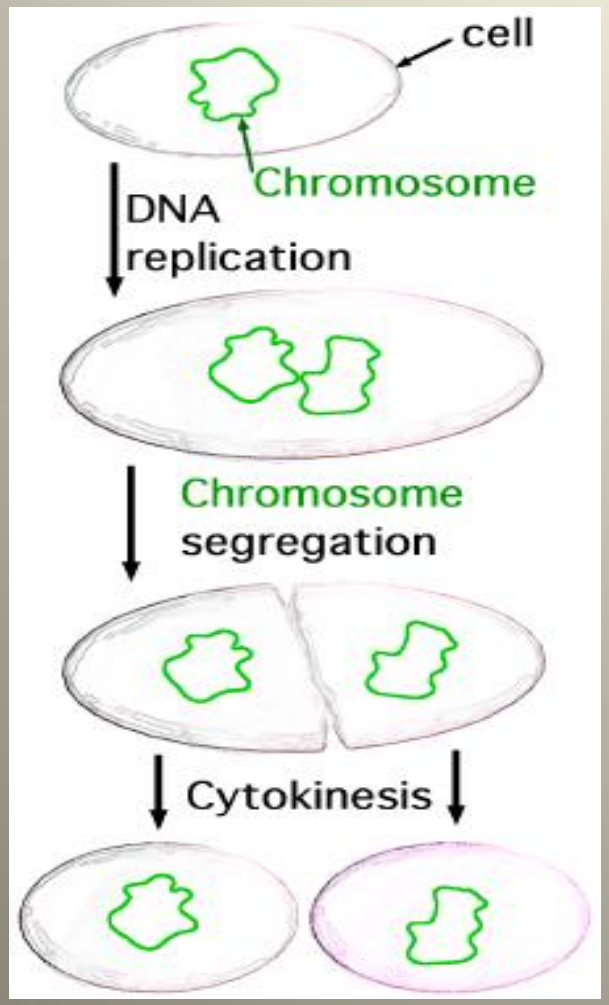
The growing cell wall is called the CELL PLATE.

Types of Asexual Reproduction

1. Cloning

- Produces offspring from a single body cell of parent.
- New organism genetically identical to parent.

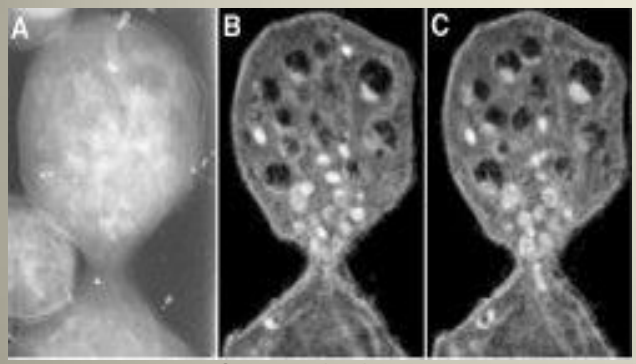
Types of Asexual Reproduction



2. Binary Fission

- **One-celled organism undergoes mitosis to form two daughter cells of equal size.**
- **Examples: Ameba, paramecium, bacteria**

Types of Asexual Reproduction



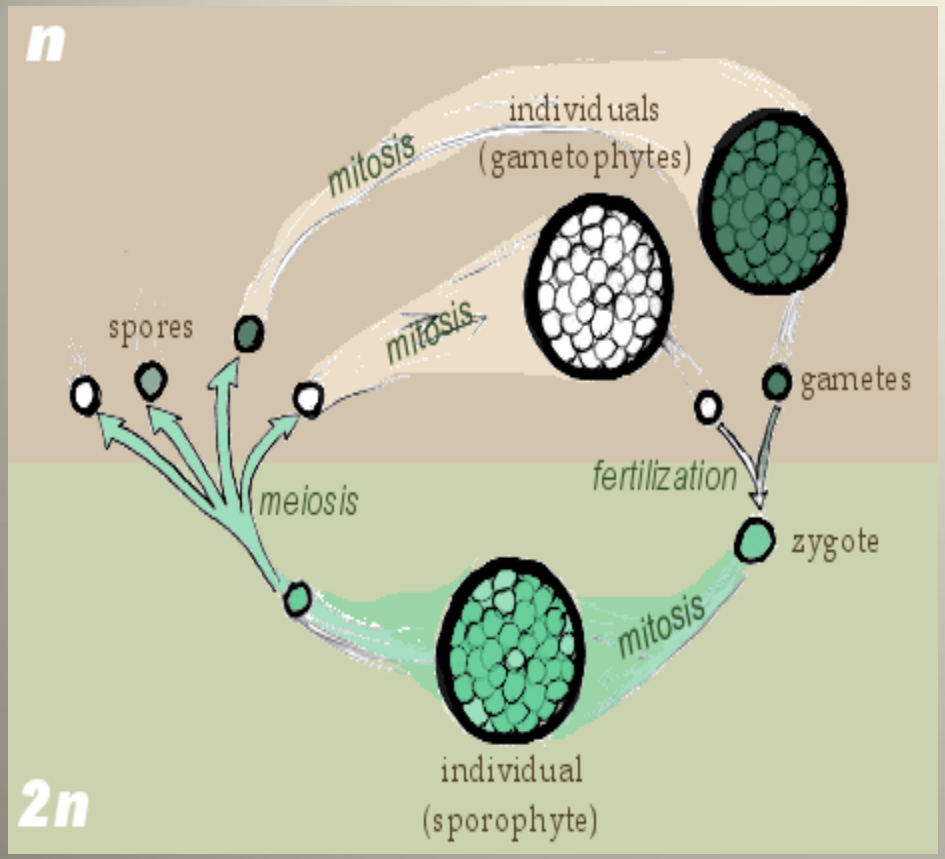
Yeast budding

Hydra budding

3. Budding

- **Unequal cytoplasm division**
- **Bud smaller than parent**
- **Bud may or may not remain attached**
- **Example: yeast, hydra**

Types of Asexual Reproduction



Spores produced in a sporic life cycle

4. Sporulation

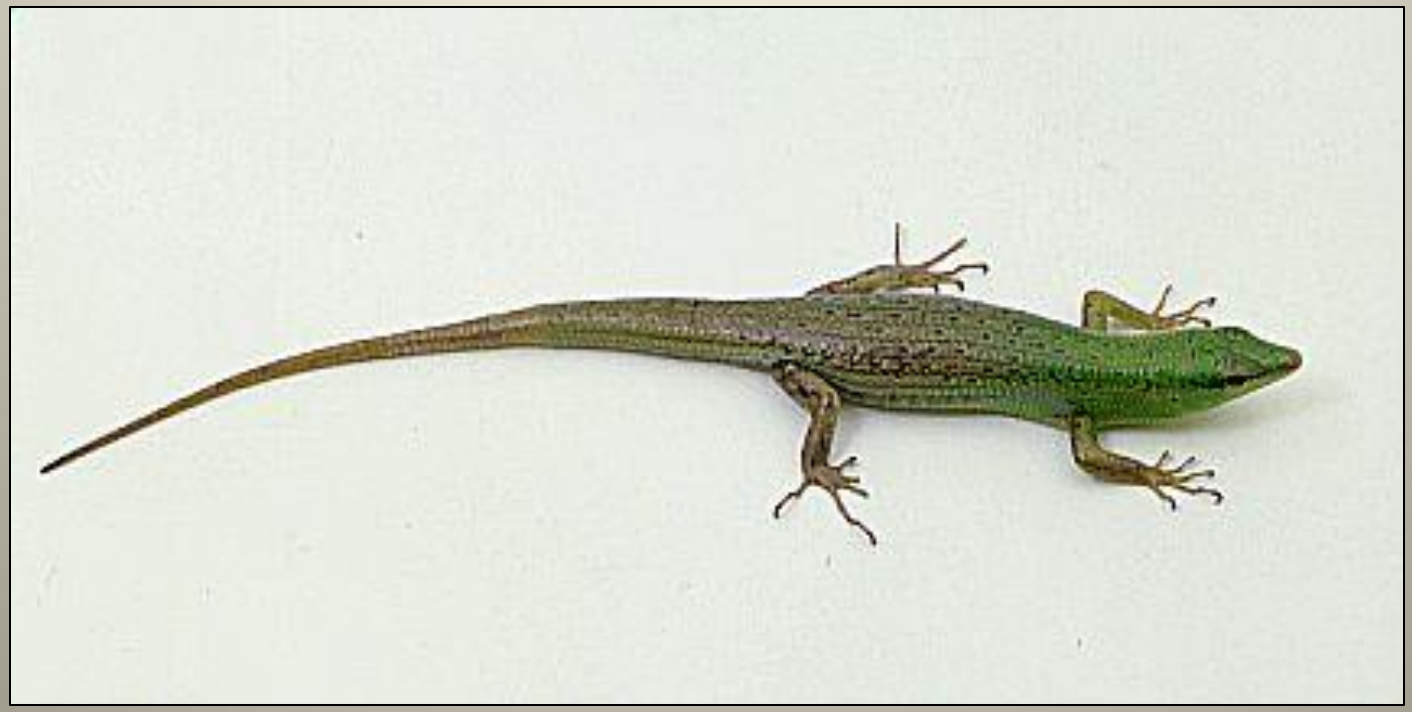
- **Forming of spores**
- **Spores are single cells produced by mitotic divisions**
- **Spores have tough coats and survive unfavorable conditions**

Types of Asexual Reproduction

5. Regeneration

- **Development of a new organism from part of the parent organism**
  - i.e. seastar
- **Replacement of lost body parts in invertebrates**
  - i.e. lobster claw

REGENERATION is the replacement of lost or damaged body parts.



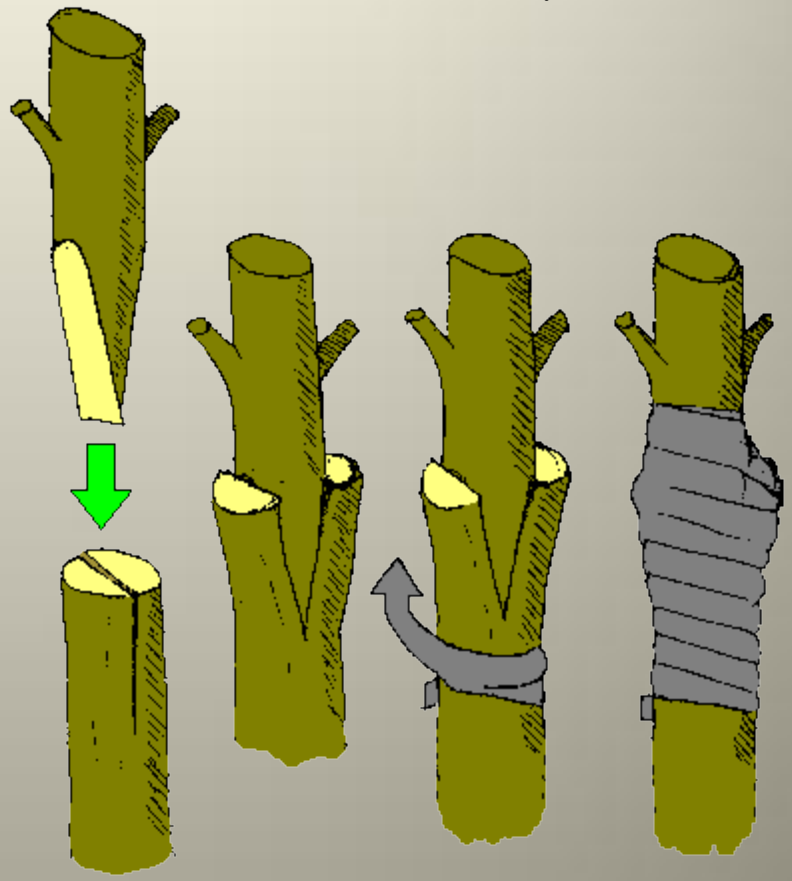
For example, a lizard may regenerate a lost tail.

Lizard loses tail.

CUTTINGS

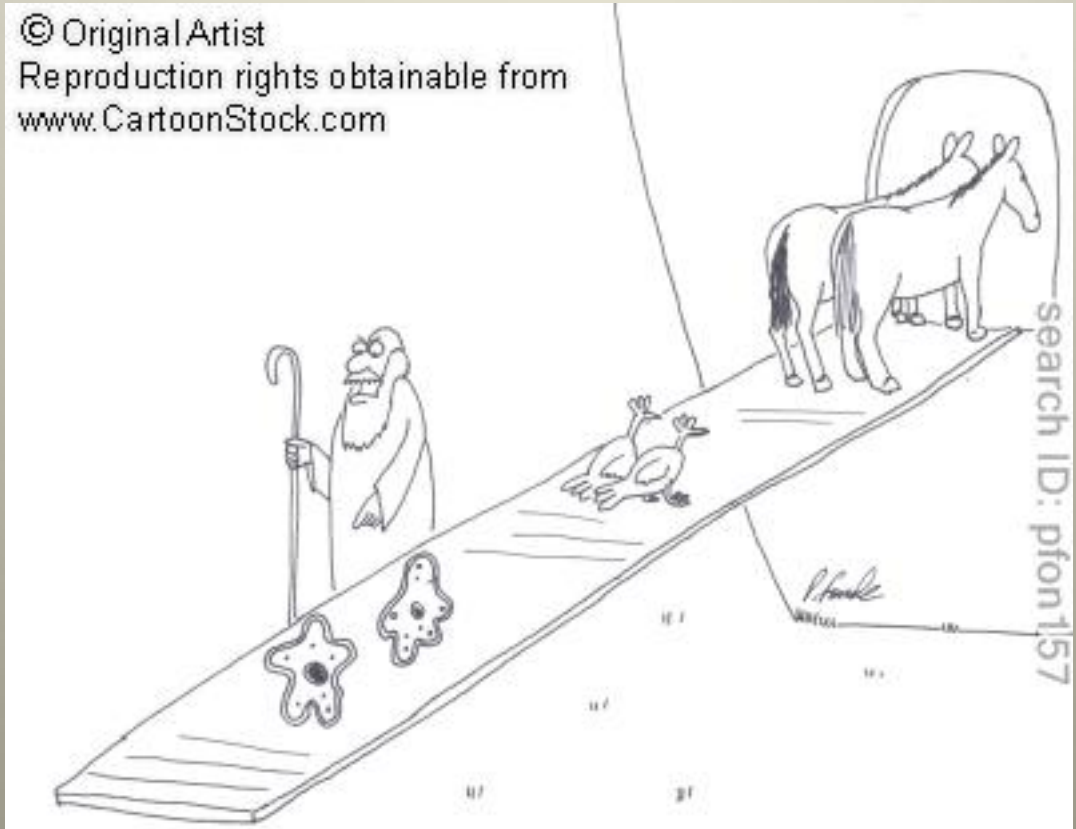
RUNNERS

GRAFTING



CLEFT (OR TOP WEDGE) GRAFT

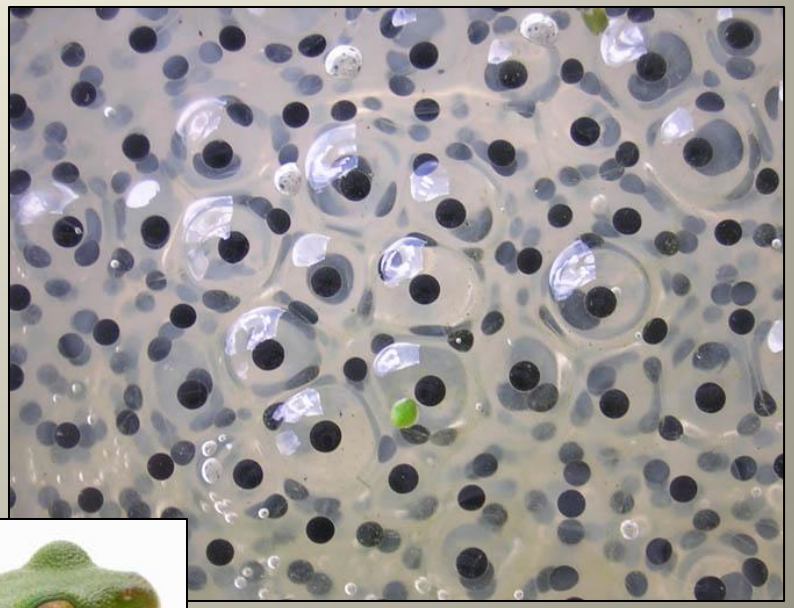
MEIOSIS AND SEXUAL REPRODUCTION



"Nice try! We only need *one* of you. You can just turn around and be on your way, buddy."

