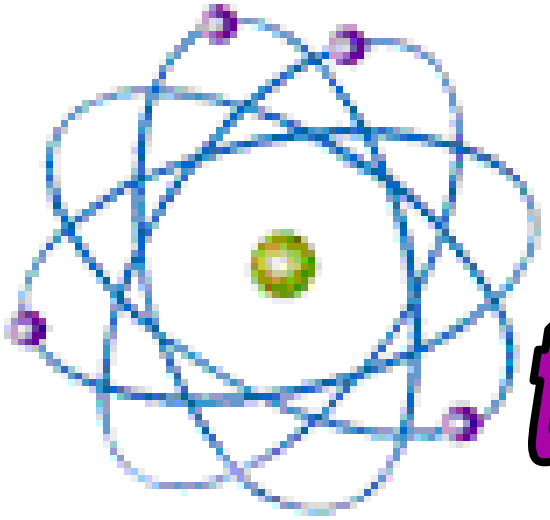
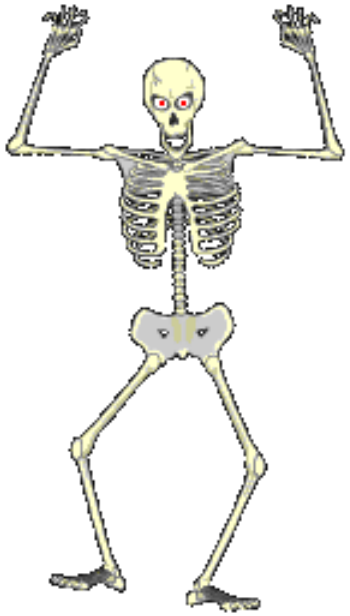


Welcome to the Fall 2016 Science EOC Academy



Chapter 2 CHEMISTRY OF LIFE

CARBON

THE ELEMENT FOUND IN ALL LIVING THINGS

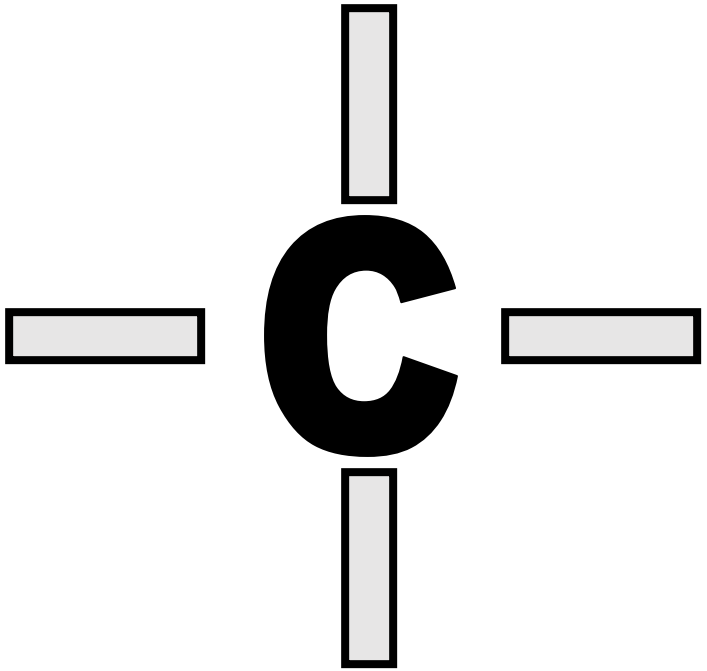
"THE BUILDING BLOCK OF THE MOLECULES OF LIFE"

ORGANIC COMPOUNDS

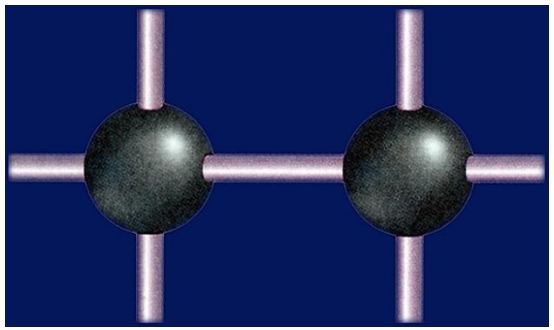
MOLECULES CONTAINING CARBON THAT ARE FOUND IN LIVING THINGS

UNIQUE PROPERTIES OF CARBON:

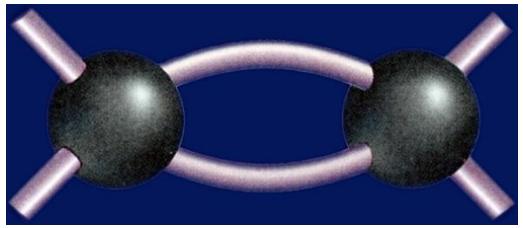
1. A CARBON ATOM HAS _ FOUR _ ELECTRONS AVAILABLE FOR BONDING IN ITS OUTER ENERGY LEVEL; THEREFORE, IT CAN FORM _ FOUR _ BONDS WITH OTHER ATOMS



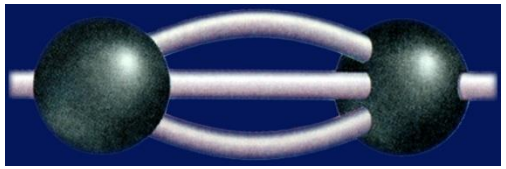
2. WHEN CARBON ATOMS BOND, THEY CAN FORM SINGLE BONDS, DOUBLE BONDS, OR TRIPLE BONDS



SINGLE BOND



DOUBLE BOND



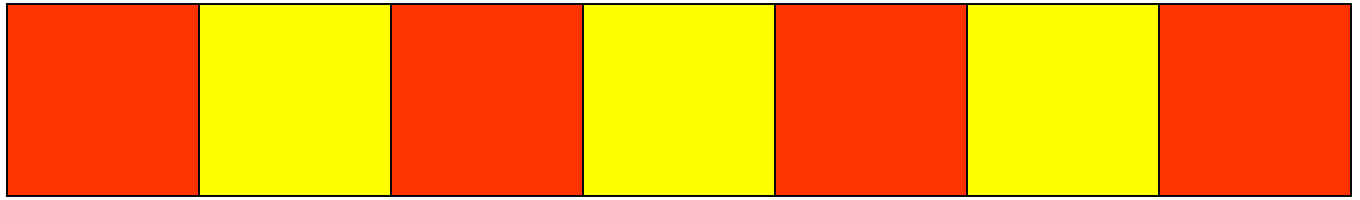
TRIPLE BOND

POLYMERS

LARGE MOLECULES FORMED WHEN MANY SMALLER MOLECULES BOND TOGETHER

ALSO KNOWN AS MACROMOLECULES

POLY = " MANY **"** **MACRO = "** LARGE **"**



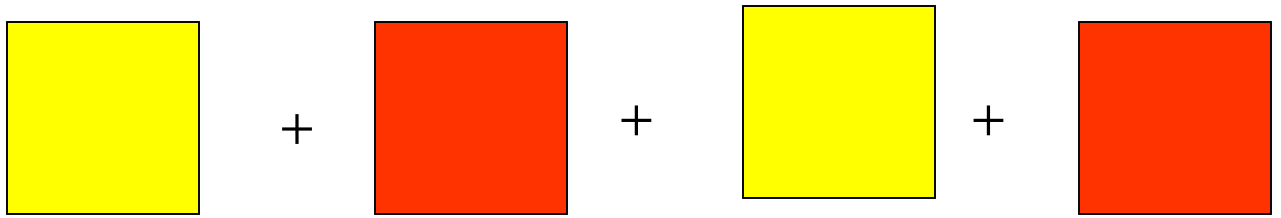
SMALLER MOLECULES FORM POLYMERS

MONOMERS

THE SMALLER UNITS COMPOSING A POLYMER

ALSO KNOWN AS SUBUNITS

MONO = " ONE " **SUB = " BELOW "**



MONOMERS BOND TO FORM POLYMERS

TYPES OF MONOMERS:	TYPES OF POLYMERS:
MONOSACCHARIDES →	CARBOHYDRATES
GLYCEROL + FATTY ACIDS →	LIPIDS
AMINO ACIDS →	PROTEINS
NUCLEOTIDES →	NUCLEIC ACIDS

CHEMICAL REACTIONS

OCCUR WHEN BONDS ARE FORMED OR BROKEN, CAUSING SUBSTANCES TO RECOMBINE INTO DIFFERENT SUBSTANCES

PARTS OF A CHEMICAL REACTION:

REACTANTS —CATALYSTS→ PRODUCTS

TYPES OF REACTIONS INVOLVING MONOMERS AND POLYMERS:

1. CONDENSATION REACTIONS - REACTIONS IN WHICH MONOMERS REMOVE A MOLECULE OF WATER TO FORM A POLYMER

CON = " WITH ; TOGETHER "

MONOMER + MONOMER ---→ POLYMER + WATER

Types of Energy

Exothermic Energy: Chemical Reaction releases more energy than it absorbs.

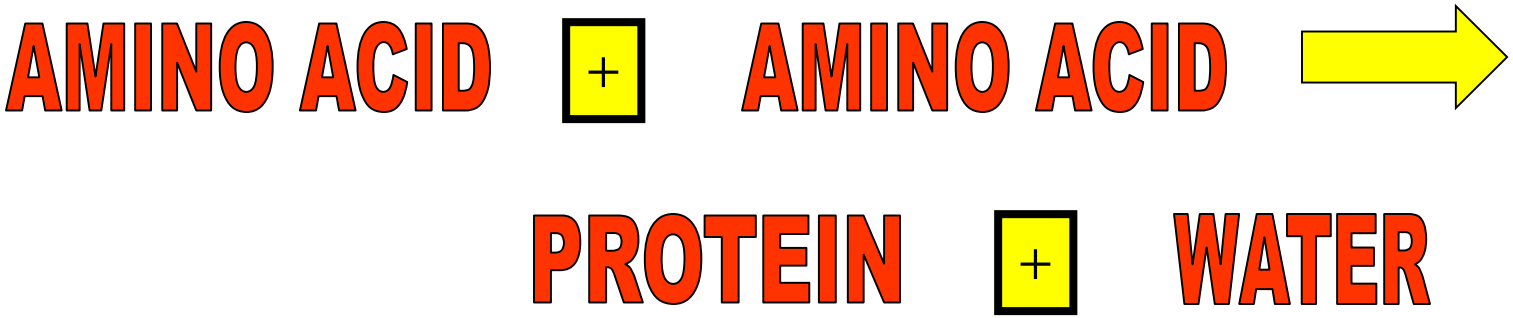
Endothermic Energy: Chemical Reaction absorbs more energy than it releases.

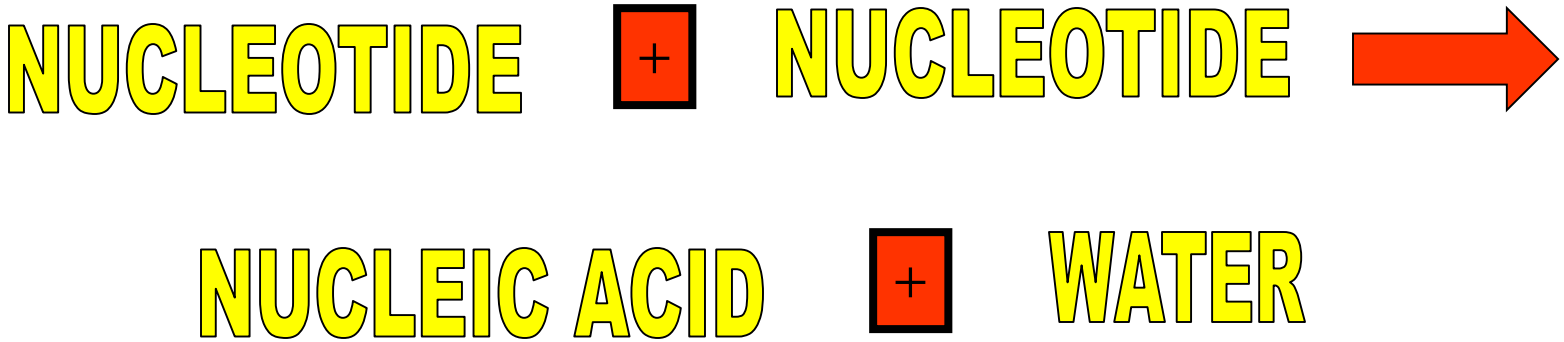
Activation Energy: Is the amount of energy that needs to be absorbed for a chemical reaction to start.

CONDENSATION REACTIONS:

MONOSACCHARIDE + MONOSACCHARIDE → CARBOHYDRATE + WATER

GLYCEROL + FATTY ACIDS → LIPID + WATER


AMINO ACID
+
AMINO ACID
PROTEIN
+
WATER


NUCLEOTIDE
+
NUCLEOTIDE
NUCLEIC ACID
+
WATER

2. HYDROLYSIS REACTIONS - REACTION IN WHICH A MOLECULE OF WATER IS ADDED TO A POLYMER TO BREAK IT DOWN INTO MONOMERS

HYDRO = " WATER " LYSIS = " TO SPLIT "

POLYMER + WATER →

MONOMER + MONOMER

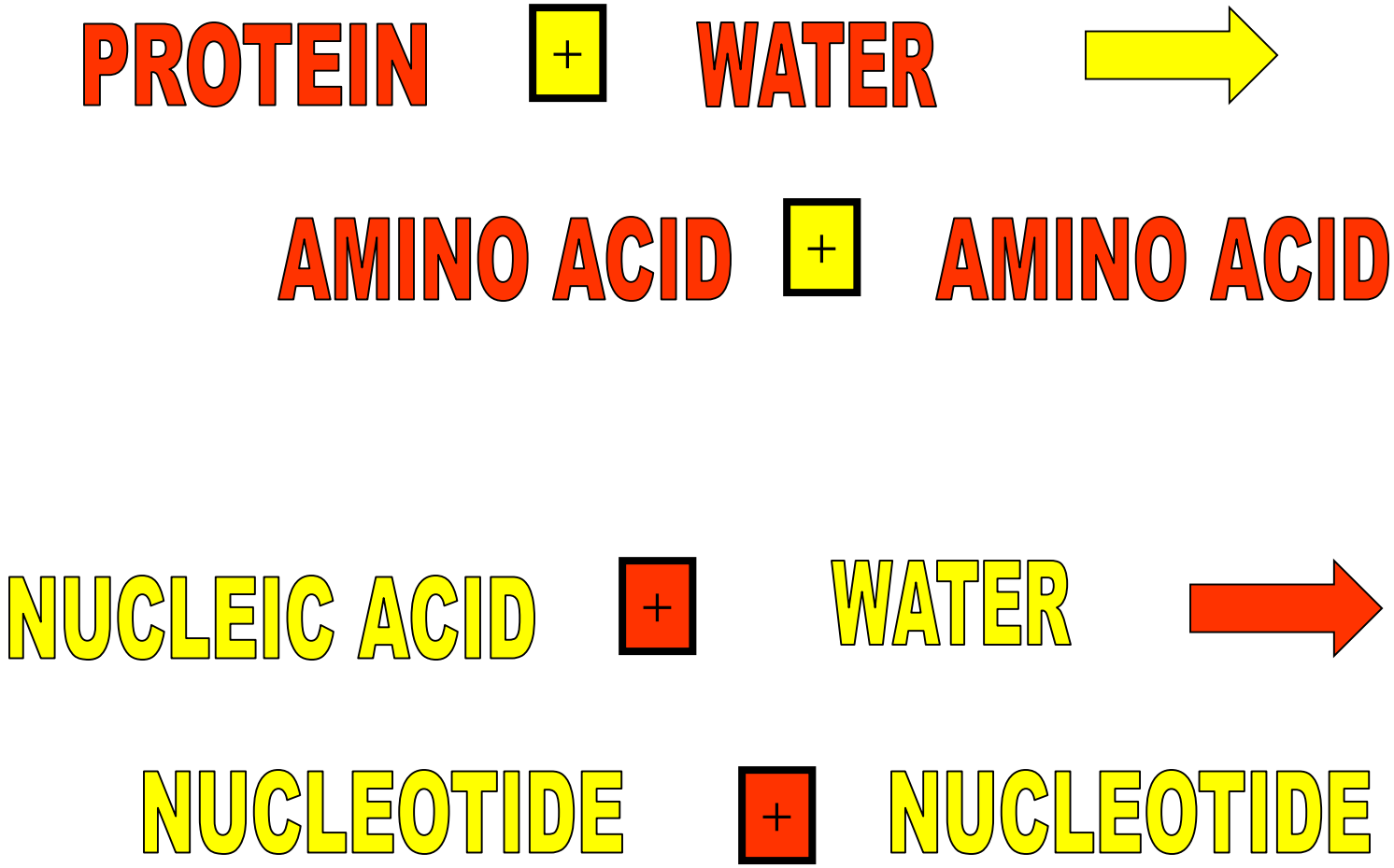
EXAMPLES OF HYDROLYSIS REACTIONS:

CARBOHYDRATE + WATER →

MONOSACCHARIDE + MONOSACCHARIDE

LIPID + WATER →

GLYCEROL + FATTY ACIDS


PROTEIN
+
WATER
AMINO ACID
+
AMINO ACID
NUCLEIC ACID
+
WATER
NUCLEOTIDE
+
NUCLEOTIDE

EXAMPLES OF ORGANIC COMPOUNDS:

CARBOHYDRATES

AN ORGANIC COMPOUND COMPOSED OF CARBON, HYDROGEN, AND OXYGEN WITH A RATIO OF 2 HYDROGEN ATOMS AND 1 OXYGEN ATOM FOR EVERY CARBON ATOM

$C_H{}_2{}_O$

USED BY CELL TO STORE AND RELEASE ENERGY

FORMED BY CONDENSATION REACTIONS

A. MONOSACCHARIDES - "SIMPLE SUGARS"

MONOMERS OF CARBOHYDRATES

B. DISACCHARIDES - "DOUBLE SUGARS"

DI = " TWO "

1) SUCROSE TABLE SUGAR

(GLUCOSE + FRUCTOSE)

2) MALTOSE MALT SUGAR

GLUCOSE + GLUCOSE)

3) LACTOSE MILK SUGAR

(GLUCOSE + GALACTOSE)

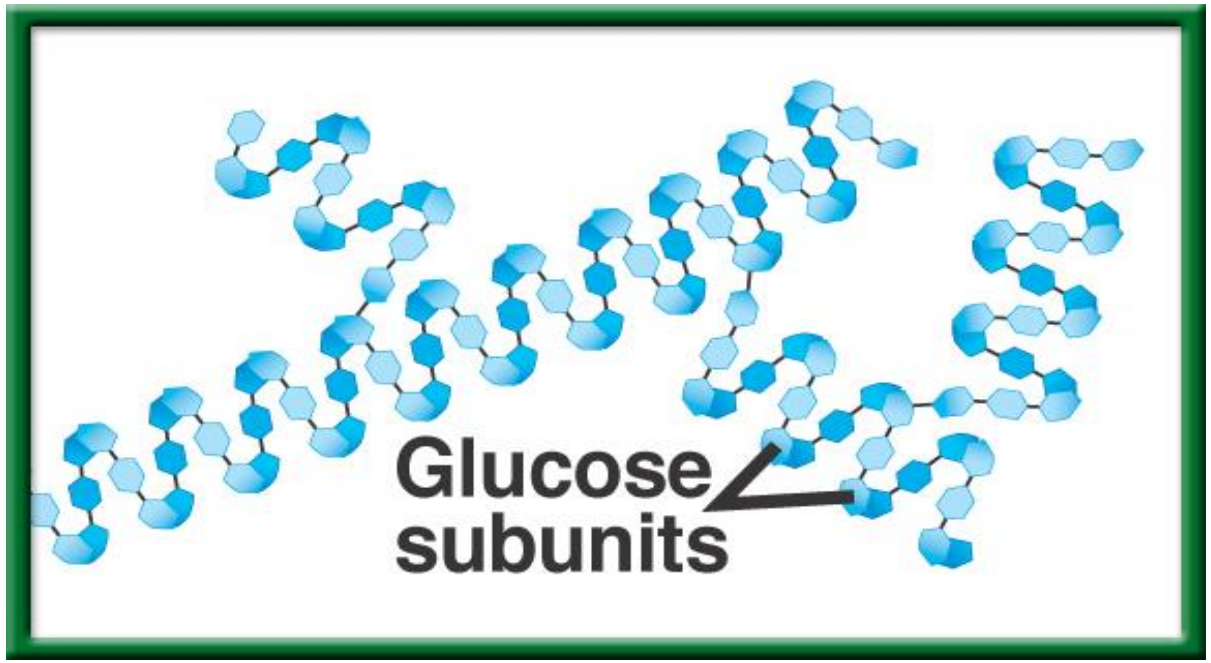
Test for monosaccharides using Benedict's Solution (glucose,fructose etc)

Color of Benedict's reagent	Approximate sugar concentration
Blue	nil
Light green	0.5-1.0%
Green to yellow	1.0%-1.5%
Orange	1.5%-2.0%
Red to red brown	>2.0%

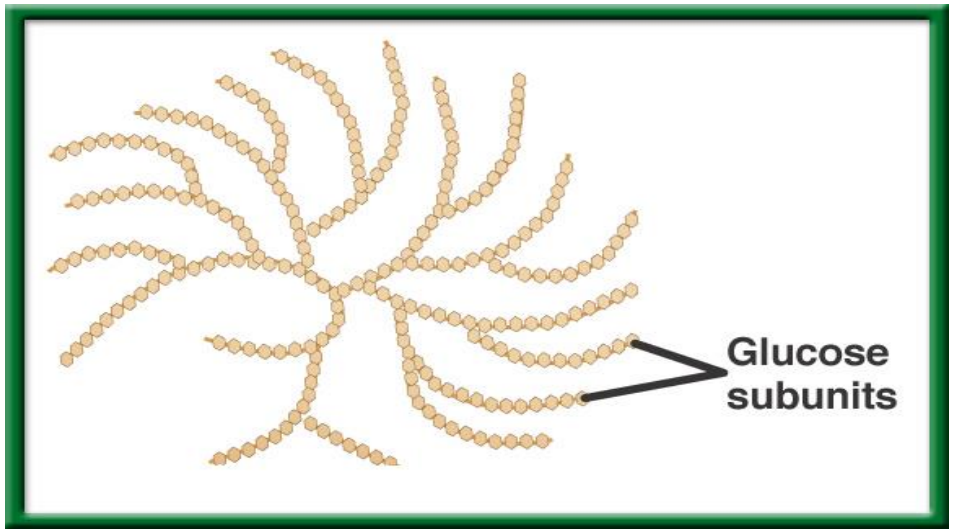
c. POLYSACCHARIDES - "MULTIPLE SUGARS"

1) STARCHES

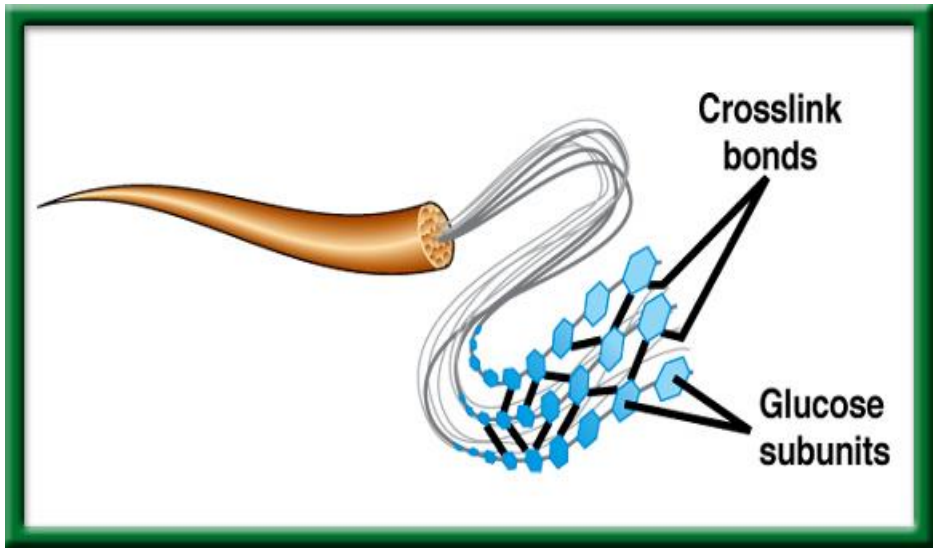
HIGHLY BRANCHED GLUCOSE CHAINS



2) GLYCOGEN ANIMAL STARCH



3) CELLULOSE PLANT STARCH



(MOST ABUNDANT ORGANIC COMPOUND ON EARTH)

Starch Test: Lugol's solution contains iodine and is an indicator for starch.Iodine turns blue-black in presence of starch.

LIPIDS

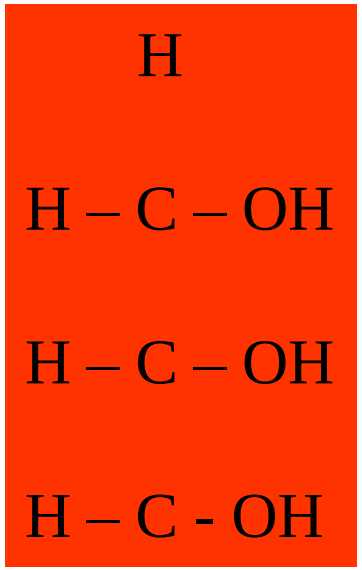
ORGANIC COMPOUNDS THAT HAVE A LARGE PROPORTION OF C - H BONDS AND LESS OXYGEN THAN CARBOHYDRATES

USED FOR LONG-TERM ENERGY STORAGE,

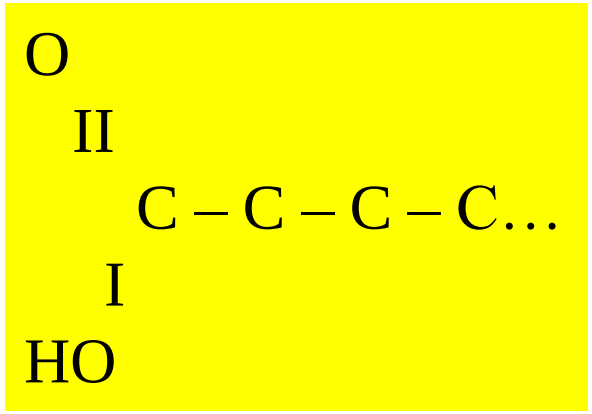
INSULATION, **AND** PROTECTIVE COATINGS

MAIN COMPONENT OF MEMBRANES **THAT SURROUND ALL LIVING CELLS**

FORMED BY CONDENSATION REACTIONS

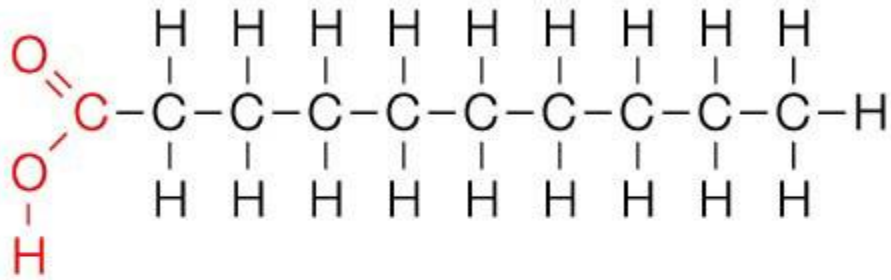


GLYCEROL MOLECULE

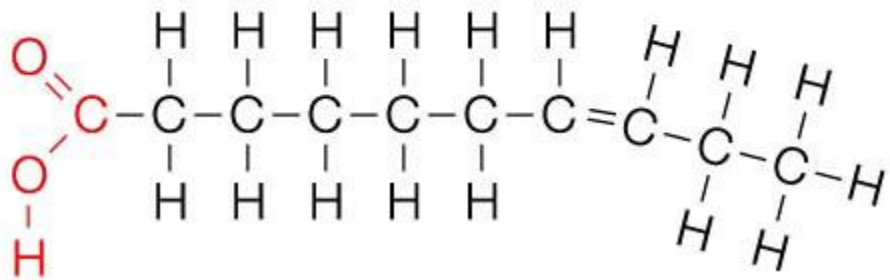


FATTY ACID CHAIN

Saturated



Unsaturated



Sudan IV is an indicator of lipids. Lipids turn from pink to a red colour.

PROTEINS

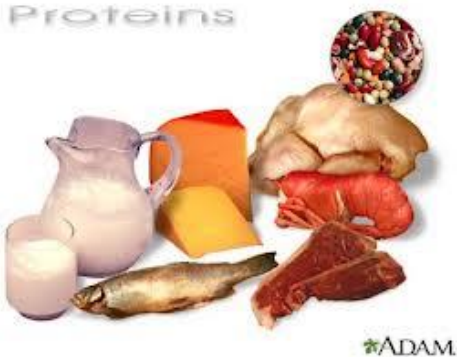
LARGE, COMPLEX POLYMER COMPOSED OF CARBON, HYDROGEN, OXYGEN, NITROGEN, AND SOMETIMES SULFUR

FORMED BY CONDENSATION REACTIONS

CHARACTERISTICS OF PROTEINS:

1) ESSENTIAL TO ALL LIFE

2) BUILD STRUCTURE AND CARRY OUT CELL METABOLISM



3) " BUILDING BLOCKS " OF MANY STRUCTURAL COMPONENTS OF ORGANISMS

4) IMPORTANT IN MUSCLE CONTRACTIONS

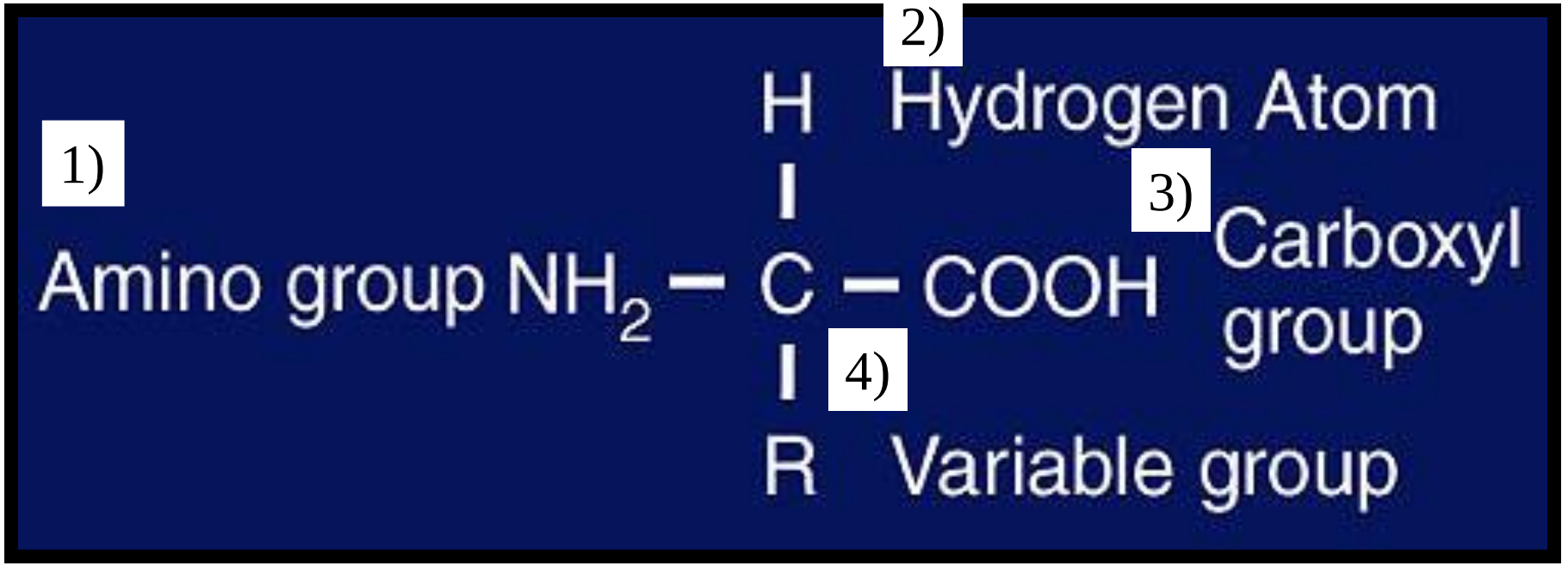
5) IMPORTANT IN TRANSPORTING OXYGEN IN THE BLOODSTREAM (HEMOGLOBIN)

6) PROVIDE IMMUNITY (ANTIBODIES)

7) CARRY OUT CHEMICAL REACTIONS

AMINO ACIDS

THE BASIC BUILDING BLOCKS OF PROTEINS



THERE ARE APPROXIMATELY 20 DIFFERENT AMINO ACIDS IN THE HUMEN BODY!

THE SEQUENCE OF AMINO ACIDS
IN THE PROTEIN DETERMINE
THE FUNCTION OF THE PROTEIN

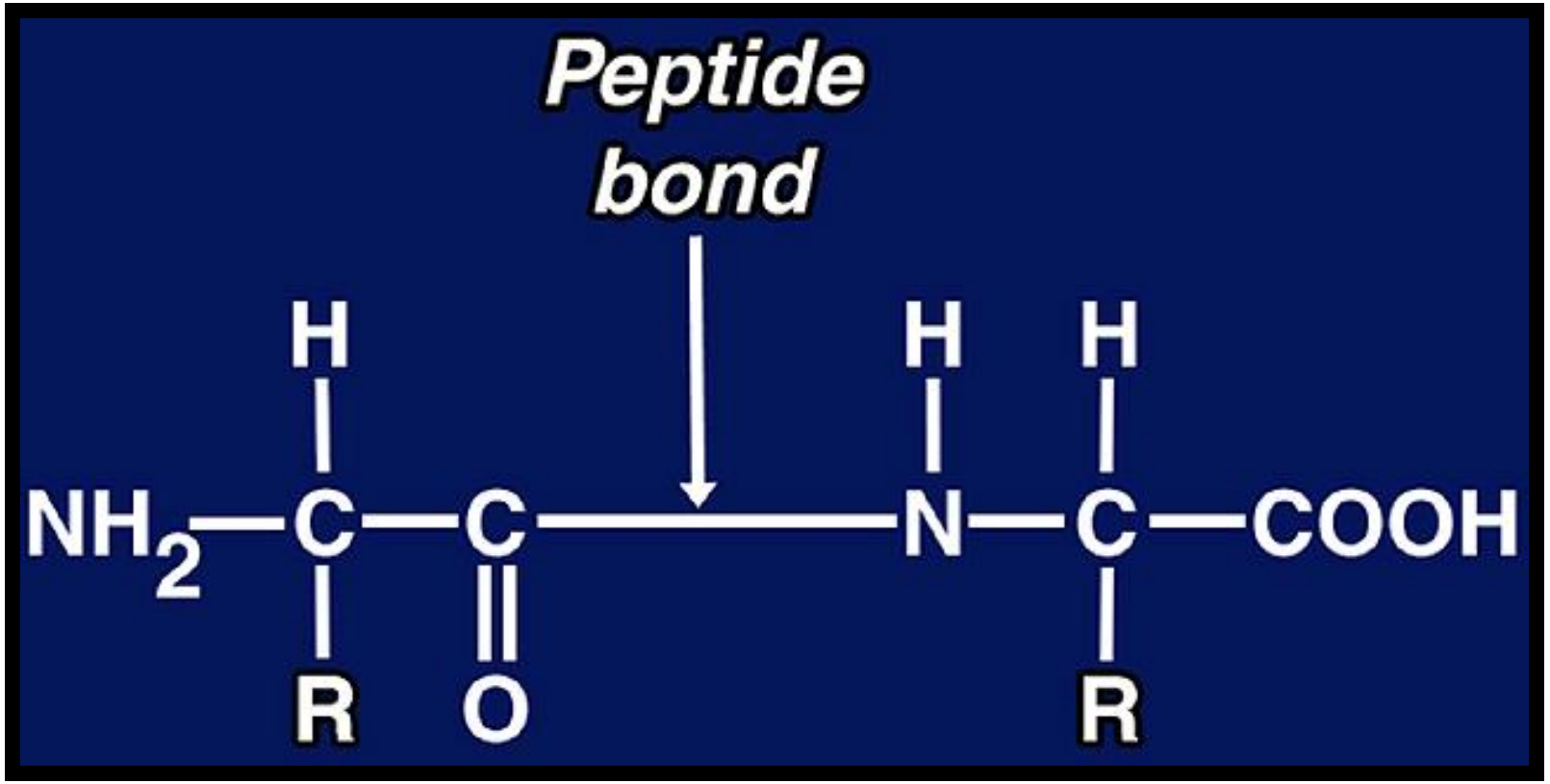
SOME AMINO ACIDS ARE ACIDIC

SOME AMINO ACIDS ARE BASIC

SOME AMINO ACIDS ARE NOT CHARGED

PEPTIDE BOND

THE COVALENT BOND BETWEEN TWO AMINO ACIDS WHEN FORMING PROTEINS



Protein test:

Biuret reagent reacts with the peptide bonds that join amino acids together, producing colour changes from blue to pink(+),violet(++),and purple(+++).The + sign indicates the relative amounts of peptide bonds.