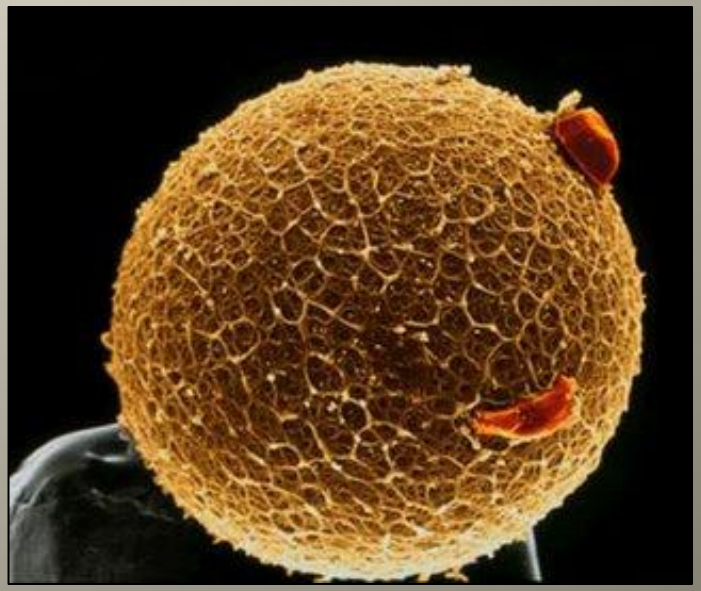
In SEXUAL REPRODUCTION there are two parents.
Each contributes a specialized cell to the new generation.

Specialized sex cells are known as the GAMETES.



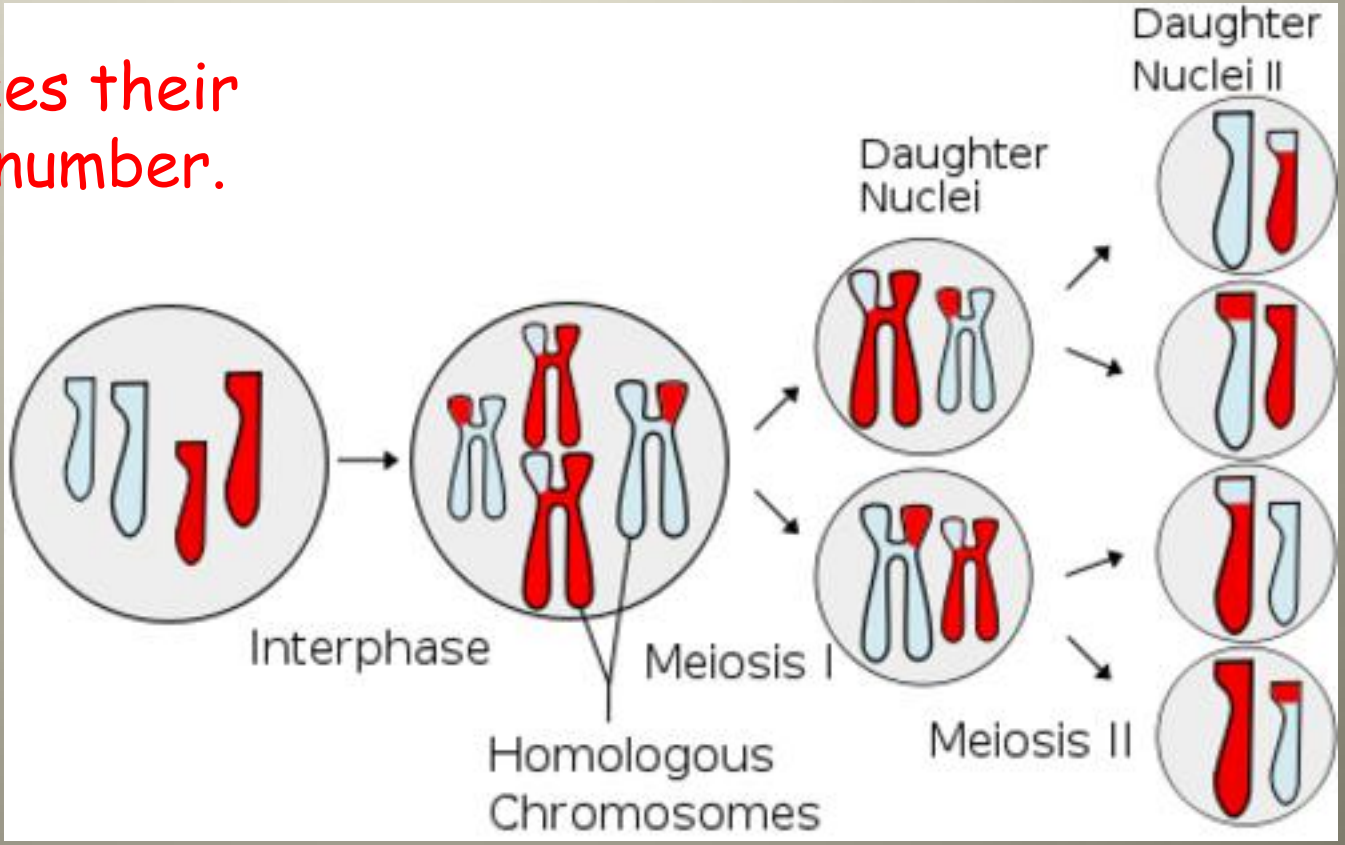
One type of gamete, the SPERM cell, is produced by the male parent.

Another type of gamete, the EGG cell (ovum), is produced by the female parent.



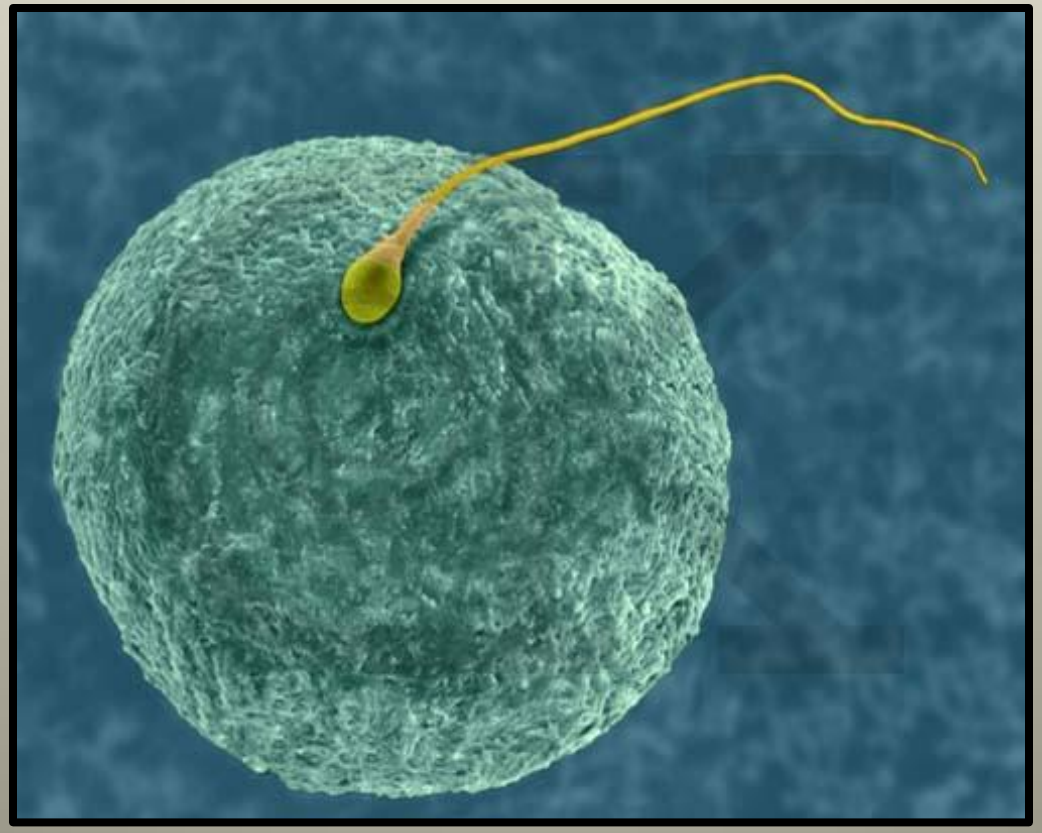
The sperm and egg cells are produced by a special kind of cell division called MEIOSIS.

Meiosis reduces their chromosome number.



http://www.youtube.com/watch?v=D1_-mQS_FZ0

FERTILIZATION is when the sperm and egg fuse together.