Type of nutrient	Type of test/reagent
Monosaccharides	Benedict's reagent
Starch	Lugol's solution
Lipids	Sudan IV indicator
Proteins	Biuret reagent

ENZYMES

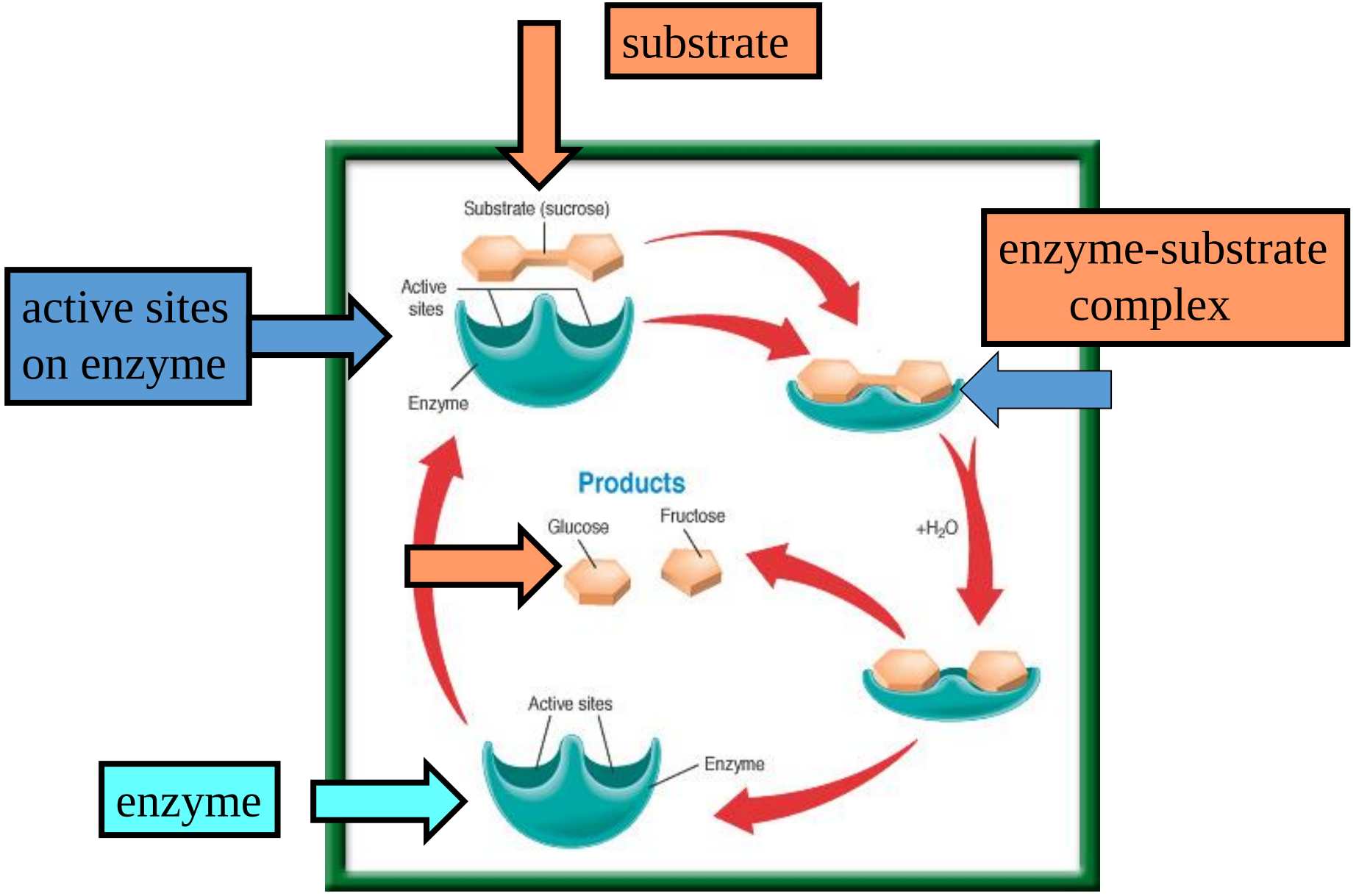
A PROTEIN THAT CHANGES THE RATE OF A CHEMICAL REACTION

"BIOLOGICAL CATALYSTS"

ACT AS CATALYSTS TO SPEED UP CHEMICAL REACTIONS OCCURING IN THE CELL

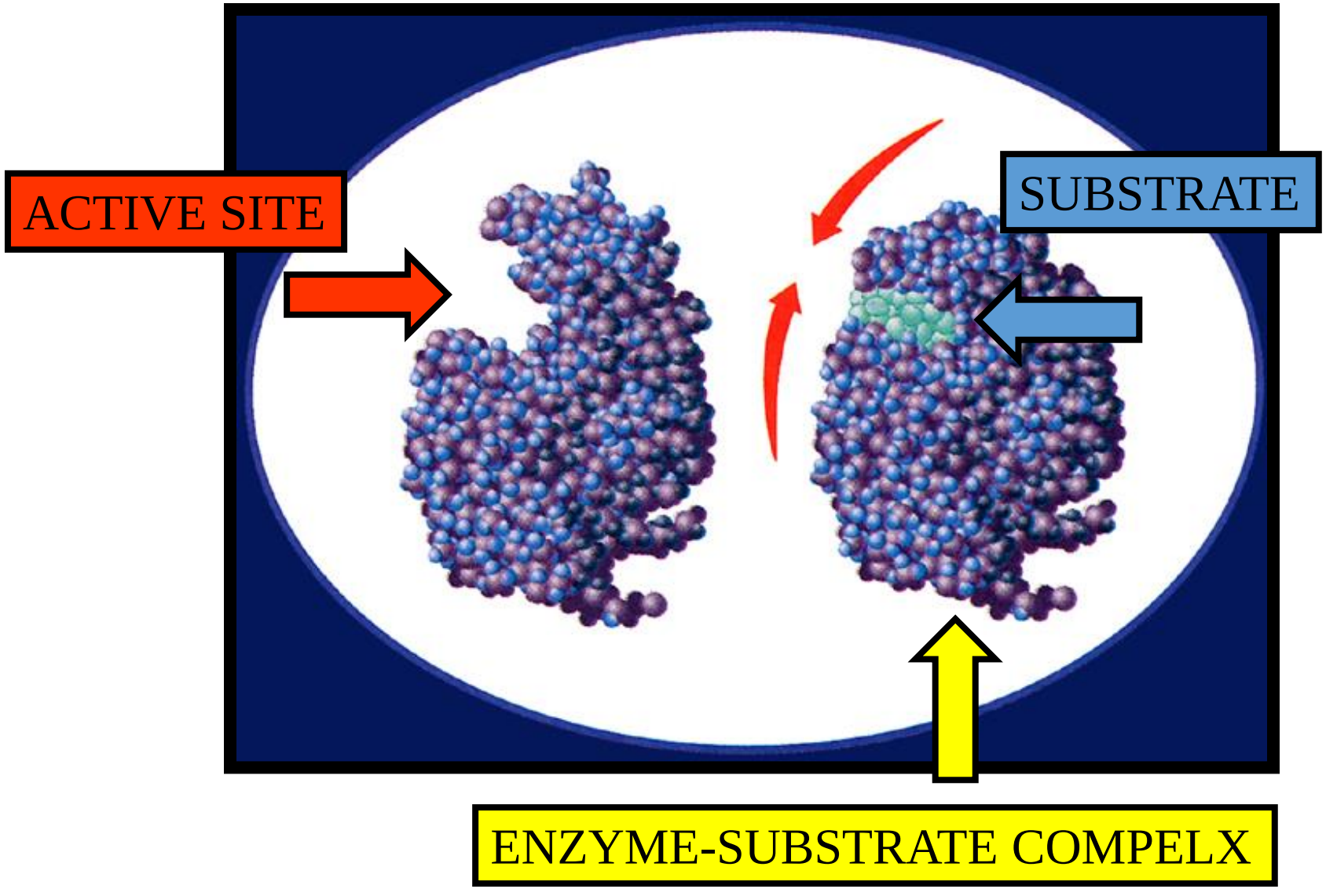
INVOLVED IN NEARLY ALL

METABOLIC PROCESSES



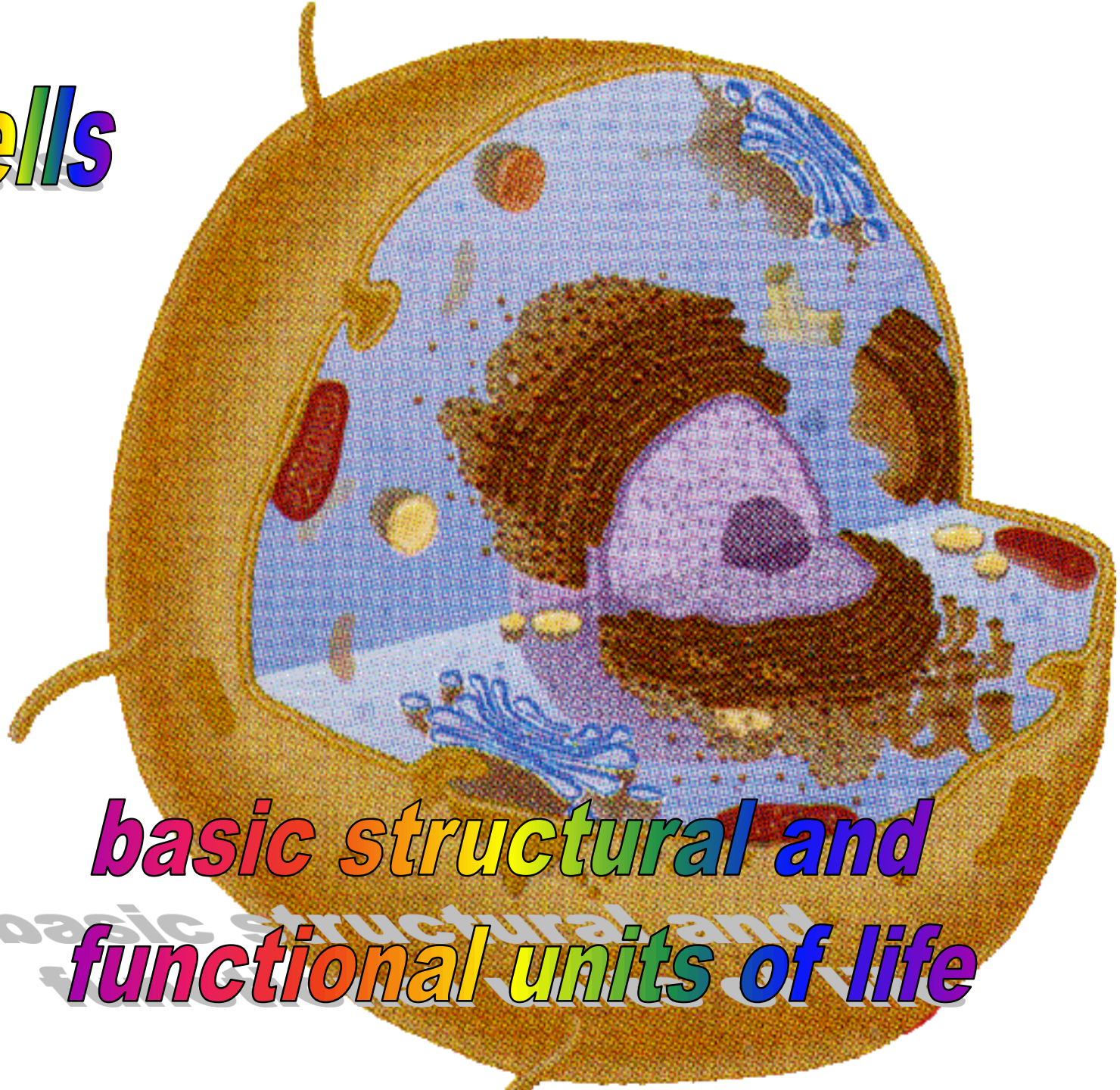
ACTION OF AN ENZYME

ACTION OF ENZYMES



CHAPTER 3: CELLSTRUCTURE AND FUNCTION

Cells



basic structural and functional units of life

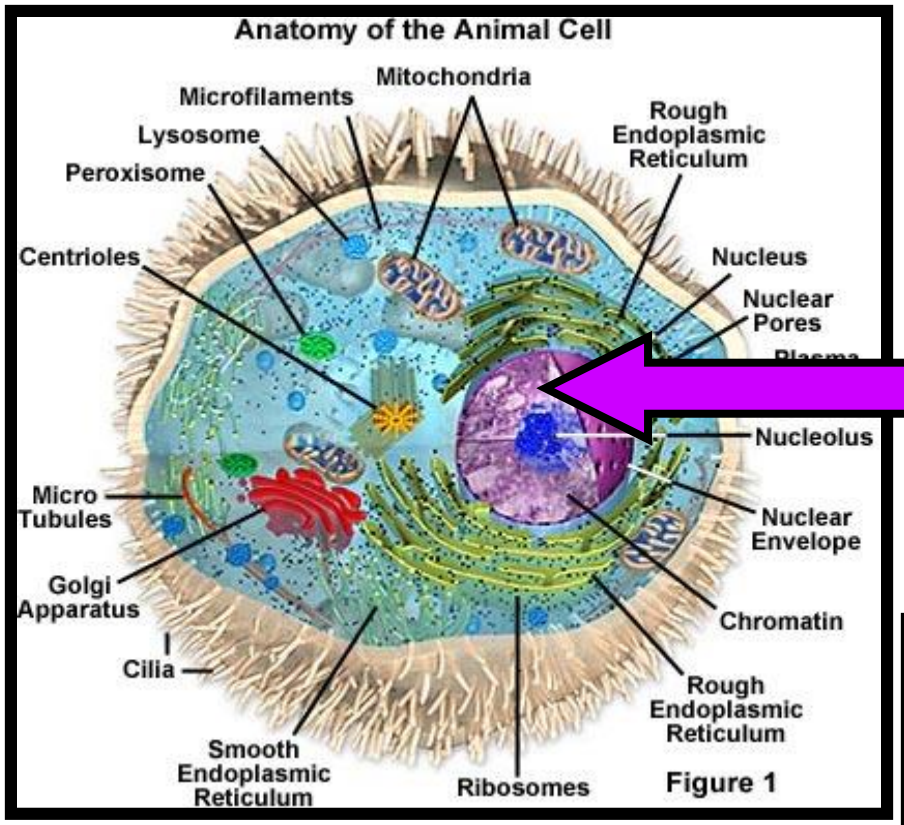
Cells

the basic units of living organisms; the basic structural and functional units of life; they carry out the life functions of an organism

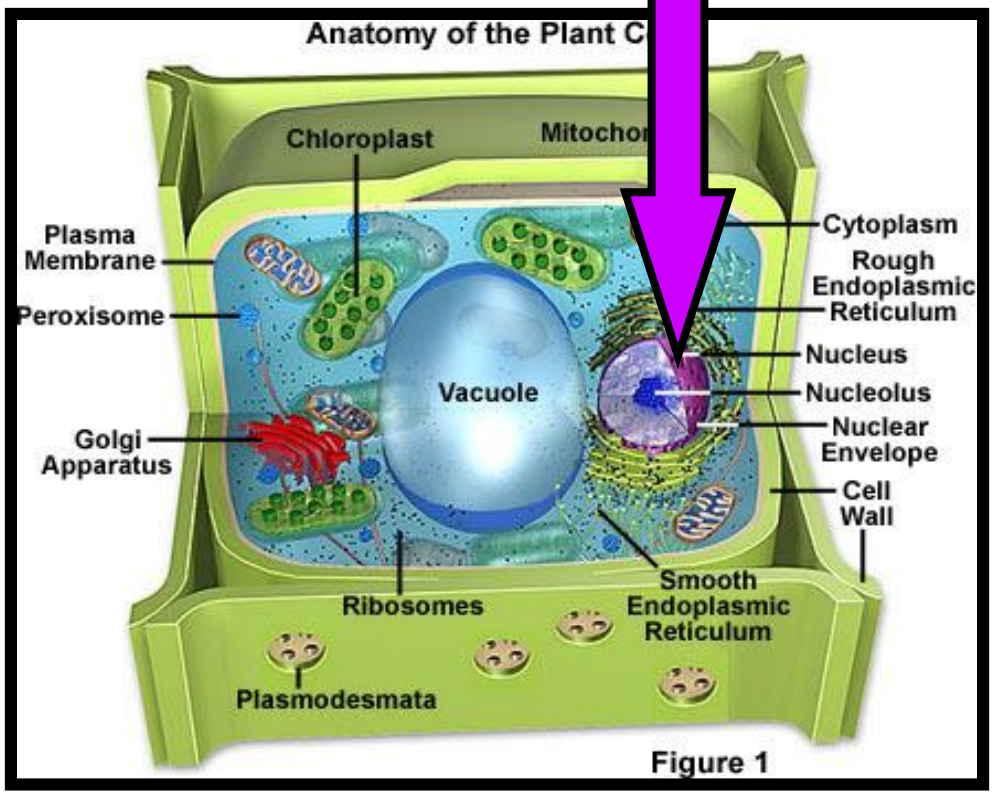
Cells take in raw materials, such as amino acids, change them into more complex molecules such as protein, and then transport these molecules where they are needed.

Cells produce energy for life processes by breaking down molecules like glucose. They also get rid of waste molecules produced by these processes.

MAIN STRUCTURES OF A CELL



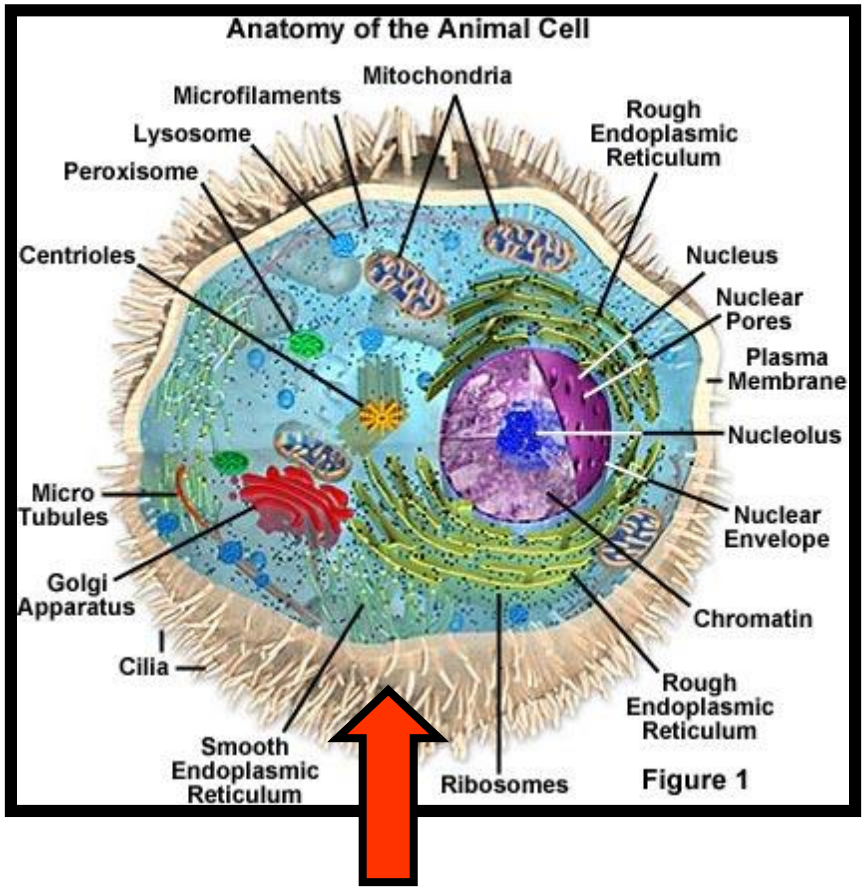
NUCLEUS



1. <u>nucleus</u> – "control center of the cell'; contains the cell's DNA

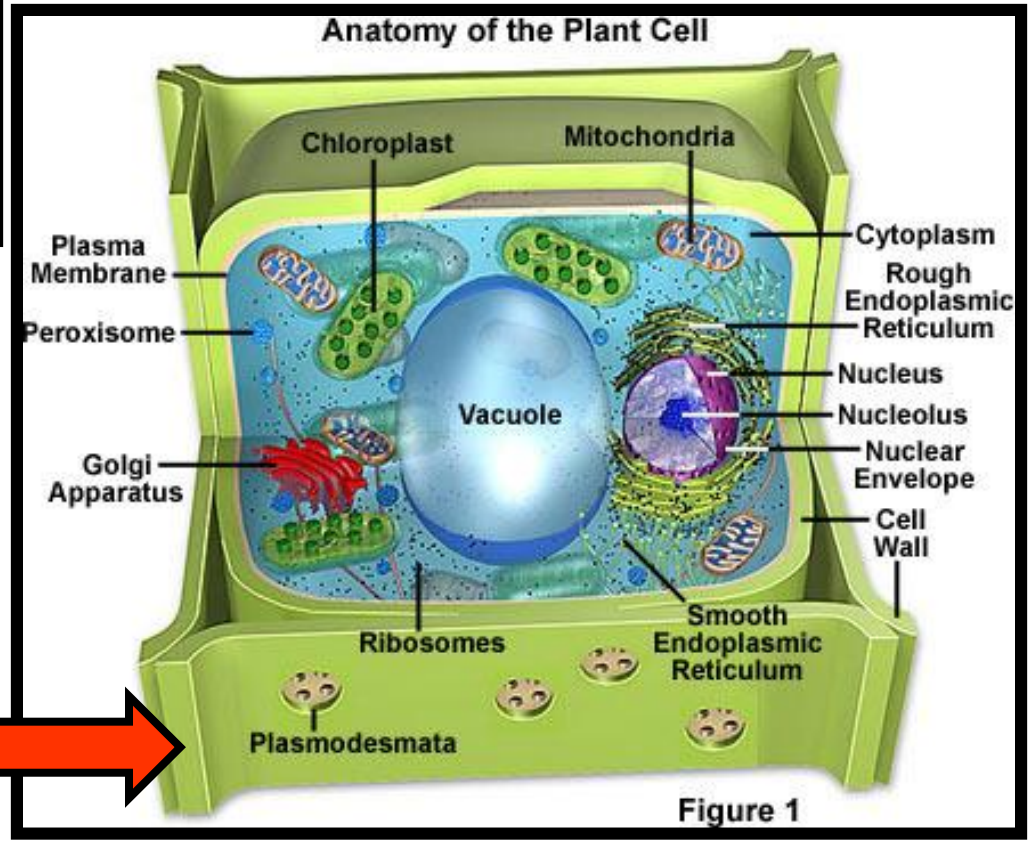
CELL MEMBRANE

2. cell membrane - outer membrane of the cell

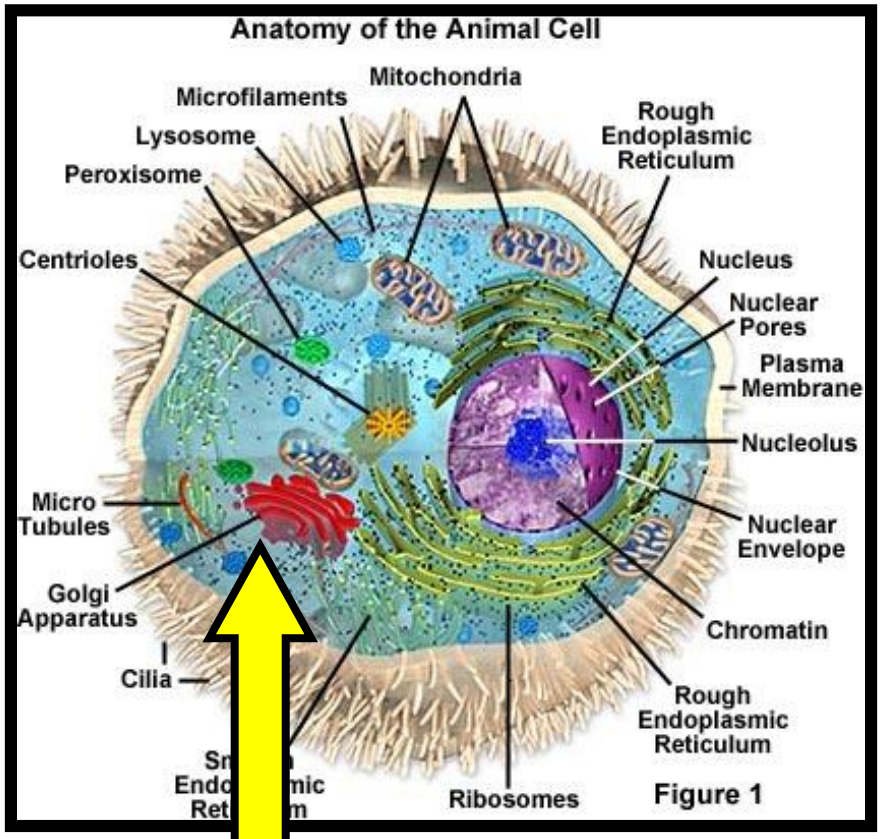


A. plasma membrane - cell membrane in animal cells

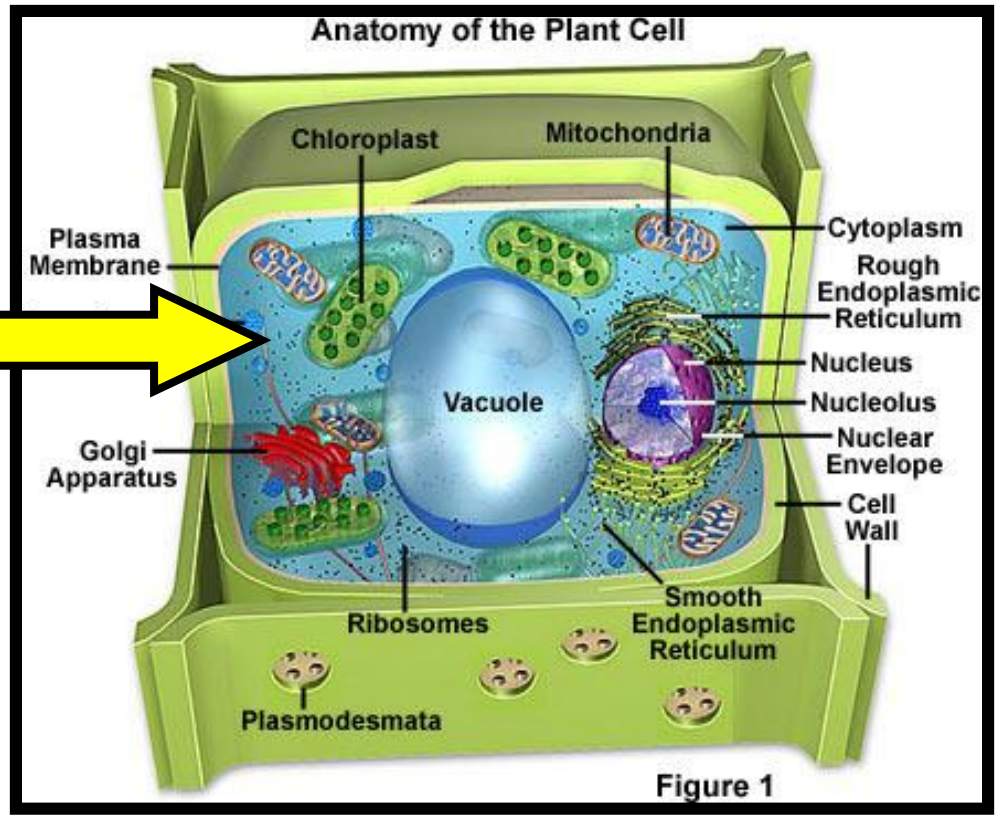
B. cell wall – cell membrane in plant cells

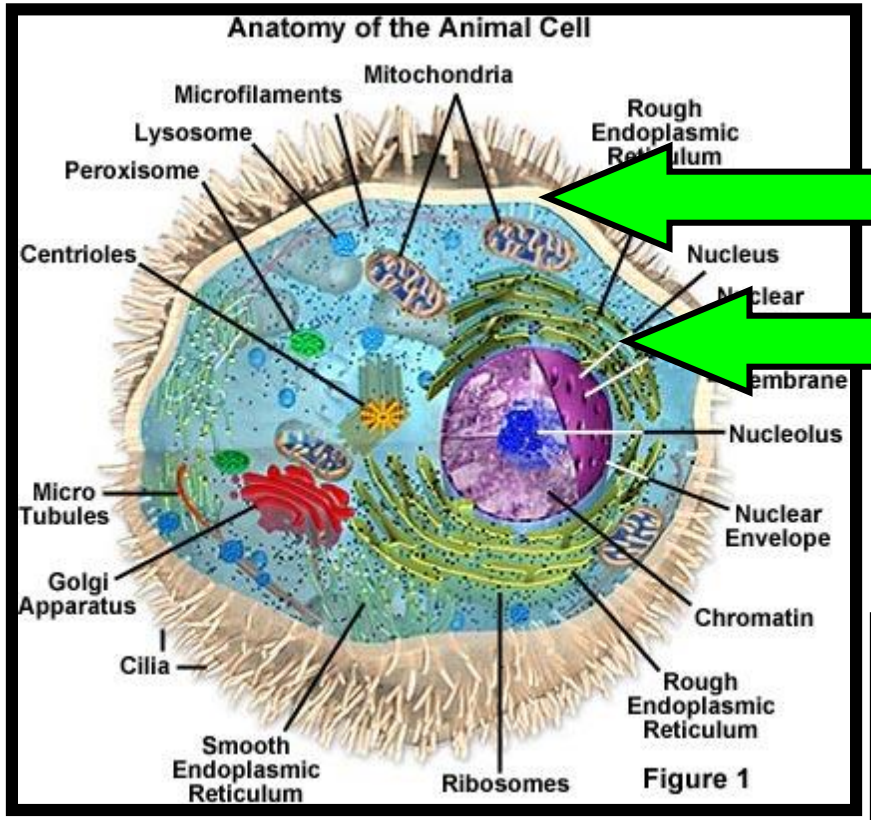


CYTOPLASM

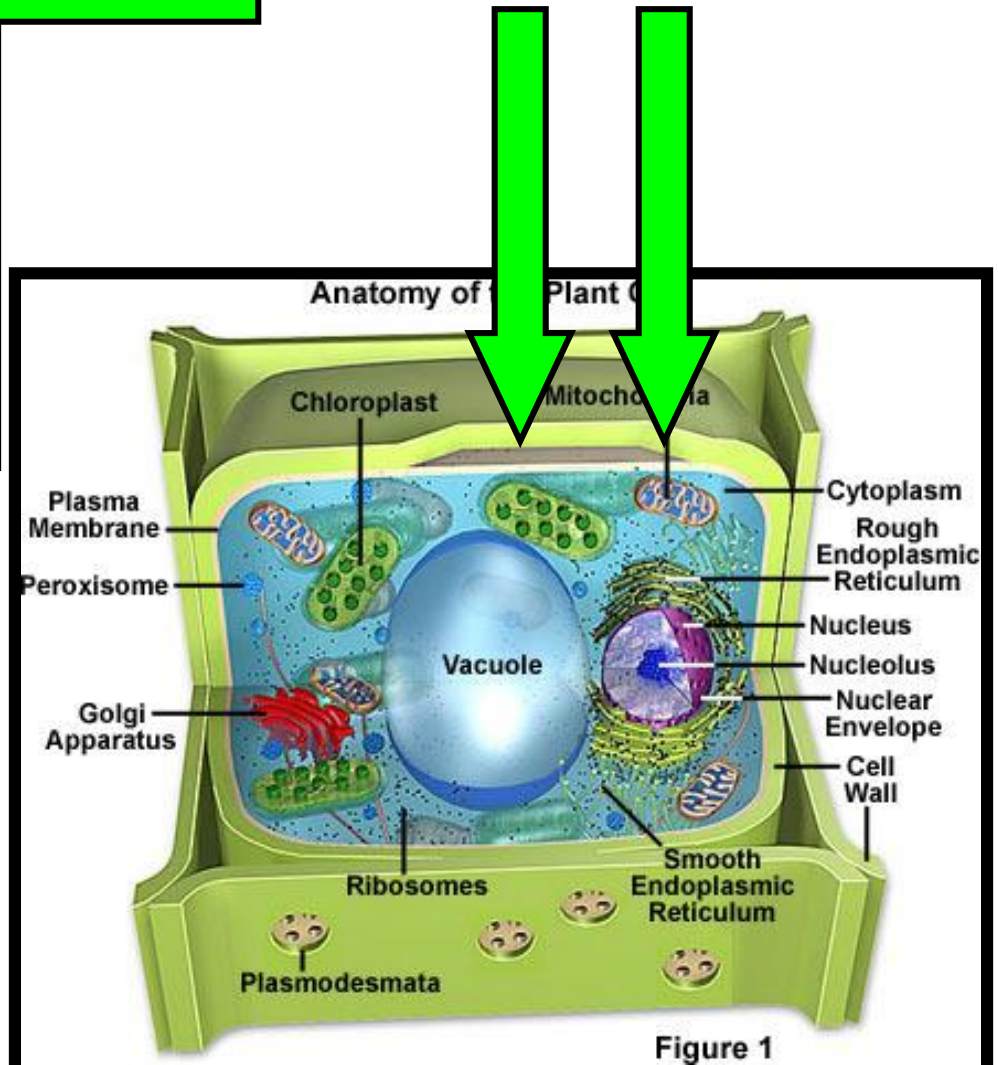


3. <u>cytoplasm</u> – semi-fluid located inside the plasma membrane and containing the organelles





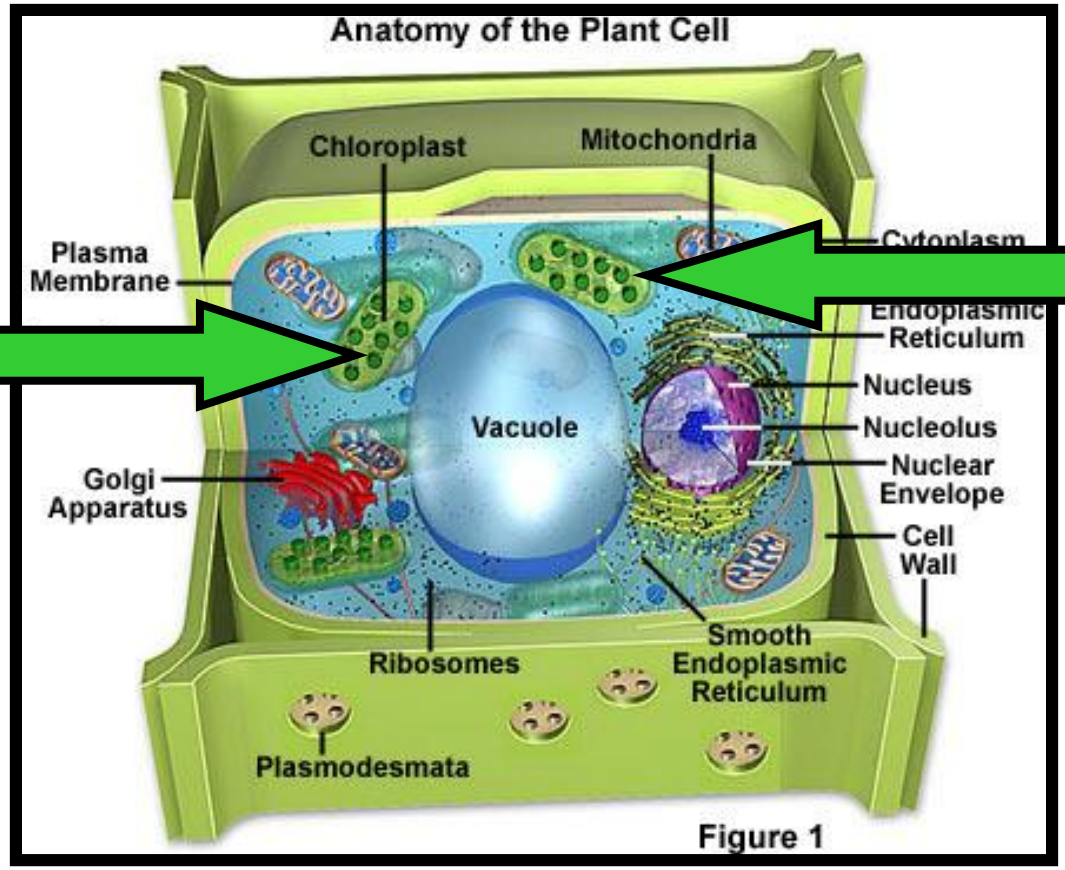
ORGANELLES



4. <u>organelles</u> – “little organs of the cell”; carry out the various functions of the cell

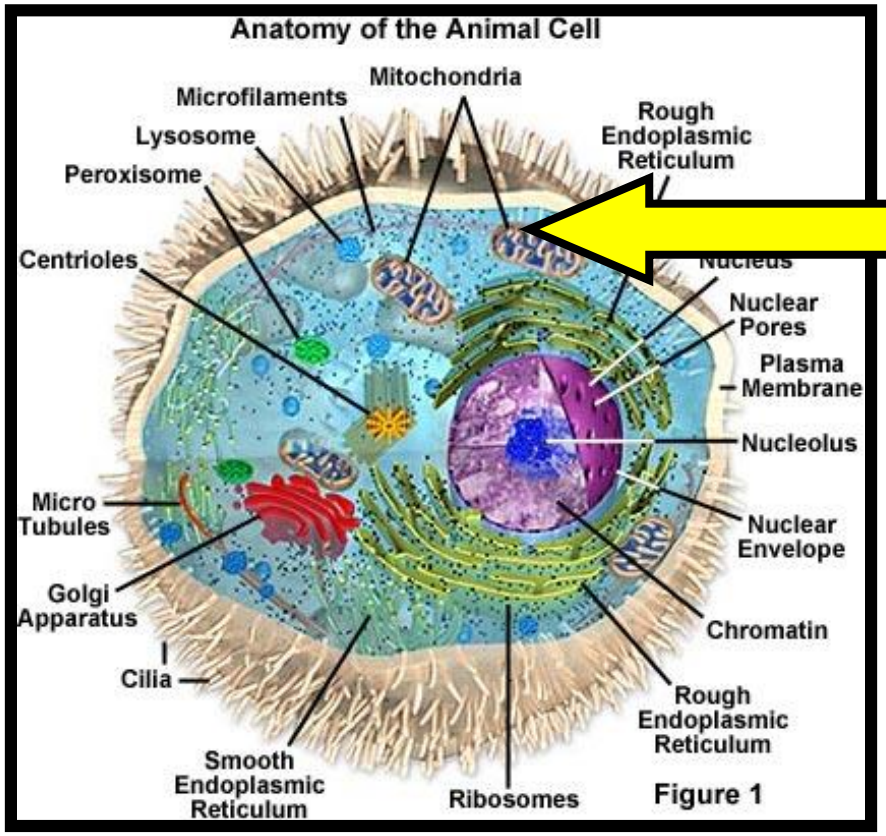
CHLOROPLASTS

5. chloroplasts – specialized plastids in plant cells; sites for the process of photosynthesis