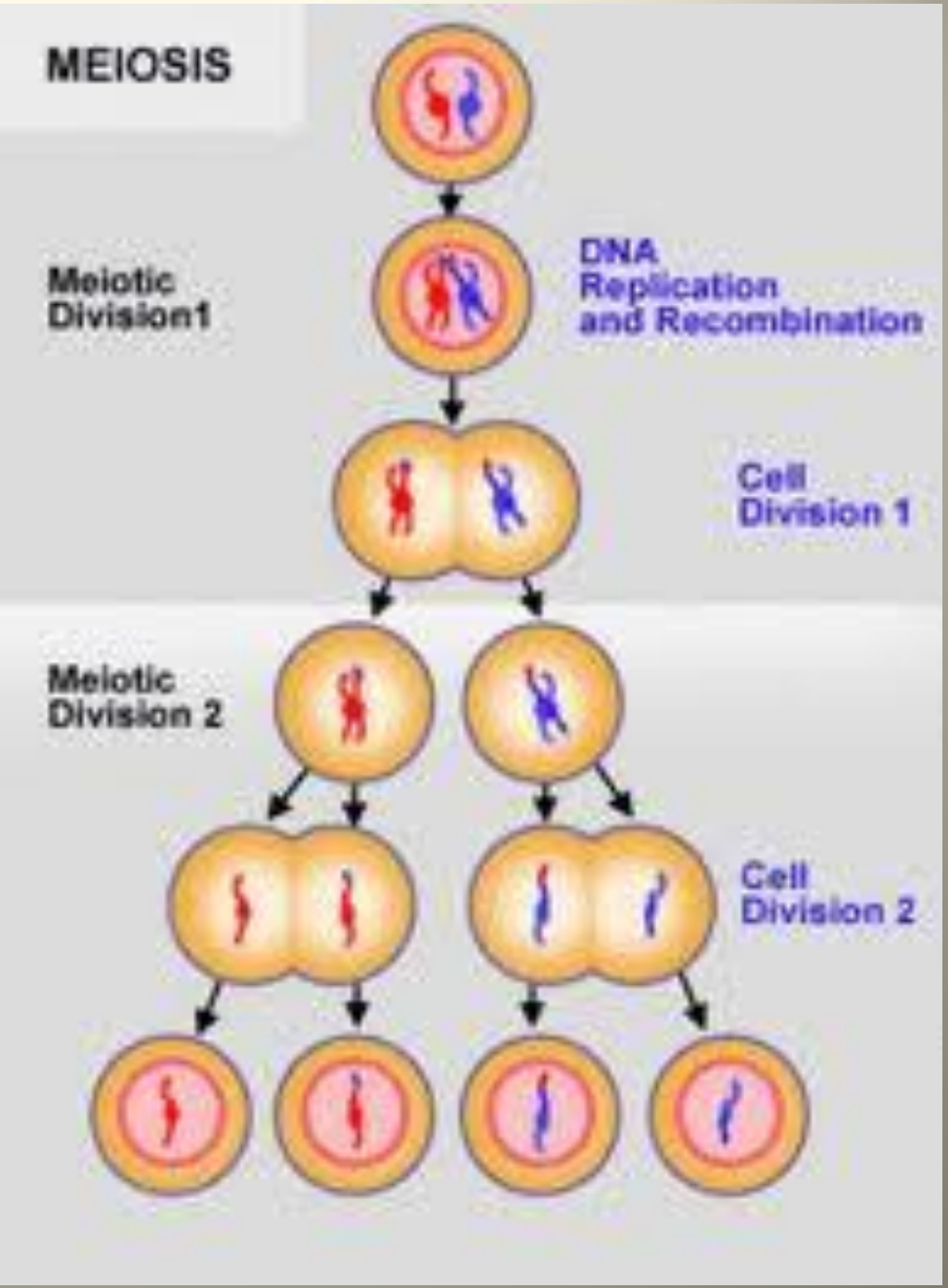


Meiosis

I
P
M
A
T
P
M
A
T

Interphase
Prophase 1
Metaphase 1
Anaphase 1
Telophase 1

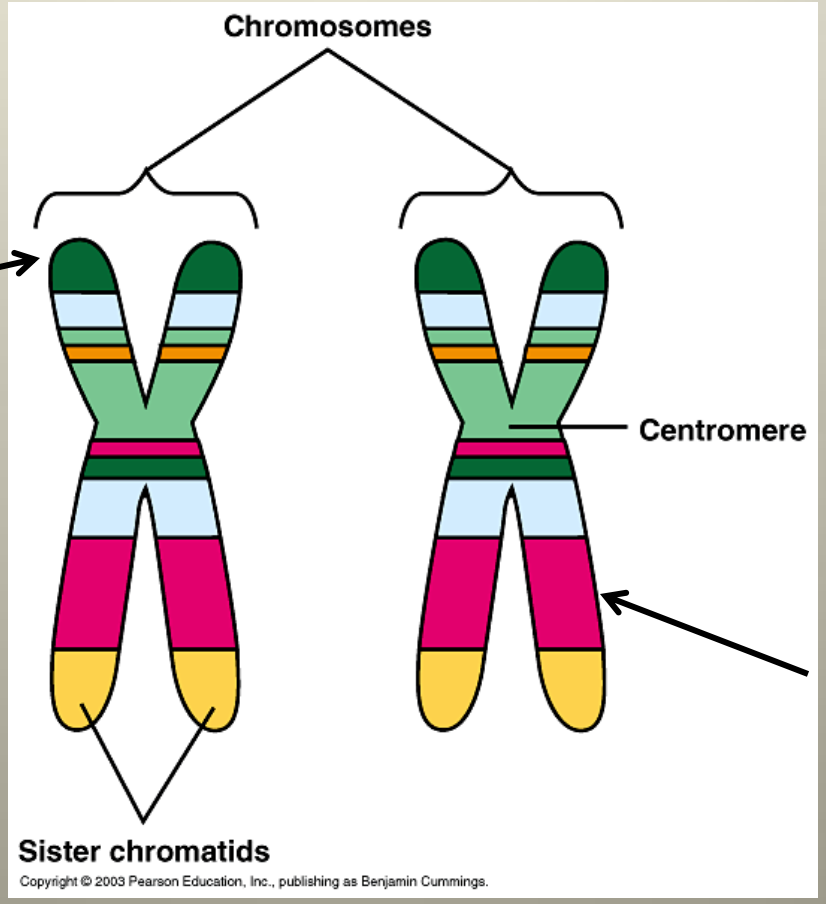
Prophase 2
Metaphase 2
Anaphase 2
Telophase 2



Fertalization results in a ZYGOTE. The Zygote undergoes repeated mitotic cell divisions to form the embryo.

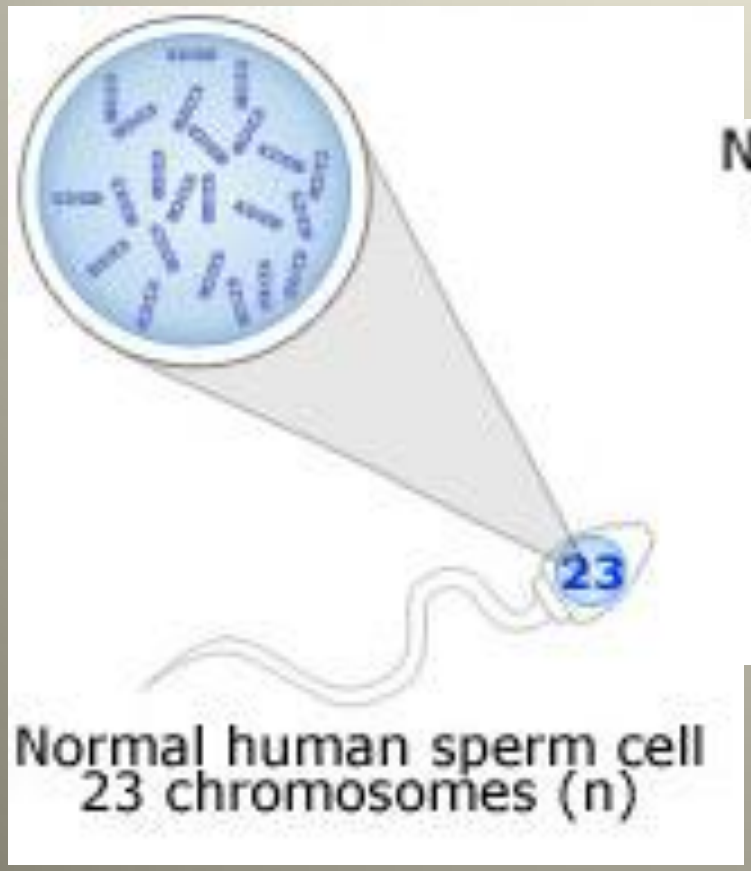
The two chromosomes of each pair are HOMOLOGOUS.
They are similar in size and shape,
and control the same traits.

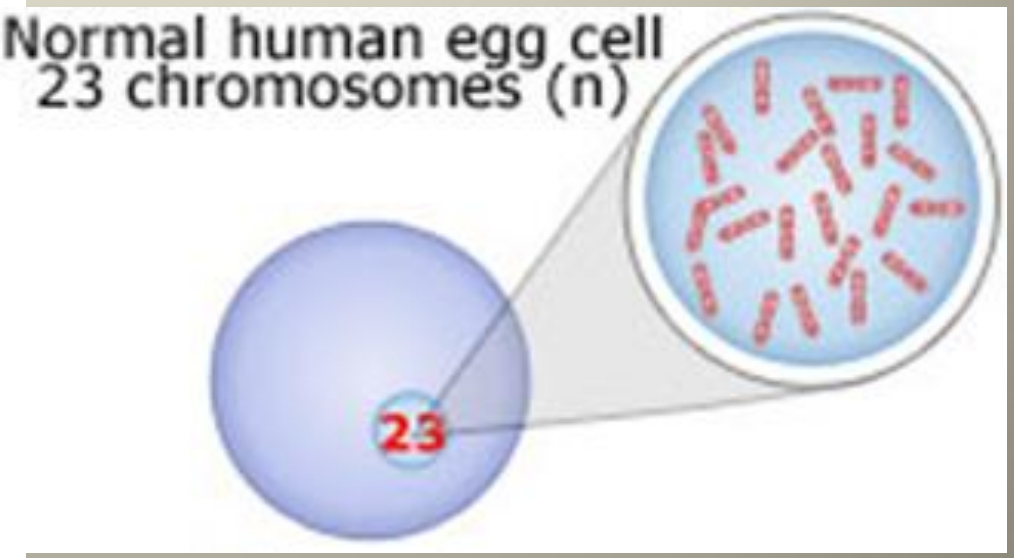
Hair color
B brown



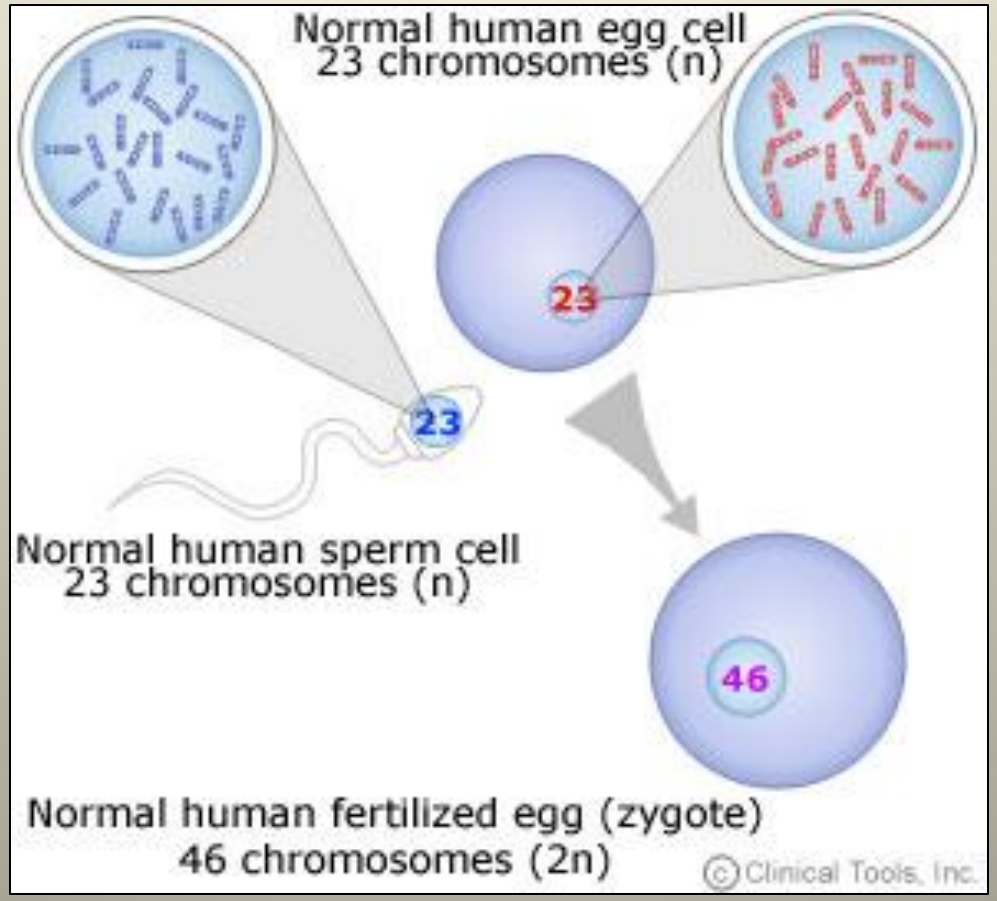
Eye color
B brown

Sperm and egg cells contain half the number of chromosomes of a human.

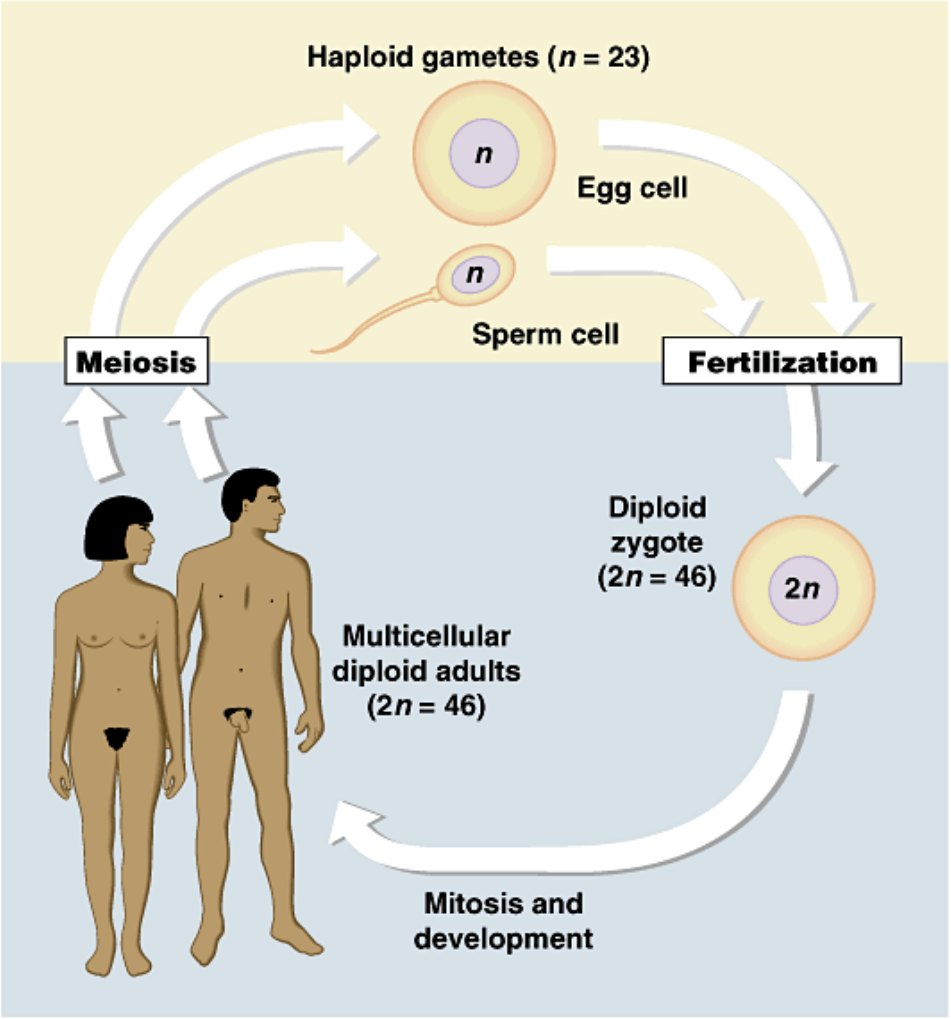




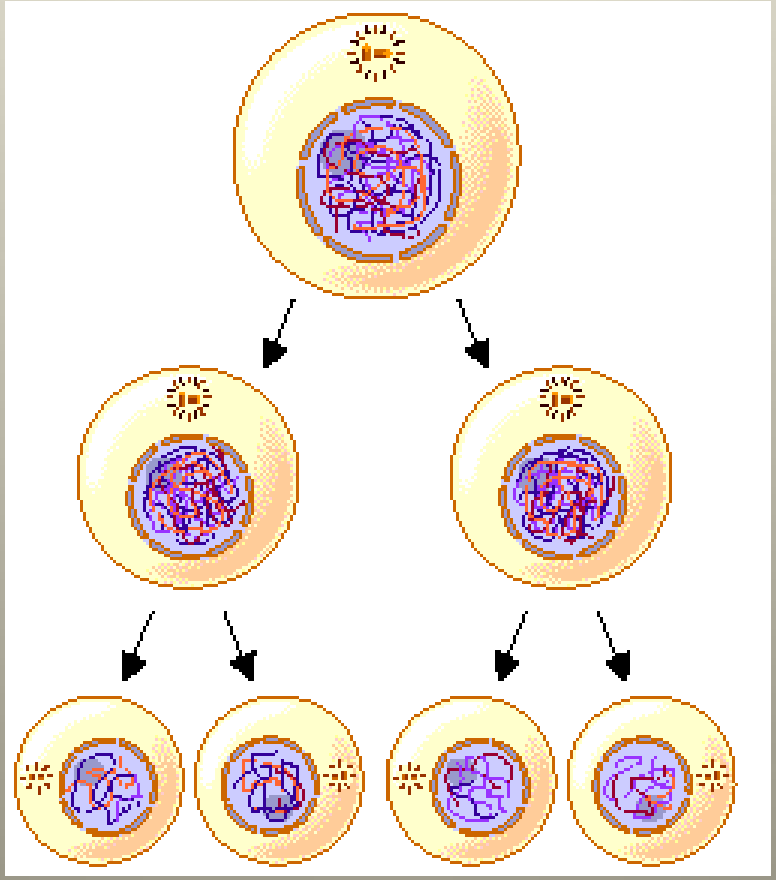
The sperm and egg cells are produced by MEIOSIS which reduces the chromosome number in half.