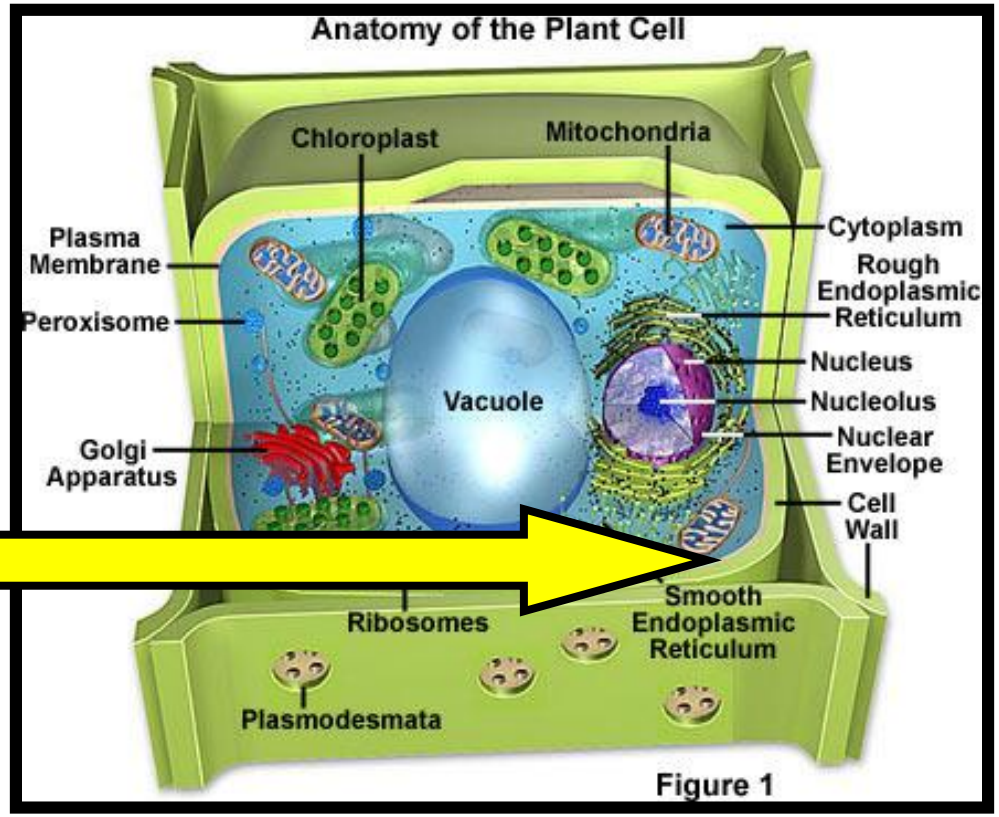
found only In plant cells

type of plastid

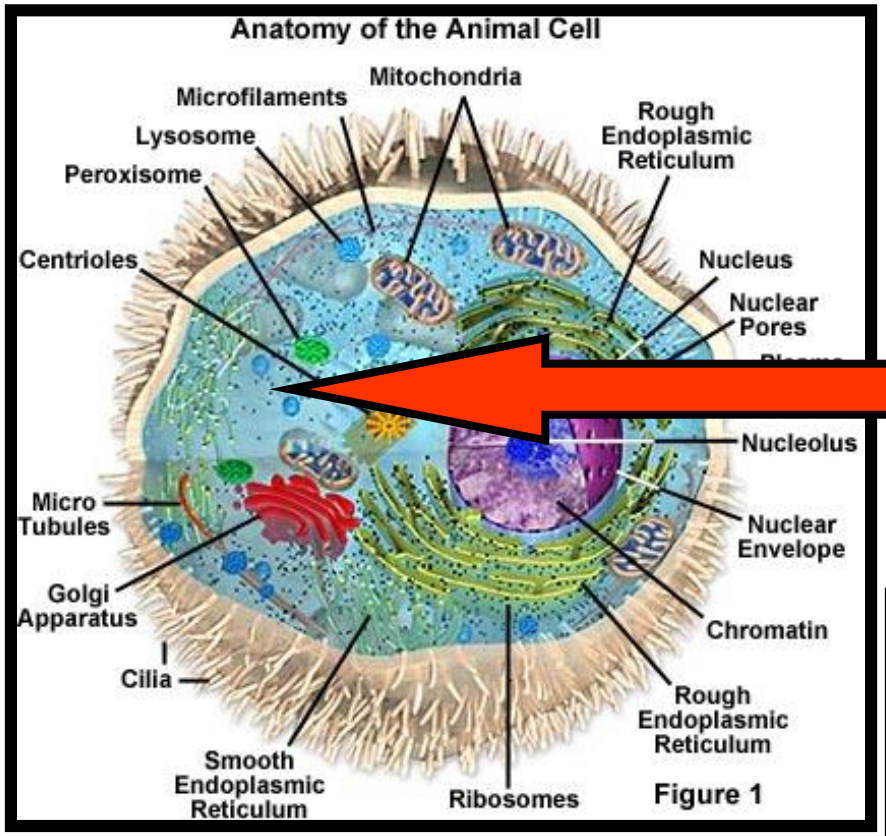


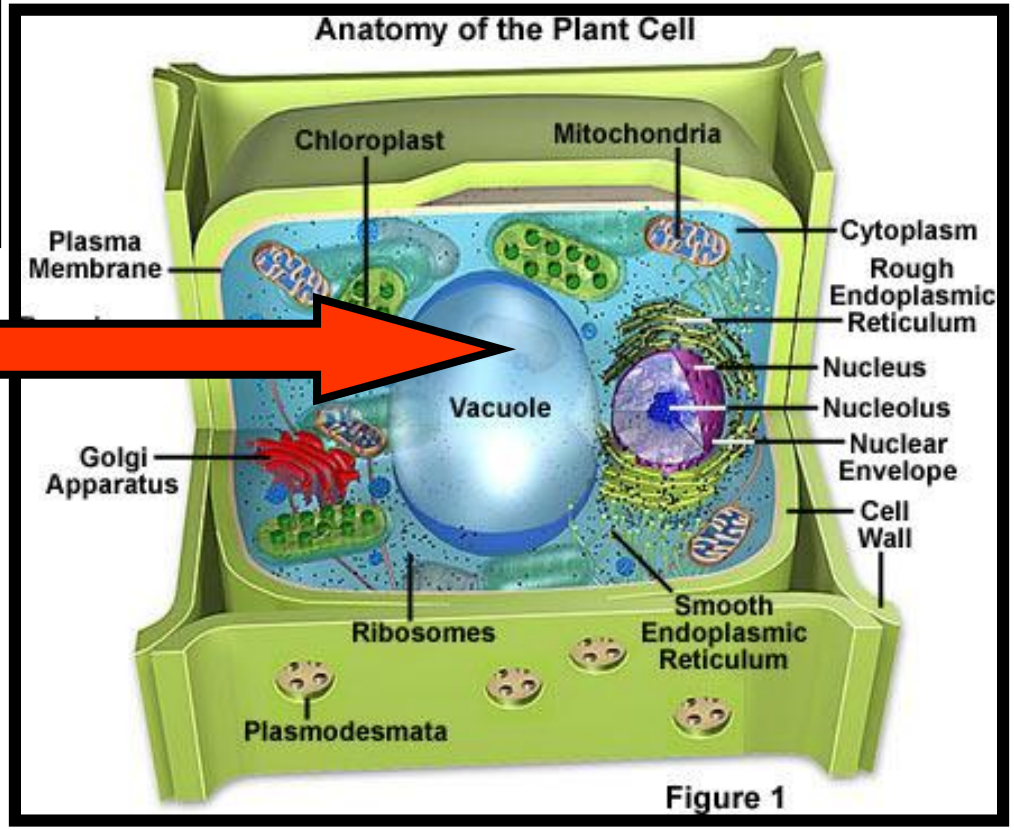
MITOCHONDRIA

6. <u>mitochondria</u> –
"powerhouses of the cell";
centers for cellular
respiration



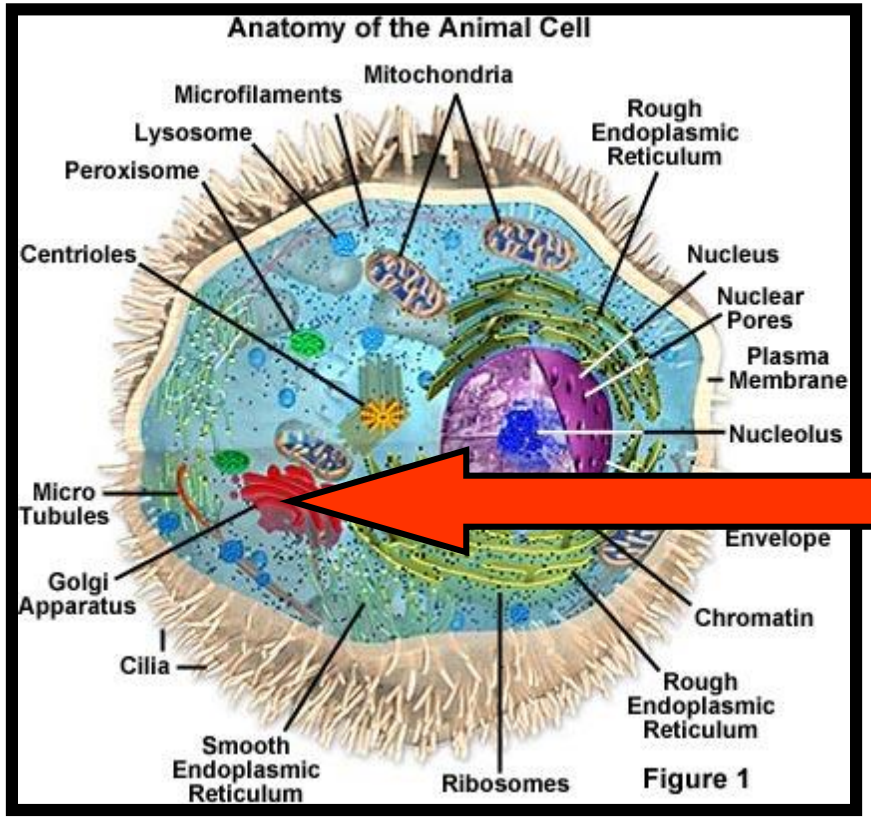
VACUOLES



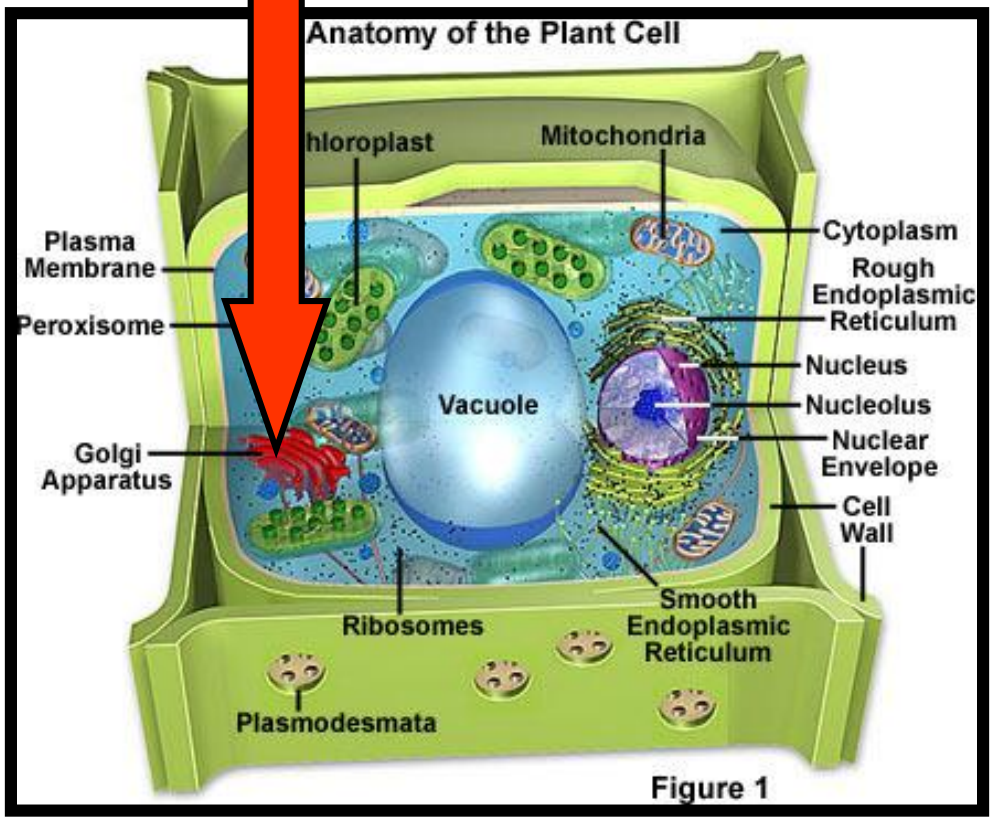


7. <u>vacuoles</u> – storage areas for water, food, lipids, wastes, and etc.

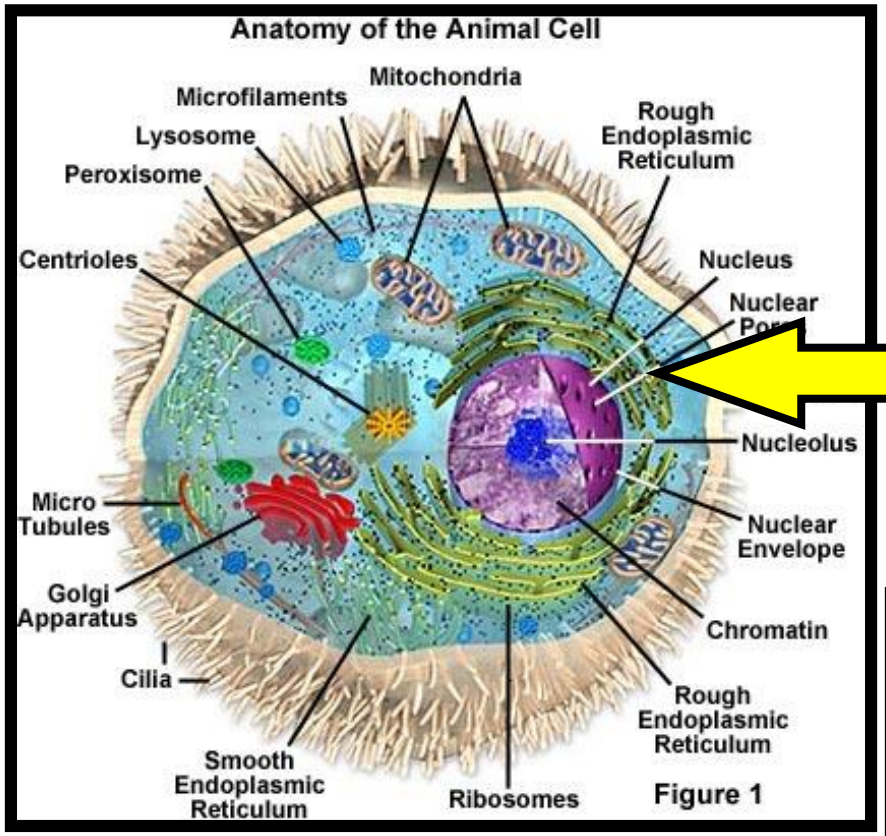
GOLGI APPARATUS

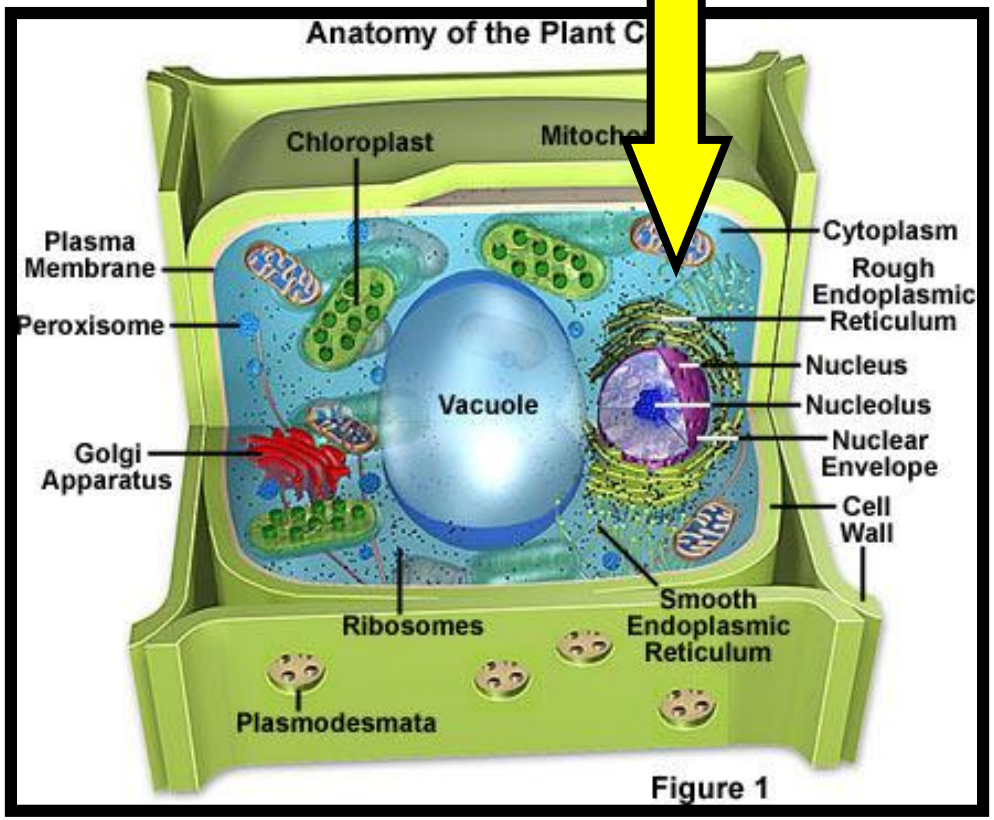


8. Golgi apparatus – "protein packaging factories of the cell"; modify, repackage, and release proteins and lipids in vesicles

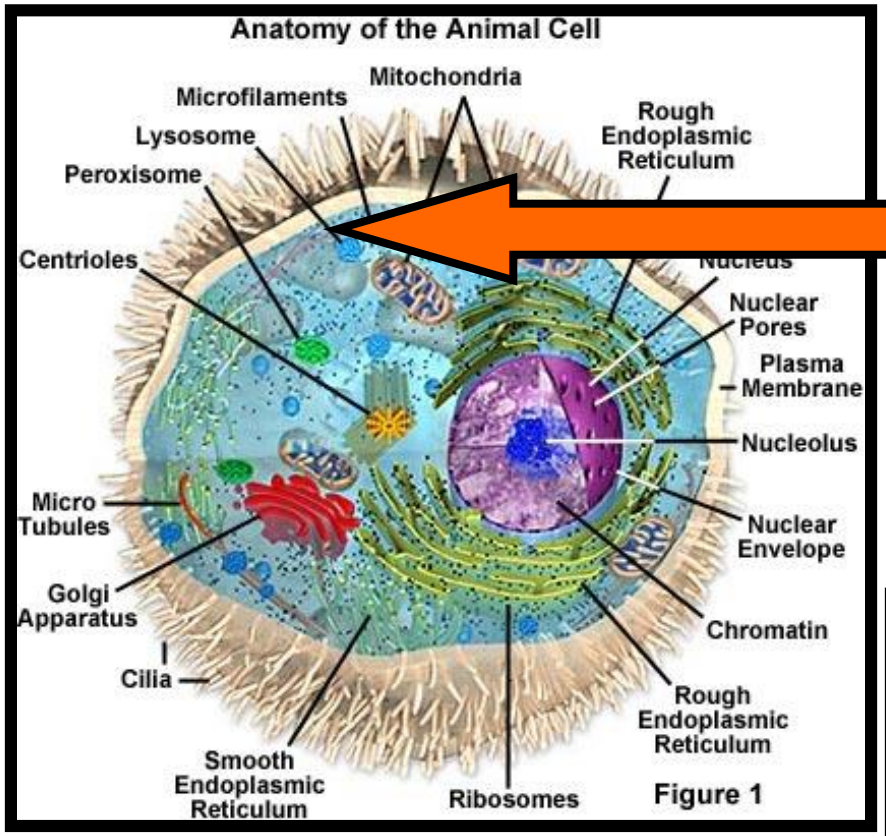


RIBOSOMES

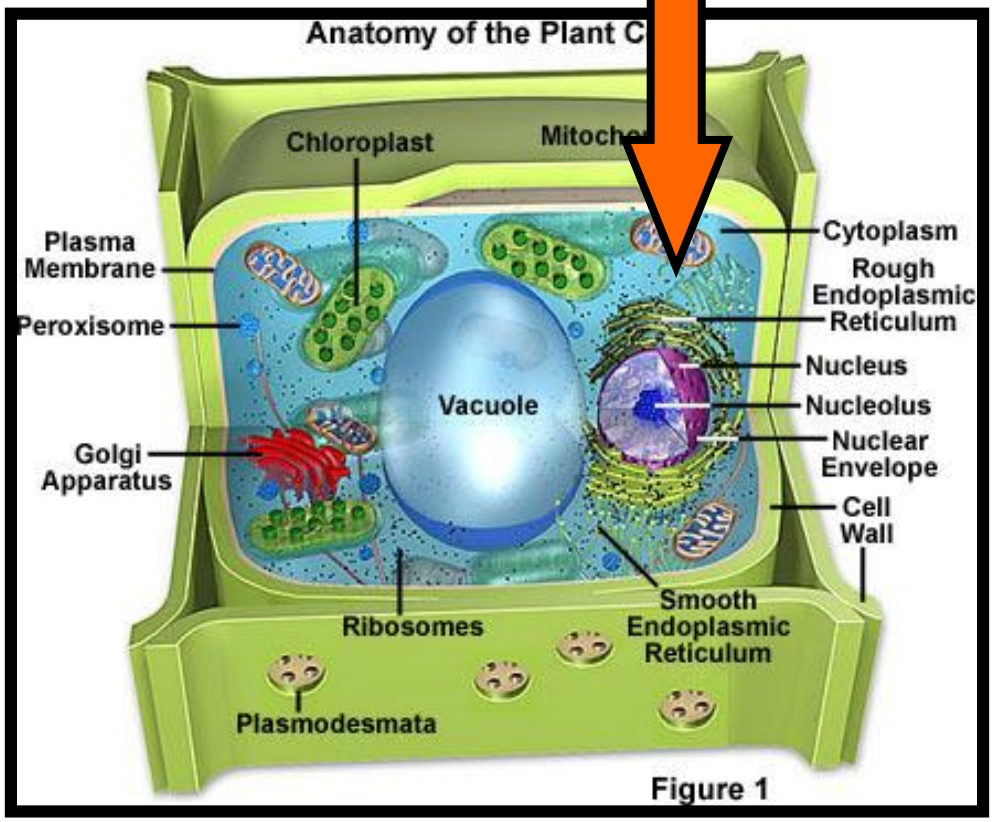




9. <u>ribosomes</u> – "protein factories of the cell"; site for protein synthesis; found free in the cytoplasm and attached to the rough endoplasmic reticulum

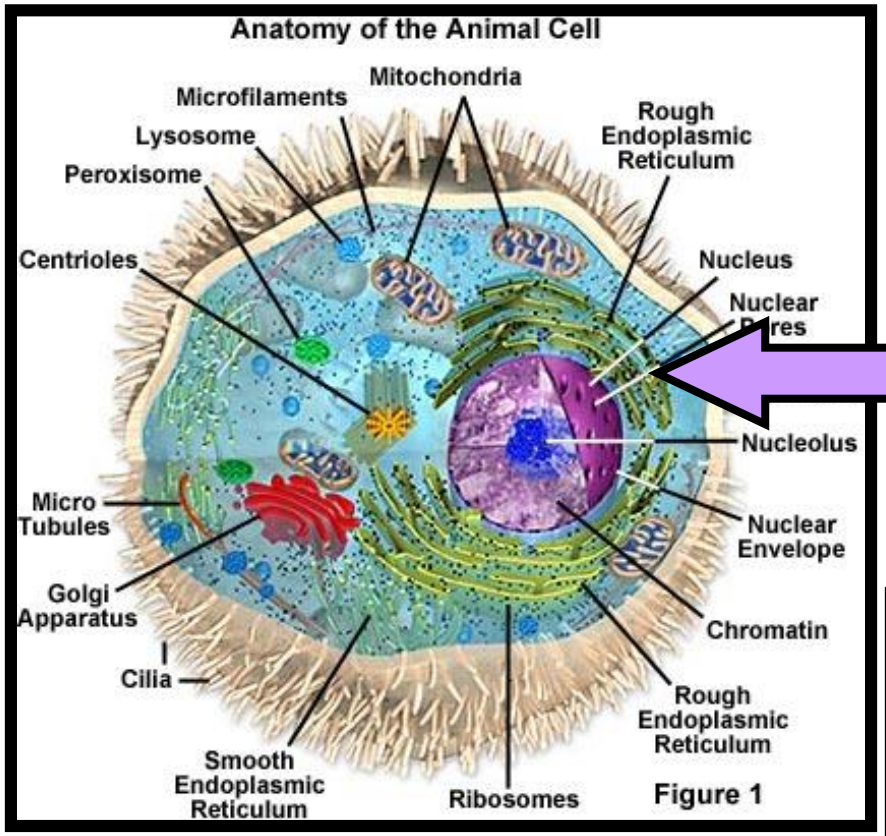


LYSOSOMES



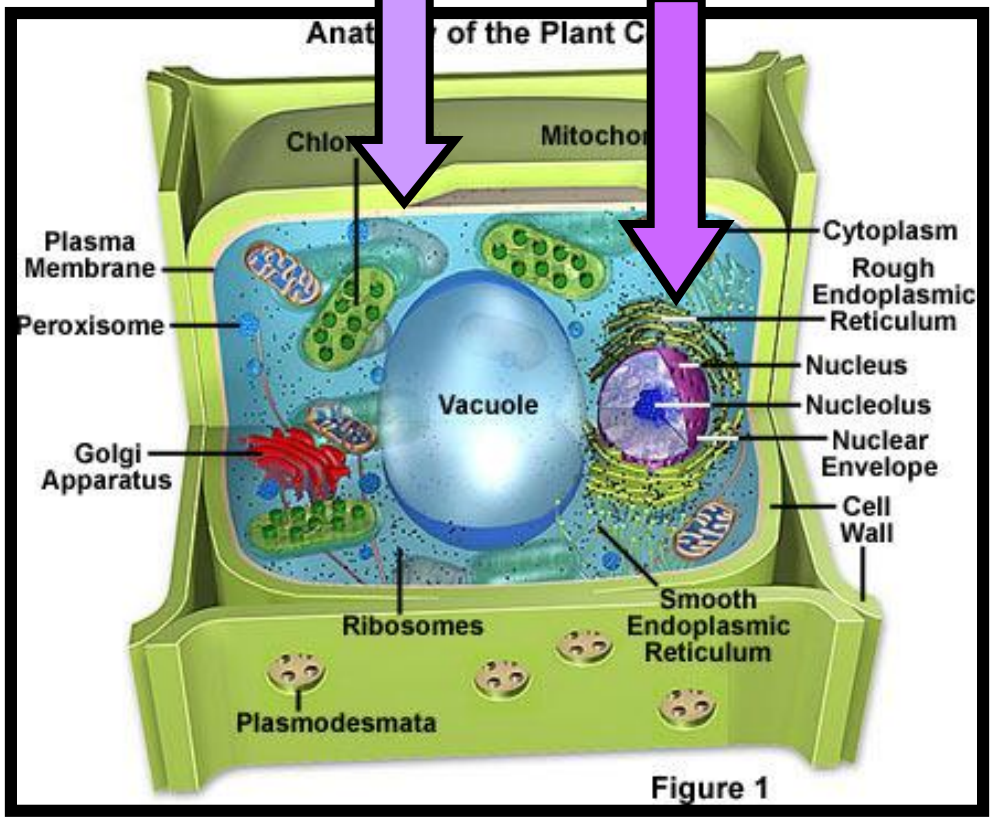
10. lysosomes – "suicide sacs of the cell"; contain hydrolytic enzymes for cell digestion

ENDOPLASMIC RETICULUM



A. rough ER – synthesizes proteins

B. smooth ER – syhthesizes lipids



11. endoplasmic reticulum – system of channels connecting the plasma membrane and nuclear envelope

Match the structures of the cell with their appropriate functions:

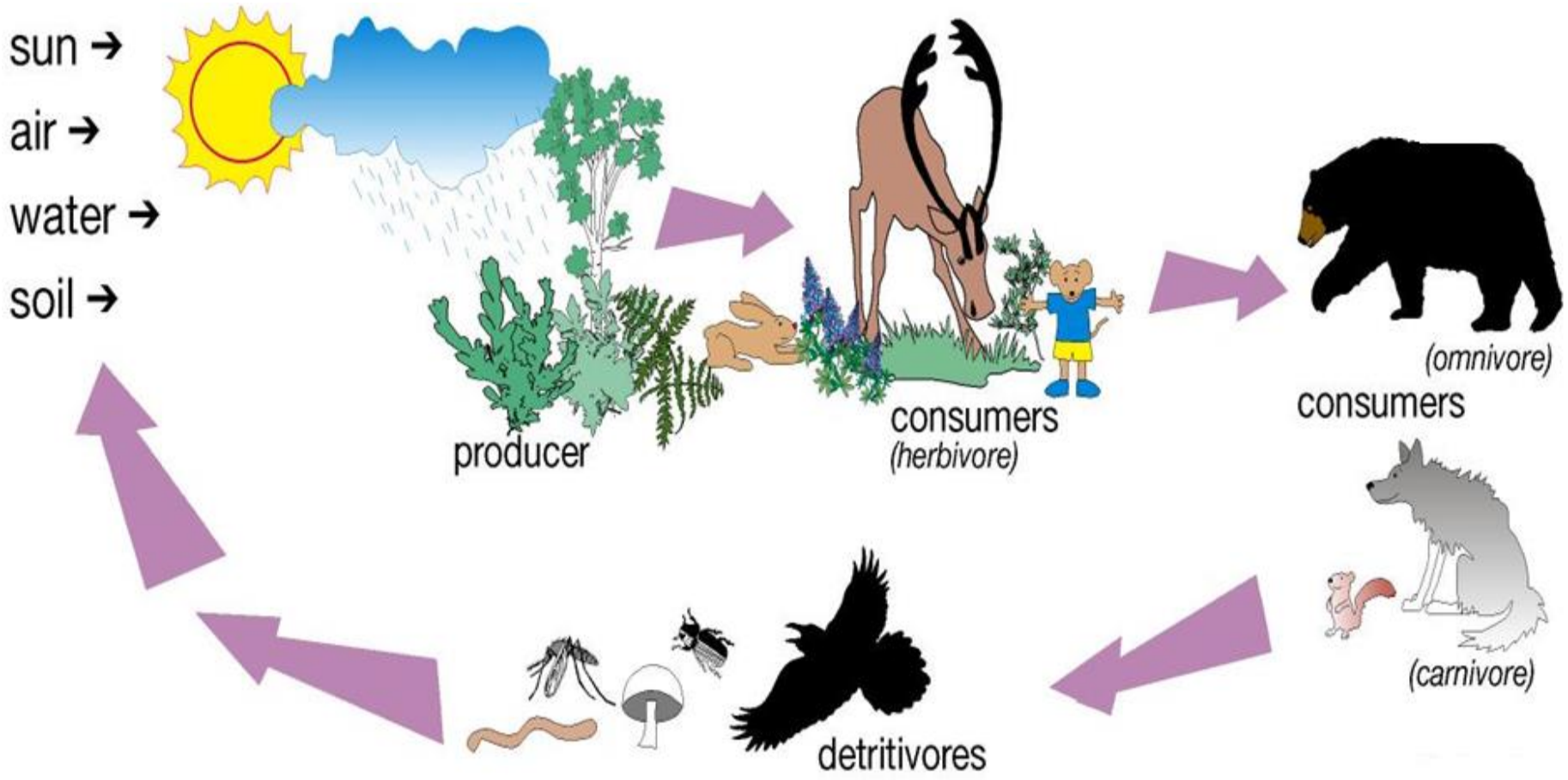
1. nucleus C
2. cell membrane F
3. cytoplasm E
4. organelles D
5. chloroplasts I
6. mitochondria B
7. vacuoles G
8. Golgi apparatus H
9. ribosomes J
10. lysosomes A
11. endoplasmic reticulum K

A. “suicide sacs”
B. “powerhouses”
C. “control center”
D. “little organs”
E. semi-fluid containing organelles
F. outer membrane
G. storage depots
H. “protein packaging factories”
I. sites of photosynthesis
J. “protein factories”
K. system of channels

Cell Energy (Photosynthesis and Respiration) Notes

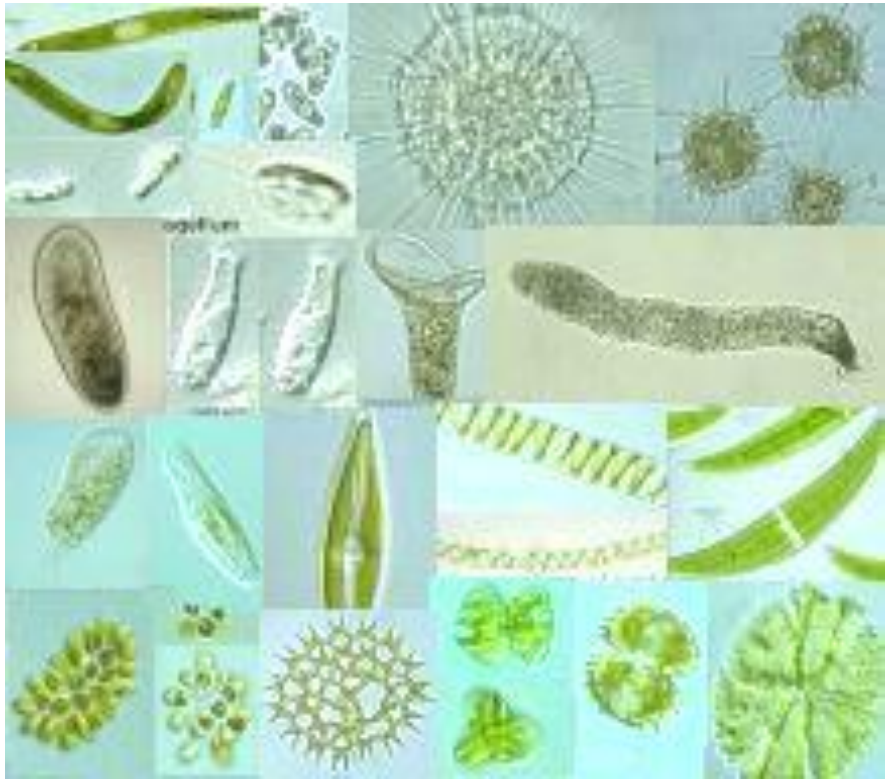
Energy:

- Energy for living things comes from **food**. Originally, the energy in food comes from the **sun**.