FERTILIZATION joins the sperm and egg to restore the species chromosome number.



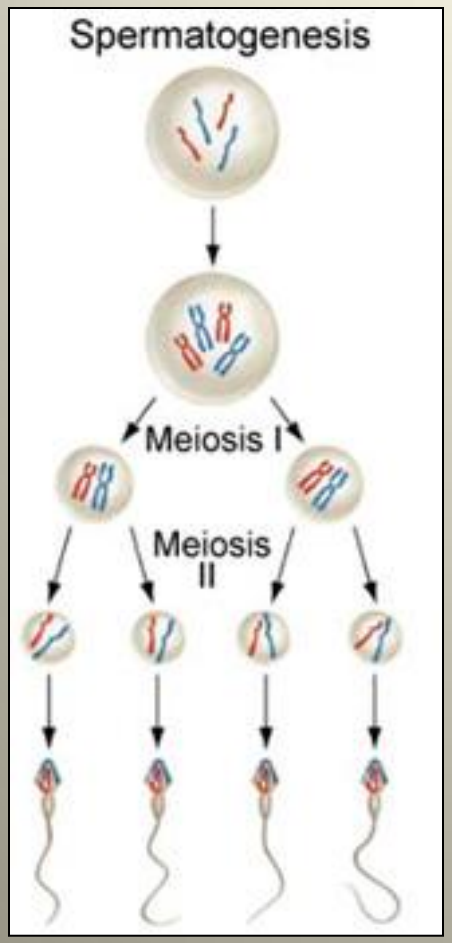
Meiosis occurs ONLY in the formation of sex cells.

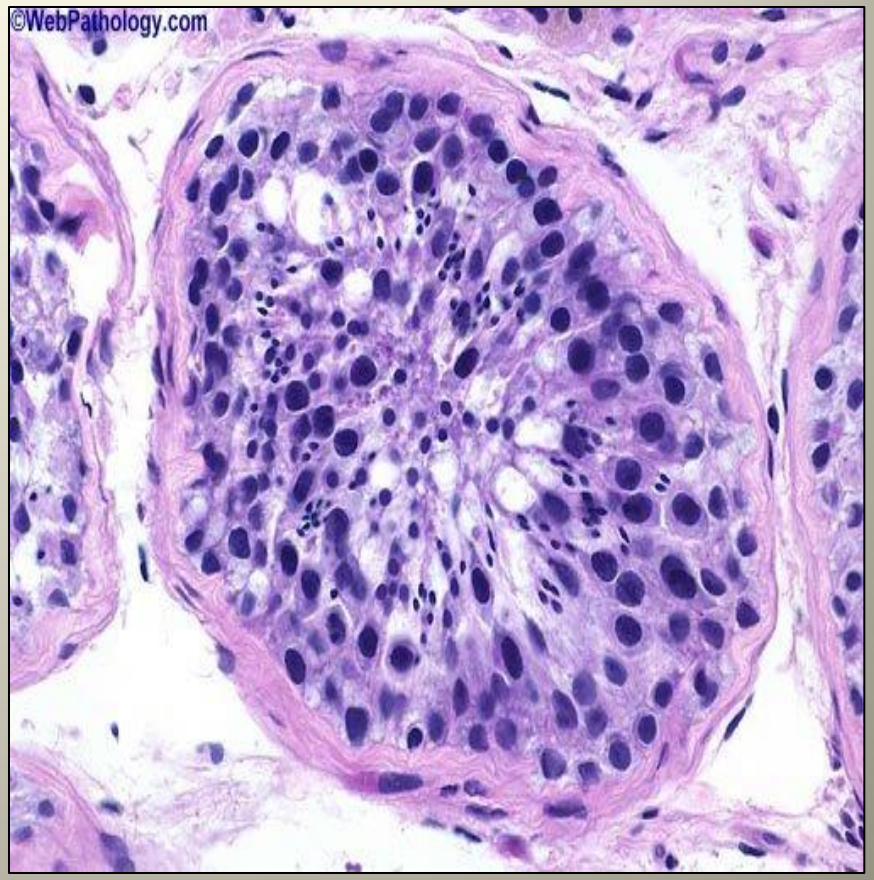


Most animals are either: female – with OVARIES,
or male - with TESTES.

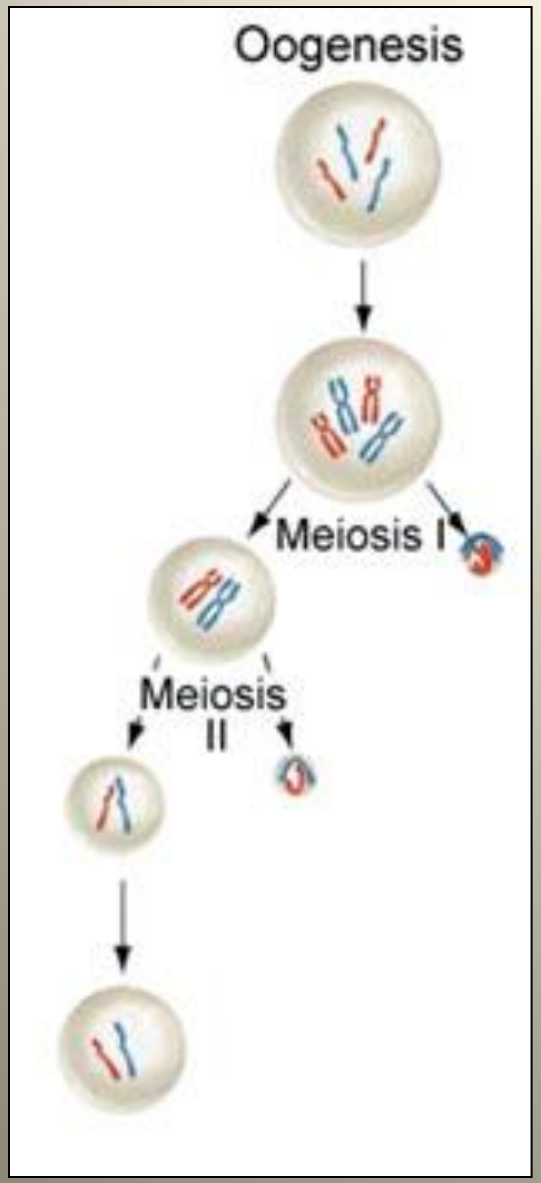
But some animals are HERMAPHRODITES:
they have both ovaries AND testes.

SPERMATOGENESIS





In the testes, 4 sperm are produced by each meiotic division.



OOGENESIS

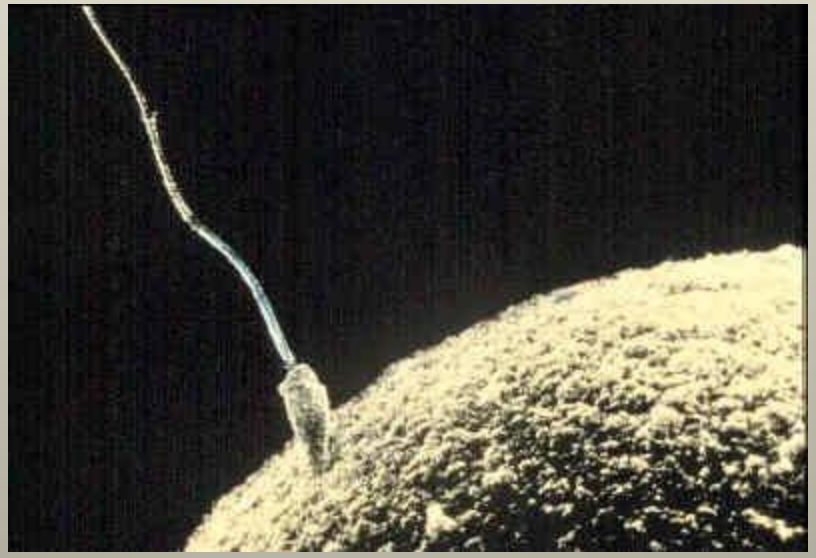
During egg production in the ovaries, division of the cytoplasm is unequal.

Only one mature egg cell is formed.

The other "cells" are called POLAR BODIES.

They disintegrate in the body.

FERTILIZATION is the union of a sperm with an egg to form a ZYGOTE - the first cell of the new organism.



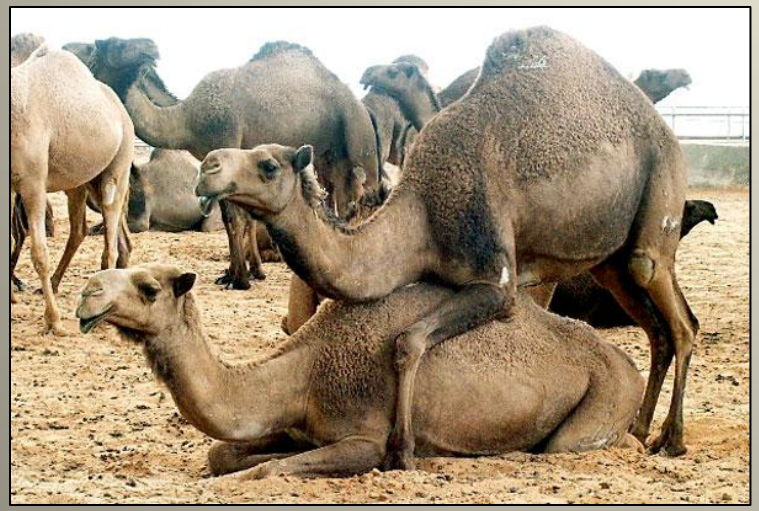
The union of a sperm and egg outside the body of the female is called EXTERNAL FERTILIZATION.

This generally occurs in a water environment
(in fish, frogs, and many other aquatic vertebrates).

Large numbers of gametes are released to

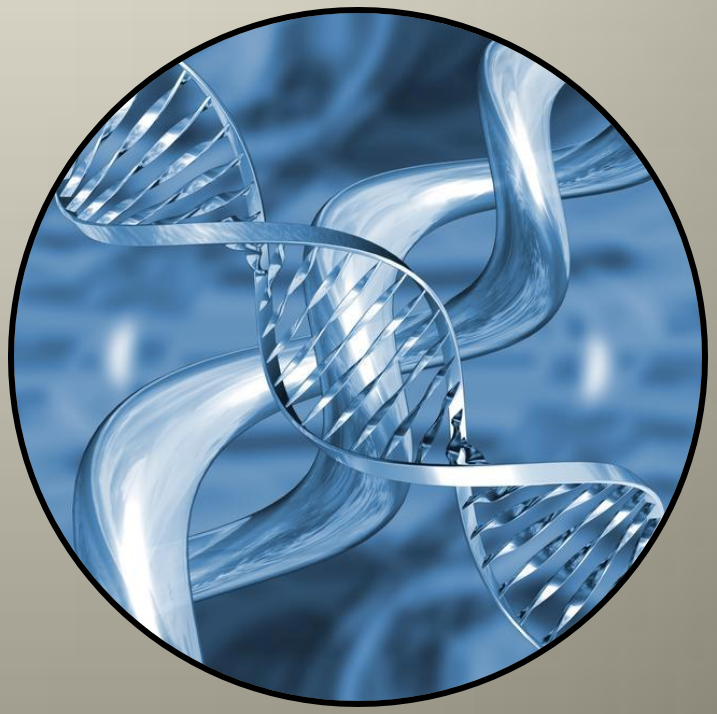
1. increase the chances that fertilization will take place
2. help ensure that at least some of the fertilized eggs will develop and survive to adulthood.

The union of a sperm and egg in the moist reproductive tract of a female is called INTERNAL FERTILIZATION.

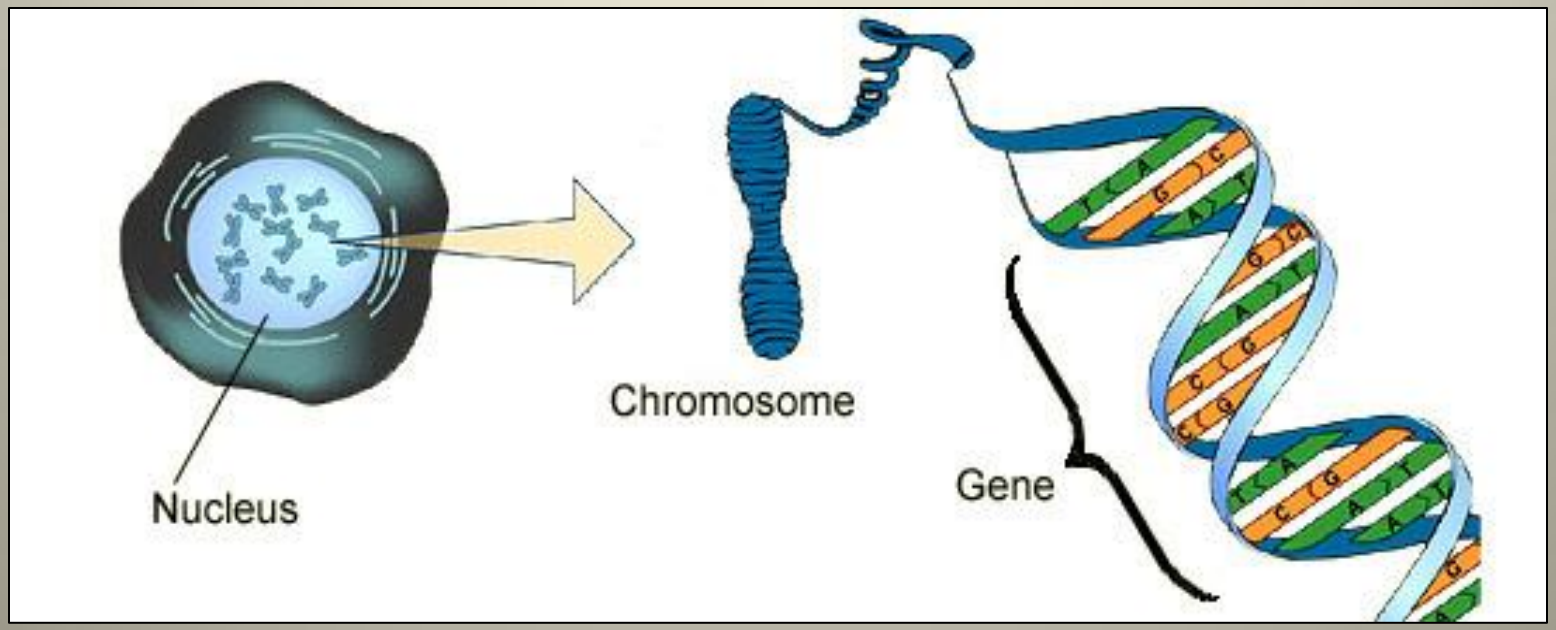


This occurs in terrestrial (land-dwelling) vertebrates, including birds and mammals.