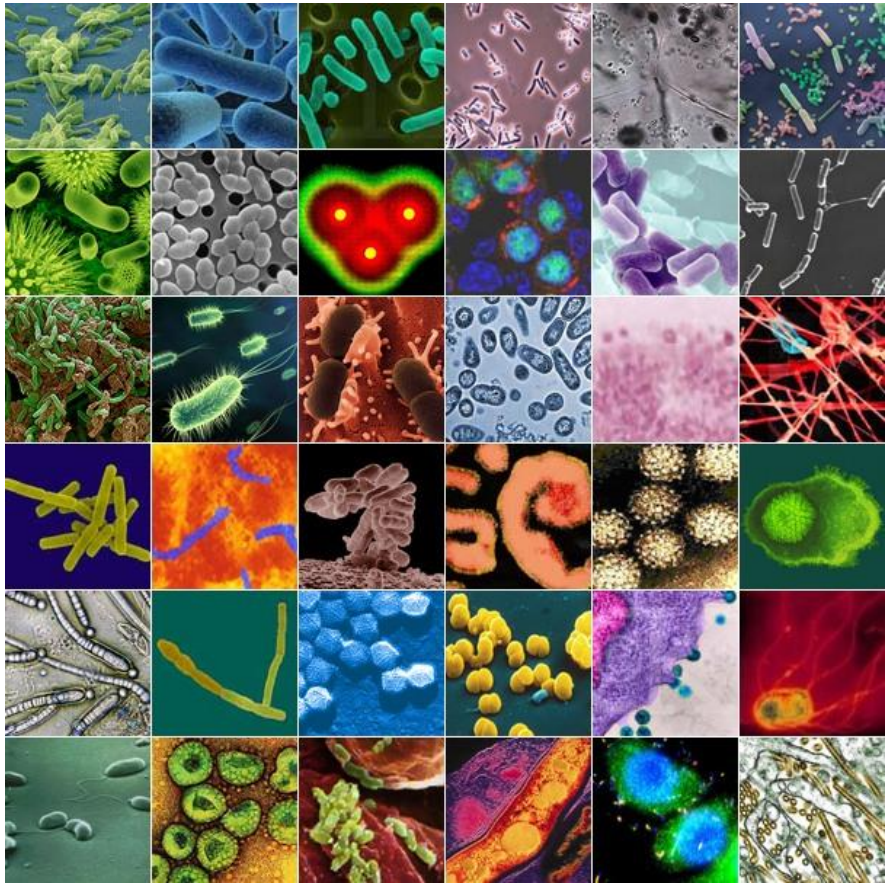


CHAPTER 4: CELLS AND ENERGY

- Organisms that use **light energy** from the sun to produce food—**autotrophs** (auto = self)
  Ex: **plants** and some microorganisms (some bacteria and protists)

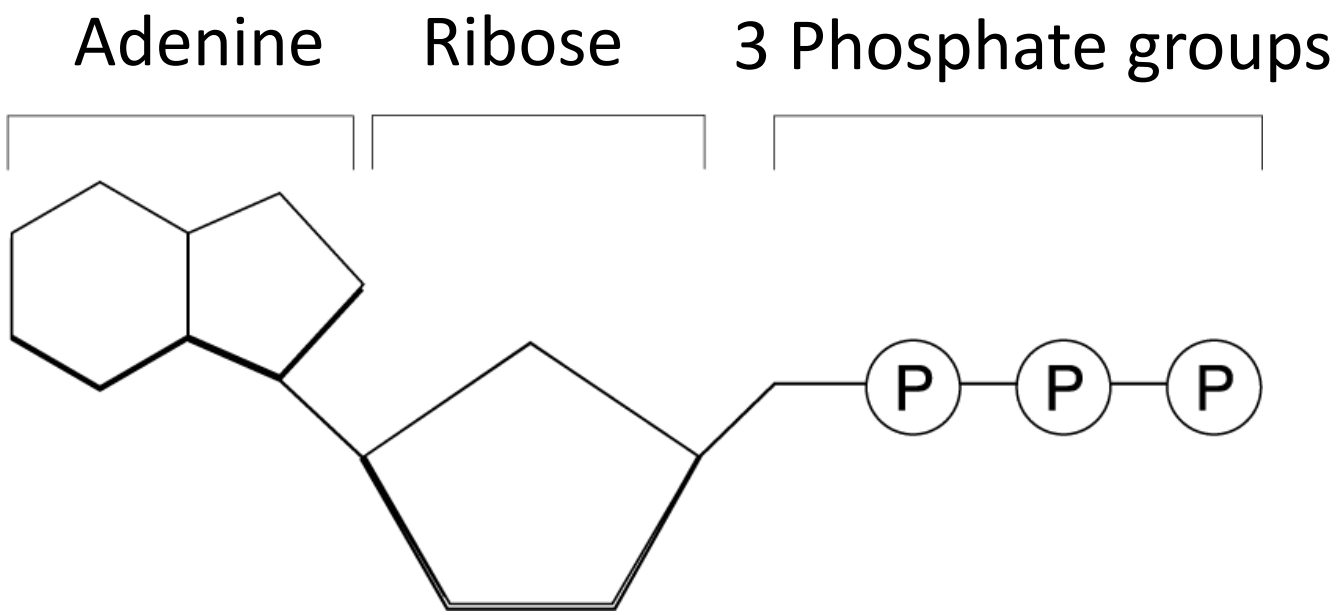


- Organisms that **CANNOT** use the sun's energy to make food—**heterotrophs**
  Ex: **animals** and most microorganisms

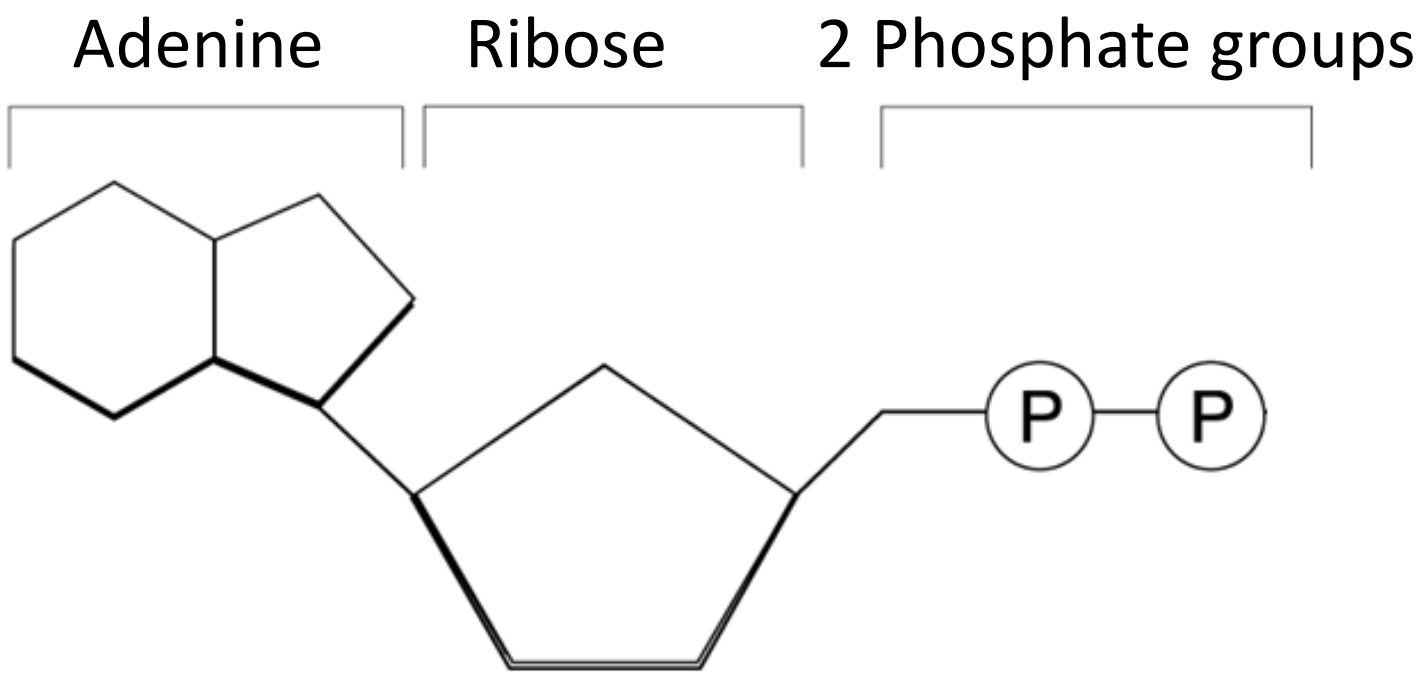


Cell Energy:

- Cells usable source of **energy** is called **ATP**
- ATP stands for **adenosine triphosphate**

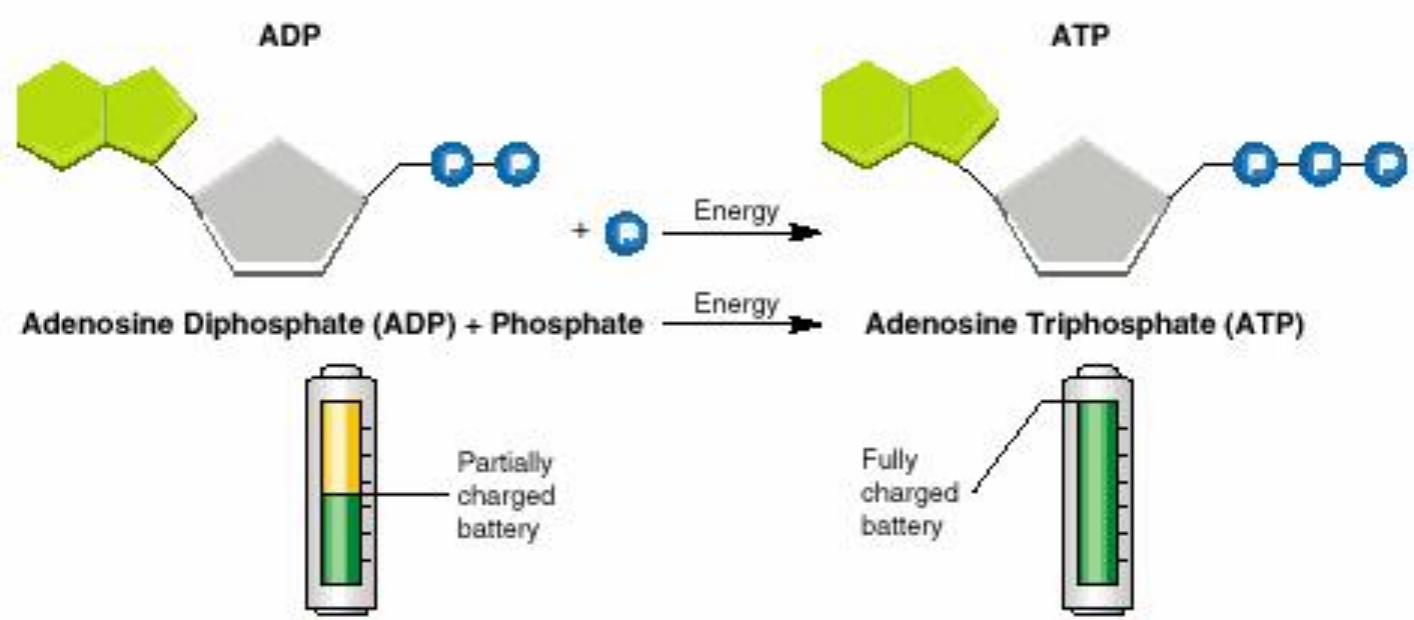


- ADP stands for **adenosine diphosphate**



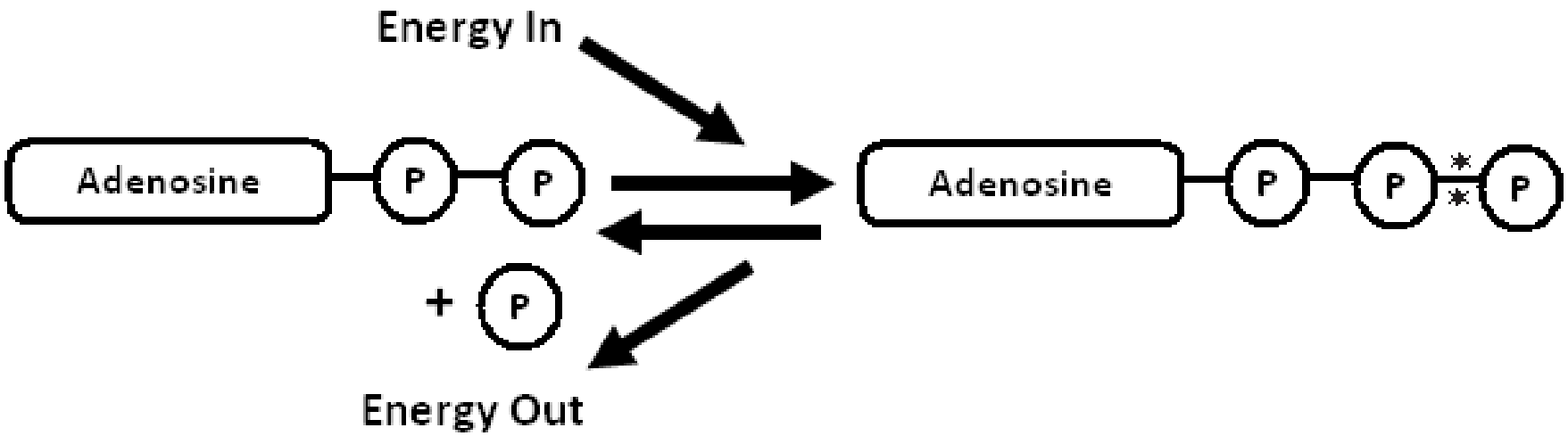
- All energy is stored in the **bonds** of compounds—**breaking** the bond **releases** the energy

- When the cell has energy available it can store this energy by adding a **phosphate group** to ADP, producing **ATP**



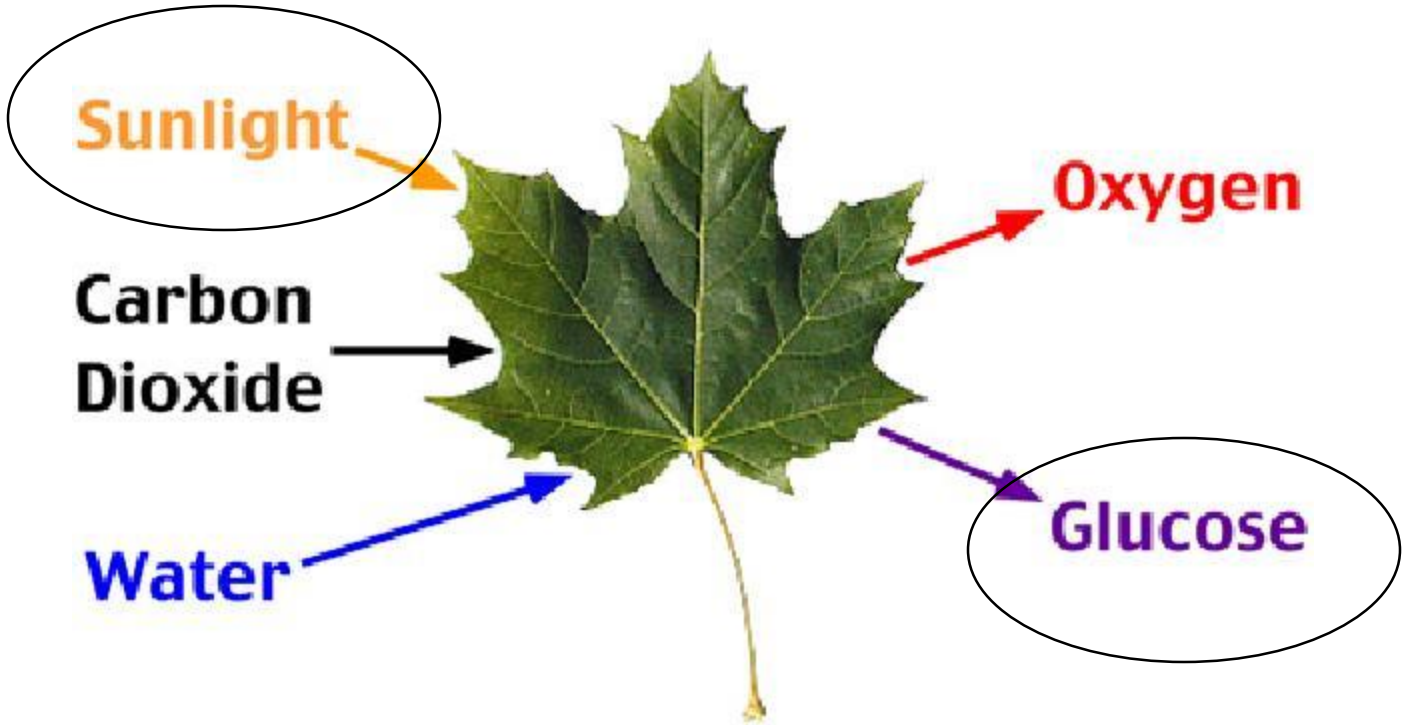
ADP vs. ATP ATP can be compared to a fully charged battery because both contain stored energy, whereas ADP resembles a partially charged battery. **Predicting** *What happens when a phosphate group is removed from ATP?*

- ATP is converted into ADP by breaking the **bond** between the second and third phosphate groups and releasing **energy** for cellular processes.

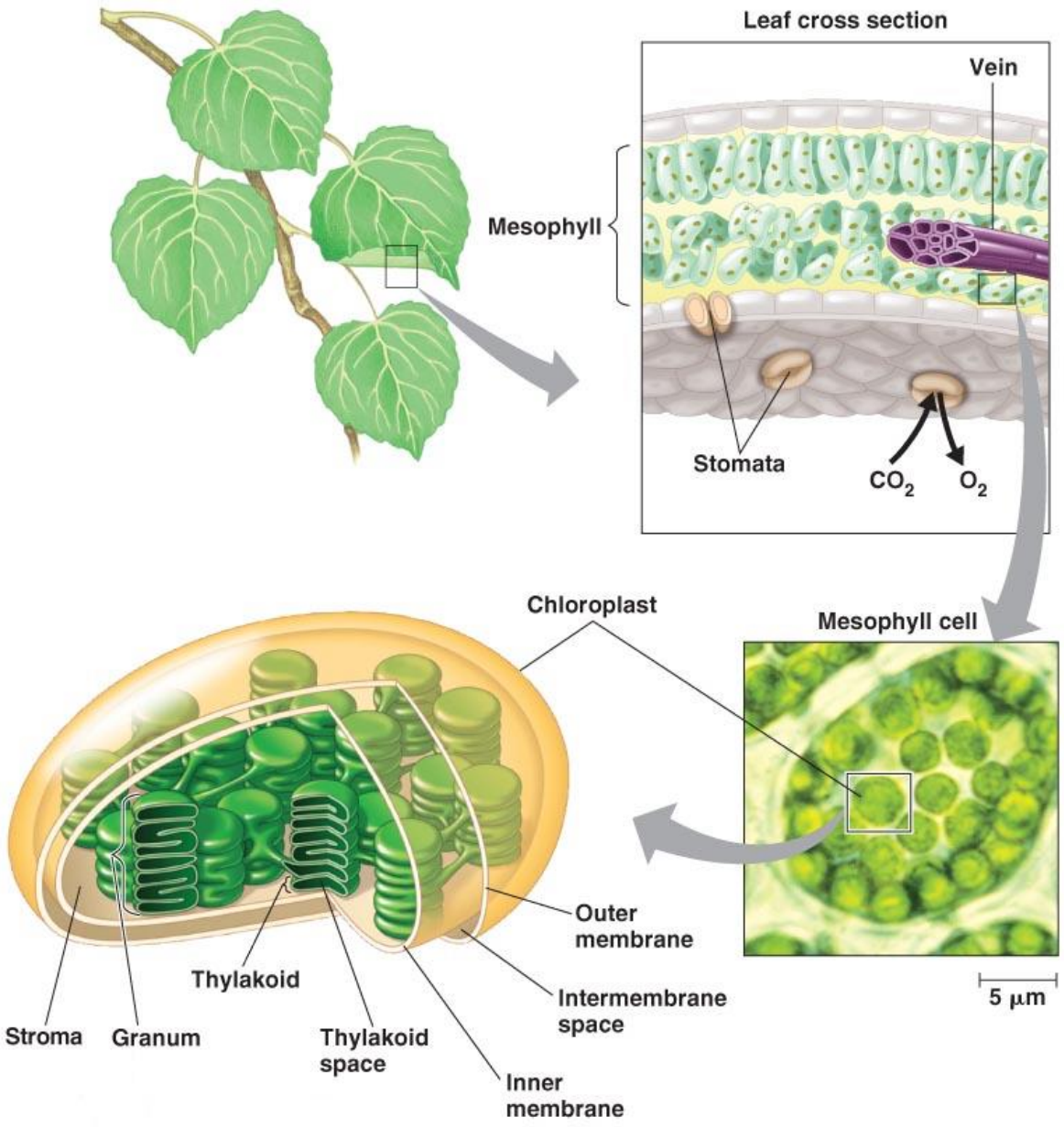


Photosynthesis:

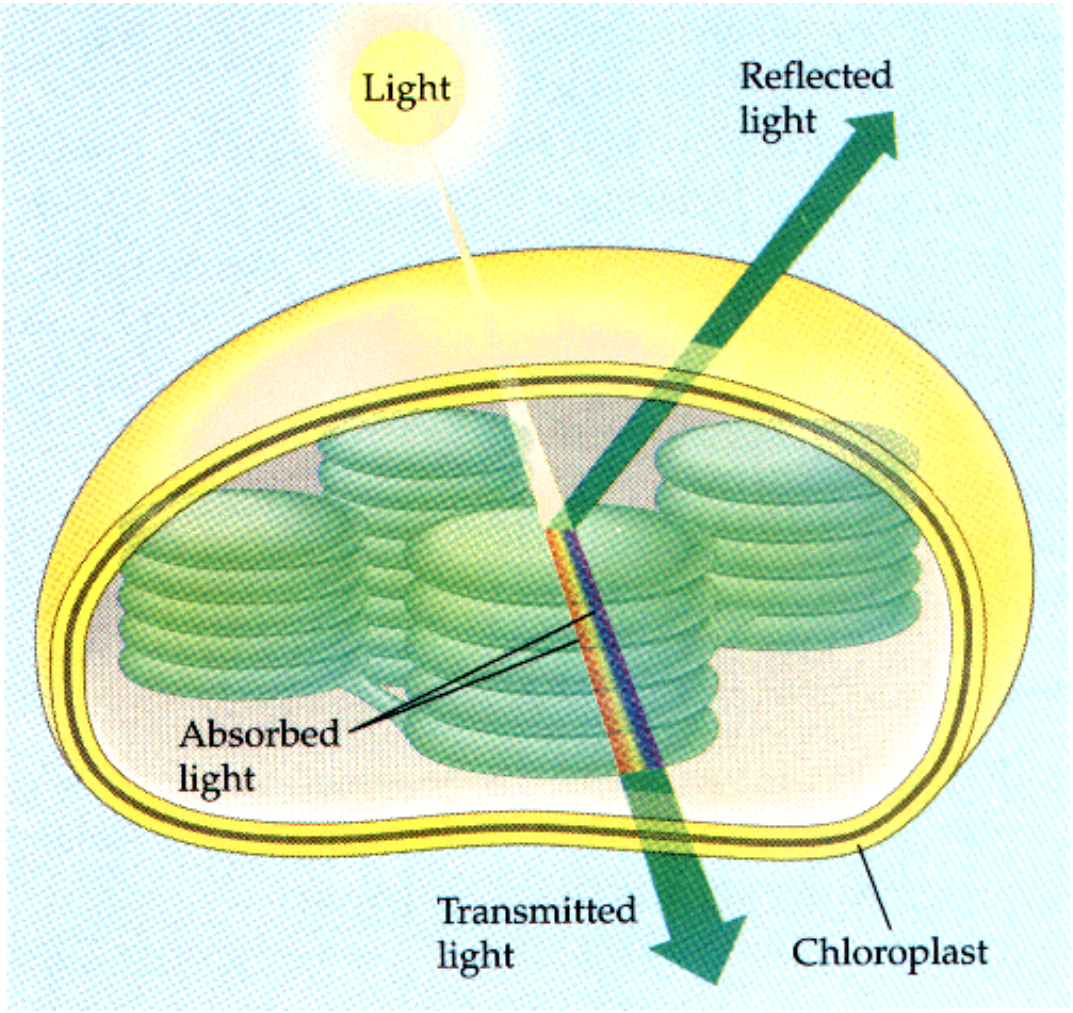
- Photosynthesis is the process by which the energy of **sunlight** is **converted** into the energy of **glucose**



- Photosynthesis occurs in the **chloroplasts** of plants



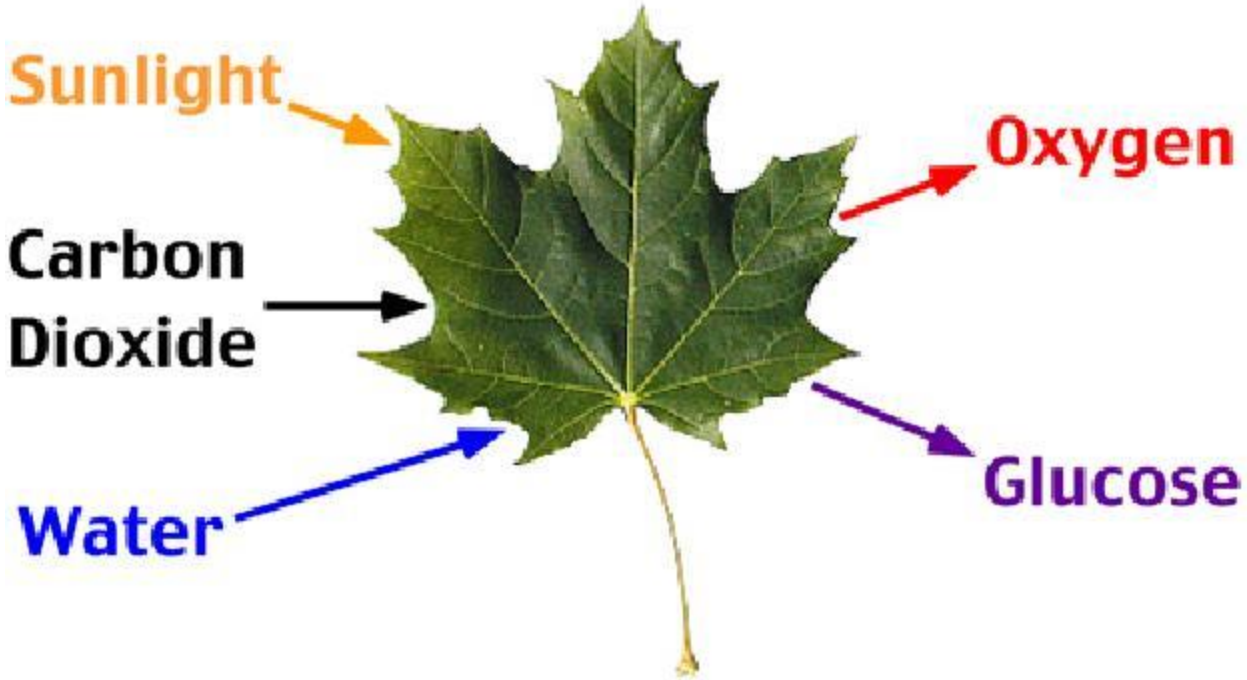
- Light absorbing compound is a **pigment**—pigments **absorb** some **wavelengths** of light and **reflect** others—the color our eyes see is the color that the pigment **reflects**



- General formula for photosynthesis:

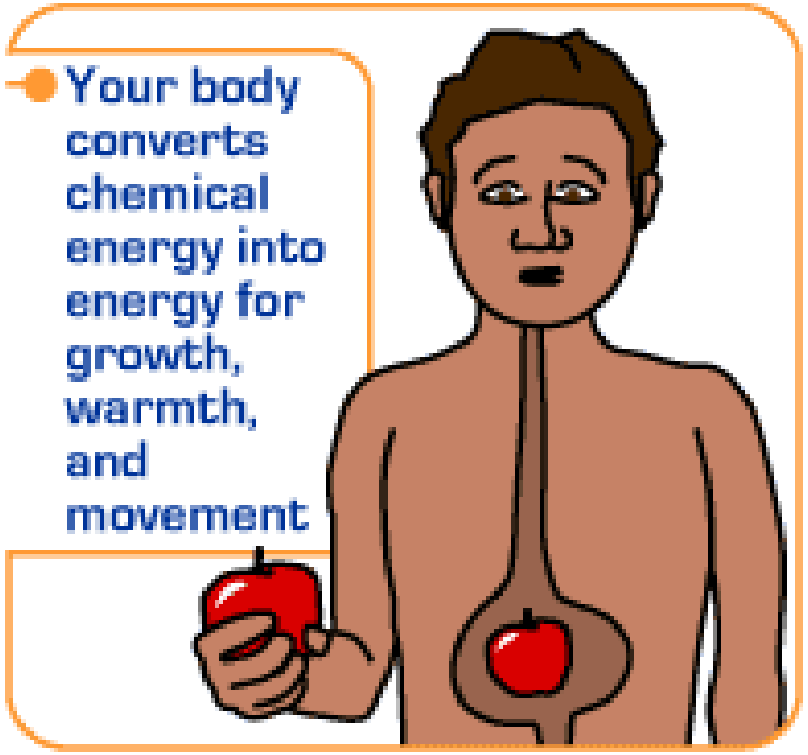
carbon dioxide + water + light ⟶ glucose + oxygen

$6CO_2 + 6H_2O + light \longrightarrow C_6H_{12}O_6 + 6O_2$

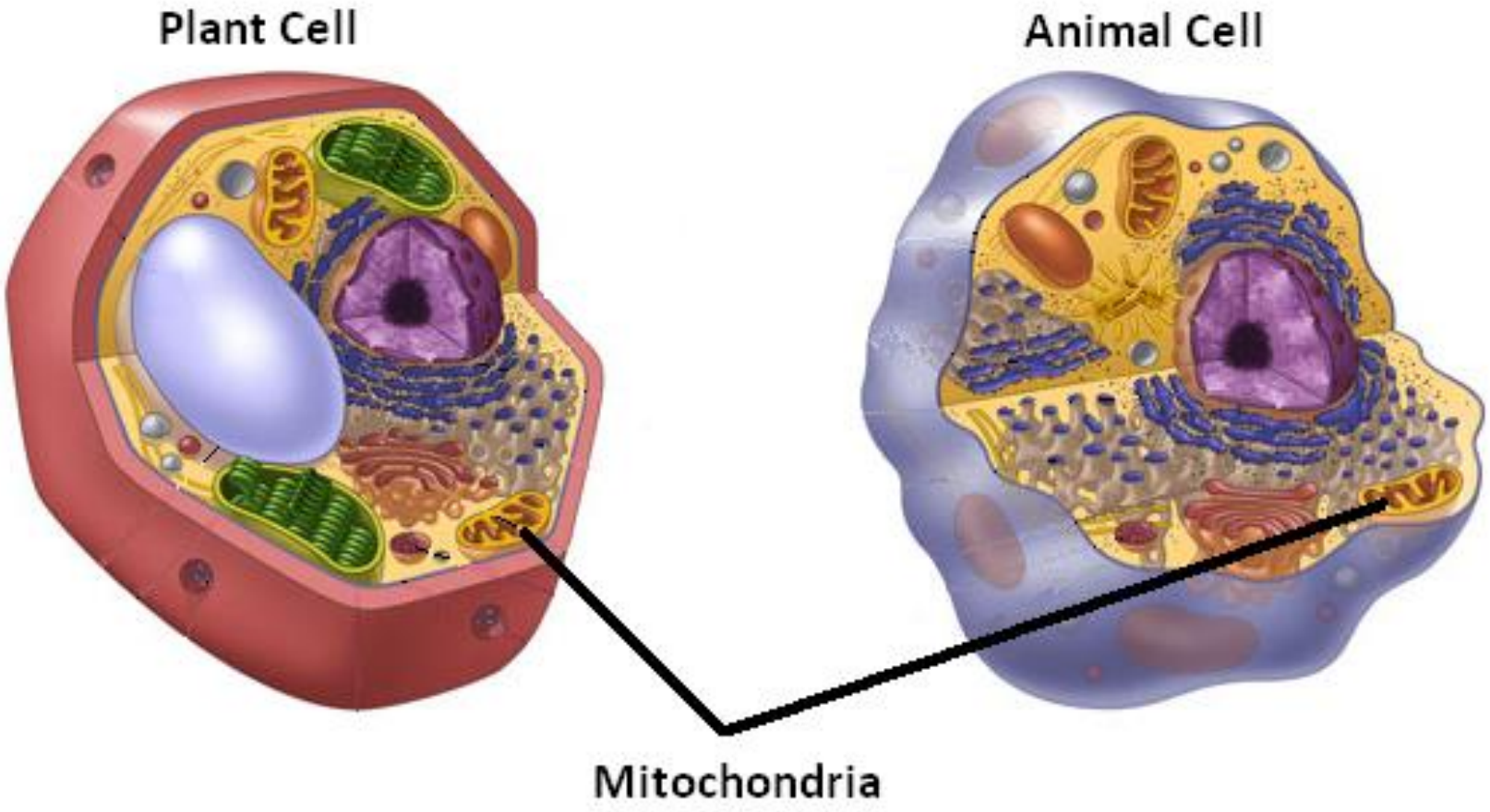


Cellular Respiration: (2 kinds—Aerobic and Anaerobic)

- Cellular respiration is the process by which the energy of **glucose** is **released** in the cell to be used for life processes (**movement, breathing, blood circulation**, etc…)



- Respiration occurs in **ALL cells** and can take place either **with or without oxygen** present.



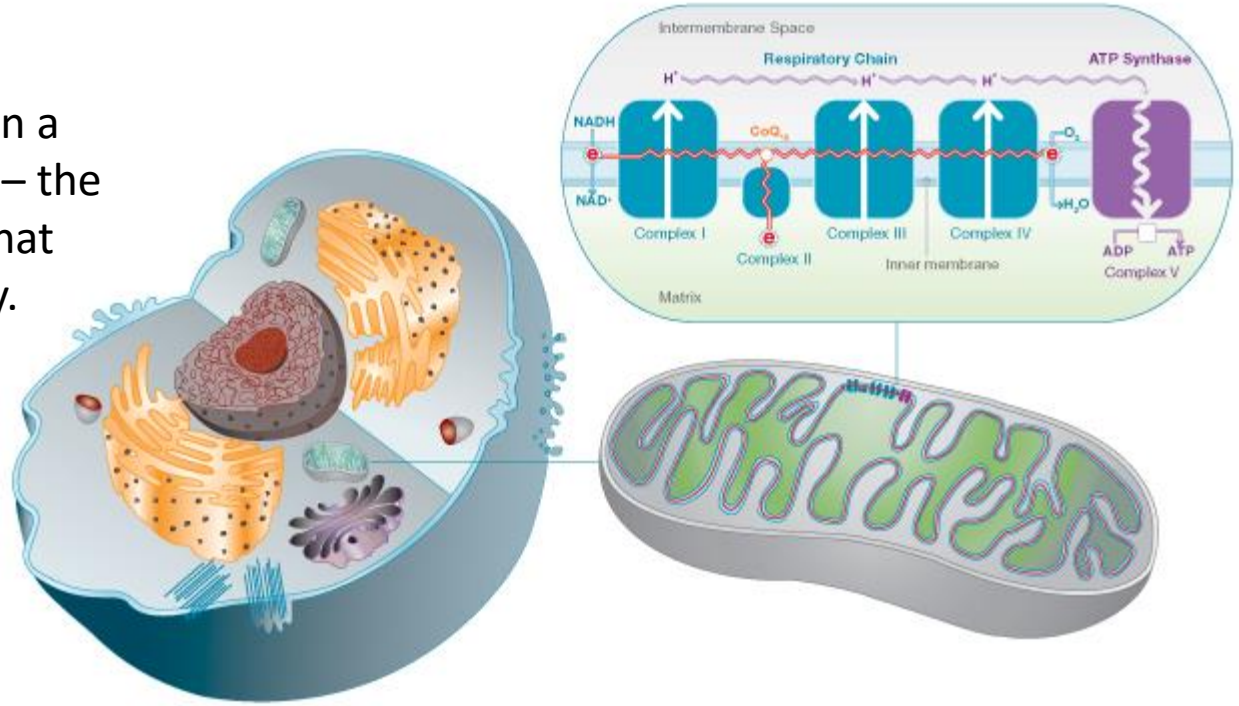
Aerobic Respiration: requires oxygen

- Occurs in the **mitochondria** of the cell
- Total of **36 ATP** molecules produced
- General formula for aerobic respiration:

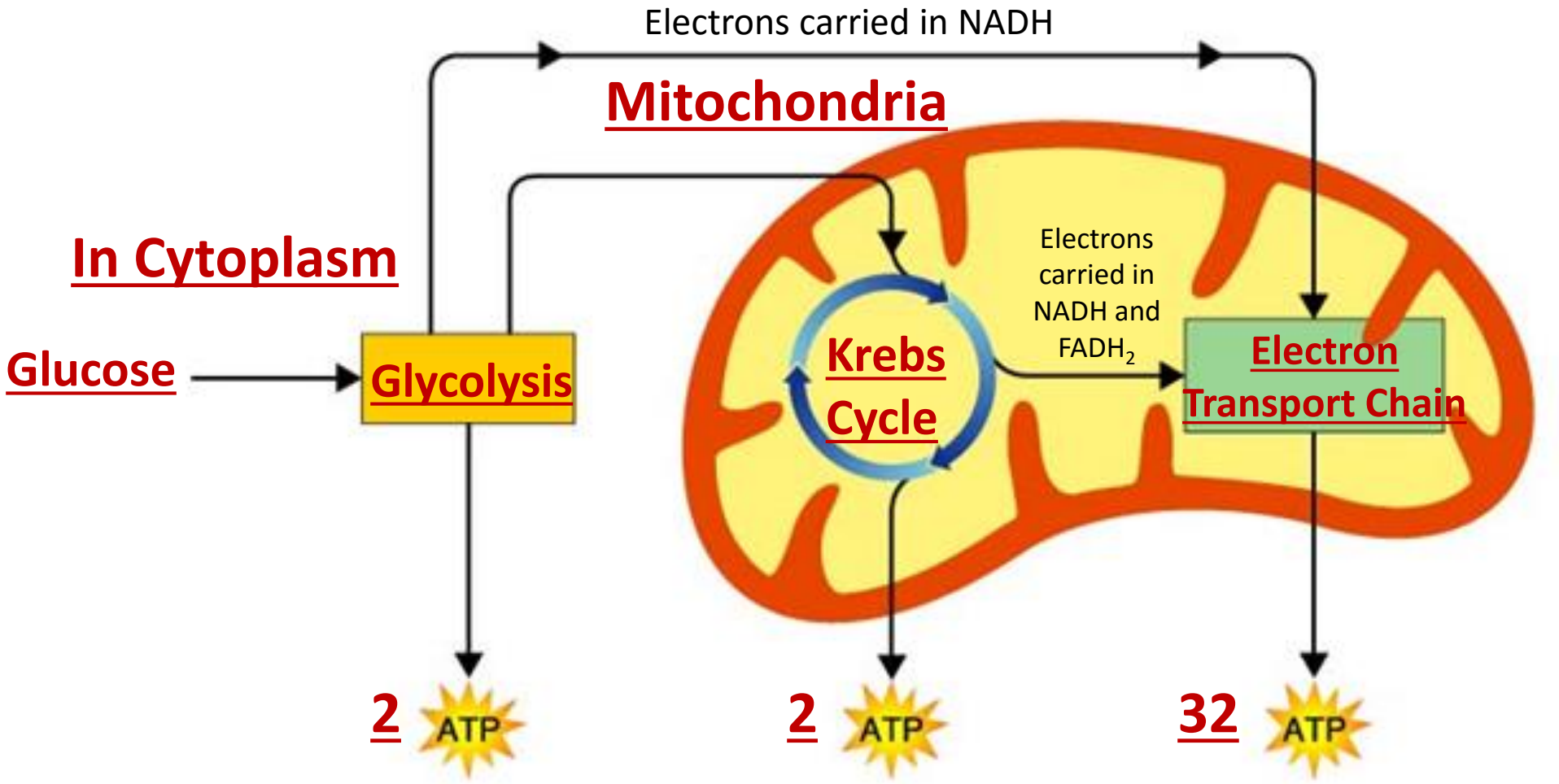
$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6\,CO_2 + 6H_2O + \mathbf{36\ ATP}$$

glucose + oxygen ⟶ carbon dioxide + water + energy

Human cells contain a specialized structure – the mitochondrion – that generates energy.