GENETICS is the branch of biology that deals with inheritance.



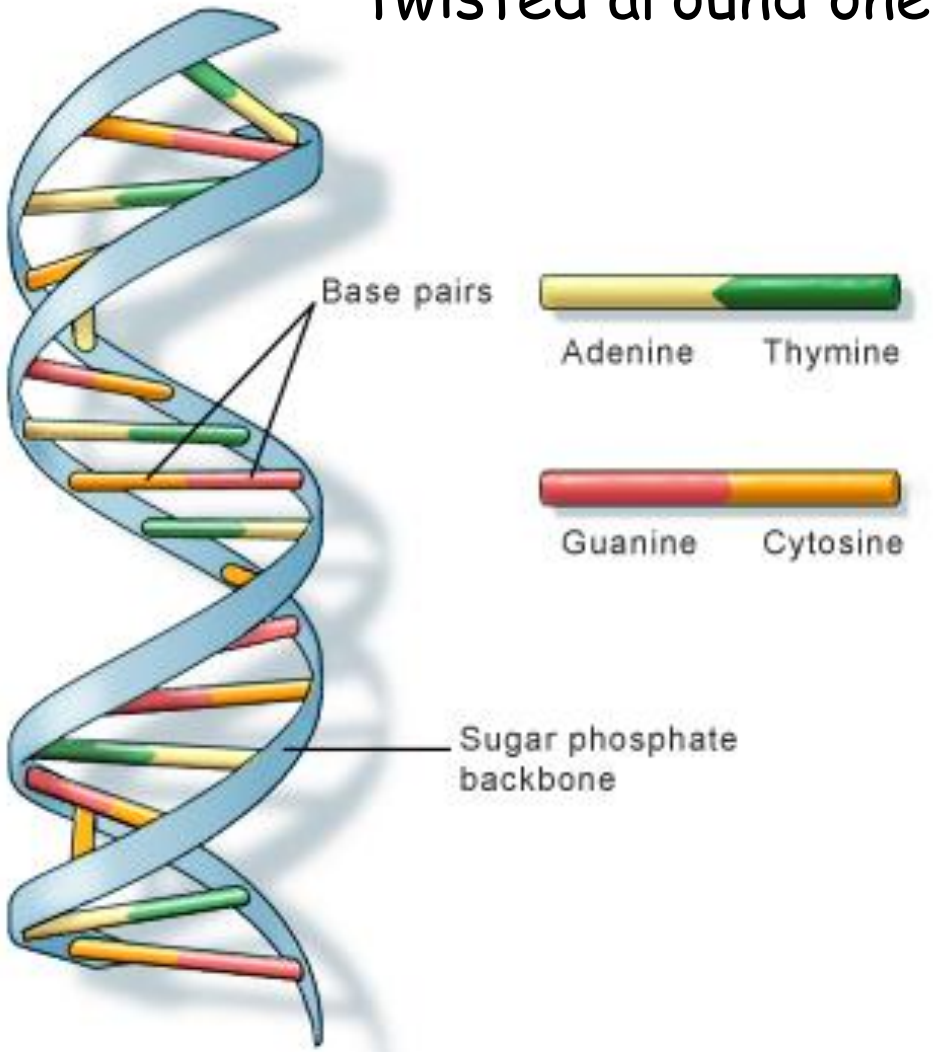
DNA is the genetic material that is passed from generation to generation.



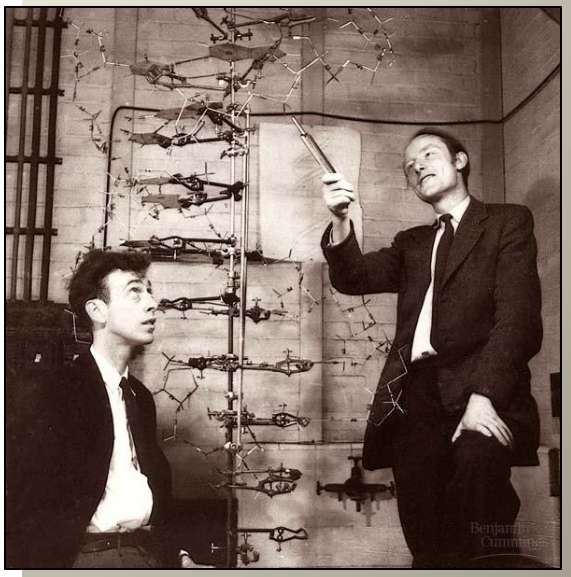
Cells -> Nucleus –> Chromosomes –> Gene –> Trait

BIGGEST----------→ smallest

WATSON and CRICK described the DNA molecule as a DOUBLE HELIX – two strands joined together and twisted around one another.

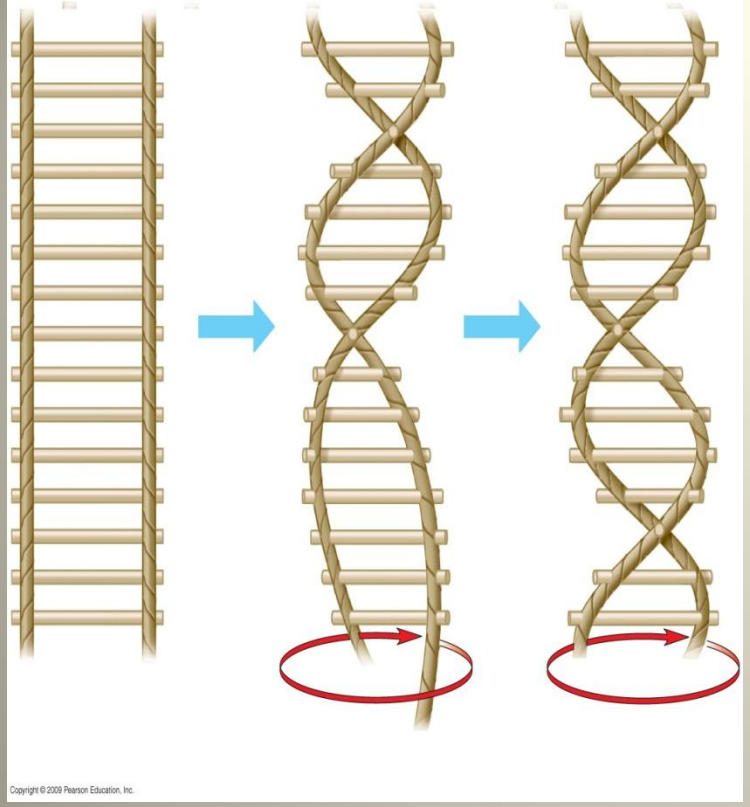


U.S. National Library of Medicine



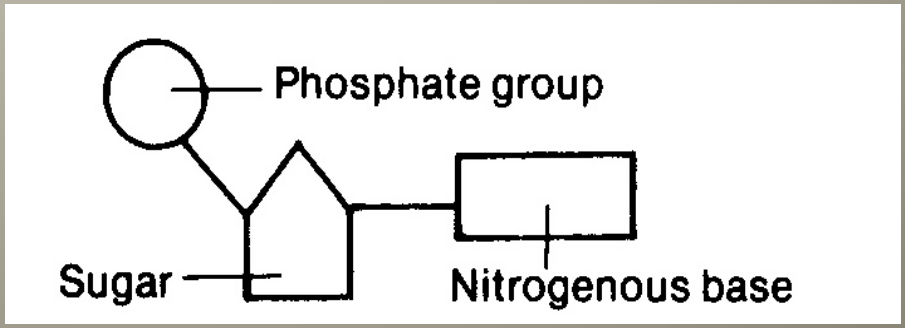
DNA molecules are very long.

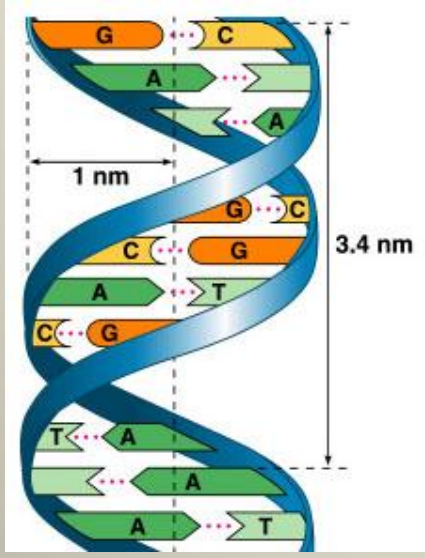
Each DNA is made up of thousands of units called NUCLEOTIDES.

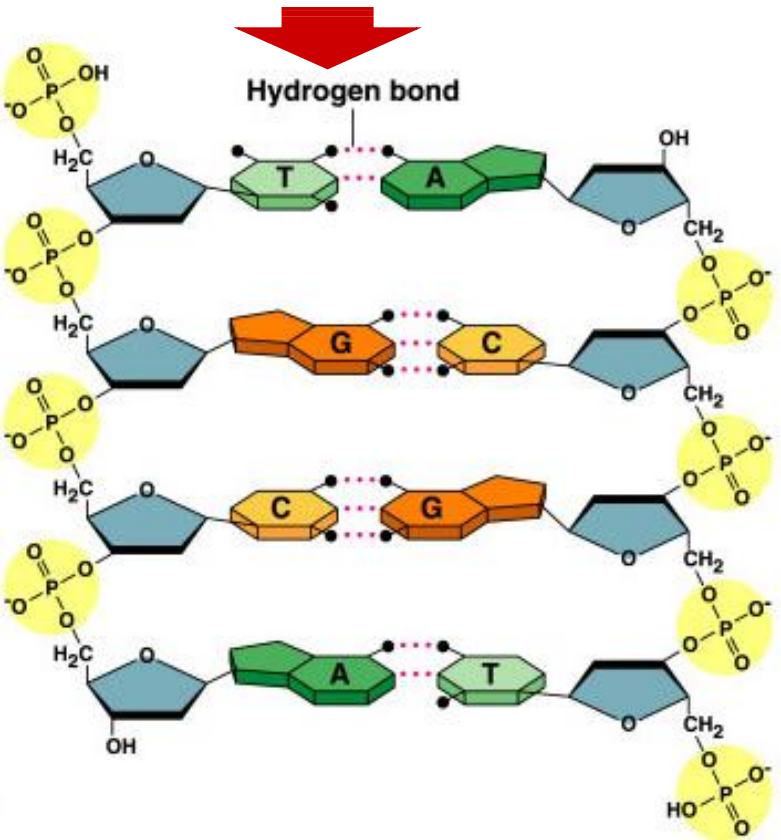


- Watson and Crick also proposed that DNA is shaped like a long zipper that is twisted into a coil like a spring.

Each nucleotide has three parts: sugar, phosphate, nitrogenous base





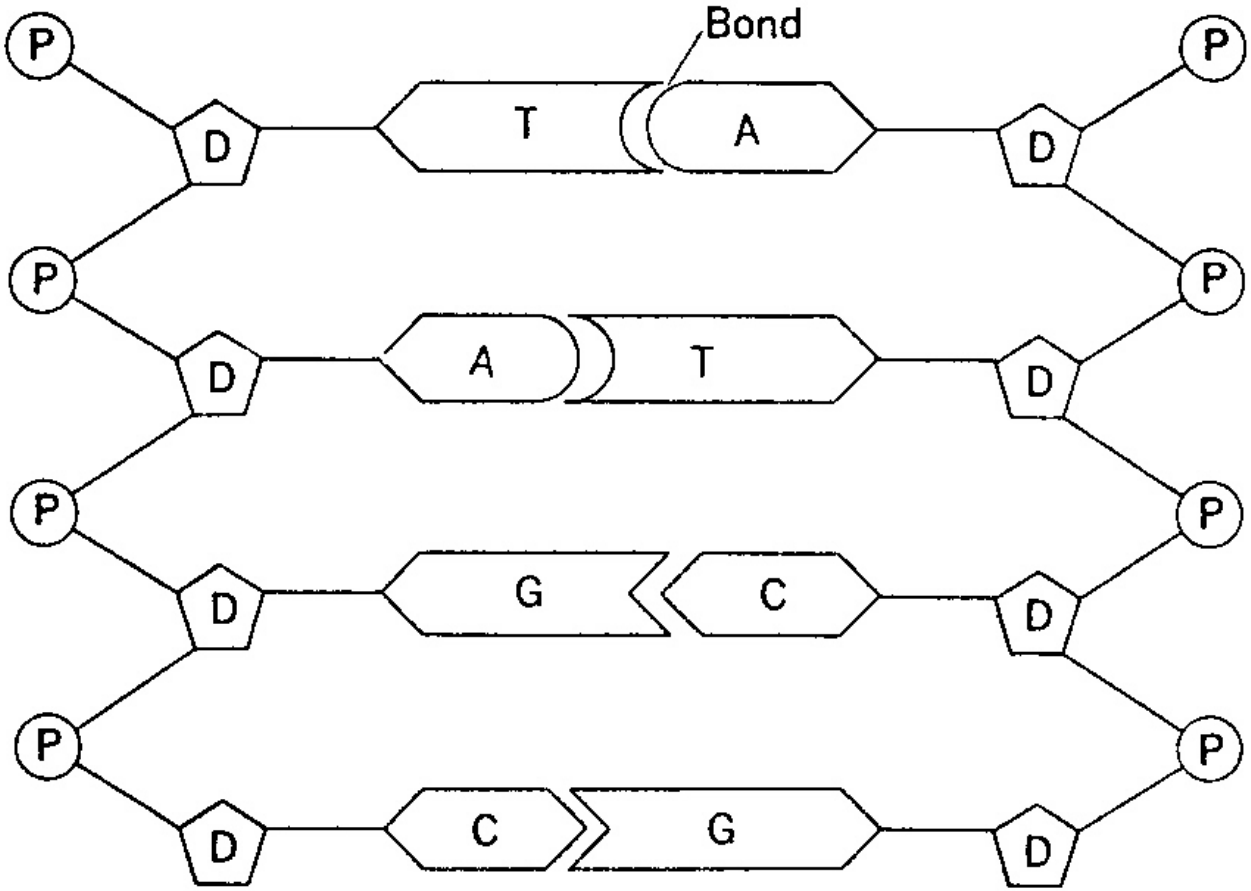


The four nitrogenous bases of DNA nucleotides bond together in only one way:

DNA -> DNA
(A) pairs with (T),
(C) pairs with (G).