- Diagram

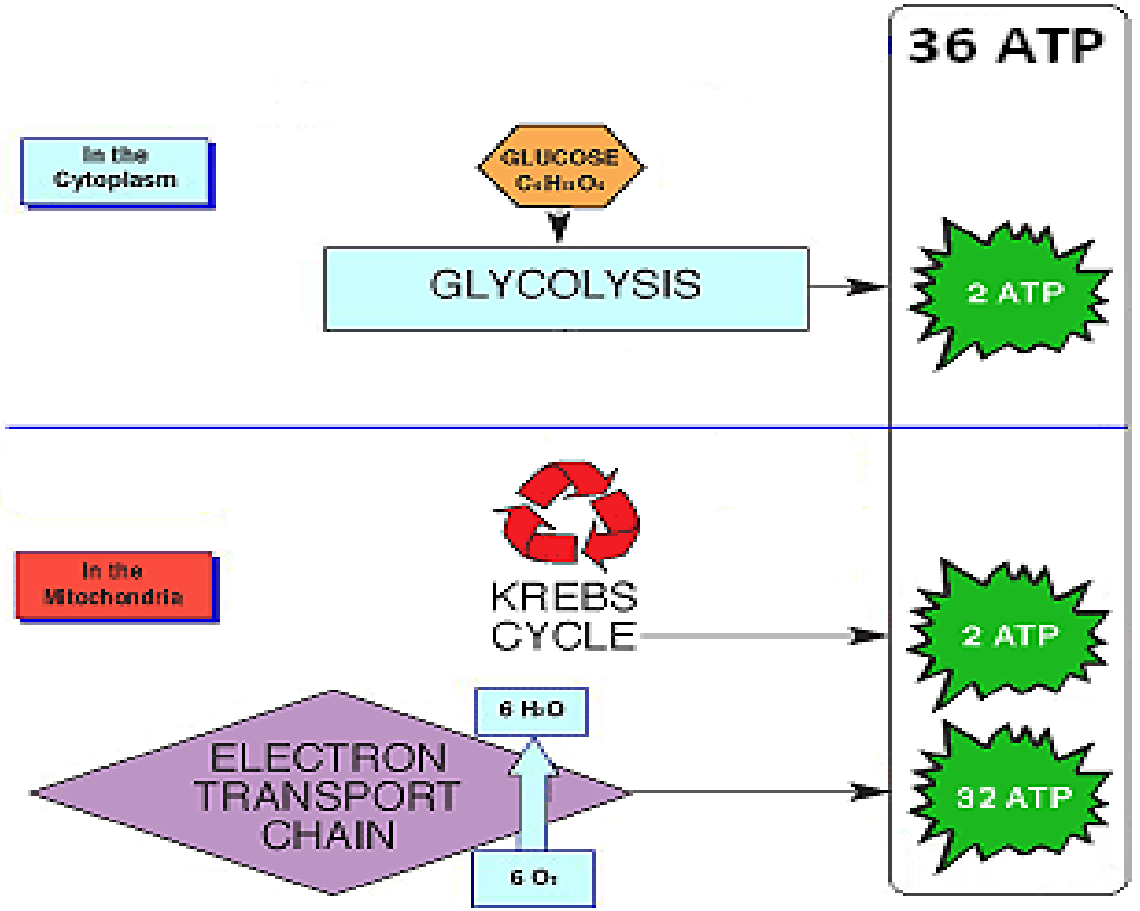

Electrons carried in NADH
Mitochondria
In Cytoplasm
Glucose
Glycolysis
Krebs Cycle
Electrons carried in NADH and $FADH_2$
Electron Transport Chain
2 ATP
2 ATP
32 ATP

Summary:

3 steps: 1st **glycolysis**

2nd **Krebs cycle**

3rd **Electron Transport Chain** (ETC)



Anaerobic Respiration: occurs when **no oxygen** is available to the cell (2 kinds: Alcoholic and Lactic Acid)

- Also called **fermentation**
- **Much less ATP produced** than in aerobic respiration

- **Alcoholic** fermentation—occurs in **bacteria** and **yeast**

  Process used in the **baking** and **brewing** industry—yeast produces CO_2 **gas** during fermentation to make dough **rise** and give bread its holes

glucose ⟶ ethyl alcohol + carbon dioxide + **2 ATP**

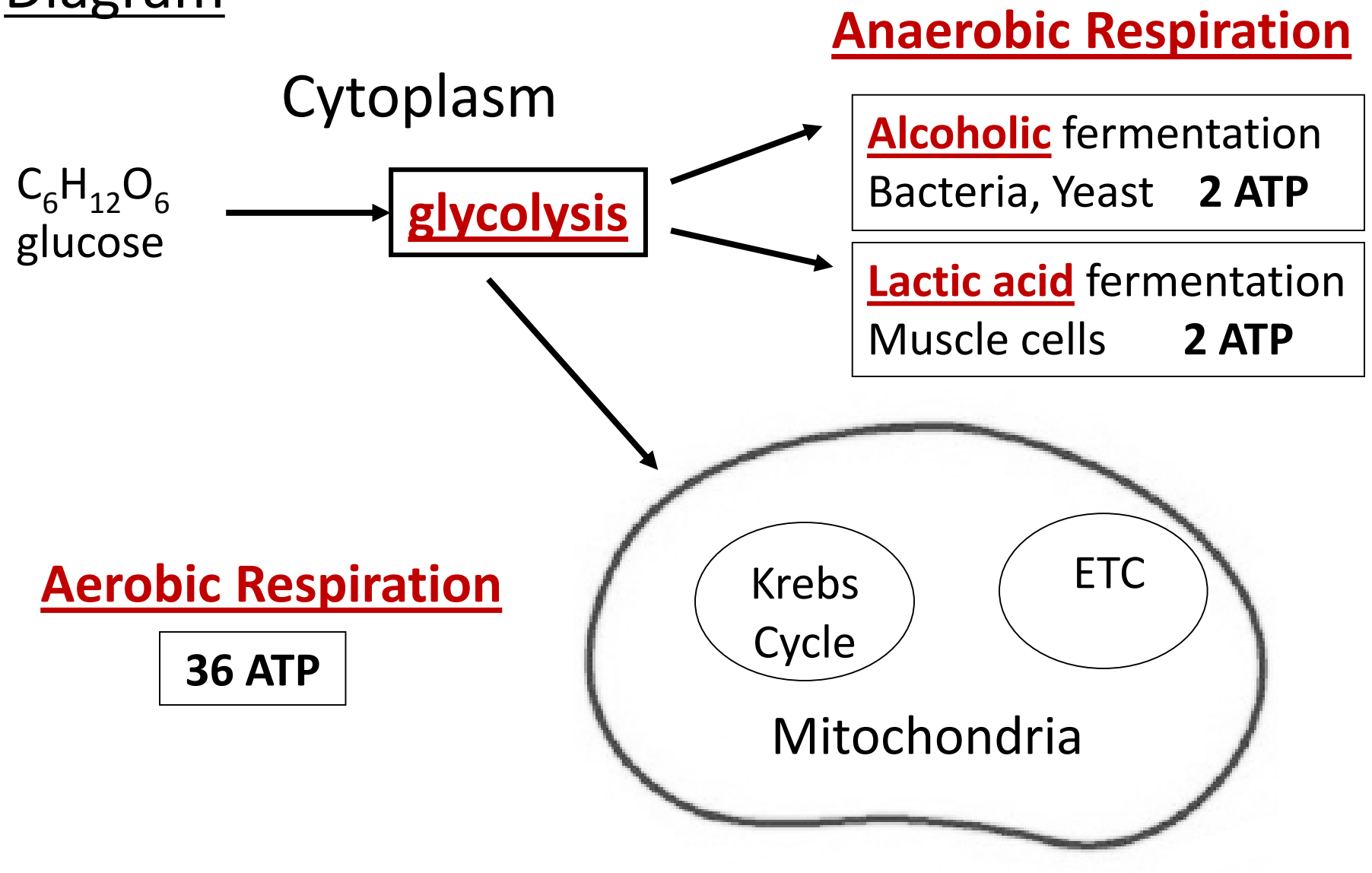
- **Lactic acid** fermentation—occurs in **muscle cells**

  Lactic acid is produced in the muscles during rapid **exercise** when the body **cannot** supply enough **oxygen** to the **tissues**—causes **burning sensation** in muscles

glucose ⟶ lactic acid + carbon dioxide + **2 ATP**

- First step in anaerobic respiration is also **glycolysis**

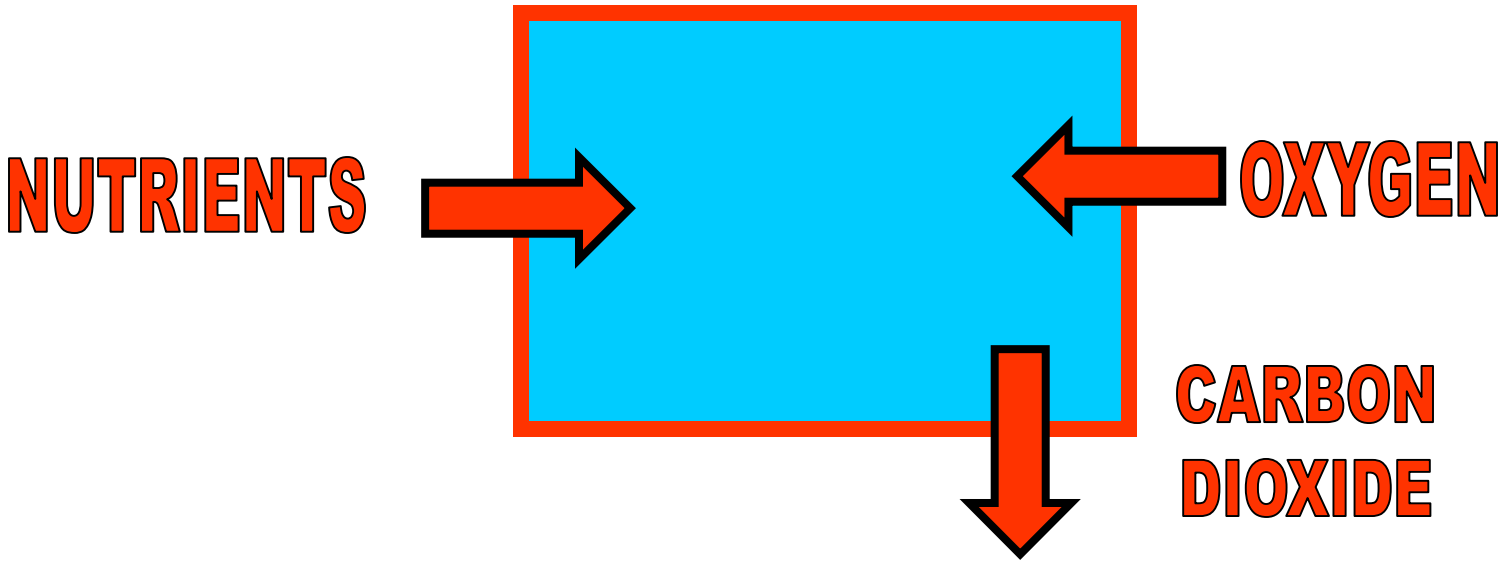
Diagram



CHAPTER 5: CELL GROWTH AND DIVISION

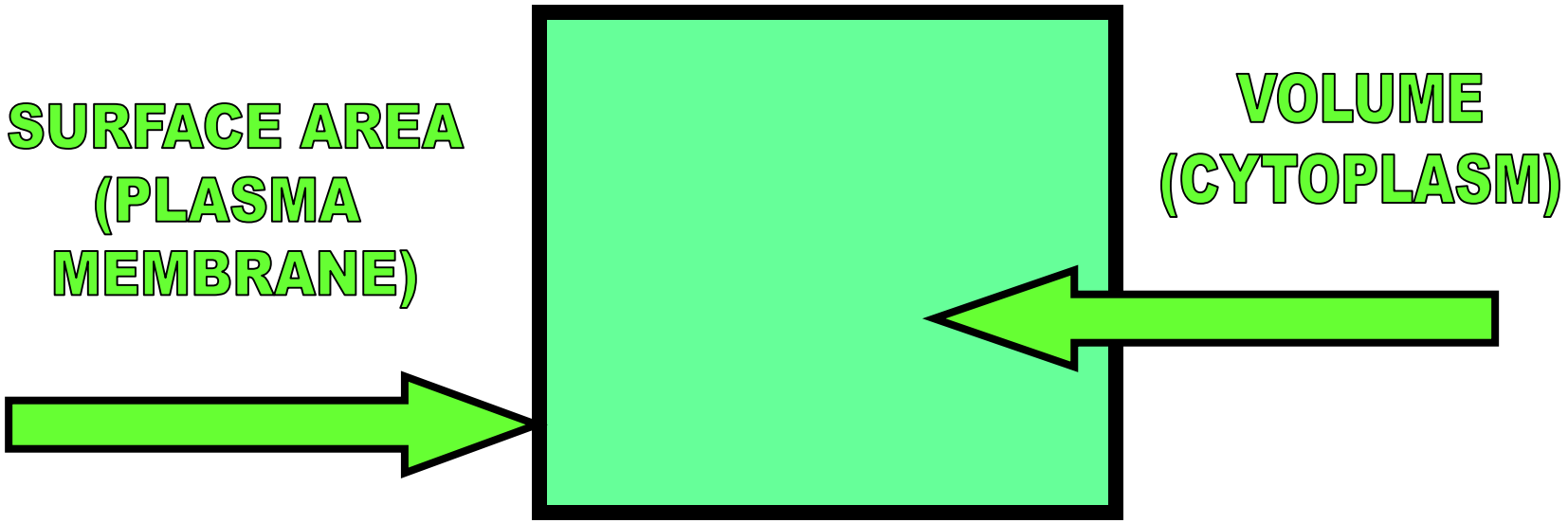
FACTORS LIMITING CELL SIZE

1. DIFFUSION RATES - LIMITS CELL SIZE BECAUSE CELLS REQUIRE A CONSTANT SUPPLY OF NUTRIENTS AND OXYGEN AND MUST REMOVE CARBON DIOXIDE AND OTHER WASTES TO REMAIN ALIVE



3. SURFACE AREA -TO - VOLUME RATIO

AS A CELL'S SIZE INCREASES,
ITS VOLUME INCREASES MUCH FASTER
THAN ITS SURFACE AREA



CELL DIVISION (MITOSIS)

THE PROCESS BY WHICH CELLS REPRODUCE

CHROMOSOMES - DARK-STAINING STRUCTURES THAT CONTAIN GENETIC MATERIAL;

ROD-SHAPED, GENE-BEARING STRUCTURES WHICH FORM DURING CELL DIVISION

STRUCTURES THROUGH WHICH **GENES** ARE TRANSMITTED TO OFFSPRING

CHROMA = "**COLORED**"

SOMA = "**BODY**"

HOMOLOGOUS CHROMOSOMES - CHROMOSOMES THAT ARE IDENTICAL IN FORM AND LINEAR ARRANGEMENT; MORPHOLOGICALLY SIMILAR

HOMO = "**THE SAME**"

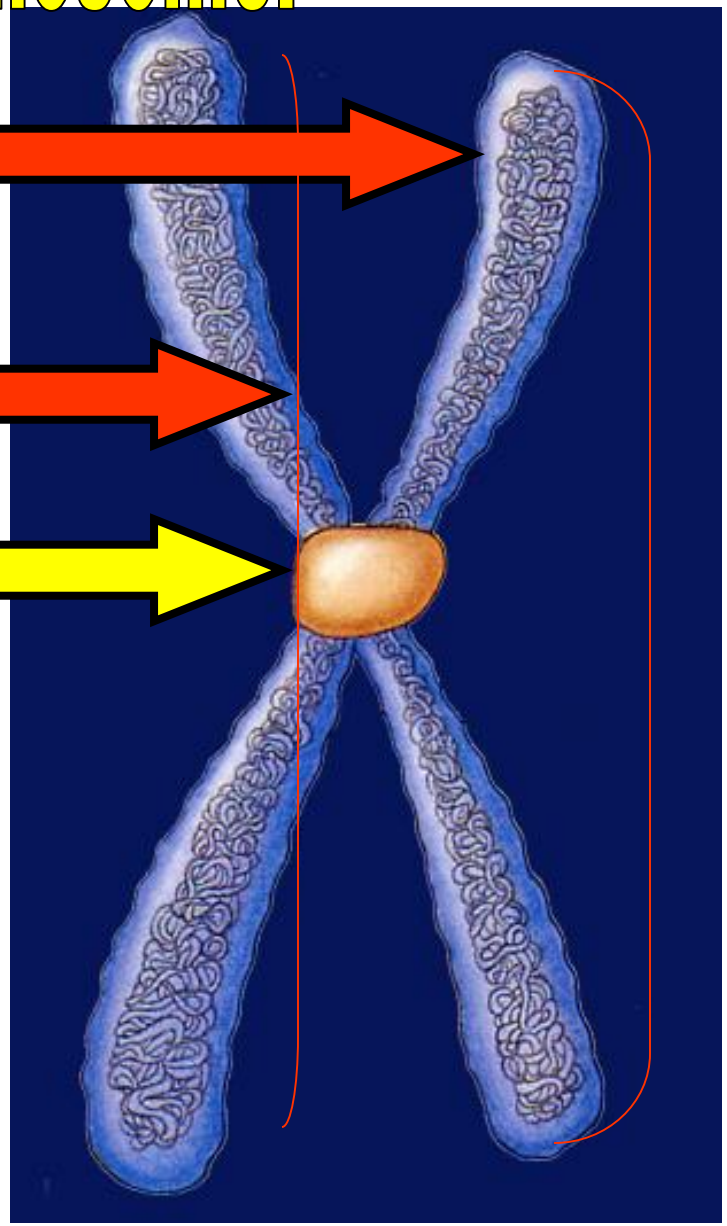
MORPHE = "**FORM**"

HOMOLOGOUS CHROMOSOMES

Structures of a chromosome:

1. chromatids
each of the two identical halves of a chromosome; sometimes called "sister chromatids"

2. centromere
the point of attachment of the sister chromatids



centro = "_ center _"

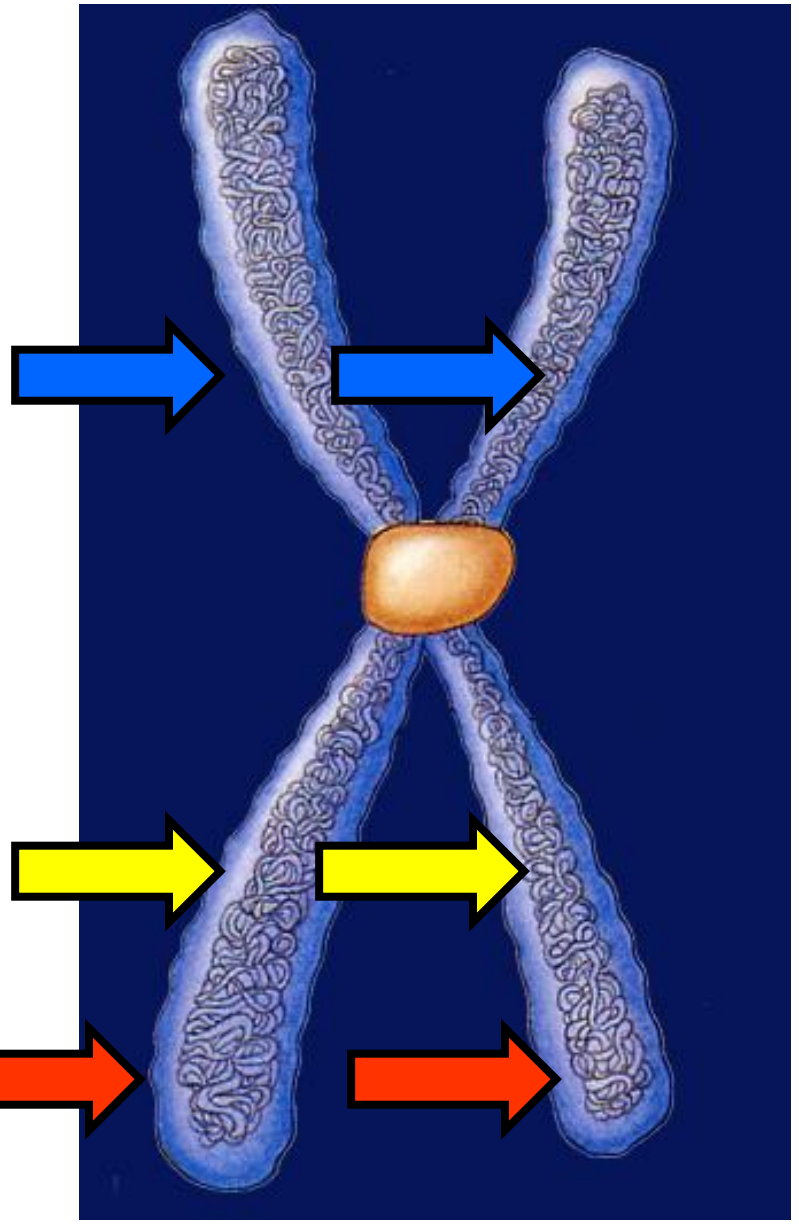
mere = "_____ portion ; _____ share _____"

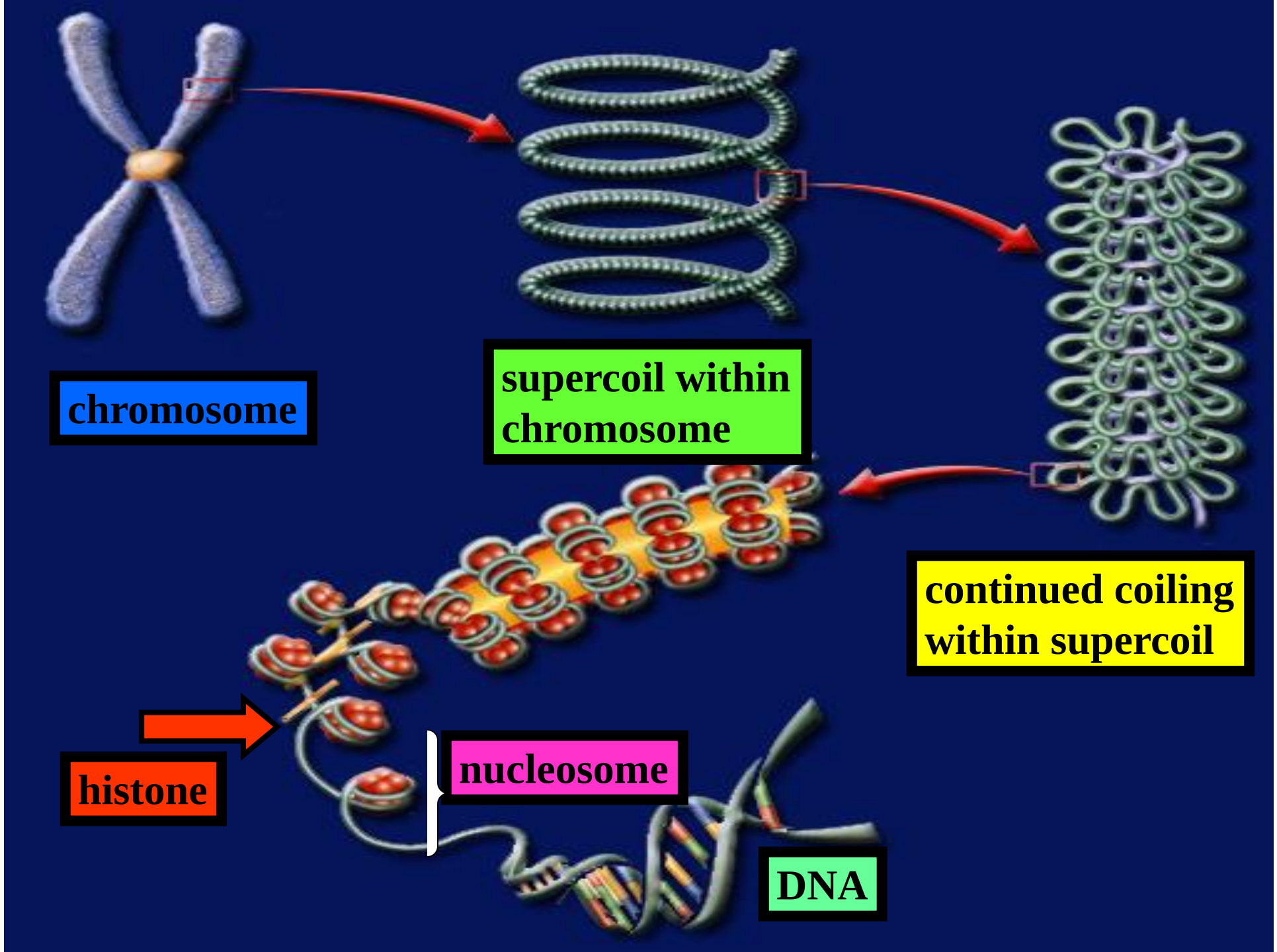
5. alleles
genes for the same trait that may have differing expressions and located at the same location on sister chromatids

genetic disease
normal, diseased

hair color
red, blonde, black, brown

shape of nose
straight, pug, roman




chromosome
supercoil within chromosome
continued coiling within supercoil
histone
nucleosome
DNA

GENE - A SEGMENT OF DNA LOCATED ON THE CHROMOSOME;

THE CARRIERS OF HEREDITARY INFORMATION IN CELLS;

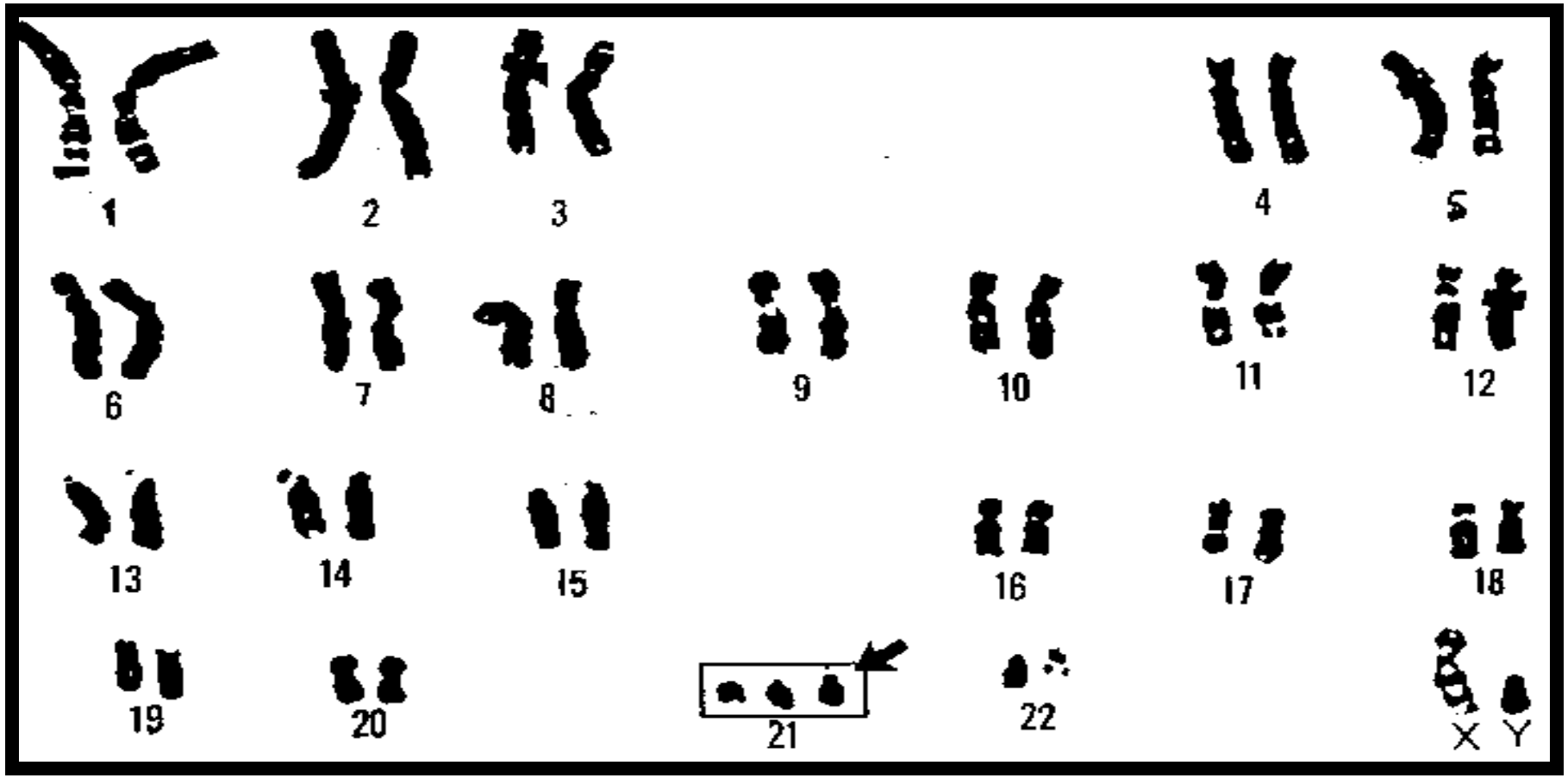
CODE FOR THE PROTEINS THAT CARRY OUT CELLULAR FUNCTIONS;

THE "HEREDITARY UNITS"

GENES = "BORN"

PRO = "FIRST"

KARYOTYPE - CHARTED ARRANGEMENT OF THE CHROMOSOMES POSSESSED BY AN INDIVIDUAL



HELPFUL IN LOCATING ABNORMALITIES IN HUMAN CHROMOSOME NUMBERS

Chromosomes in normal humans:

autosomes (body cell chromosomes) = **22 pairs or 44**

sex chromosomes = **1 pair or 2**

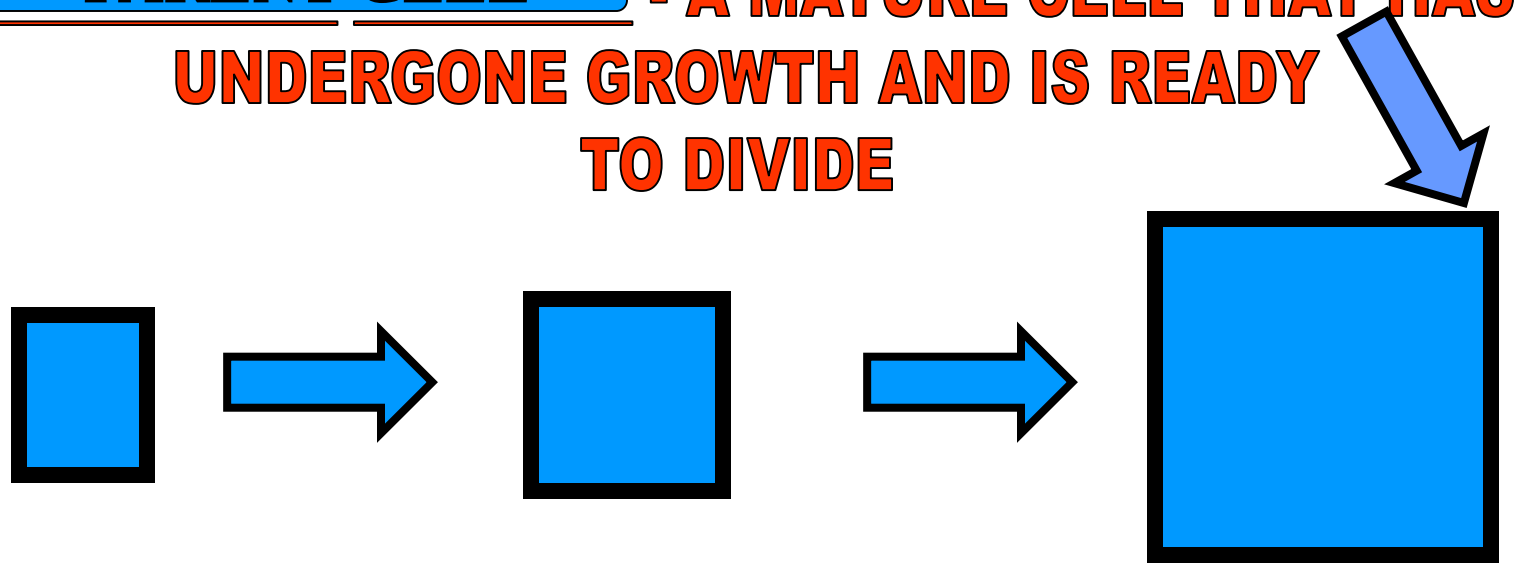
X and X sex chromosomes = female

X and Y sex chromosomes = male

total number of chromosomes = **23 pairs or 46**

GENERAL TYPES OF CELLS:

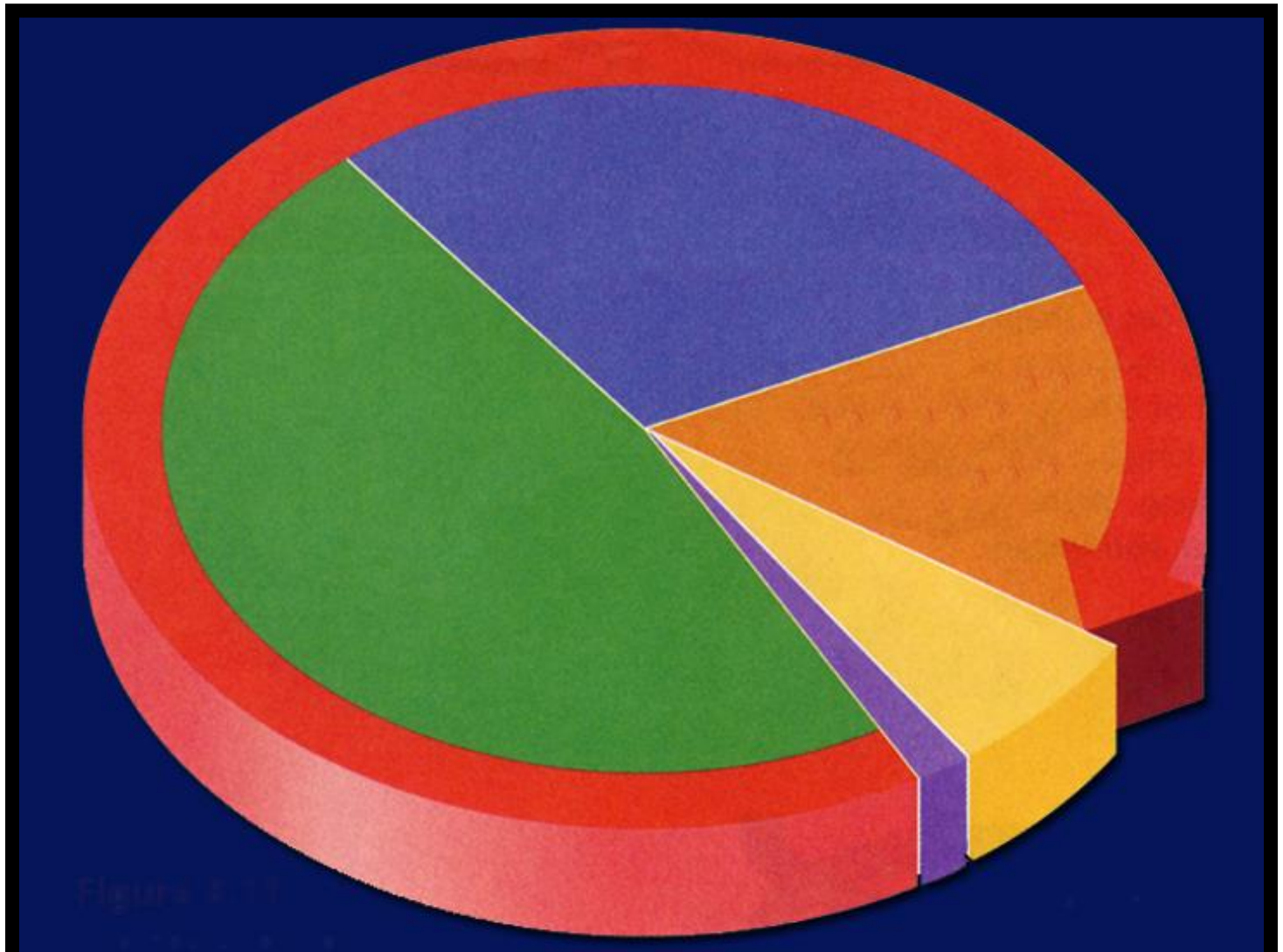
1. **PARENT CELL** - A MATURE CELL THAT HAS UNDERGONE GROWTH AND IS READY TO DIVIDE



PRECEEDED BY **REPLICATION** OF THE DNA SO THAT EACH RESULTING CELL WILL HAVE IDENTICAL GENETIC MATERIALS

Cell Cycle

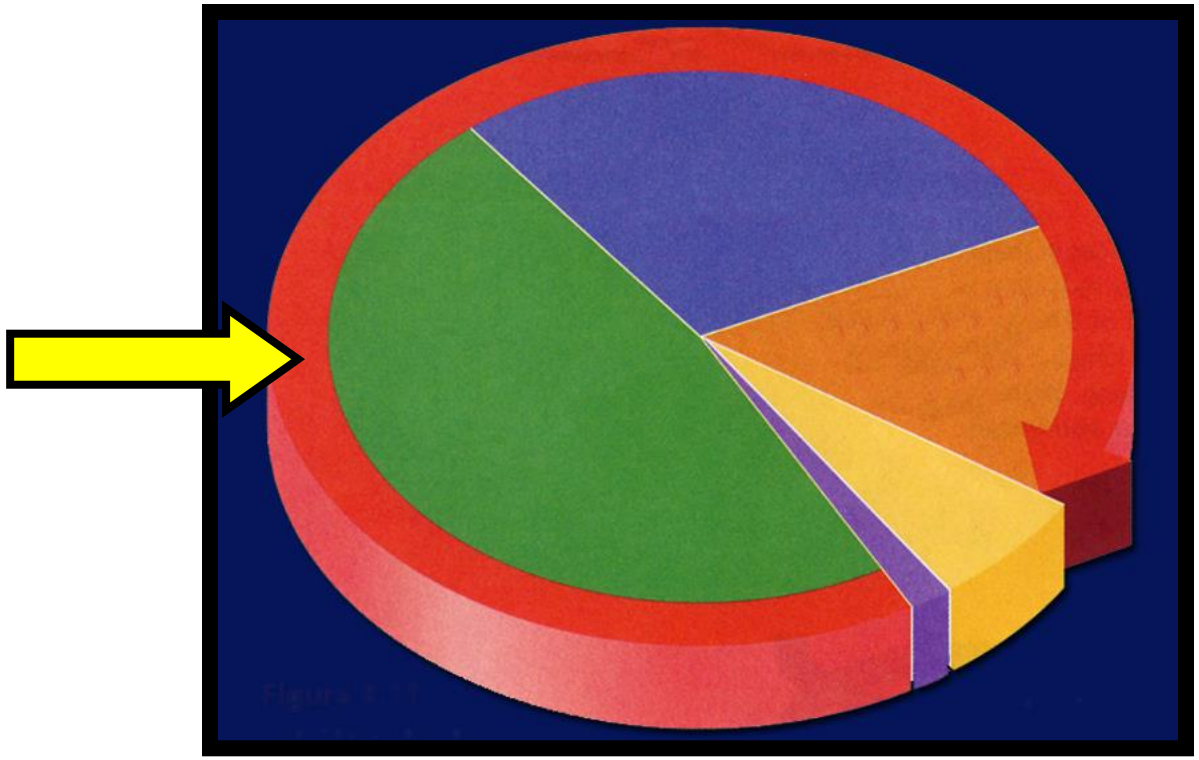
continuous sequence of growth and division of a cell, which is controlled by key enzymes



General periods of the cell cycle:

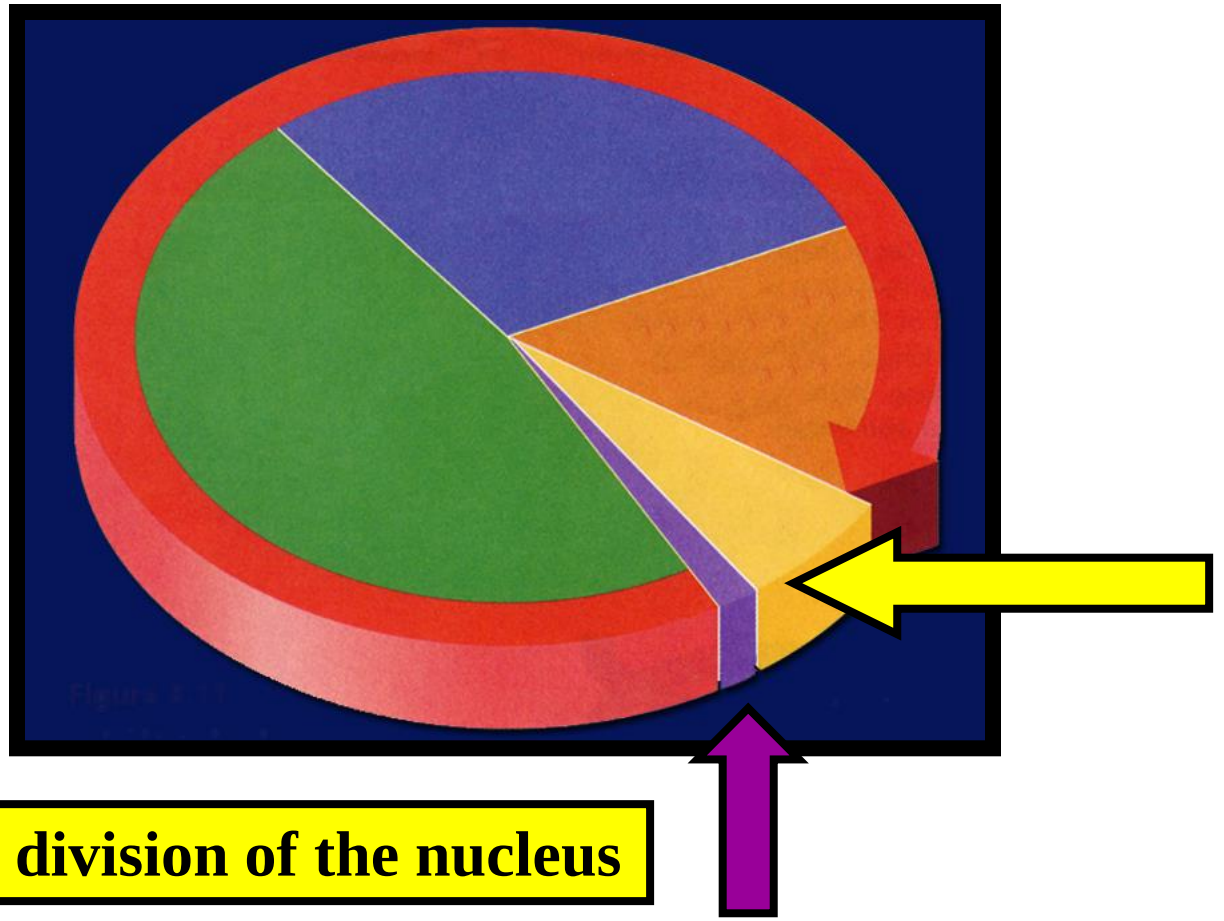
interphase

1. period of growth



mitosis

2. period of division



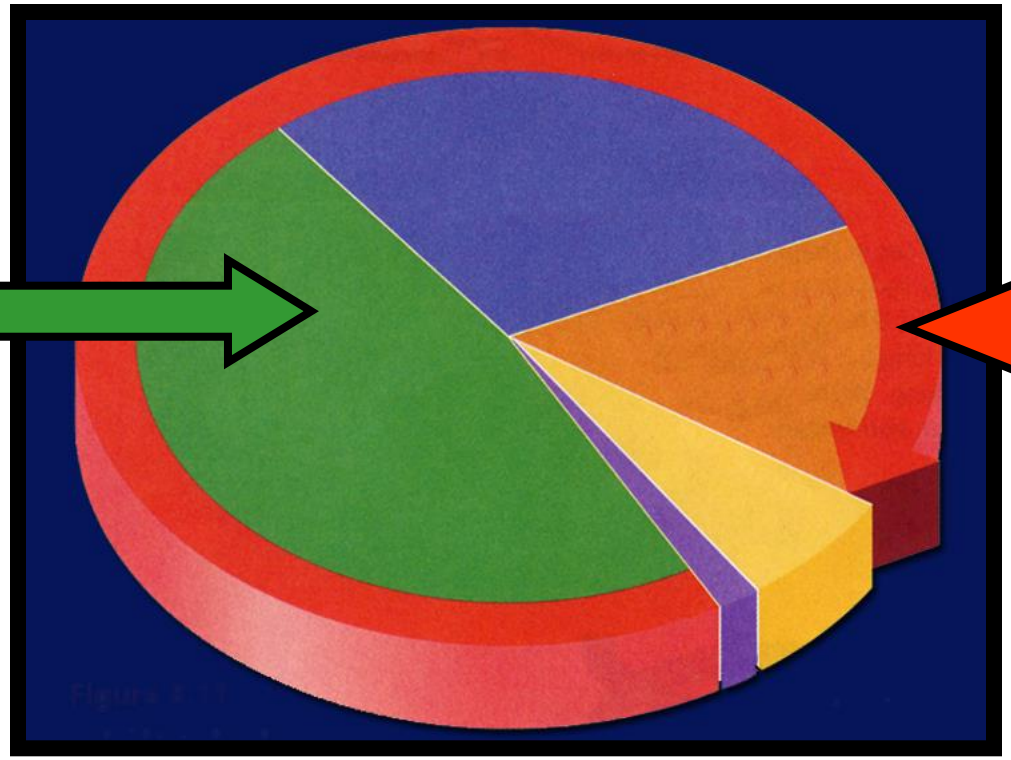
A. mitosis = division of the nucleus

B. cytokinesis = division of the cytoplasm

Characteristics of Interphase:

1. the <u>busiest</u> phase of the cell cycle

2. G$_1$ phase (gap 1 phase) – rapid growth and metabolic activity



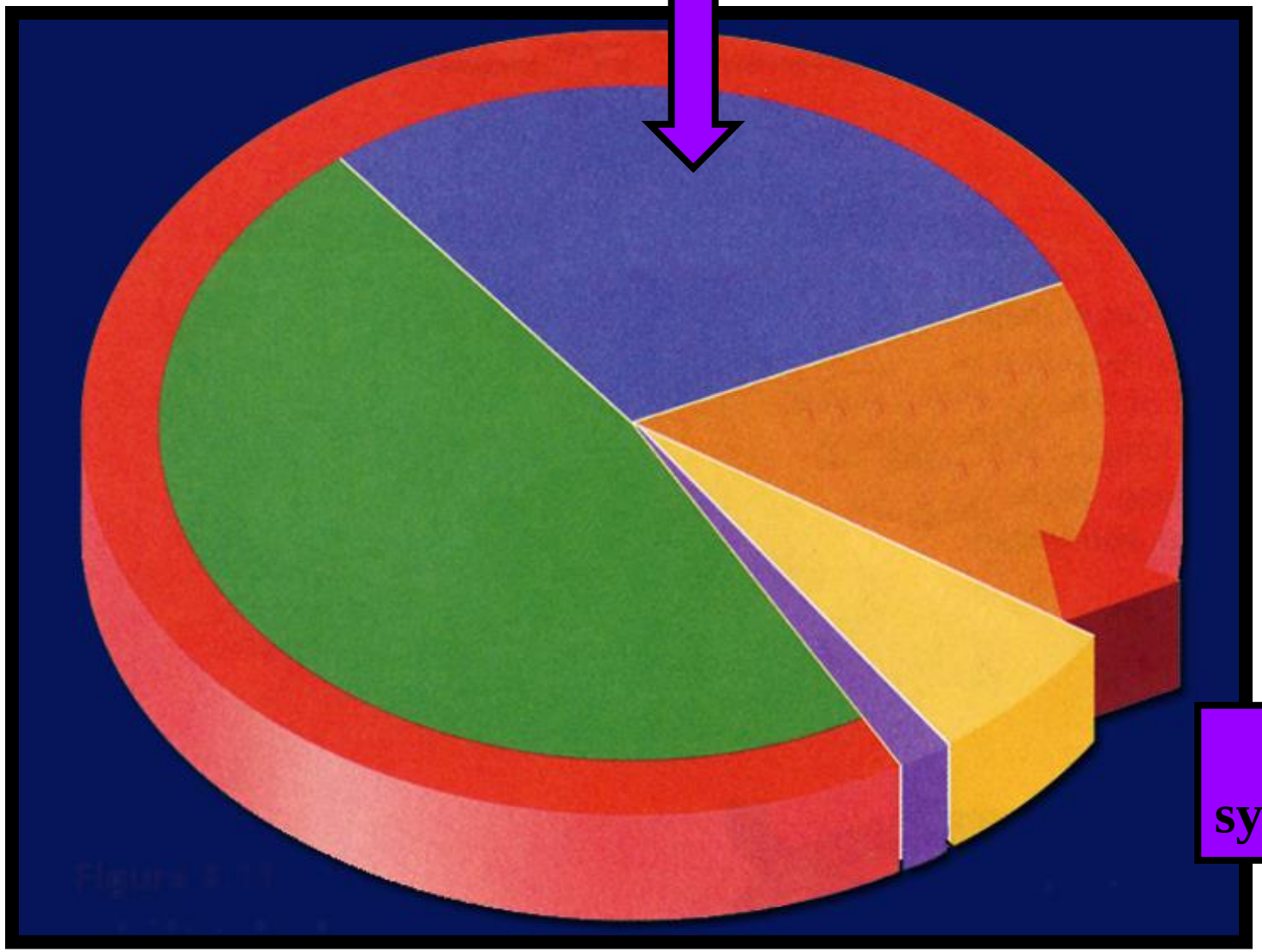
G$_1$ phase

interphase

G = growth

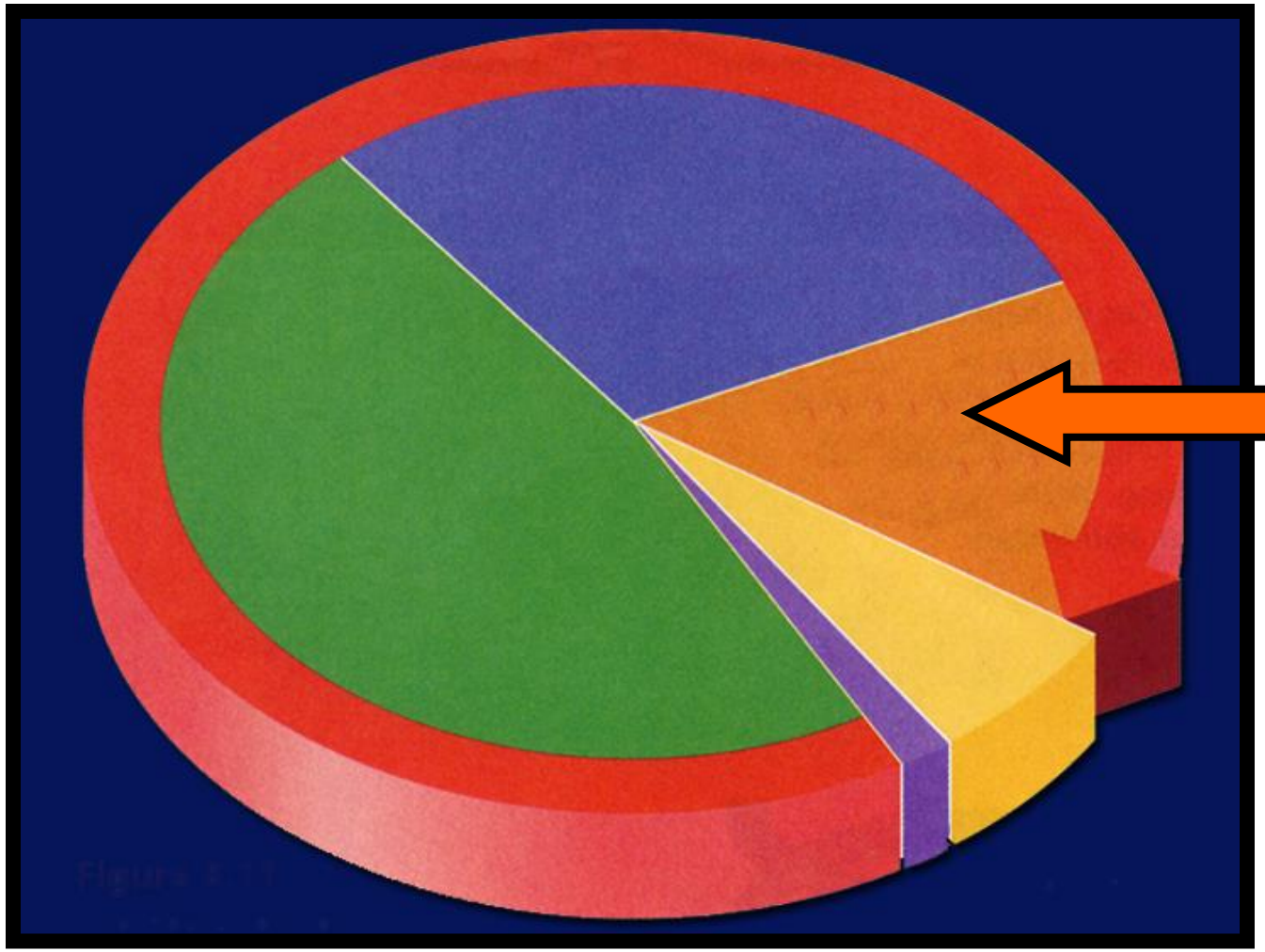
3. S phase (synthesis phase) – DNA synthesis and replication

S phase



S = synthesis

G_2 phase (gap 2 phase) – centrioles replicate; cell prepares for division

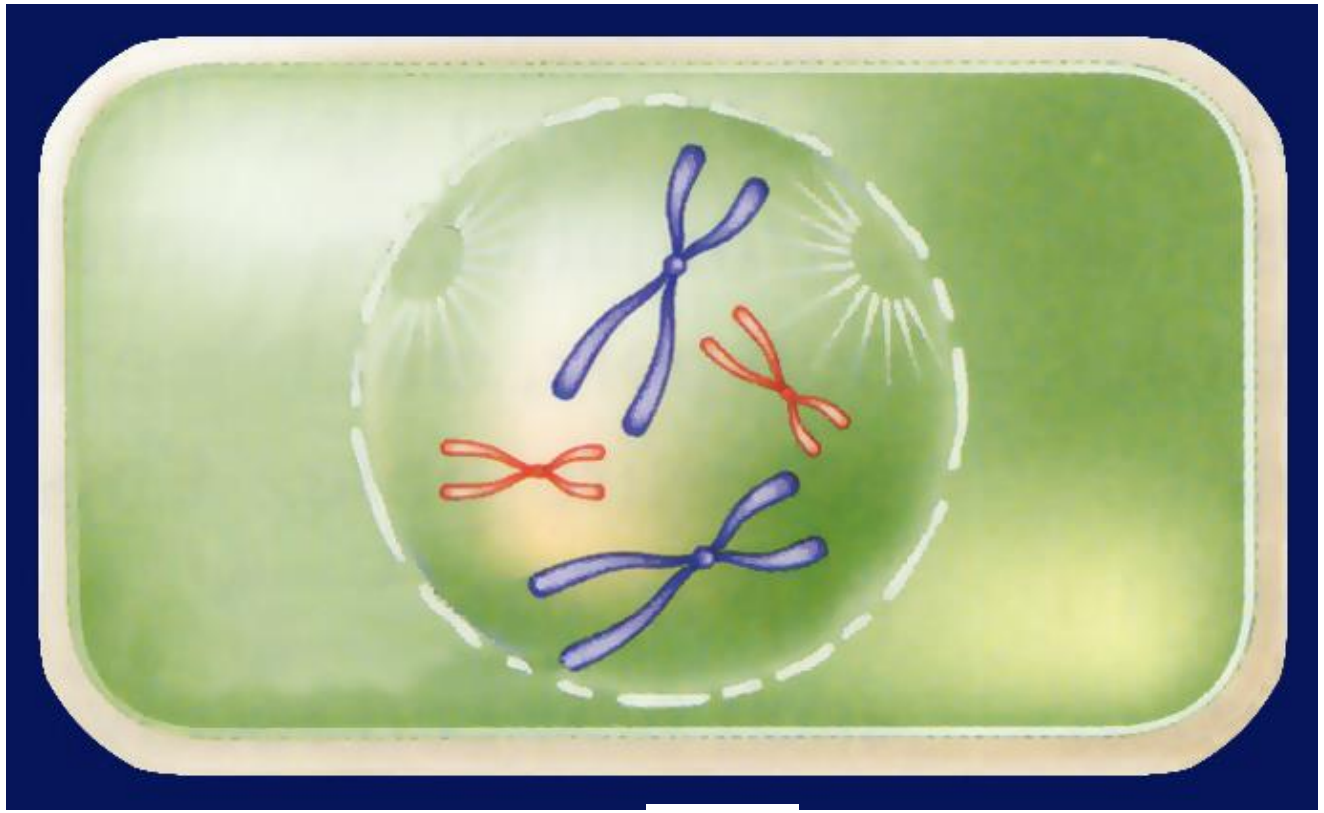


G_2 phase

The phases of mitosis:

A. prophase

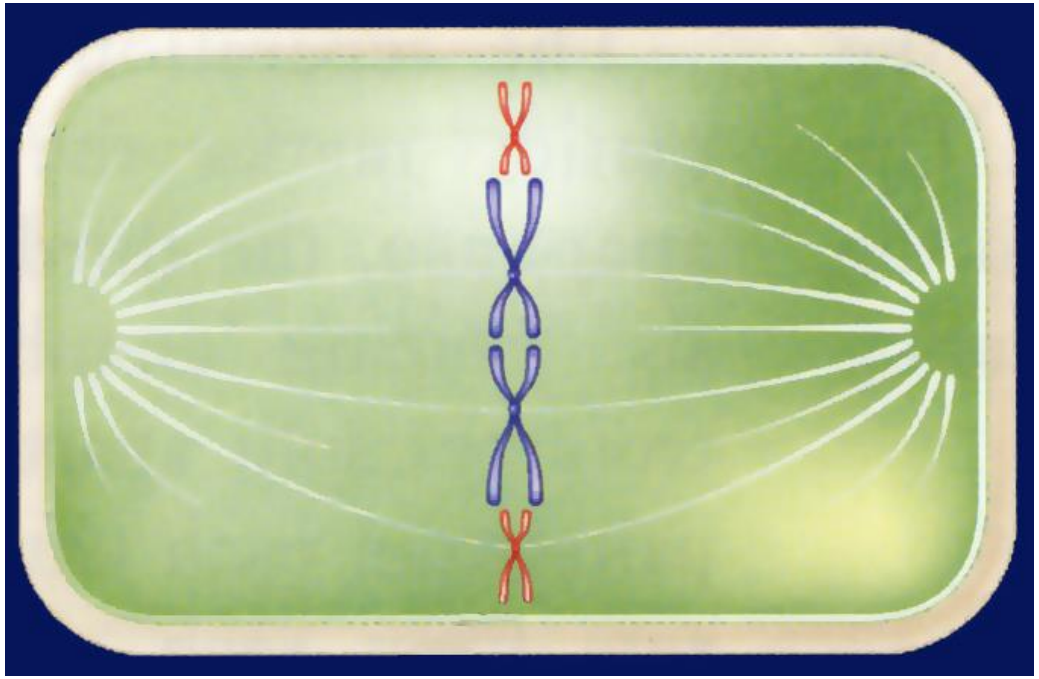
1. first and longest phase of mitosis



pro = " first "

B. metaphase

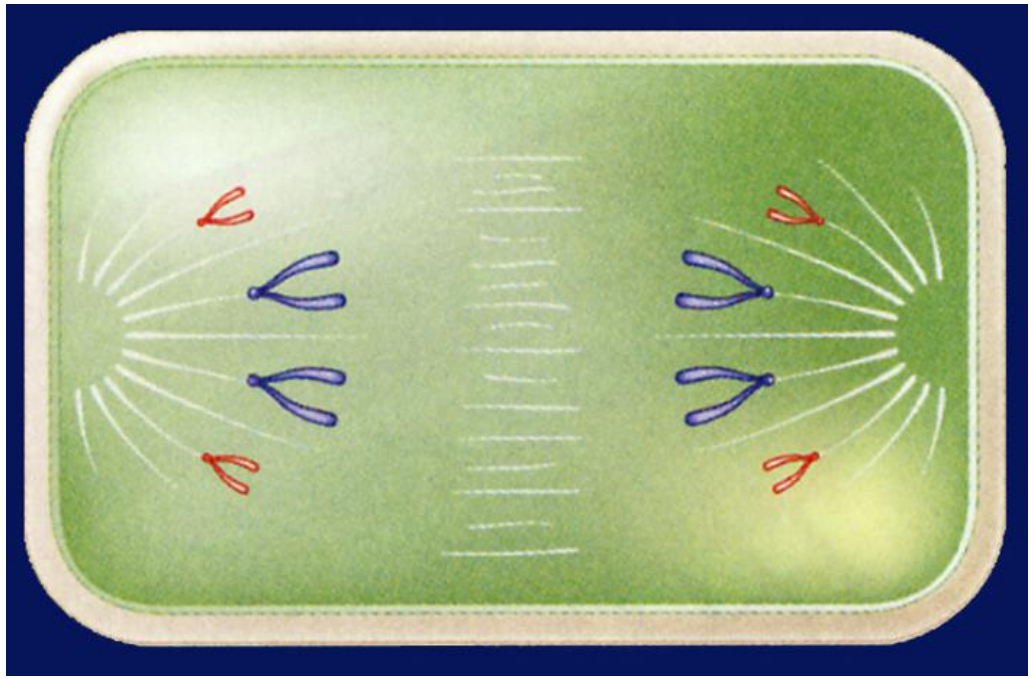
1. the second and shortest phase of mitosis



meta = " middle "

C. anaphase

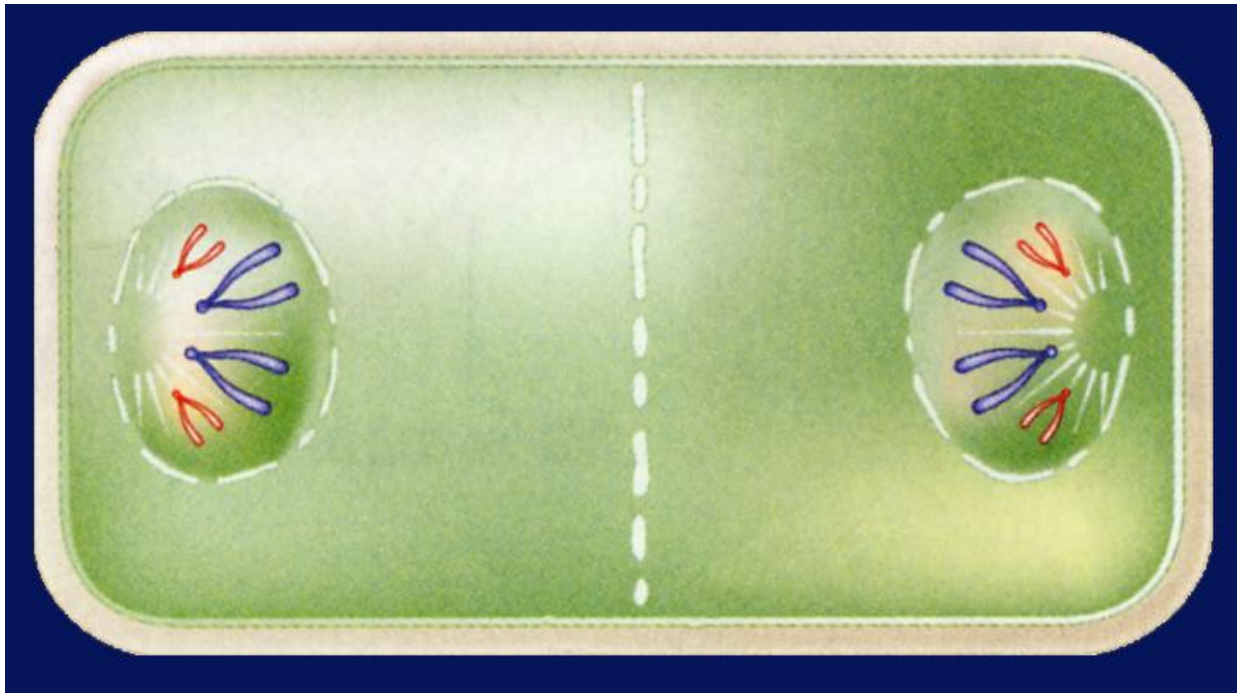
1. the third phase of mitosis in which the separation of sister chromatids occurs



ana = " up "

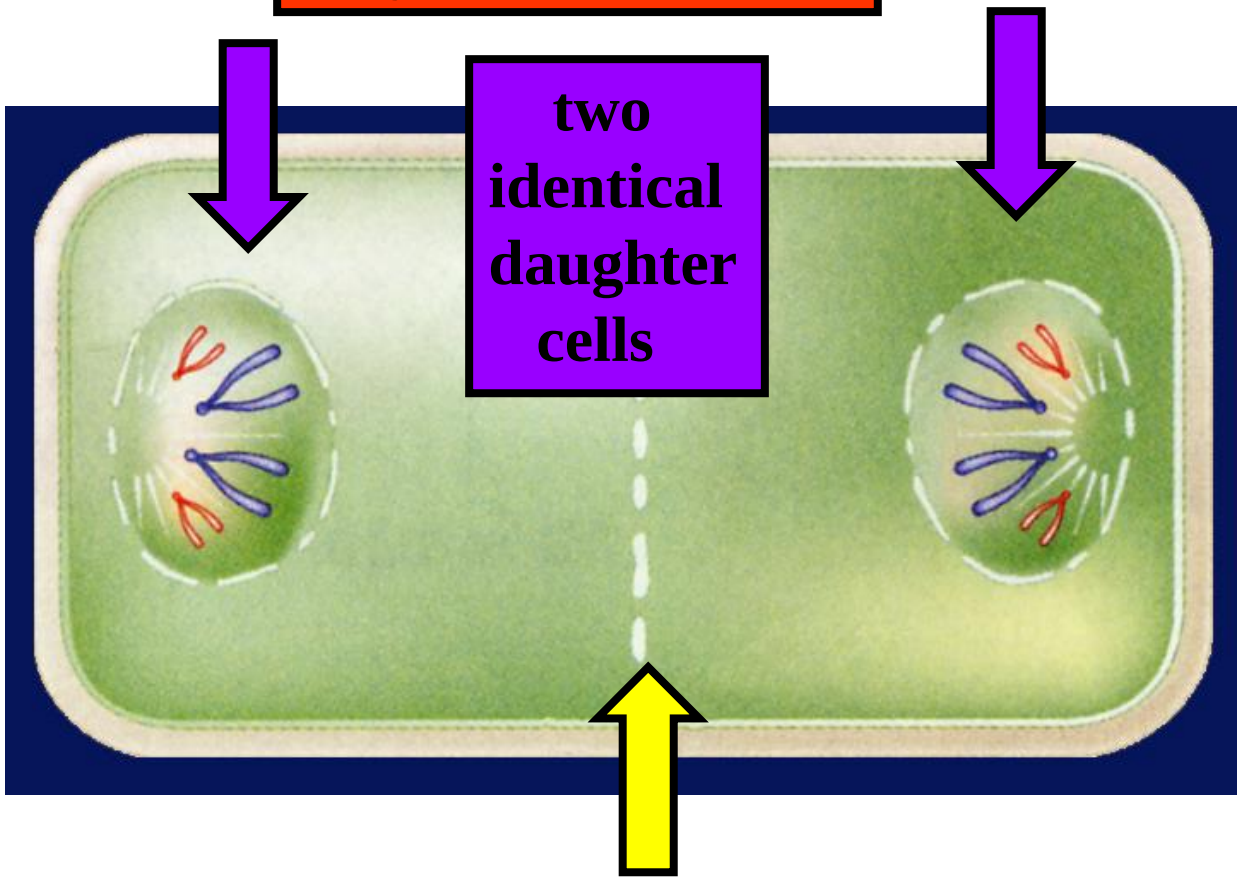
D. telophase

1. the fourth and final phase of mitosis



telo = "_ end _"

7. cytokinesis occurs



8. two daughter cells are formed

Differences between cytokinesis in plant and animal cells:

1. **animal cells – cytokinesis begins during early anaphase when the plasma membrane begins pinching in from the outside to the inside to form the cleavage furrow until the cell divides into two identical daughter cells**

2. **plant cells – vesicles formed by the Golgi apparatus fuse at the equator of the cell forming the cell plate which grows from the inside to the outside until the cell divides into two identical daughter cells; the cell plate forms into the cell wall**

Main phases of mitosis:

karyokinesis

1. division of the nucleus

karyo = " kernel ; nucleus "

kinesis = " motion "

cytokinesis

2. division of the cytoplasm

cyto = " cell "

Results of mitosis:

1. guarantees the continuity of life, resulting in the production of two new cells with chromosome sets that are identical to those of the parent cell

2. unicellular organisms remain as single cells – produces two complete new organisms

3. multicellular organisms result in cell growth and reproduction which provides new tissues, organs, and organ systems

Cancer

a malignant growth resulting from uncontrolled cell division

"a mistake in the cell cycle"

Possible causes of cancer:

1. genetic factors – predisposition in the family; genes inherited

2. environmental factors – smoking; air and water pollution

3. viral infections – that damage the genes

Cancer Prevention:

HEALTHY LIFESTYLE!!!

1. **no cigarette smoking**
2. **low fat diet**
3. **high fiber in diet**

CHAPTER 6: MEIOSIS AND MENDEL

GENE

the segment on a chromosome that controls a particular trait

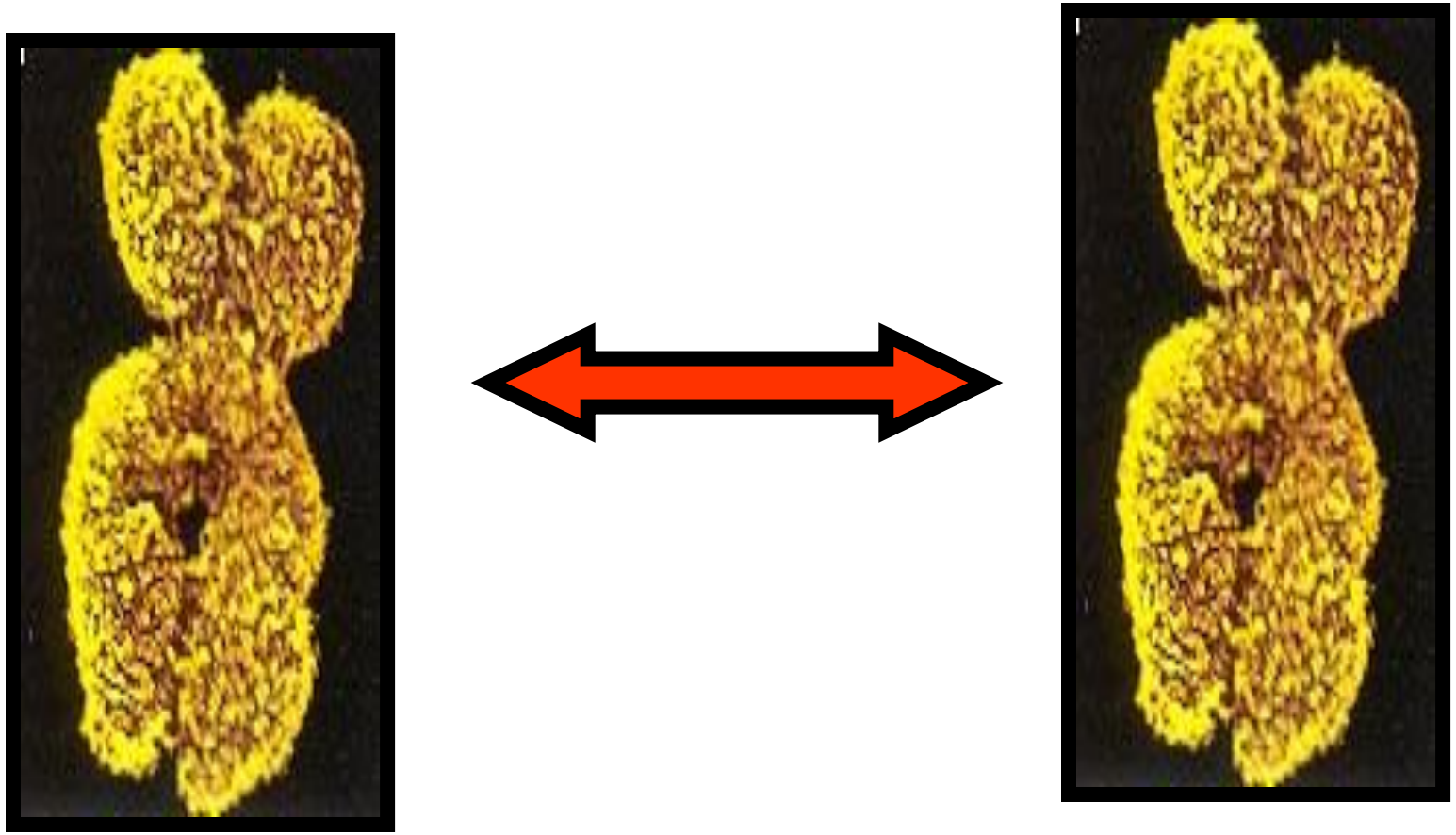
Types of chromosome numbers:

1. diploid (2n) - a cell with two of each kind of chromosome

2. haploid - (1n) - a cell containing one of each kind of chromosome

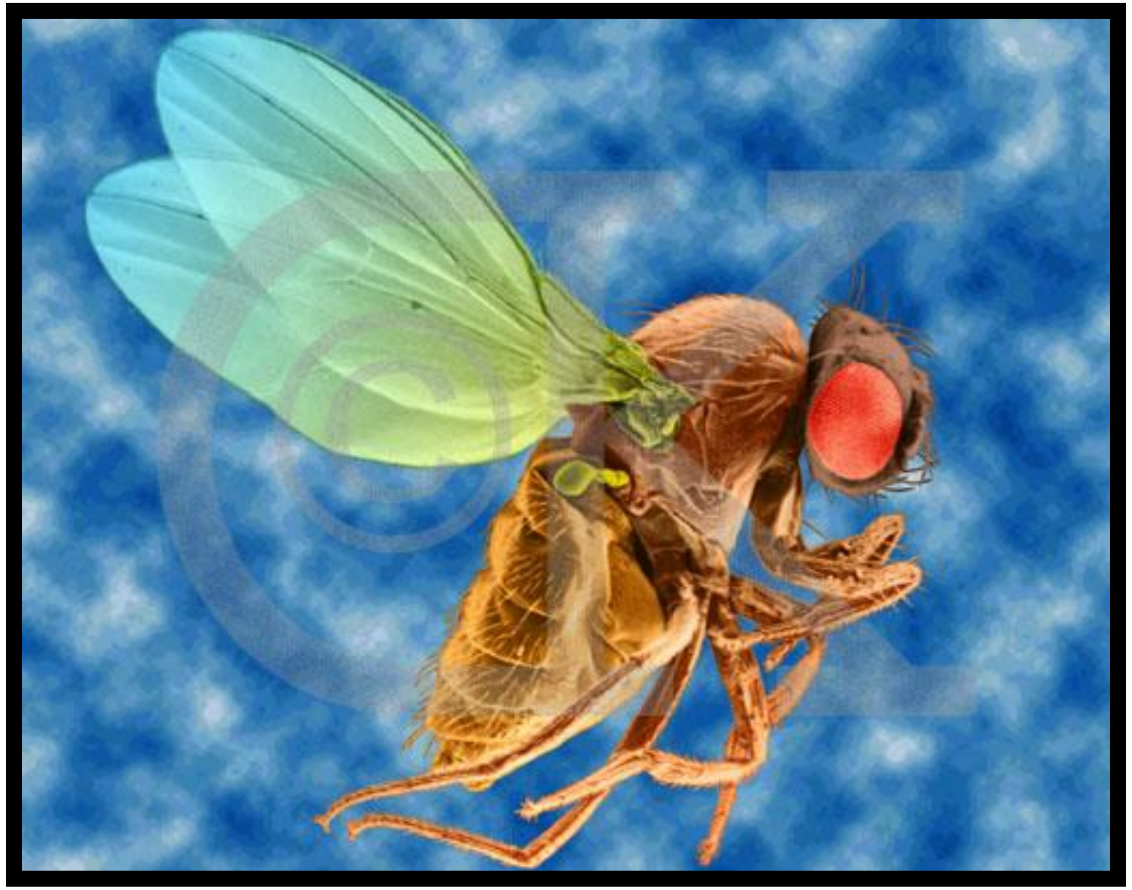
homologous chromosomes

the two chromosomes of each pair in a diploid cell



Examples of chromosome numbers:

Example:	Diploid #:	Haploid #:
1. fruit fly	**8**	**4**



9. Adder's tongue fern 1260 630

Relationship between the number of chromosomes and the complexity of an organism:

there is no relationship

meiosis

"reduction division"

the process of nuclear division that reduces the number of chromosomes from the diploid number to the haploid number

occurs only in the gametes

(egg and sperm cells)

Phases of meiosis:

1. meiosis I - first division in which the homologous chromosomes are separated into separate cells

2. meiosis II- second division in which the chromatids of each chromosome are segregated into separate cells, resulting in daughter cells with one-half the number of chromosomes of the parent cell

results in four haploid daughter cells which develop into egg and sperm cells

fertilization

the process that restores the diploid number from the haploid egg and sperm cells (zygote)

Events of meiosis I:

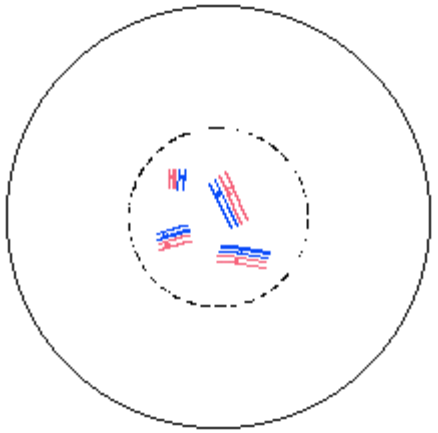
1. Prophase I

A. the DNA of the chromosomes coils up and a spindle forms

B. as the DNA coils, homologous chromosomes line up with each other, gene by gene, along their length, to form a four part structure called a tetrad

(each tetrad consists of two homologous chromosomes, each made up of two sister chromatids)

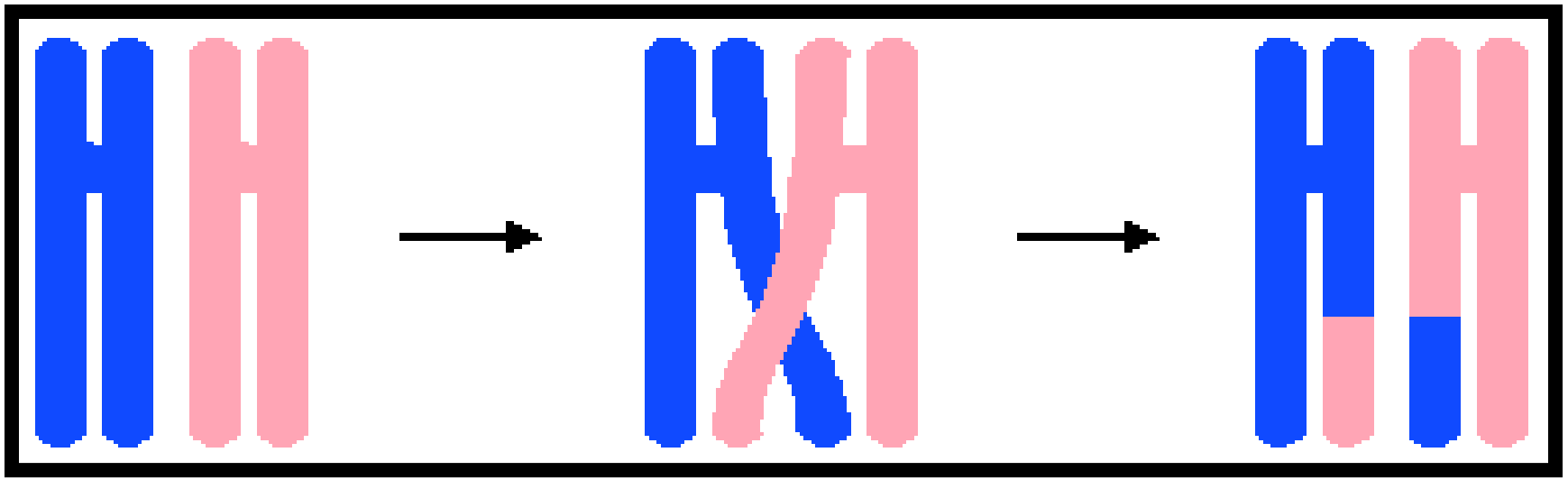
tetra = " four"



Homologous chromosomes become paired.
Crossing-over occurs between homologous chromosomes.