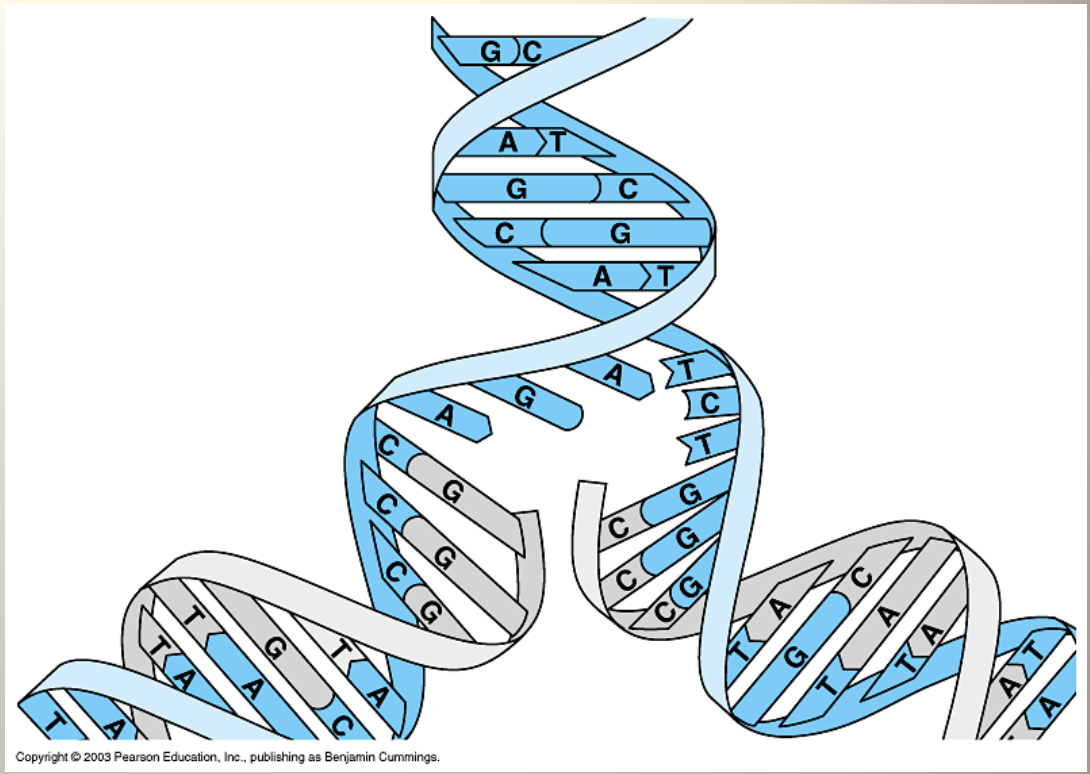
Air goes in Tires

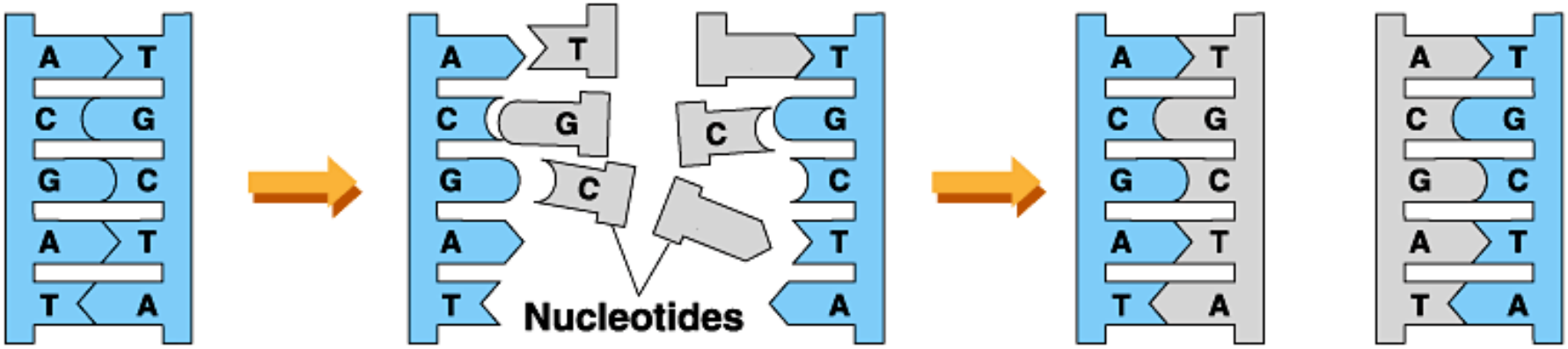
Gas goes in Cars



Hydrogen bonds hold the two strands together between the bases.

DNA REPLICATION – When DNA copies itself



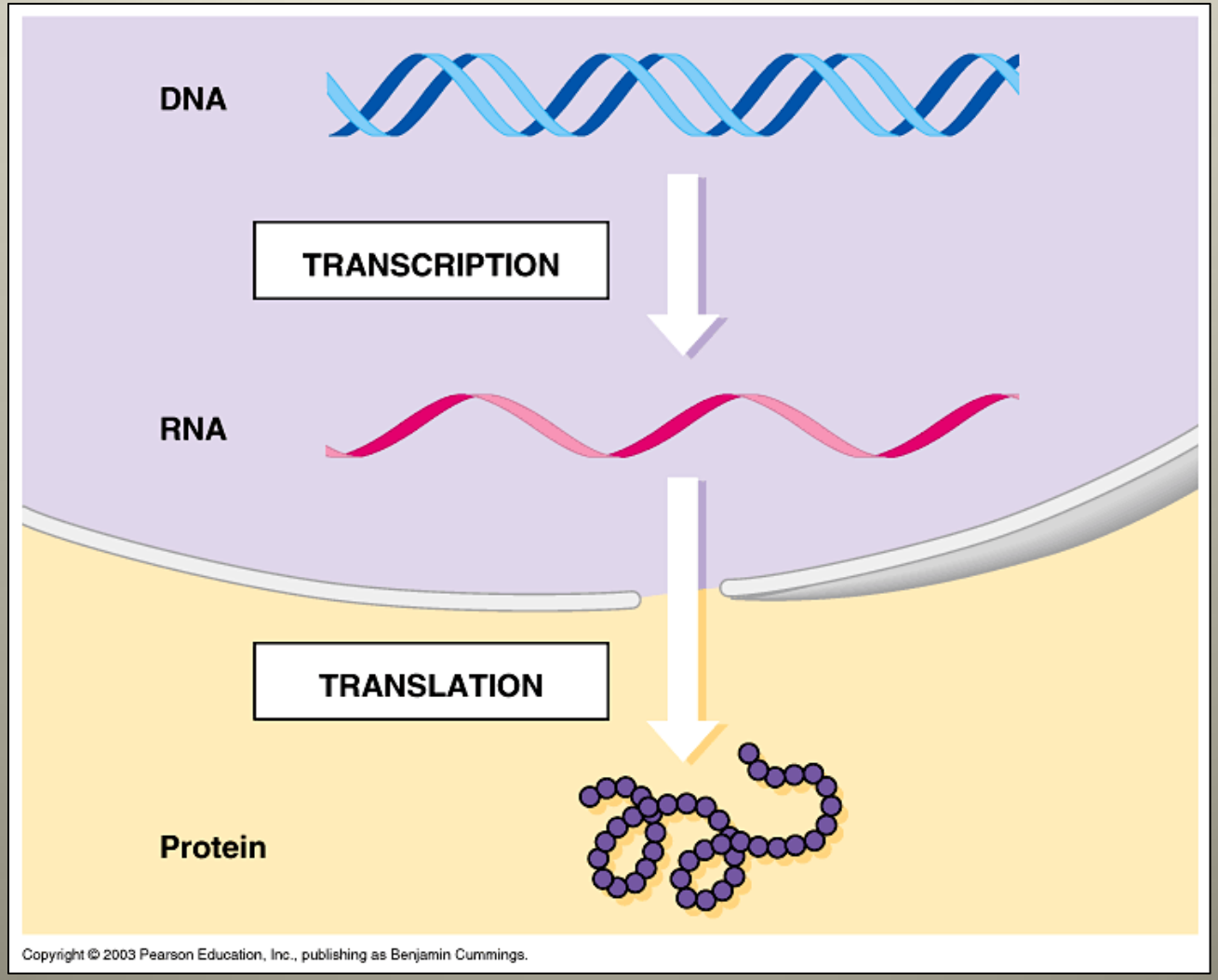


Parental molecule of DNA

Both parental strands serve as templates

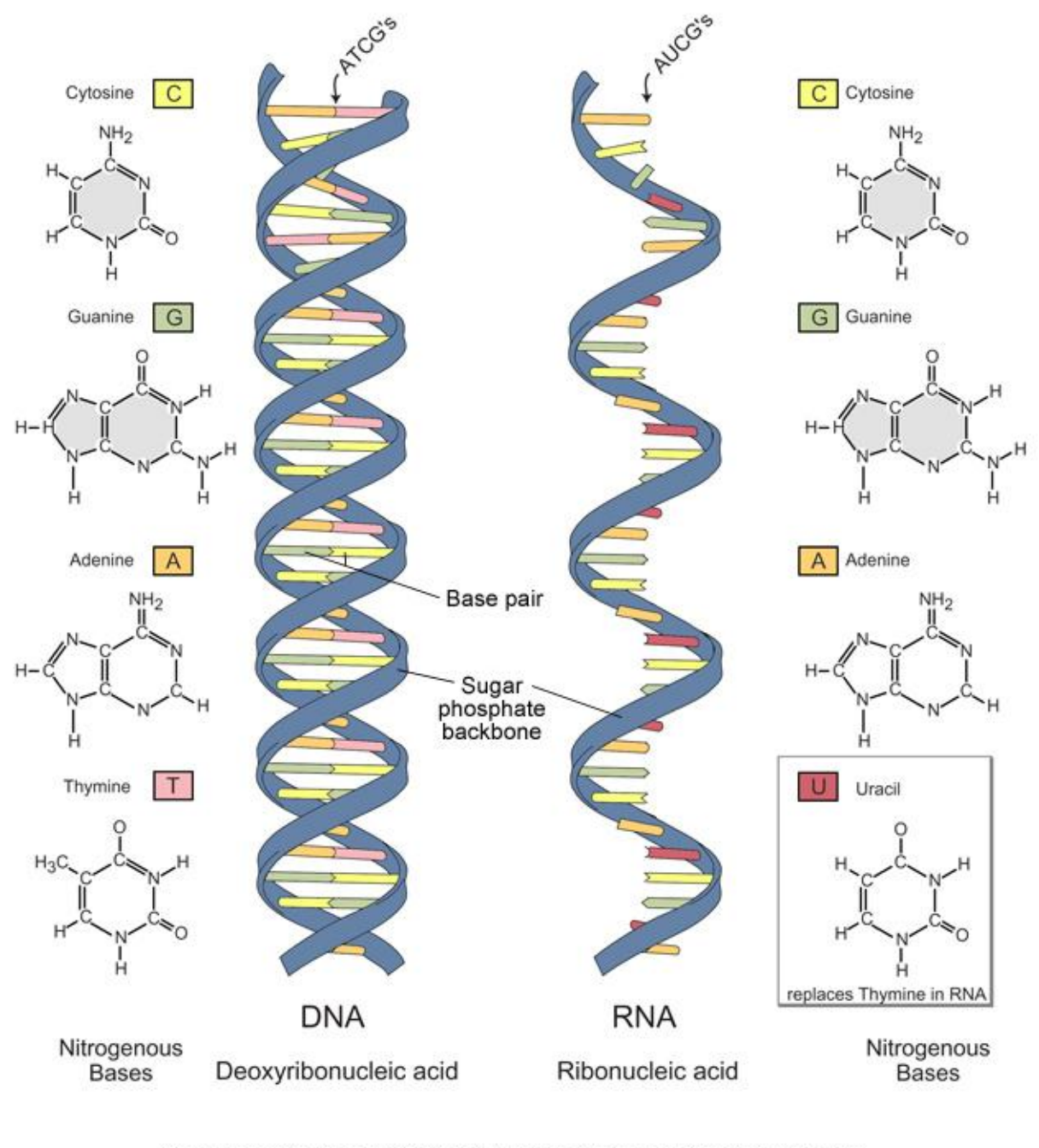
Two identical daughter molecules of DNA

The DNA controls cellular activities by providing instructions for PROTEIN SYNTHESIS.



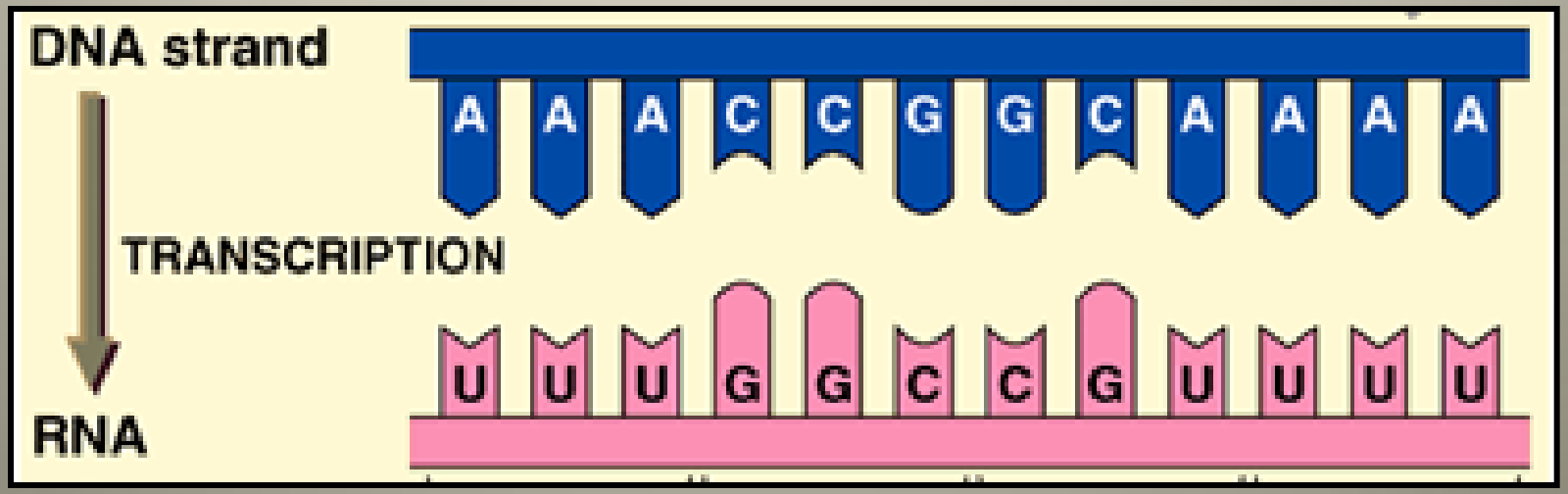
DNA ->RNA

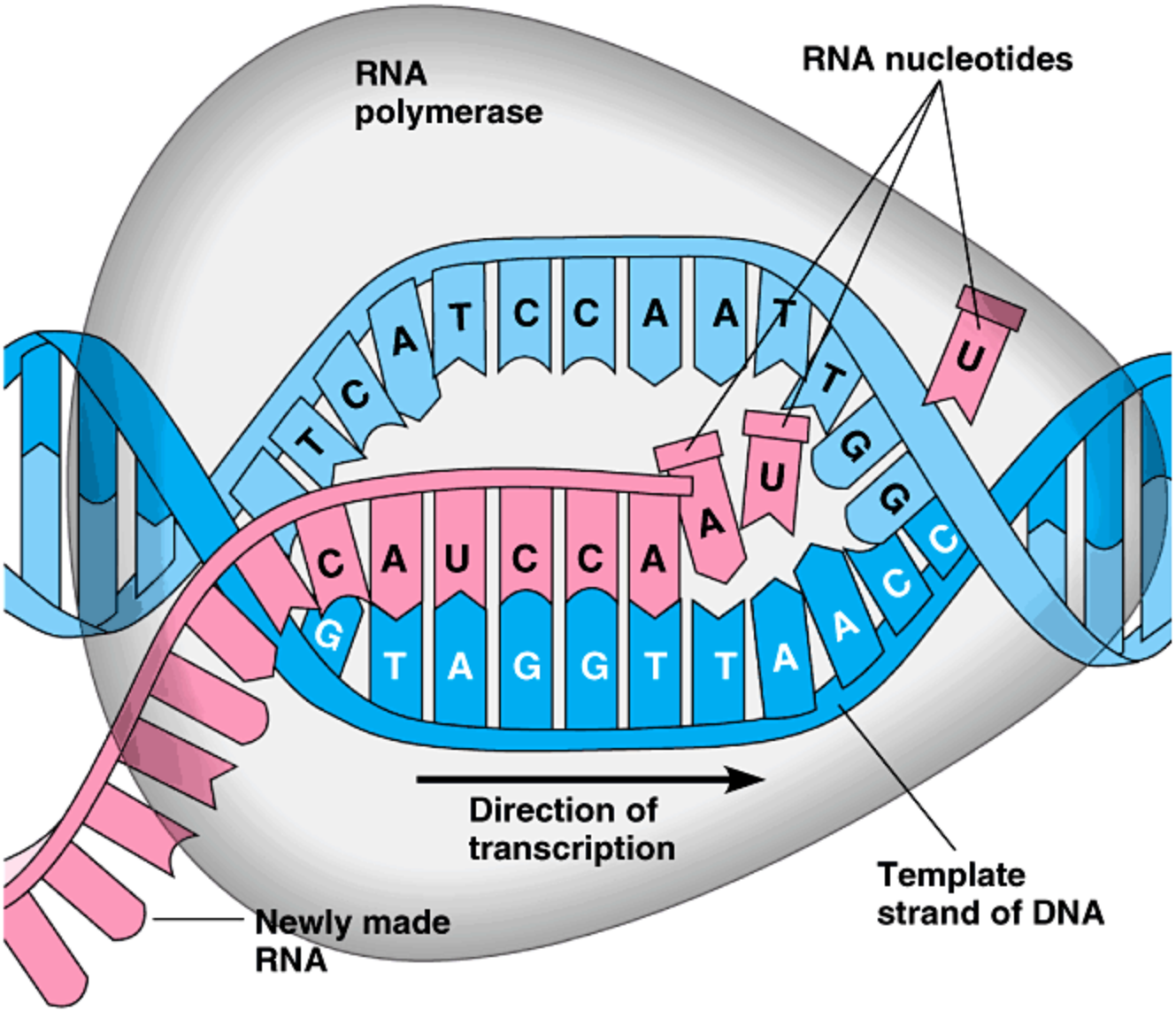
A -> U
T -> A
C <-> G

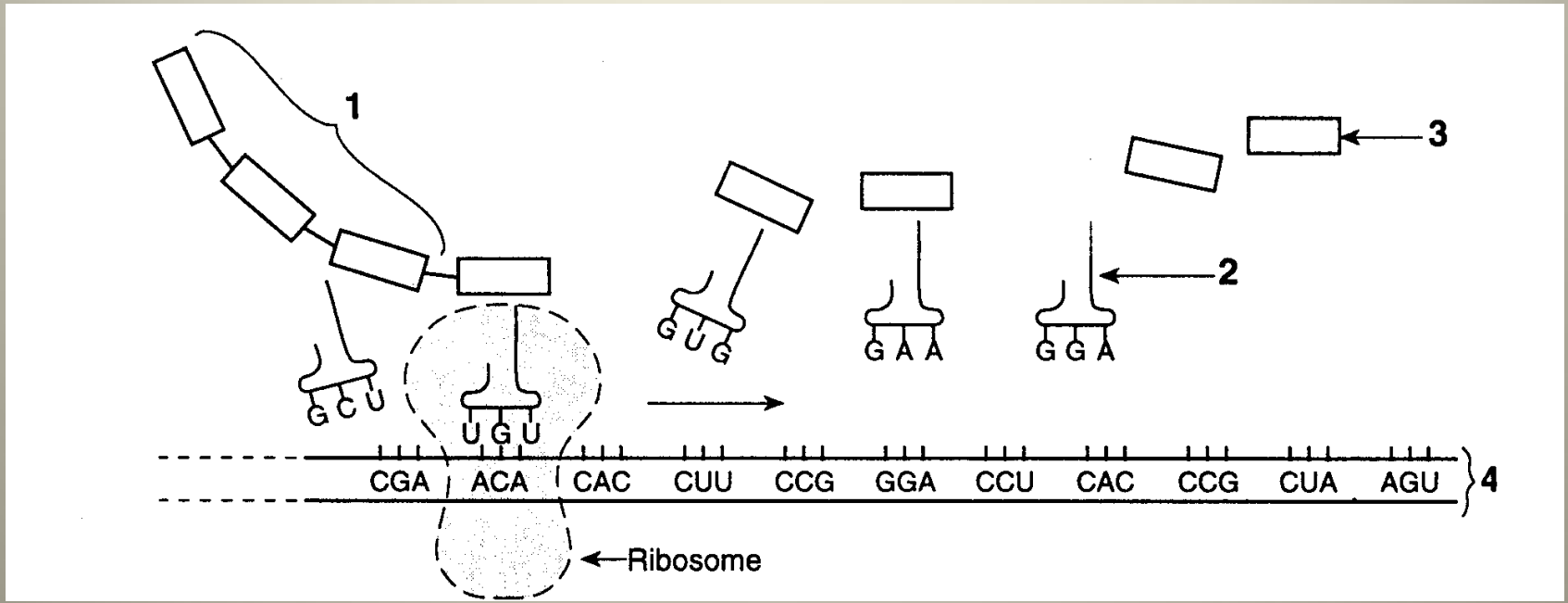


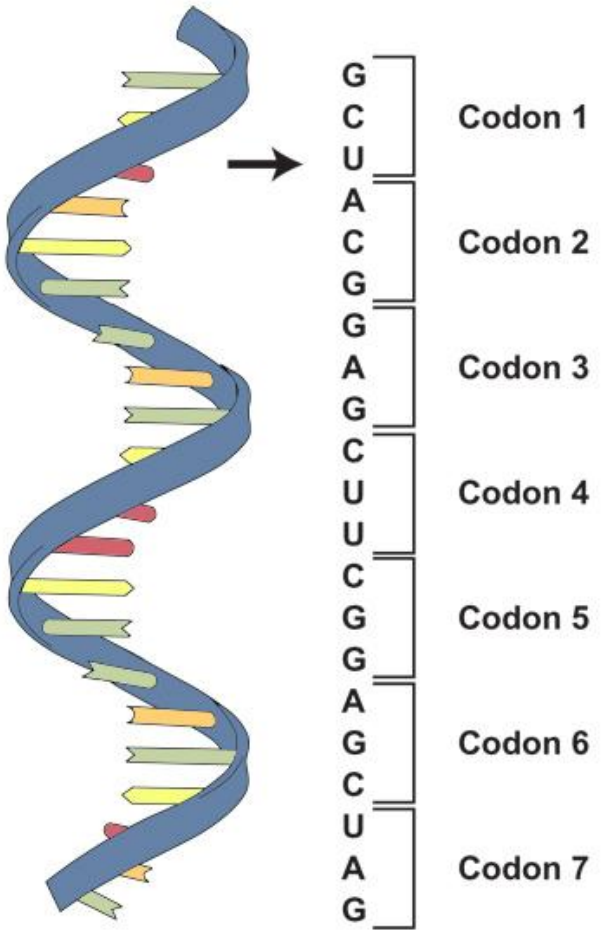
MESSENGER RNA (mRNA)
carries the DNA code to the ribosome for protein synthesis.

mRNA is formed by copying DNA as a pattern or TEMPLATE in a process called TRANSCRIPTION.






1
2
3
4
G C U
U G U
G U G
G A A
G G A
CGA
ACA
CAC
CUU
CCG
GGA
CCU
CAC
CCG
CUA
AGU
Ribosome



mRNA
Ribonucleic acid

Image adapted from: National Human Genome Research Institute. Talking Glossary of Genetic Terms. Available at: www.genome.gov/Pages/Hyperion/DIR//VIP/Glossary/Illustration/codon.shtml.

mRNA molecules are read three bases at a time.

Each three base sequence is called a CODON.

FIRST BASE	SECOND BASE: U	SECOND BASE: C	SECOND BASE: A	SECOND BASE: G	THIRD BASE
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA Stop	UGA Stop	A
	UUG Leu	UCG Ser	UAG Stop	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met or start	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val	GCG Ala	GAG Glu	GGG Gly	G

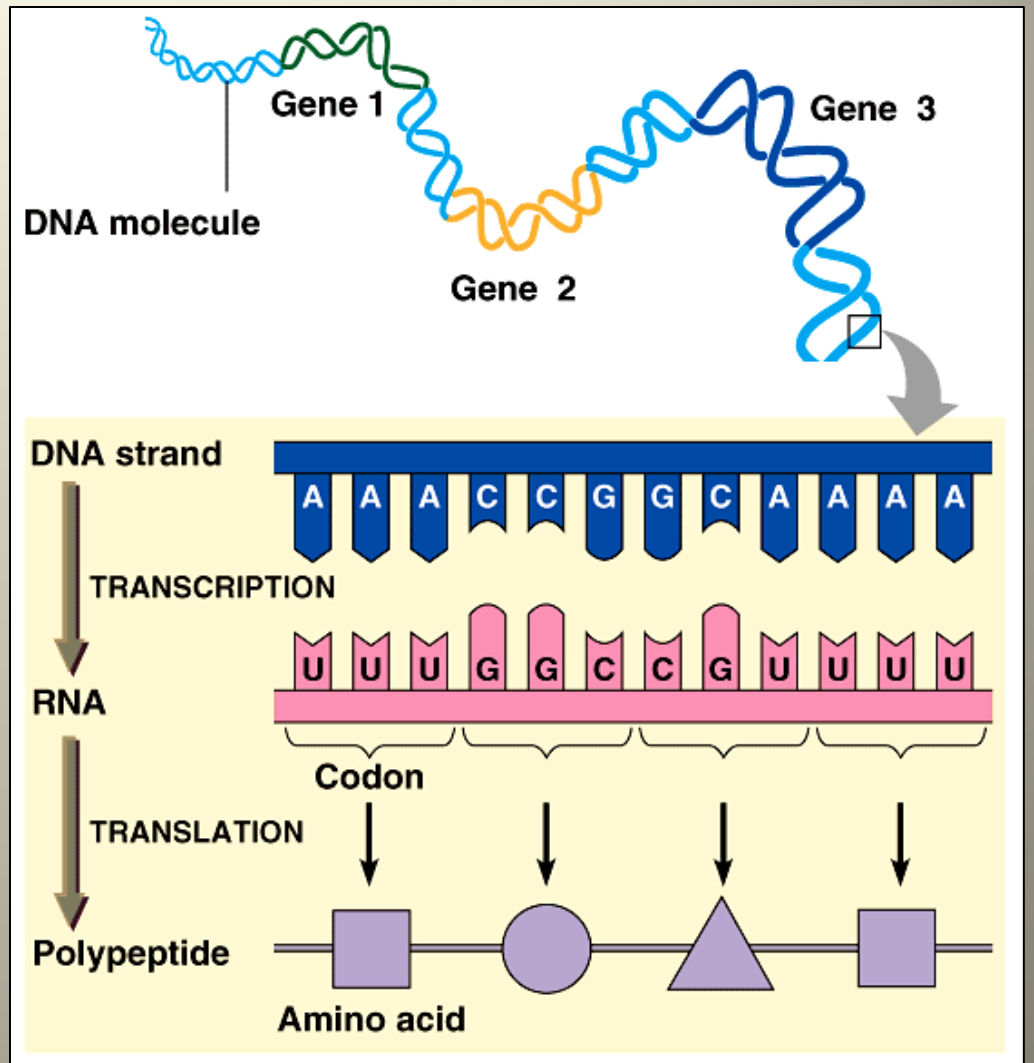
In SUMMARY:

PROTEIN SYNTHESIS requires two steps:

TRANSCRIPTION (DNA ⟶ mRNA)

and

TRANSLATION (mRNA ⟶ polypeptide)