C. Crossing - over may occur between the tightly paired chromatids of the tetrad

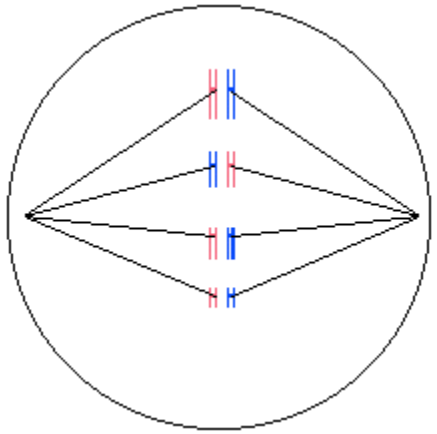
crossing - over



Human crossing over averages 3 to 4 crossovers for each pair of homologous chromosomes.

2. Metaphase I:

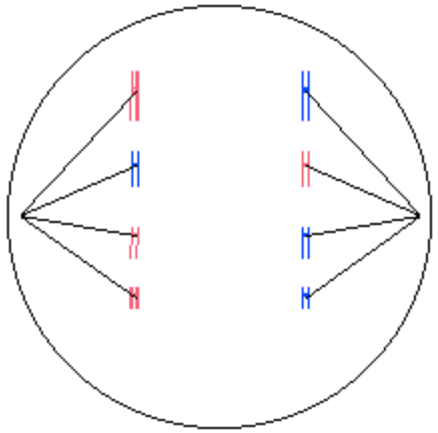
A. the centromere of each chromosome becomes attached to a spindle fiber



Homologous pairs become aligned in the center of the cell.

3. Anaphase I:

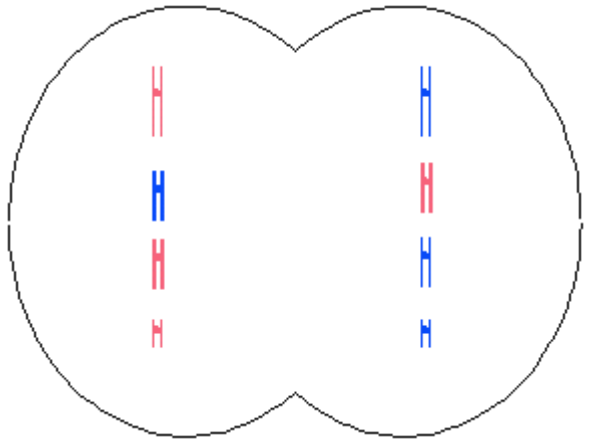
A. homologous chromosomes, each with two chromatids separate and move to opposite poles of the cell



Homologous chromosomes separate

4. Telophase I:

A. the spindle breaks down, the chromosomes uncoil, and the cytoplasm divides into two new cells



This stage is absent in some species

B. each cell has half the genetic information of the original cell because it has only one chromosome from each homologous pair

Interkinesis

Interkinesis is similar to interphase except DNA synthesis does not occur.

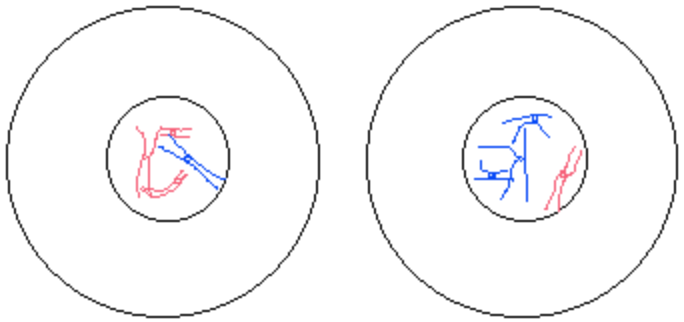
Events of meiosis II:

The newly formed cells in some organisms undergo a short resting stage (interkinesis); in other organisms, the cells go from late anaphase of meiosis I directly to meiosis II.

The second division in meiosis is simply a mitotic division of the products of meiosis I.

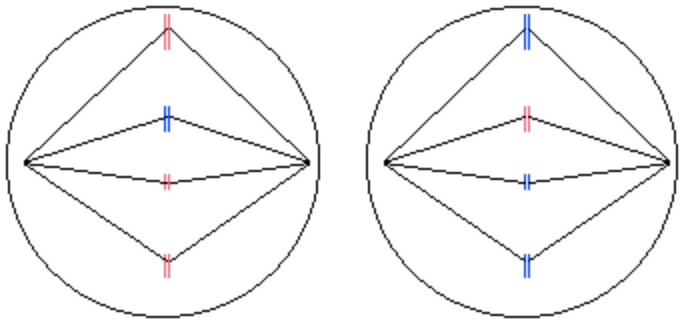
1. Prophase II:

A. a spindle forms in each of the two new cells and the spindle fibers attach to the chromosomes



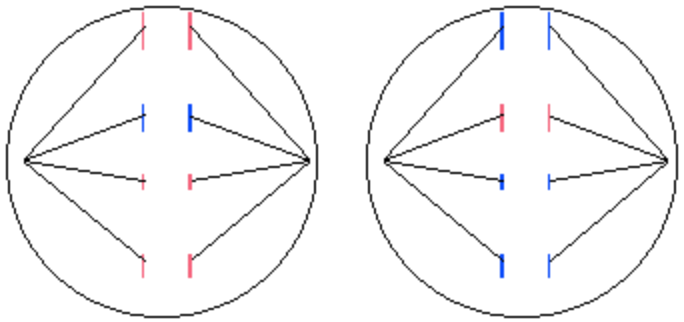
2. Metaphase II:

A. the chromosomes, still composed of sister chromatids, are pulled to the equator of the cell and line up randomly at the equator



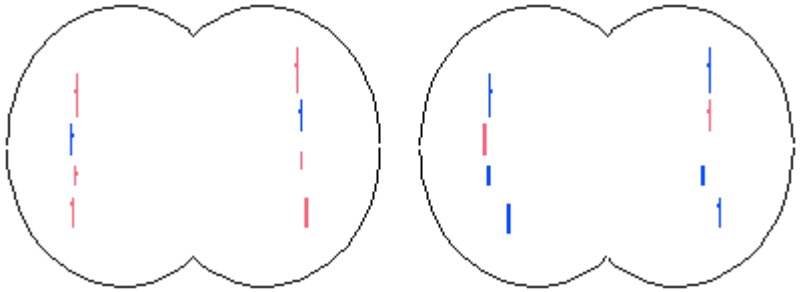
3. Anaphase II:

A. the centromeres of each chromosome splits, allowing the sister chromatids to separate and move to opposite poles

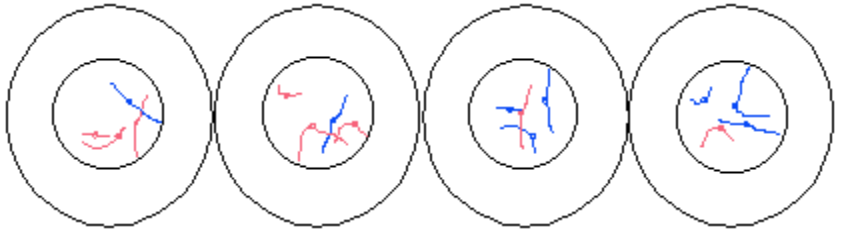


4. Telophase II:

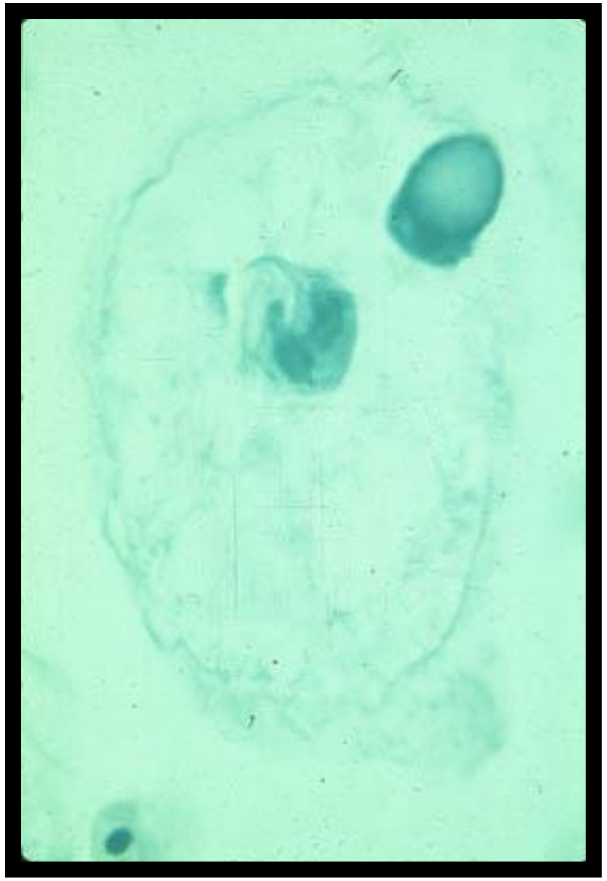
A. nuclei reform, the spindles break down, and the cytoplasm divides



B. at the end of meiosis II, four haploid cells have been formed from one diploid cell



Each cell develops into a gamete.



Sperm cell entering an egg cell.

Results of mitosis:

produces identical daughter cells to the parent cell

Results of meiosis:

because of crossing over, it results in haploid daughter cells with variations

GENETICS

the branch of biology that studies heredity

genes = " born "

HEREDITY

the passing on of characteristics from parents to offspring

PURE

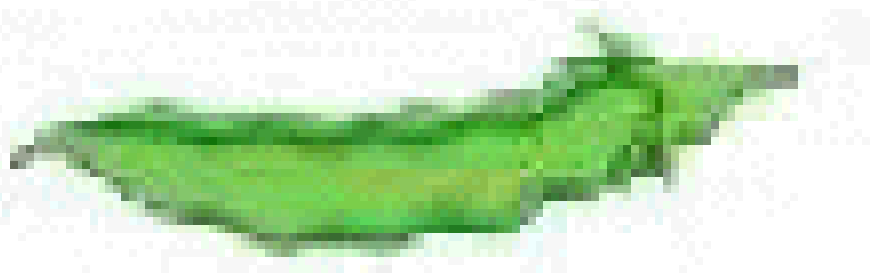
trait that always produces offspring with the same trait as its parent

(true breeding)

(homozygous)

HYBRID

offspring of parents that have different forms of a trait



(heterozygous)

POLLINATION

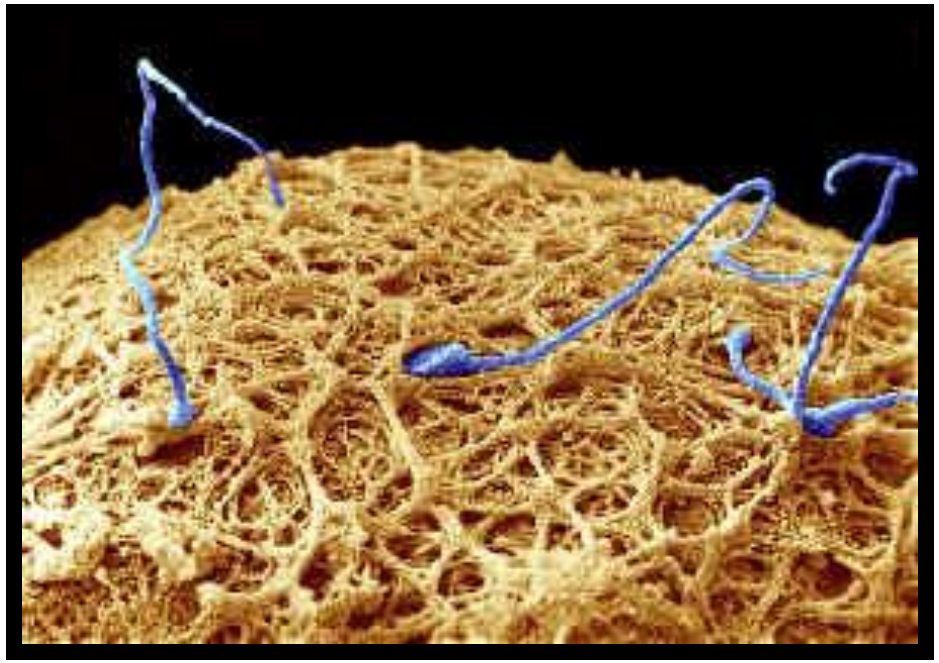
the transfer of pollen from the anthers of the male part of the plant to the stigma of the female part of the plant

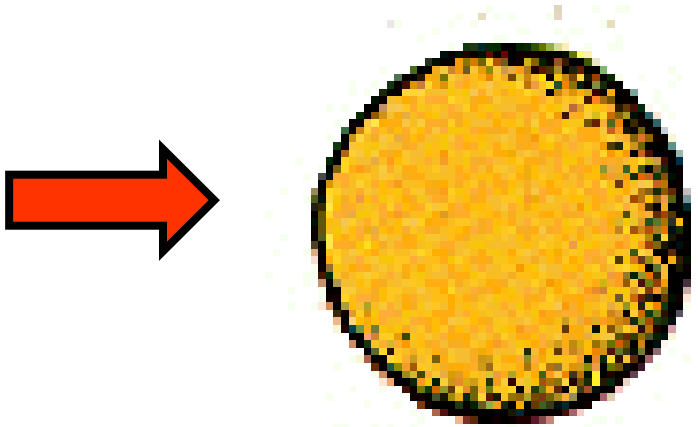
process in which the male gamete unites with the female gamete

(equivalent to fertilization in animals)

ZYGOTE

fertilized egg cell
which then developes
into a seed





flower

reproductive structure in plants; both male and female reproductive organs are located in the same flower

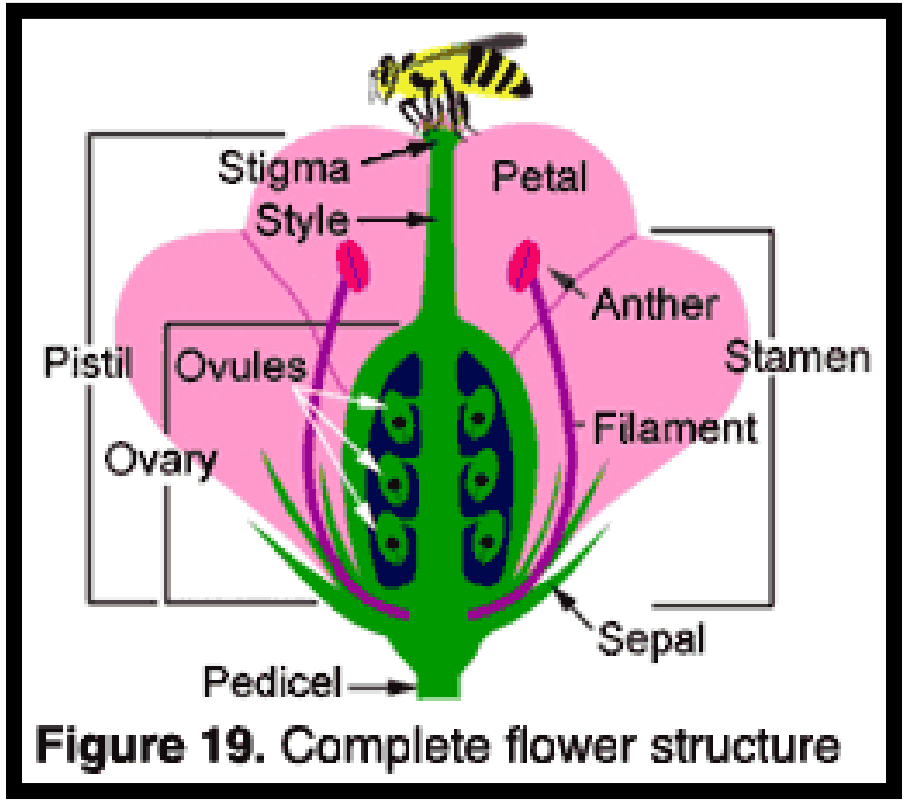
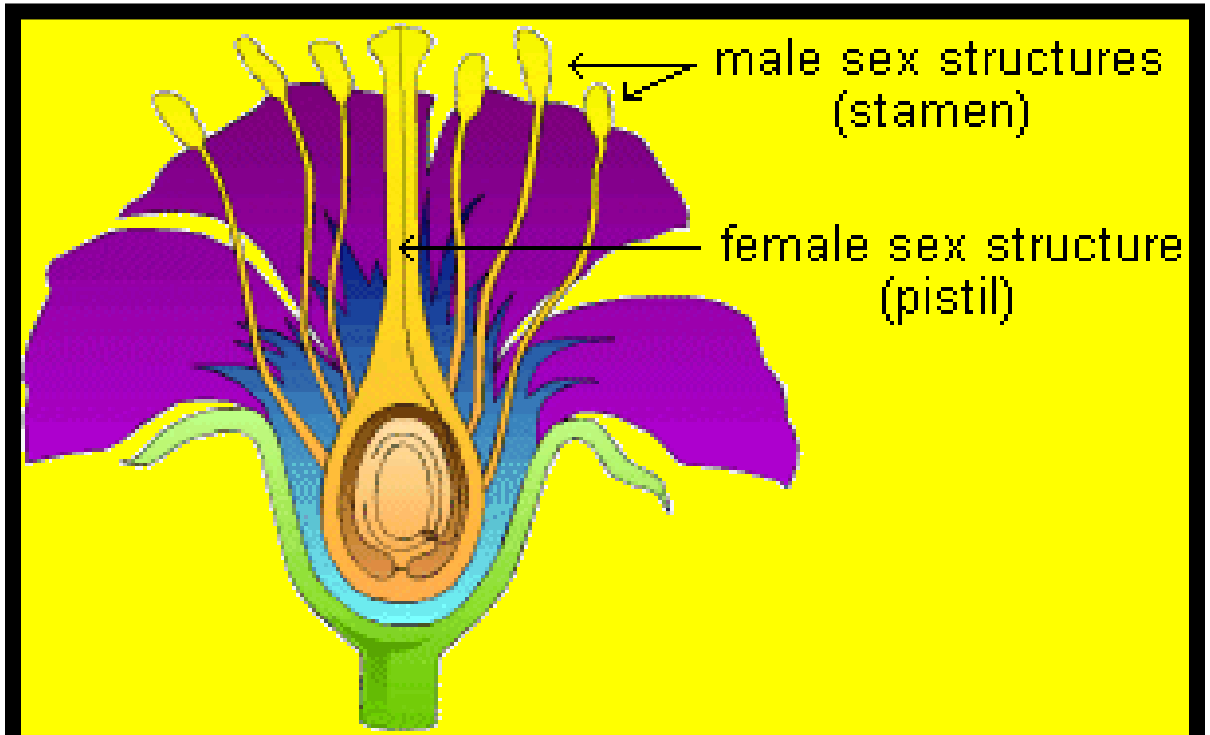


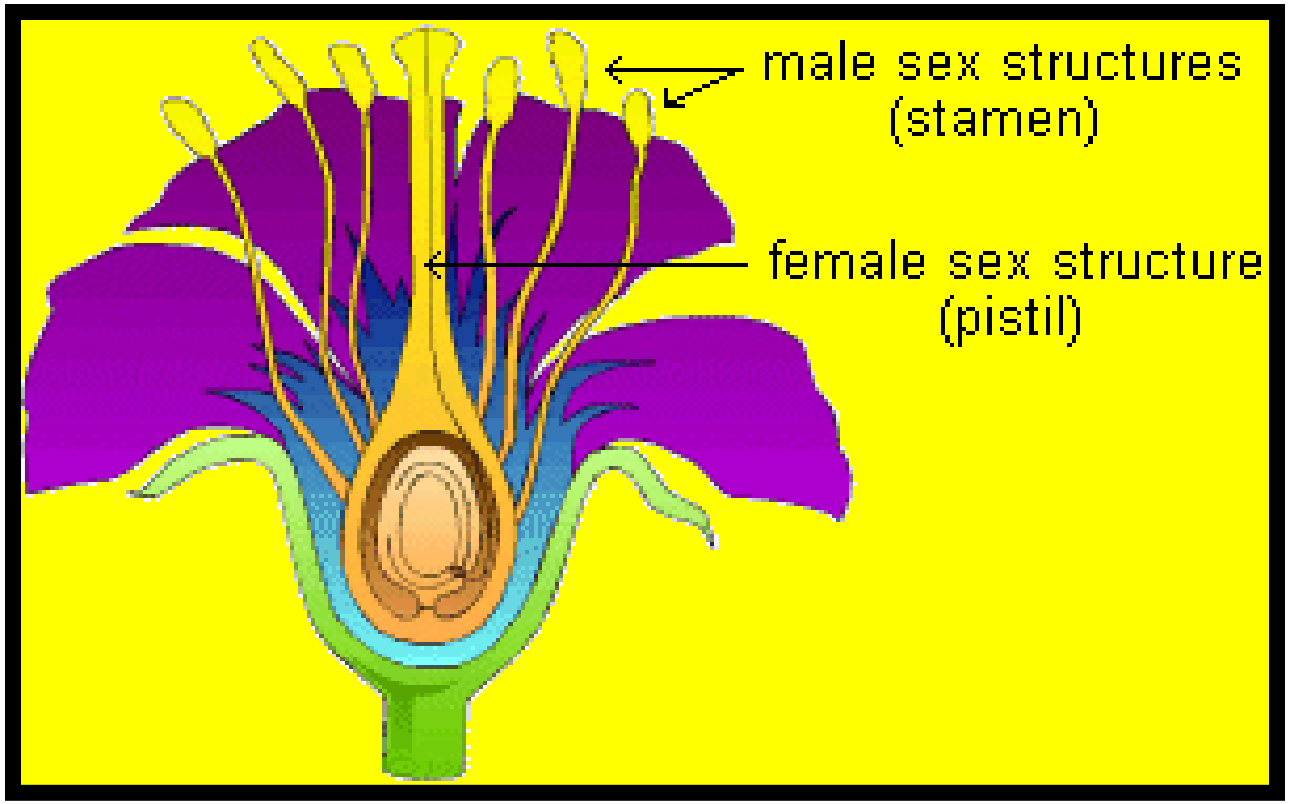
Figure 19. Complete flower structure

TYPES OF POLLINATION IN PLANTS:

1. self-pollination .

a reproductive process in which fertilization occurs within a single plant



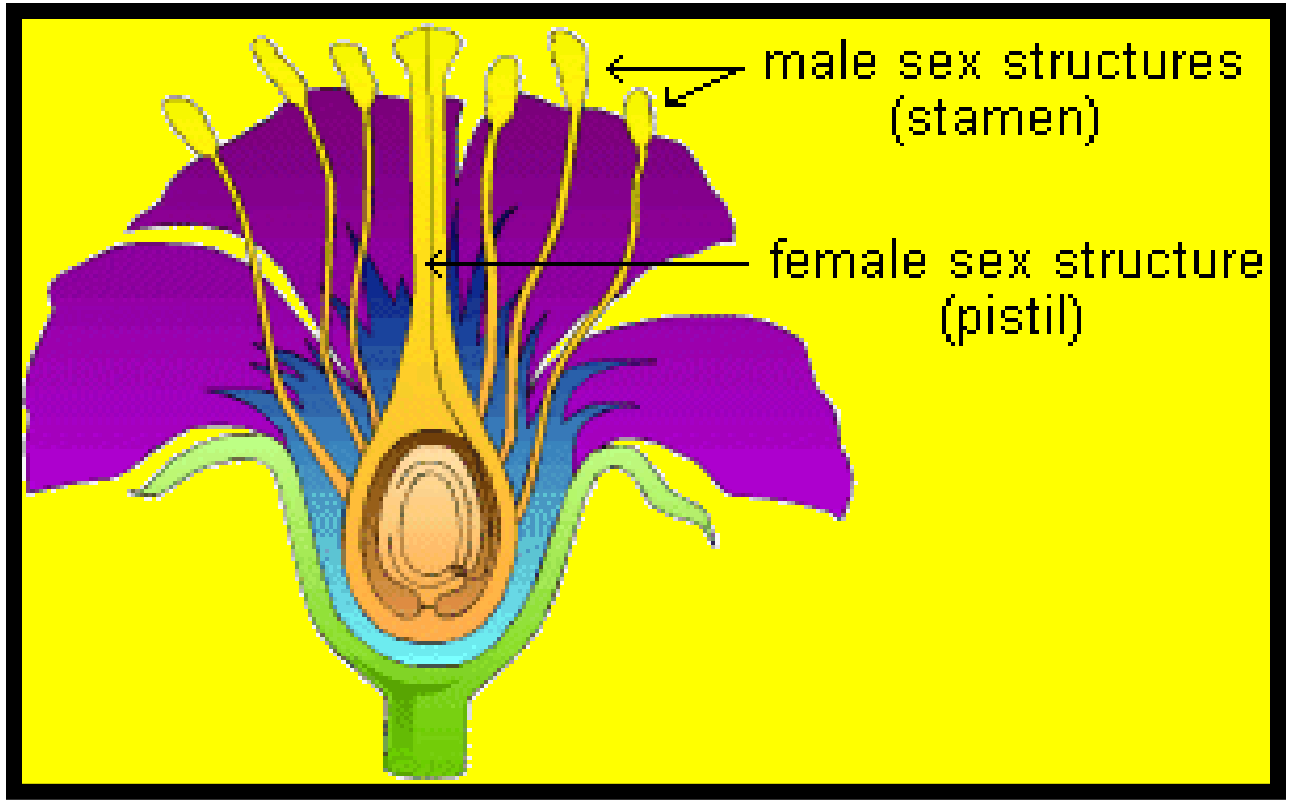


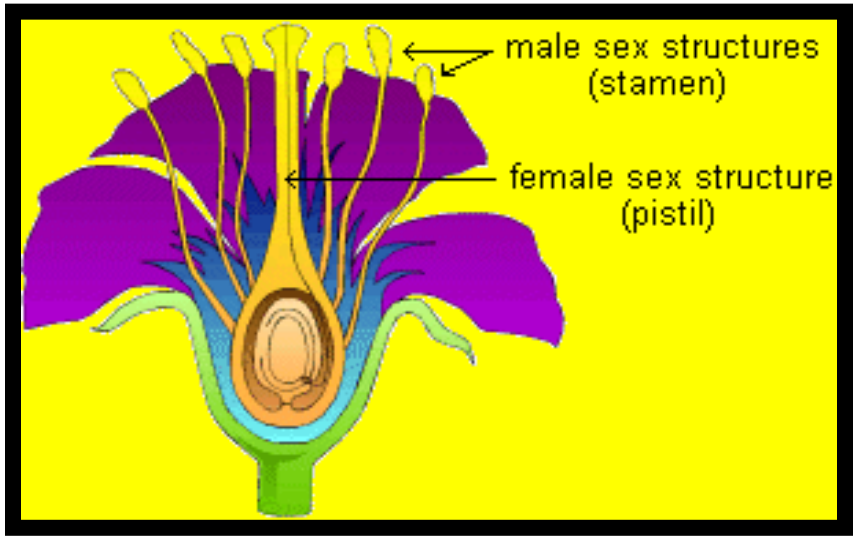
A. anthers (stamen) .

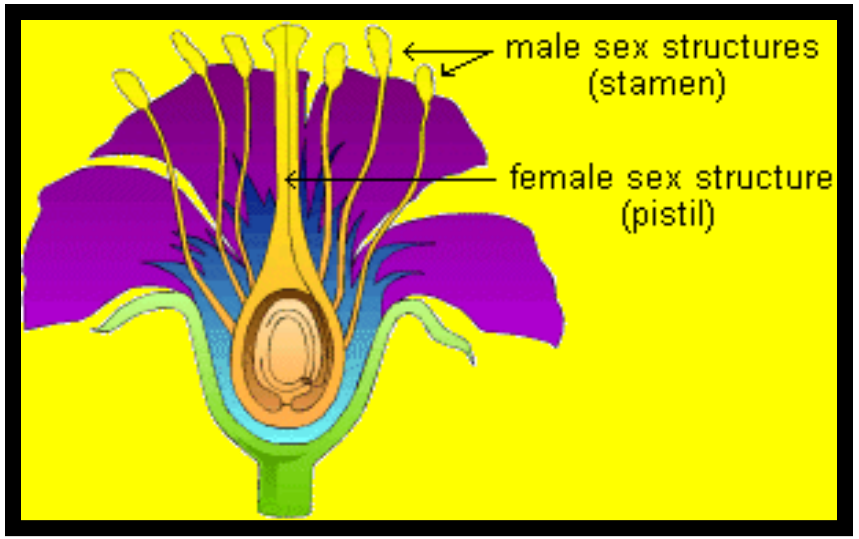
produce pollen grains that contain sperm

B. ovules (stigma tips) -

located in the ovary and produce eggs







2. cross - pollination -

the transfer of pollen from the anthers of one plant pure for one trait to the stigma of another plant pure for the contrasting trait

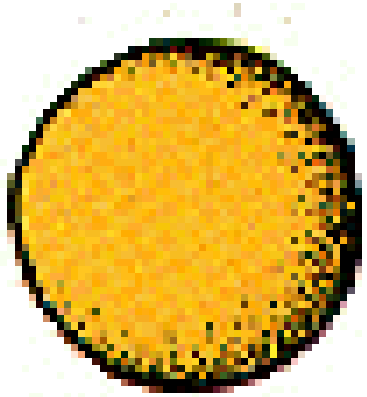
GENERATIONS OF CROSSES:

1. P
1 - the parental generation
or the original cross
P = parent

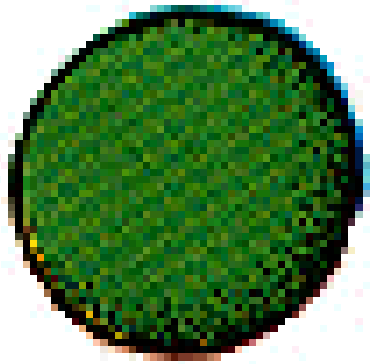
2. F_1 - first filial generation;
the offspring resulting from a cross between the parental generation

3. F_2 - second filial generation;
the offspring resulting from a cross between the first filial generation

F = FILIAL



TYPES OF TRAITS:



1. **dominant trait** .

the trait that appeared in the F 1 generation;

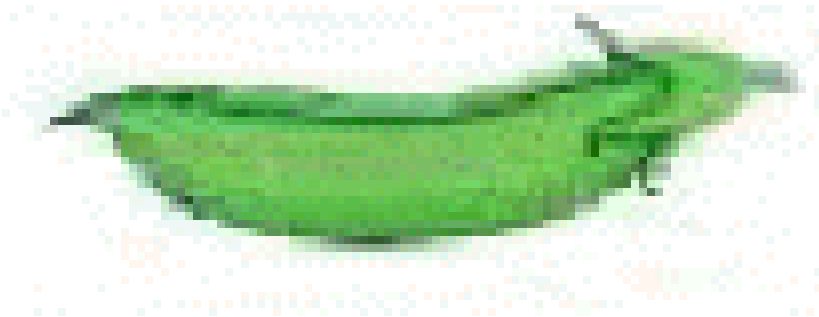
trait that always shows up;

represented by a capital letter

2. recessive trait .

the trait that appeared to be lost in the F 1 generation but that showed back up in the F 2 generation

the trait that may be masked or covered up by the dominant trait;



represented by a small letter in genetics

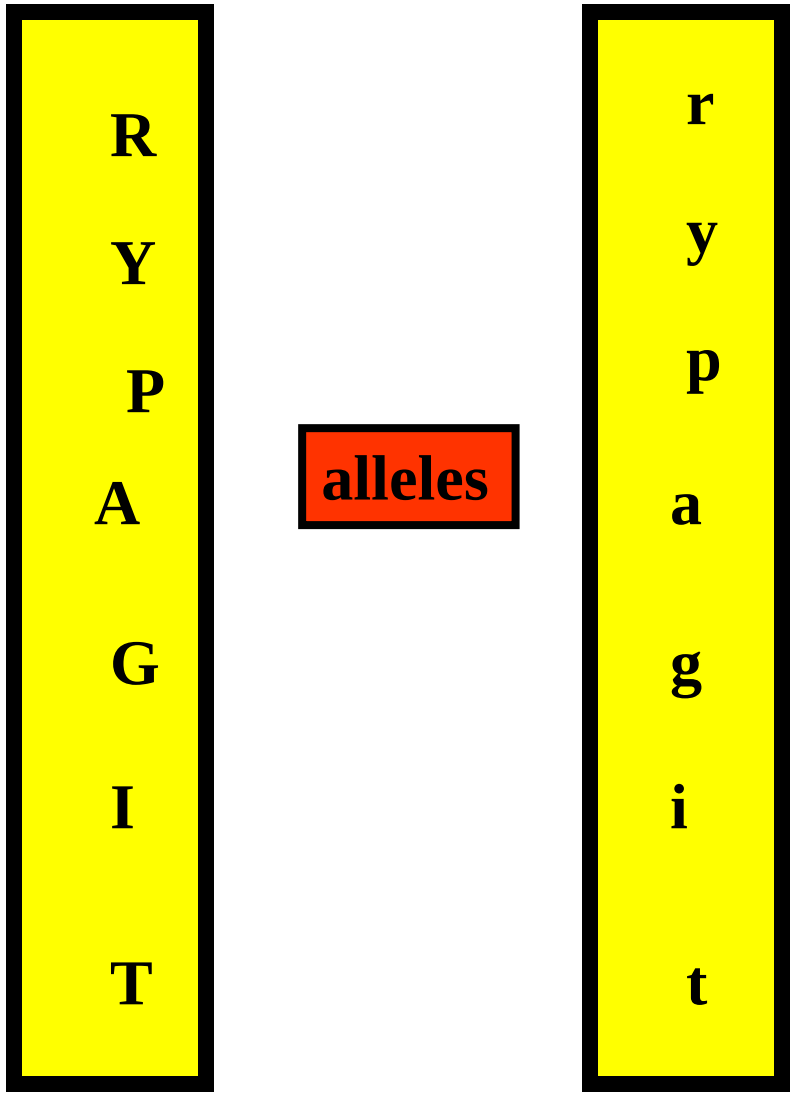
RULE OF UNIT FACTORS

states that each trait is governed
by two genes (alleles) located
on chromosomes

ALLELES

alternating forms for a gene for
each variation of a trait of an
organism

allelon = "of each other"



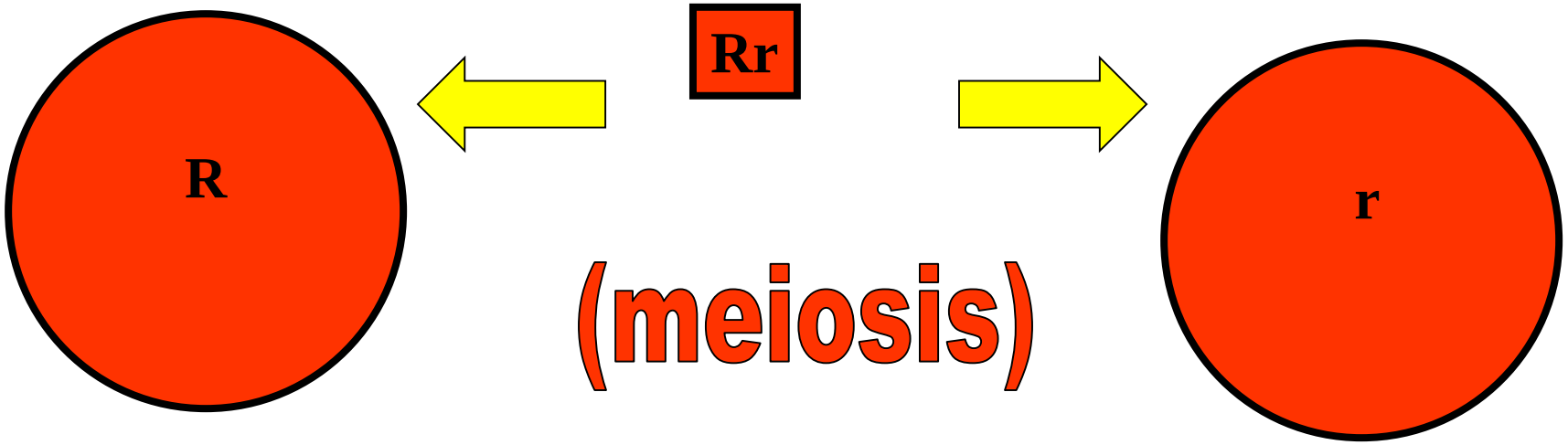
MENDEL'S LAWS OF GENETICS:

1. Law of dominance and recessiveness -

states that one factor in a pair may mask
the other factor or prevent it
from showing up
(dominant trait); the other factor
in a pair may be masked or
prevented from showing up
(recessive trait

2. Law of Segregation

states that every individual has two alleles for each gene and when gametes are produced, each gamete receives one of these alleles

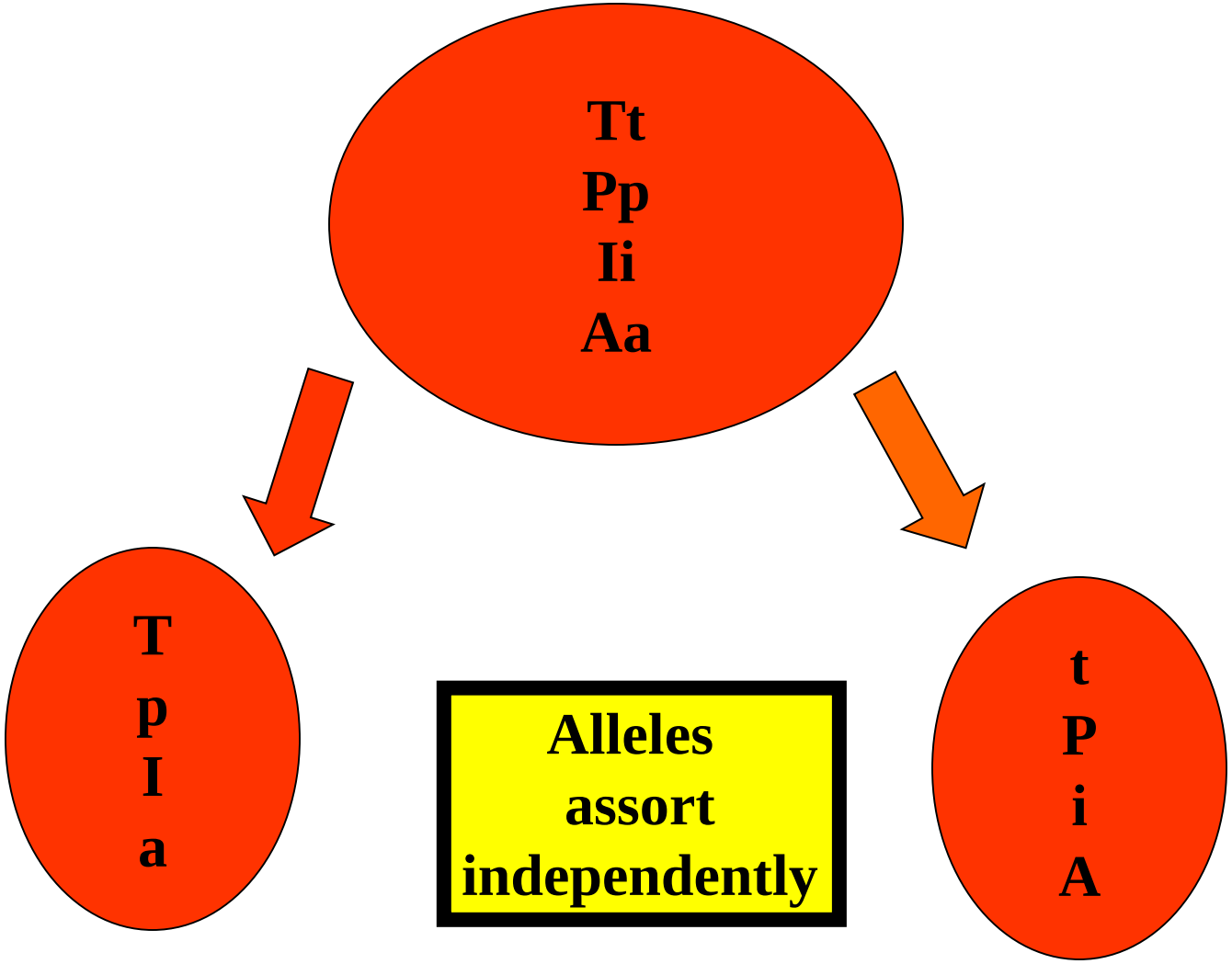


Law of Independent Assortment

states that genes for different traits
are inherited independently of each other

Mendel's factors =

"genes or alleles"