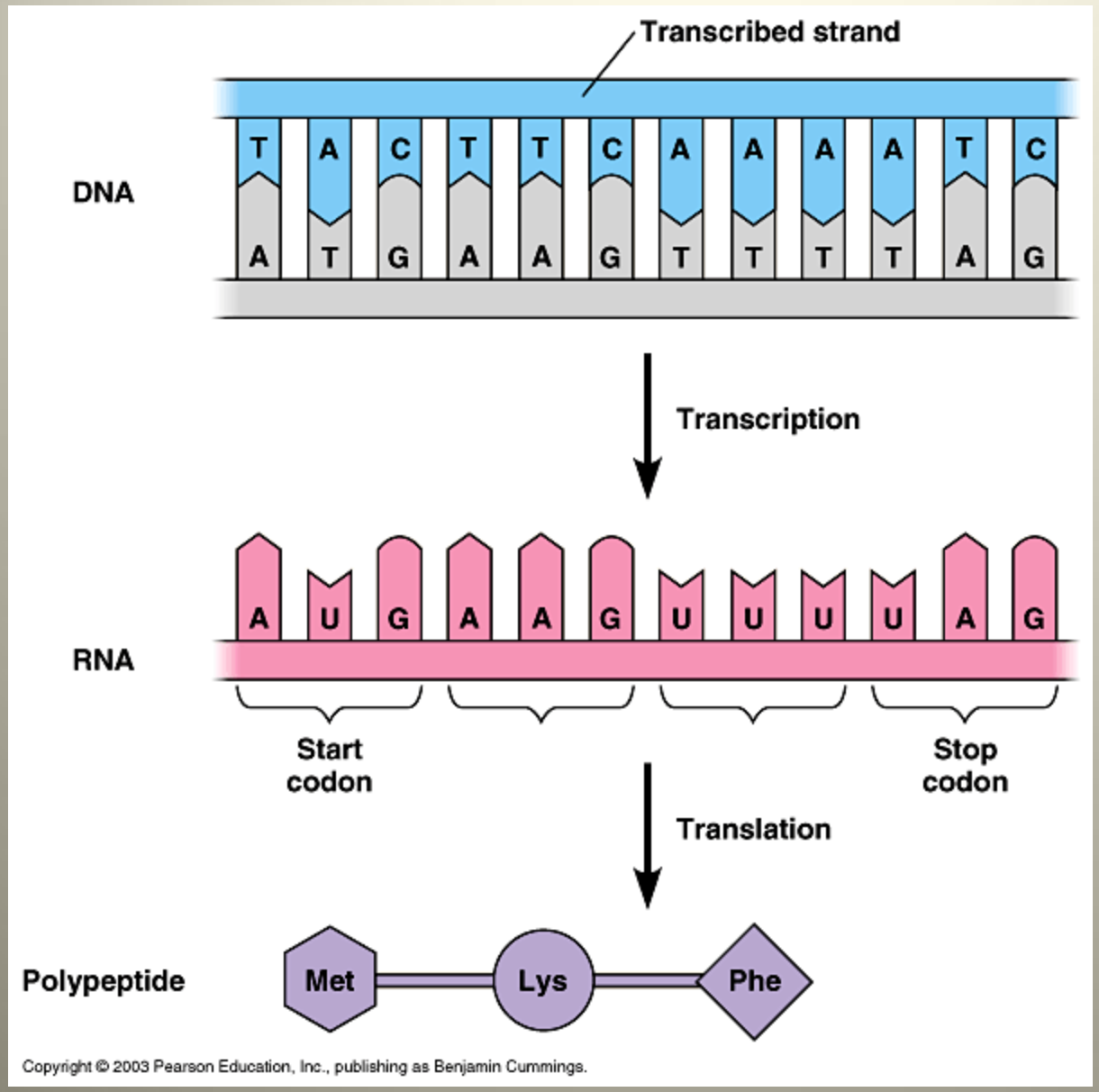


What polypeptide would be formed from this DNA strand??

TACTTCAAAATC

AUGAAGUUUUAG

met-lys-phe


Transcribed strand
DNA
T A C T T C A A A A T C
A T G A A G T T T T A G
Transcription
RNA
A U G A A G U U U U A G
Start codon
Stop codon
Translation
Polypeptide
Met
Lys
Phe
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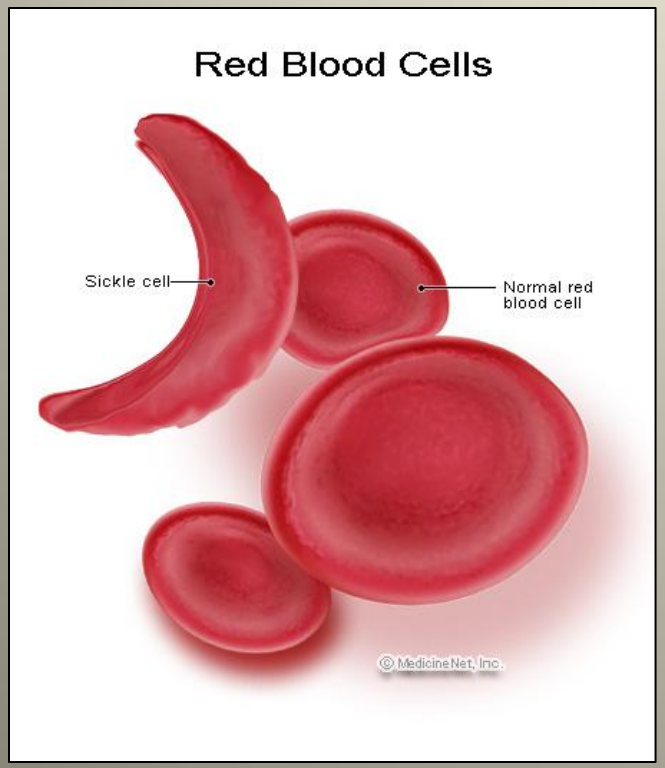
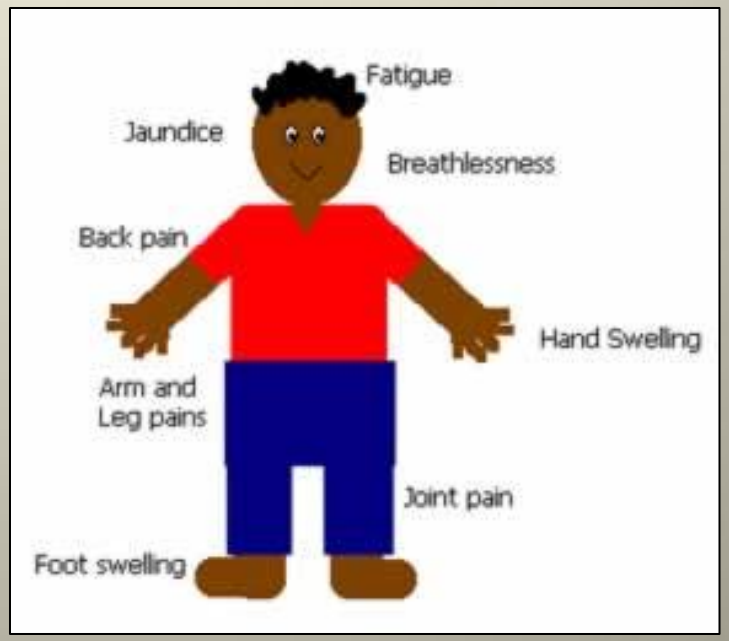
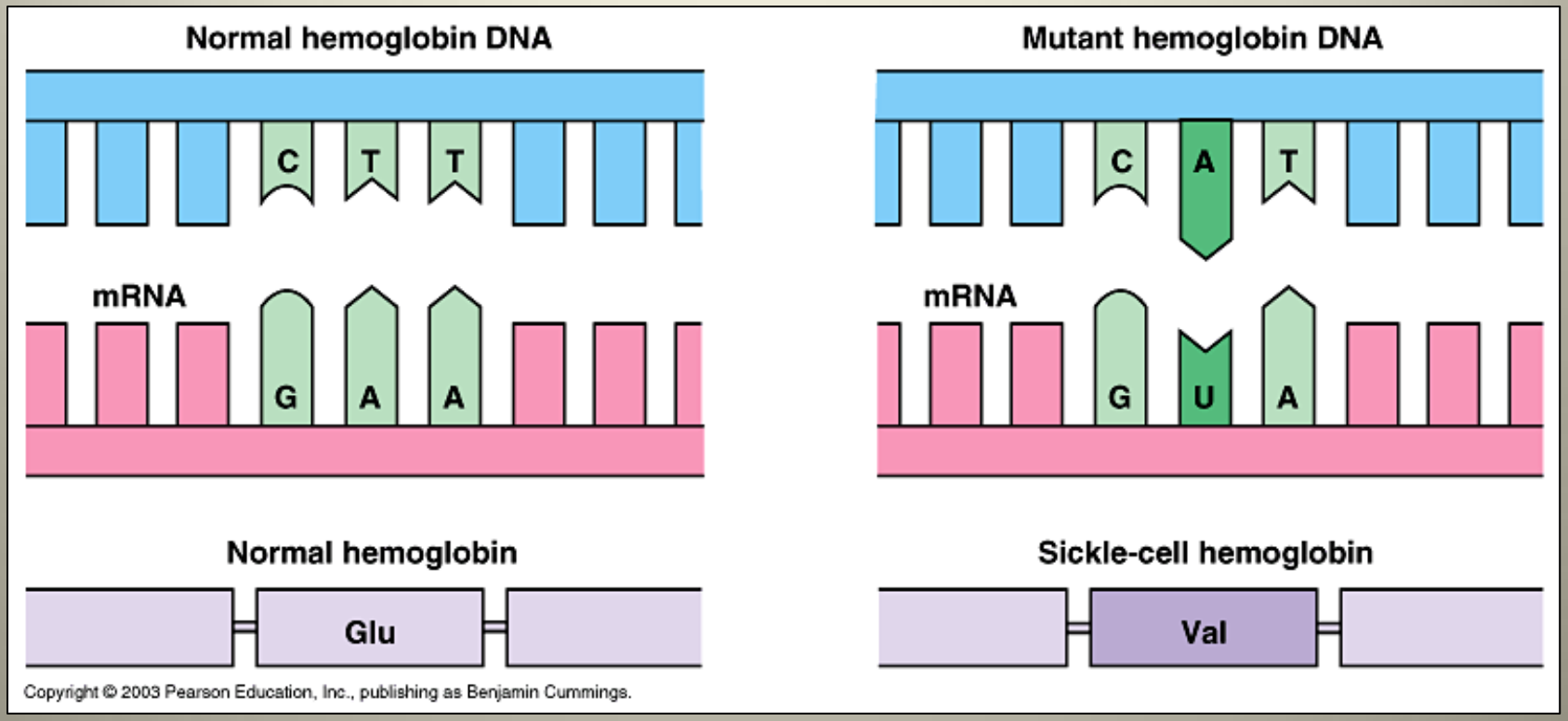
Any change in the sequence of nucleotides in a DNA molecule is a GENE MUTATION.

The mutation may result in changes that affect the structure and function of the protein made by that gene.





A single mutation of the hemoglobin gene causes sickle cell anemia.


Normal hemoglobin DNA
C
T
T
mRNA
G
A
A
Normal hemoglobin
Glu
Mutant hemoglobin DNA
C
A
T
mRNA
G
U
A
Sickle-cell hemoglobin
Val
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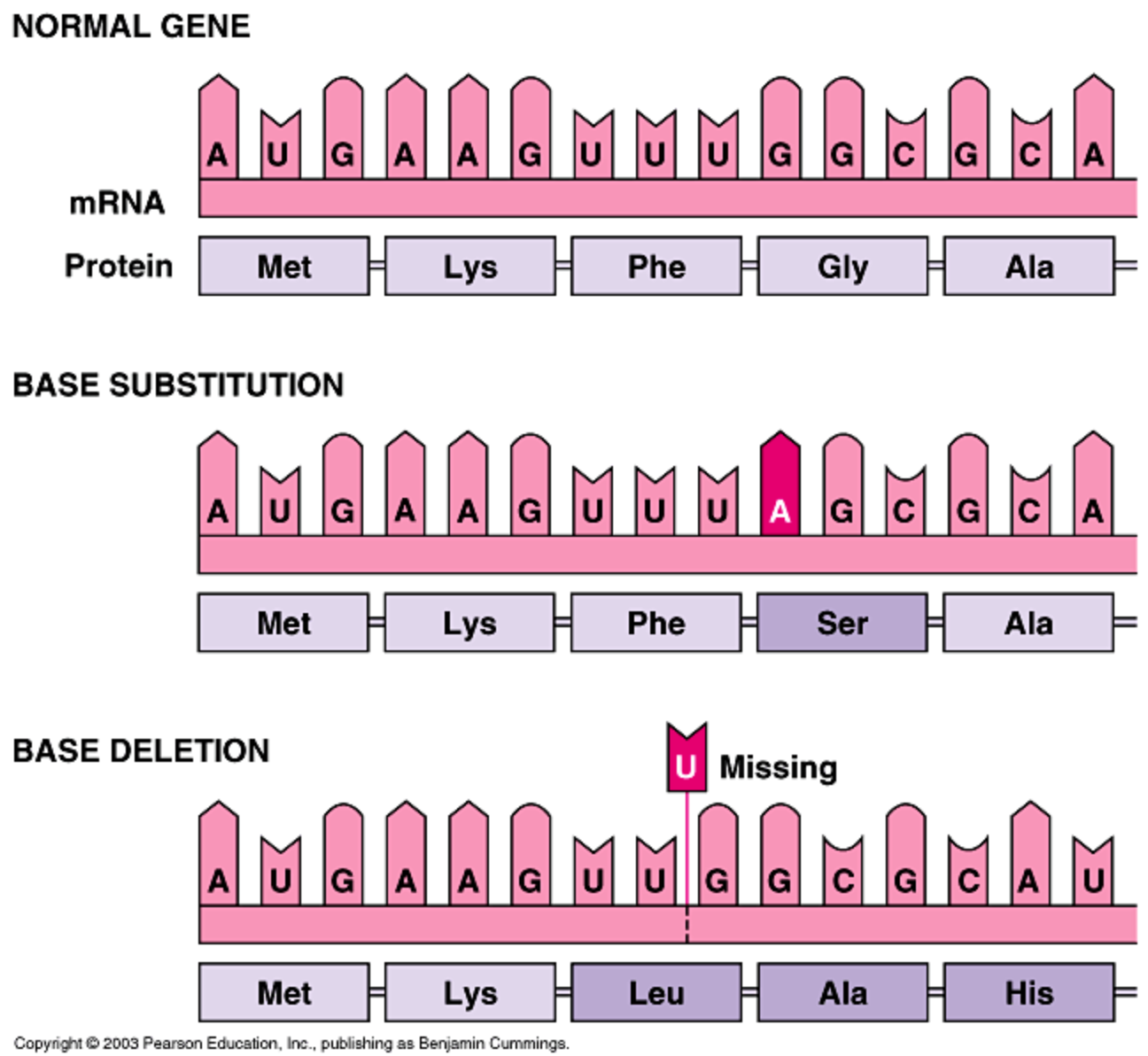

GEL ELECTROPHORESIS – "DNA fingerprinting"

Uses RESTRICTION ENZYMES to cut DNA into pieces

Then SORTS OUT the DNA by SIZE.

You can COMPARE the banding patterns produced by the DNA piles to determine the relationships between specimens.