Tt
Pp
Ii
Aa
T
p
I
a
Alleles
assort
independently
t
P
i
A

TYPES OF GENETIC MAKEUPS IN ORGANISMS:

1. **genotype** - the actual genetic makeup of an organism; uses **letters** to represent traits

genea = "breed; kind"

KEY:

T = TALL
t = SHORT

POSSIBLE GENOTYPES:

1. TT
2. Tt
3. tt

2. phenotype - the external appearance of the organism

pheno = "visible"

KEY:

T = TALL

t = SHORT

POSSIBLE PHENOTYPES:

1. TT = tall

2. Tt = tall

3. tt = short

TYPES OF ALLELE PAIRS:

1. **homozygous** - when both alleles of a pair are the same (pure)

homo = "same"

KEY:

T = TALL
t = SHORT

POSSIBLE GENOTYPES AND PHENOTYPES:

1. TT = homozygous tall

2. tt = homozygous short

2. **heterozygous** - when both alleles of a pair are different (hybrid)

hetero = "different"

KEY:

T = TALL

t = SHORT

POSSIBLE GENOTYPES AND PHENOTYPES:

1. Tt = heterozygous tall

TYPES OF GENETIC CROSSES:

1. monohybrid cross - cross between individuals that involves one pair of contrasting traits; results in four offspring

mono = "one"

2. **dihybrid cross** - cross between two individuals that involves two pairs of contrasting traits;
results in sixteen offspring

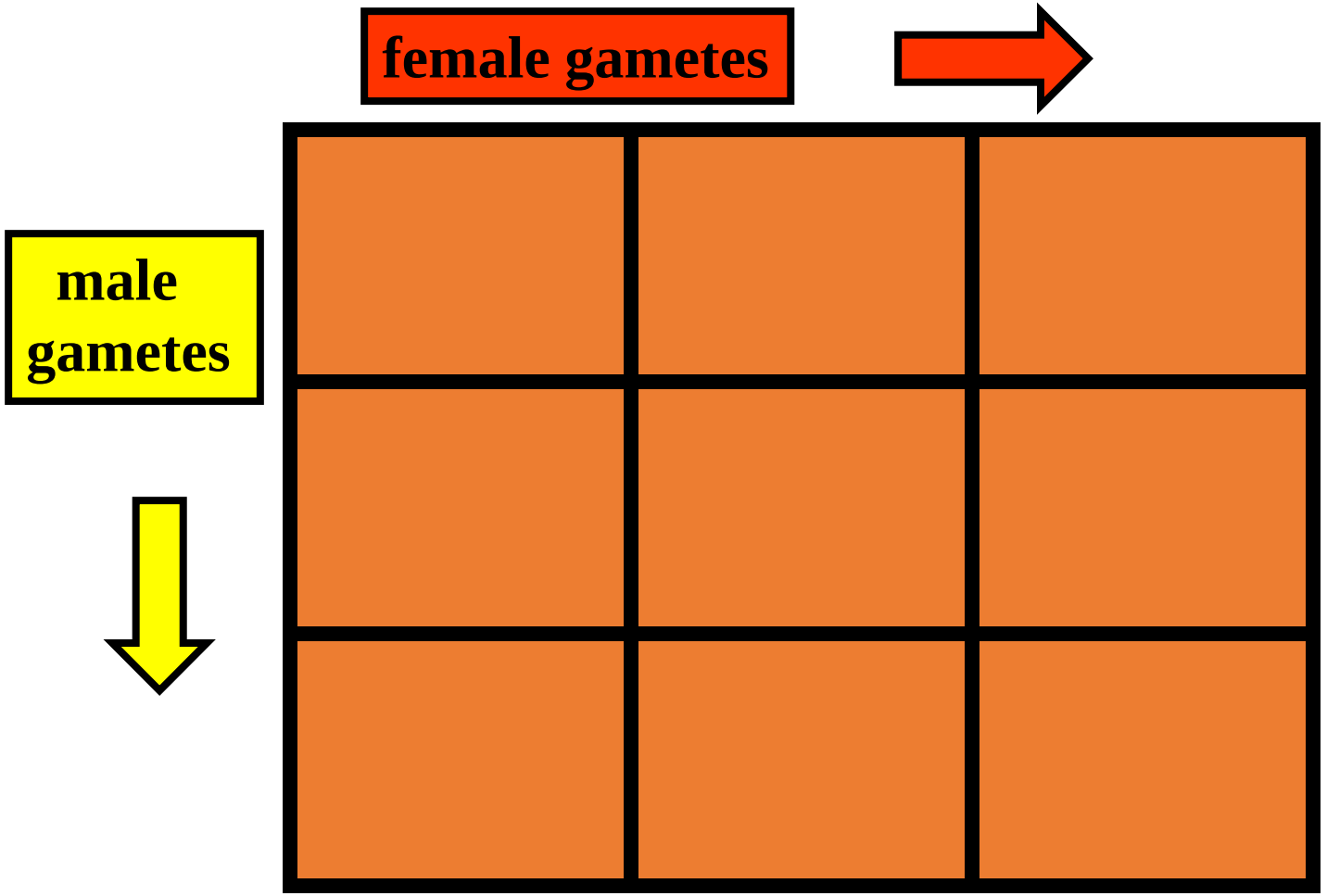
di = "two"

3. **trihybrid cross** - cross between two individuals that involves three pairs of contrasting traits; results in sixty-four offspring

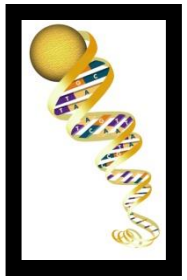
tri = "three"

PUNNETT SQUARE

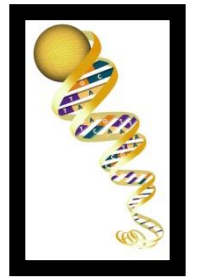
chart used to predict probabilities



CHAPTER 8: DNA TO PROTEINS



NUCLEIC ACIDS



Are complex macromolecules that store information in cells in coded form.

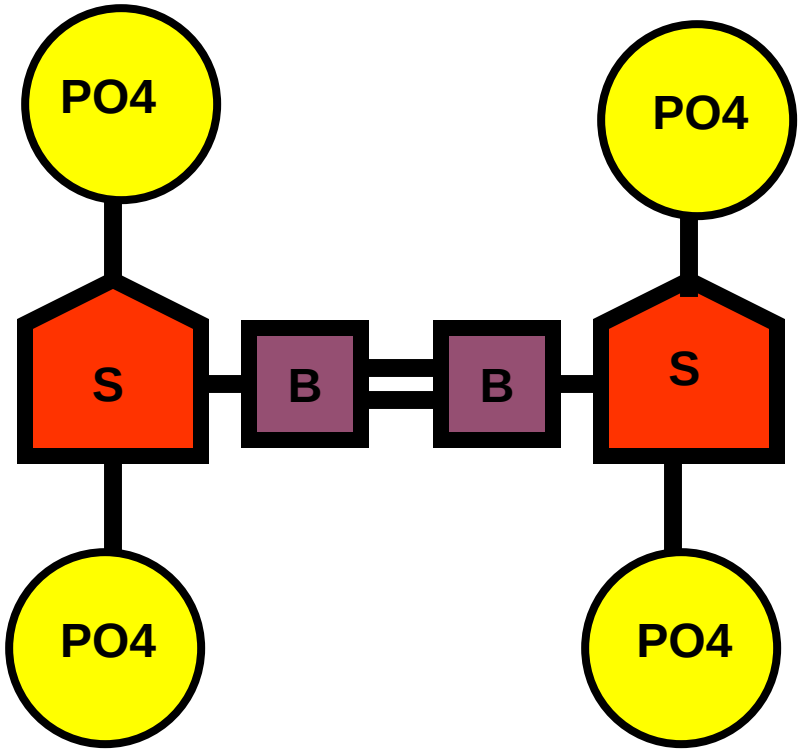
NUCLEOTIDES:

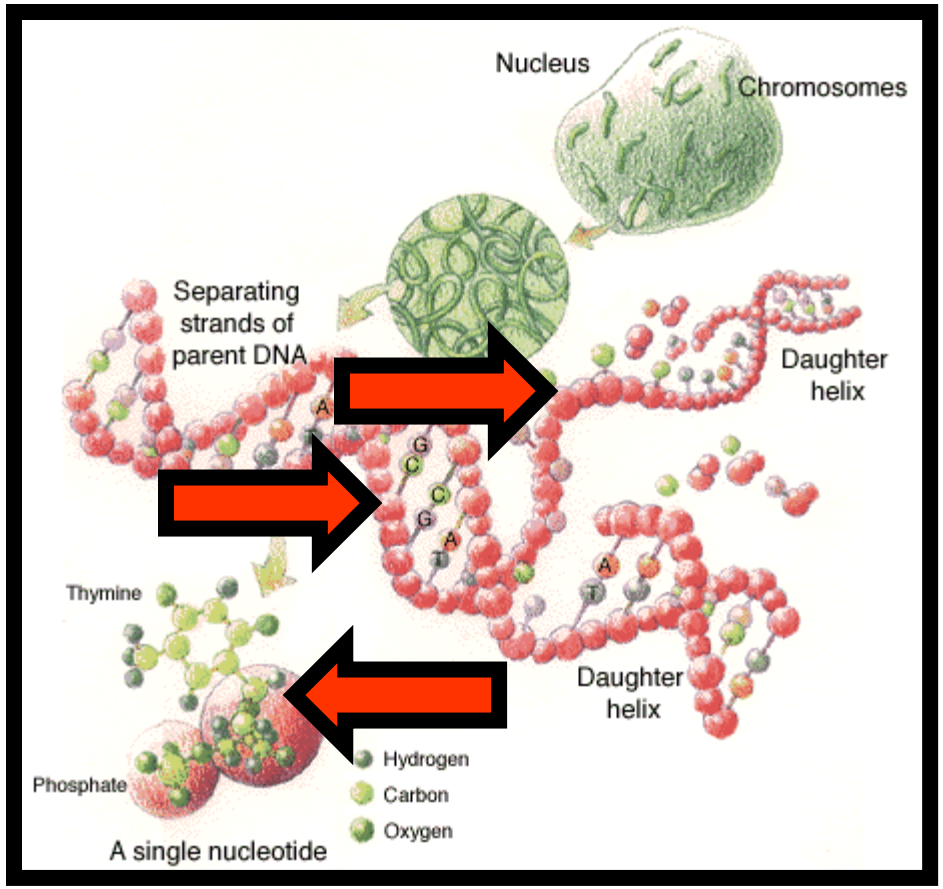
the monomers of nucleic acids

Caution: Are made up of three components (parts)

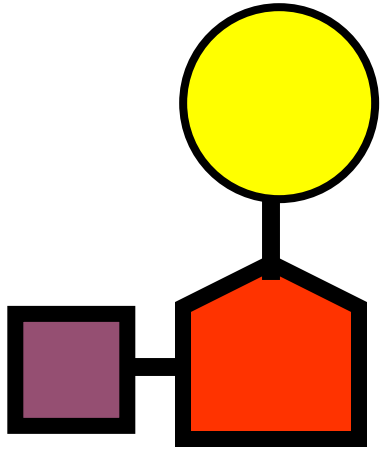
Components of nucleotides:

Part 1. five carbon sugar

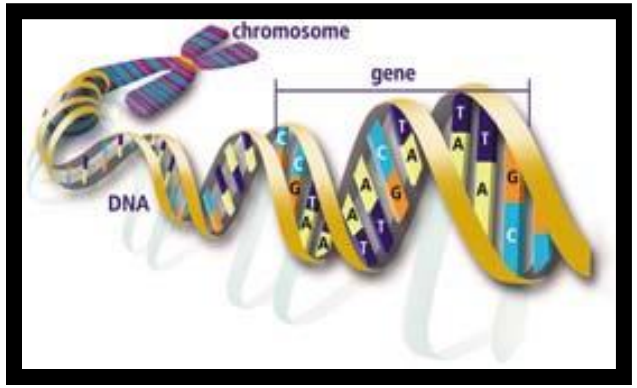




Review: the three parts that makeup a nucleotide



Types of nucleic acids:



A. DNA (deoxyribonucleic acid)

1: the nucleic acid which controls all

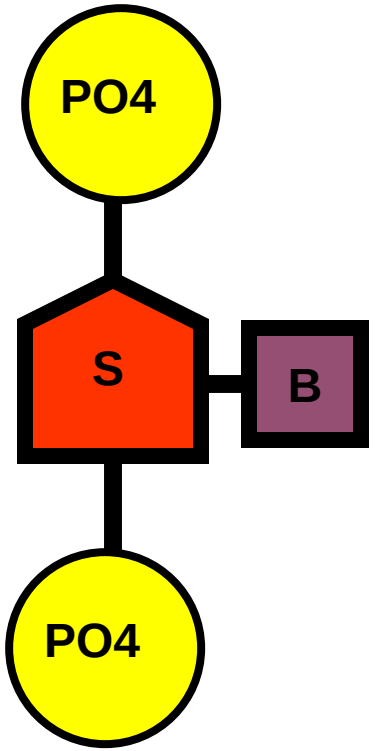
Of the cell activities. How: through the production of proteins;

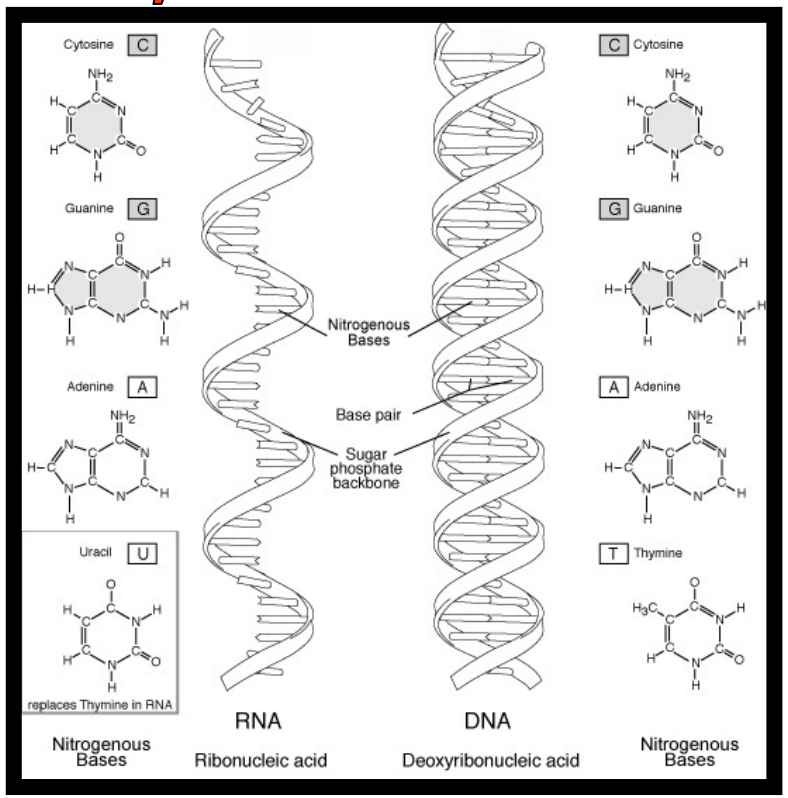
It forms the **genetic code** which

is passes to offspring

Nucleic Acid #2:
RNA (ribonucleic acid)

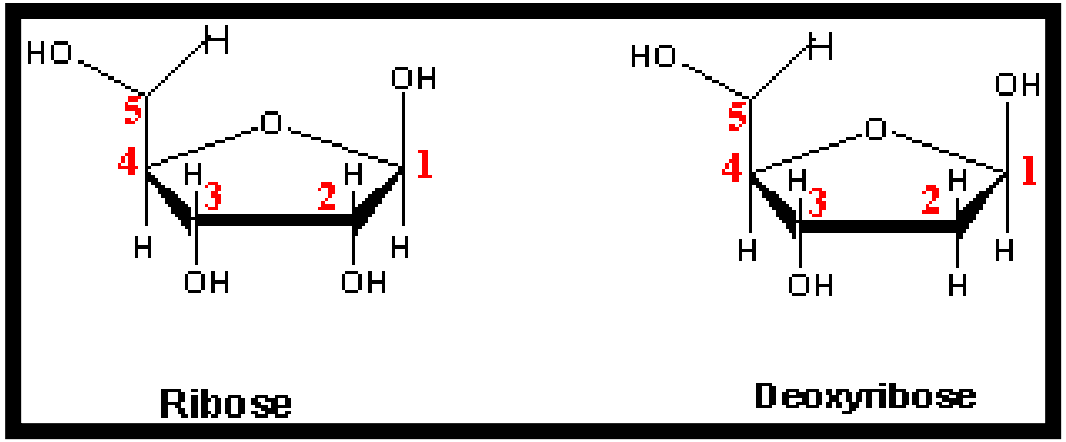
Function: It's RNA which synthesizes(makes) Proteins (Where?)





Types of sugars in nucleic acids:

1. deoxyribose - five-carbon (pentose)
sugar in DNA



2. ribose - five-carbon (pentose)
sugar in RNA

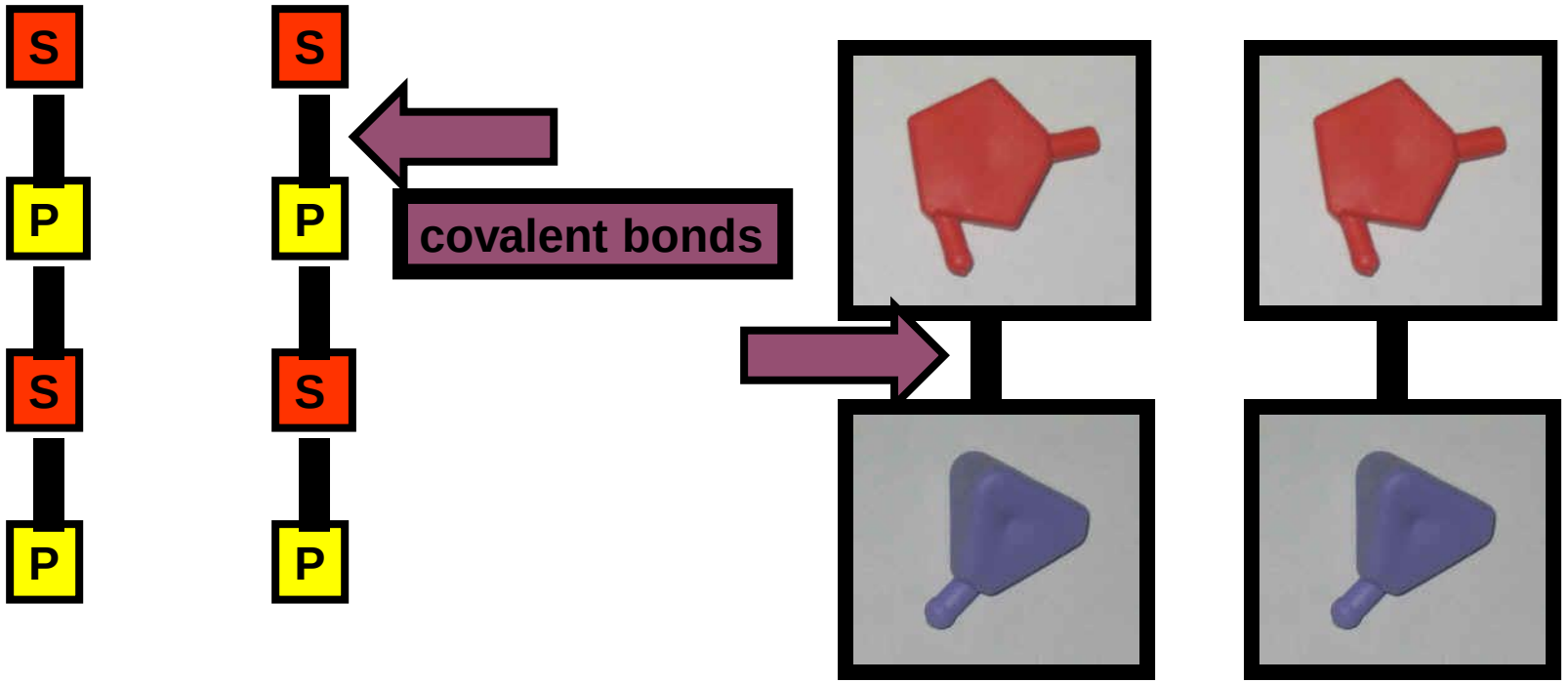
Primary functions of DNA:

1. to copy itself exactly for new cells that are created

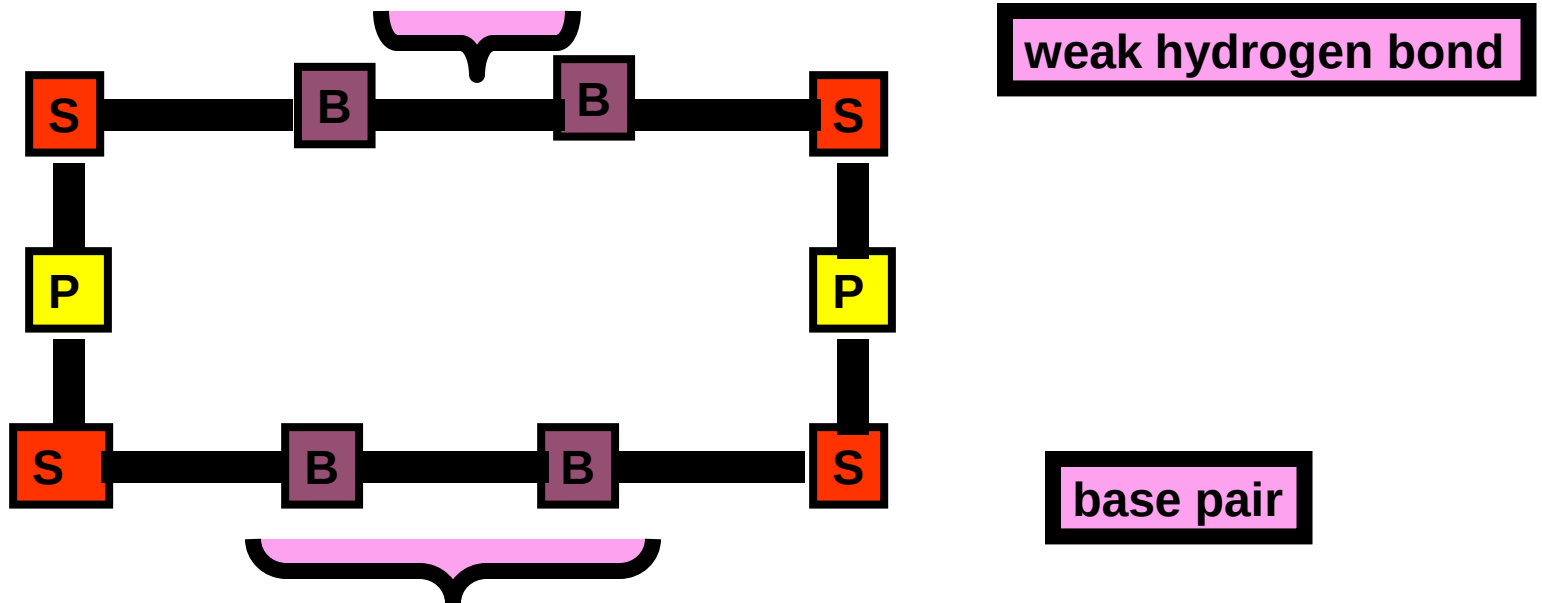
2. to store and use information to direct the activities of the cell

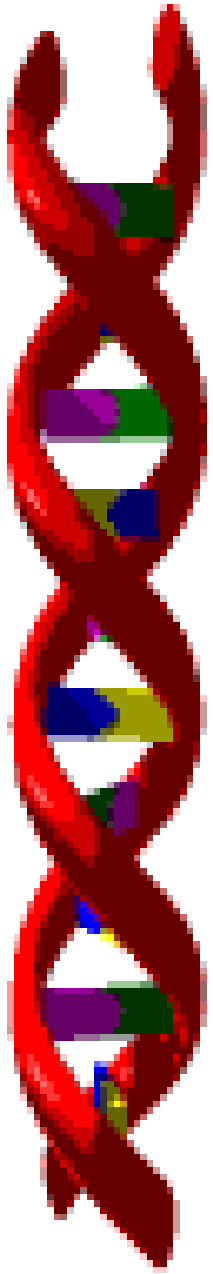
Basic structure of DNA:

1. strands (chains or uprights) -
composed of alternating sugar and phosphate groups

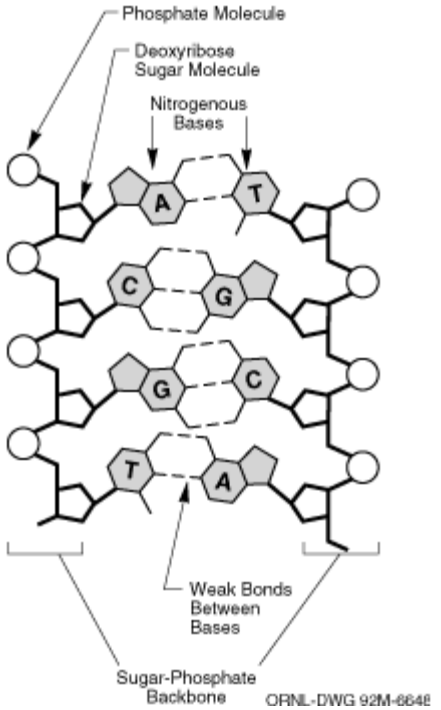


2. rungs (steps) - composed of a pair of nitrogenous bases connected by weak hydrogen bonds;
bases are attached to the sugars of the strands





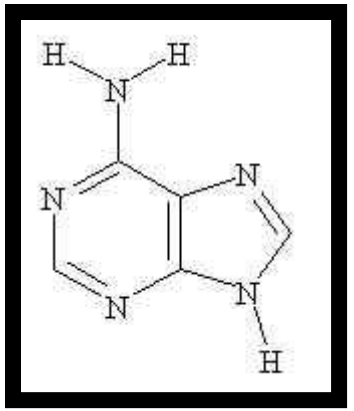
The general shape of the DNA molecule is a double stranded spiralled helix .



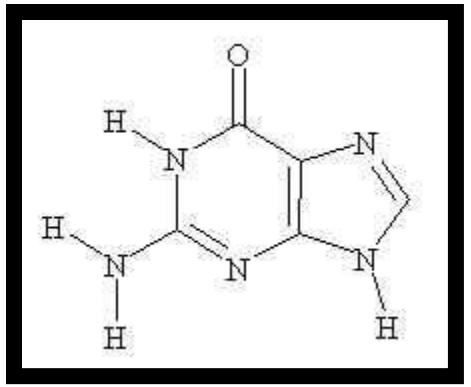
Types of Nitrogen bases in nucleic acids:

A. **purines** - organic molecules in the form of a double ring of carbon and nitrogen atoms

1) **adenine** **A**

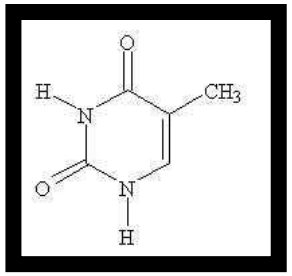


2) **guanine** **G**

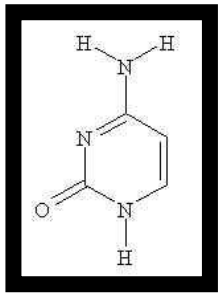


B. pryimidines - organic molecules in the form of a single ring of carbon and nitrogen atoms

1) thymine T



2) cytosine C



3) uracil U

Complementary base pairings in DNA:

thymine = adenine A = T

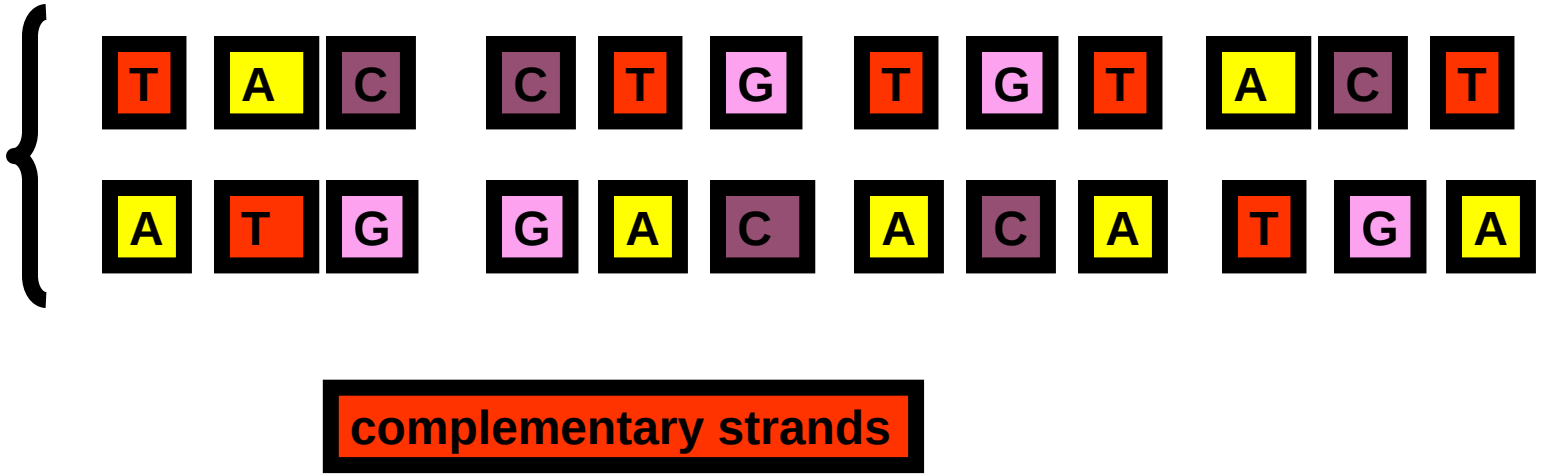
(forms two weak hydrogen bonds)

cytosine ≡ guanine C ≡ G

(forms three weak hydrogen bonds)

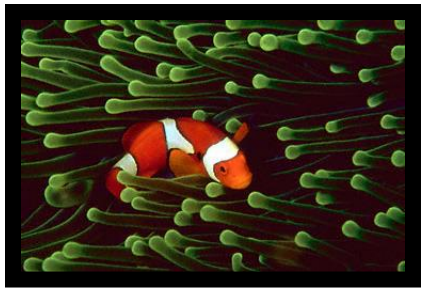
complementary strands

the sequential arrangement of nitrogen bases along one strand is the exact complement of the sequential arrangement of bases on the adjacent strand



All organisms have the same four nucloetide bases in their DNA, adenine, thymine, cytosine, and guanine but the sequence of nucleotide bases forms the unique genetic information of an organism.





DNA Replication

the process occurs in the nuclues, in which a DNA molecule is duplicated,
enabling the DNA to pass on an
identical copy of itself.

Results: the genetic code

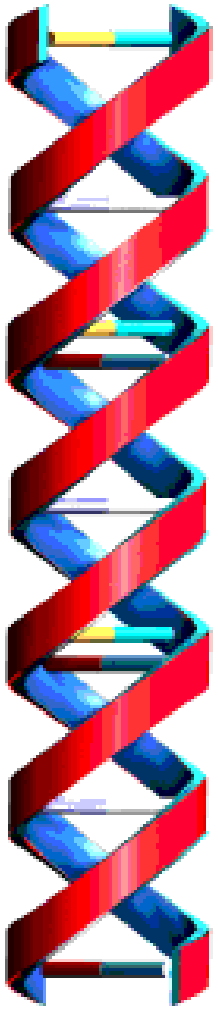
Is passed to the daughter cells during

mitosis

(cell reproduction

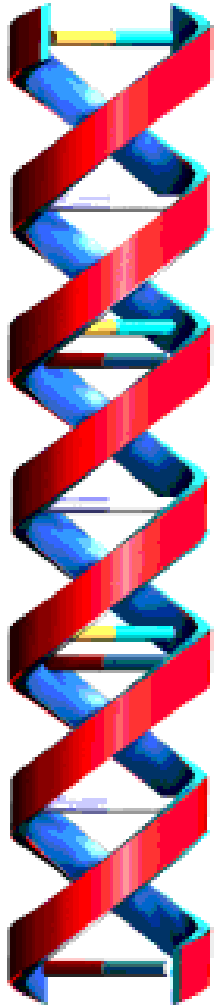
errors are corrected by

repair enzymes



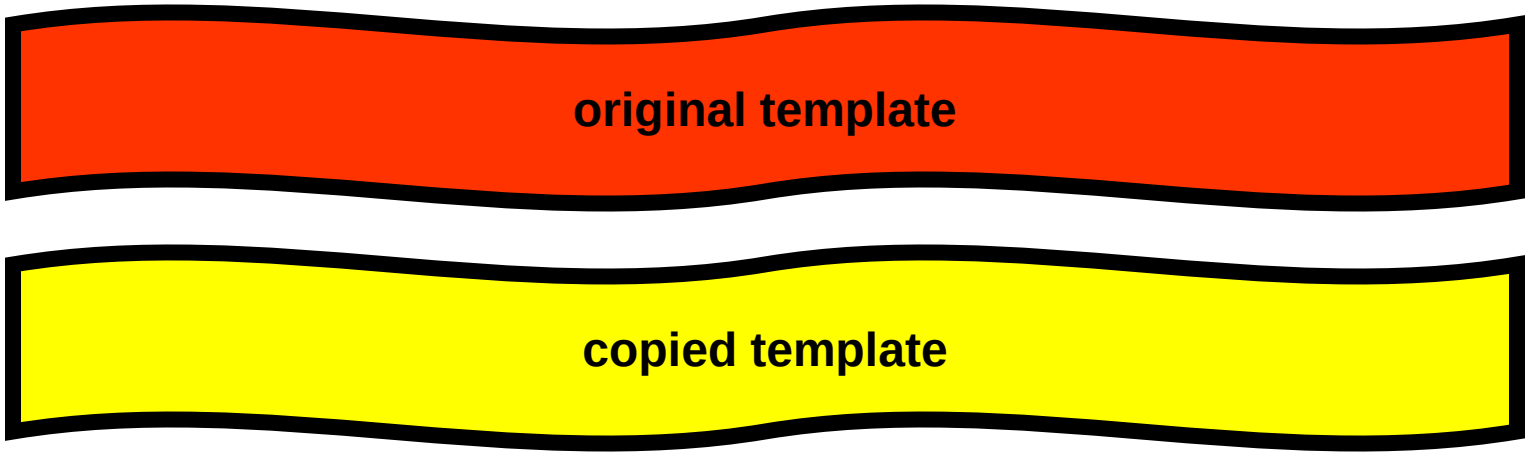
In replication:

DNA makes DNA



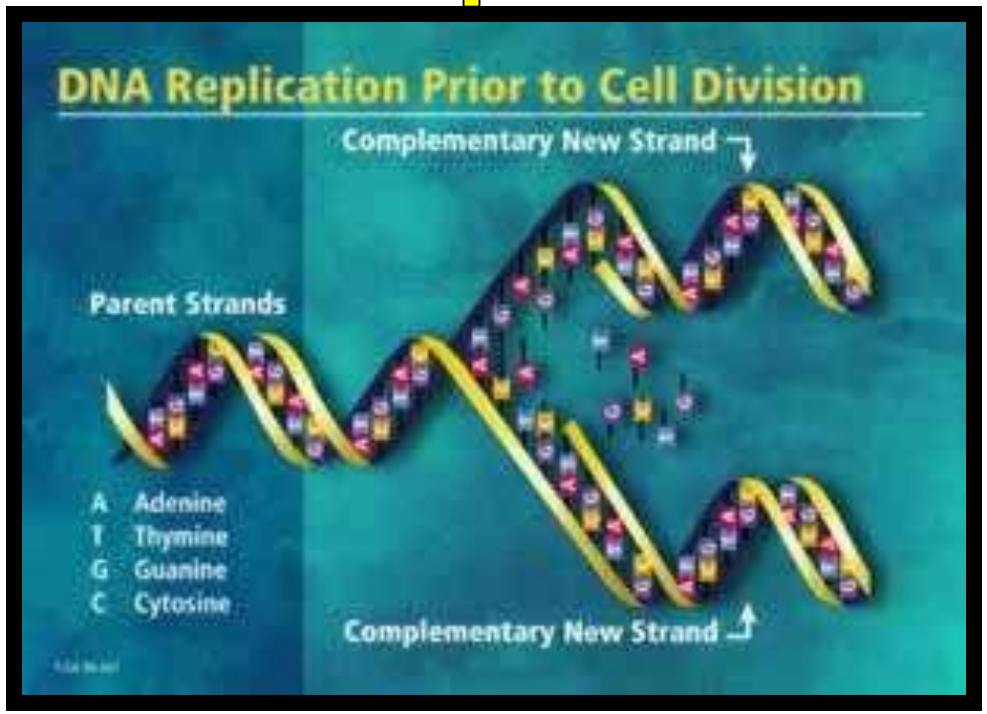
template

a pattern or mold established by each strand of the DNA molecule for replication

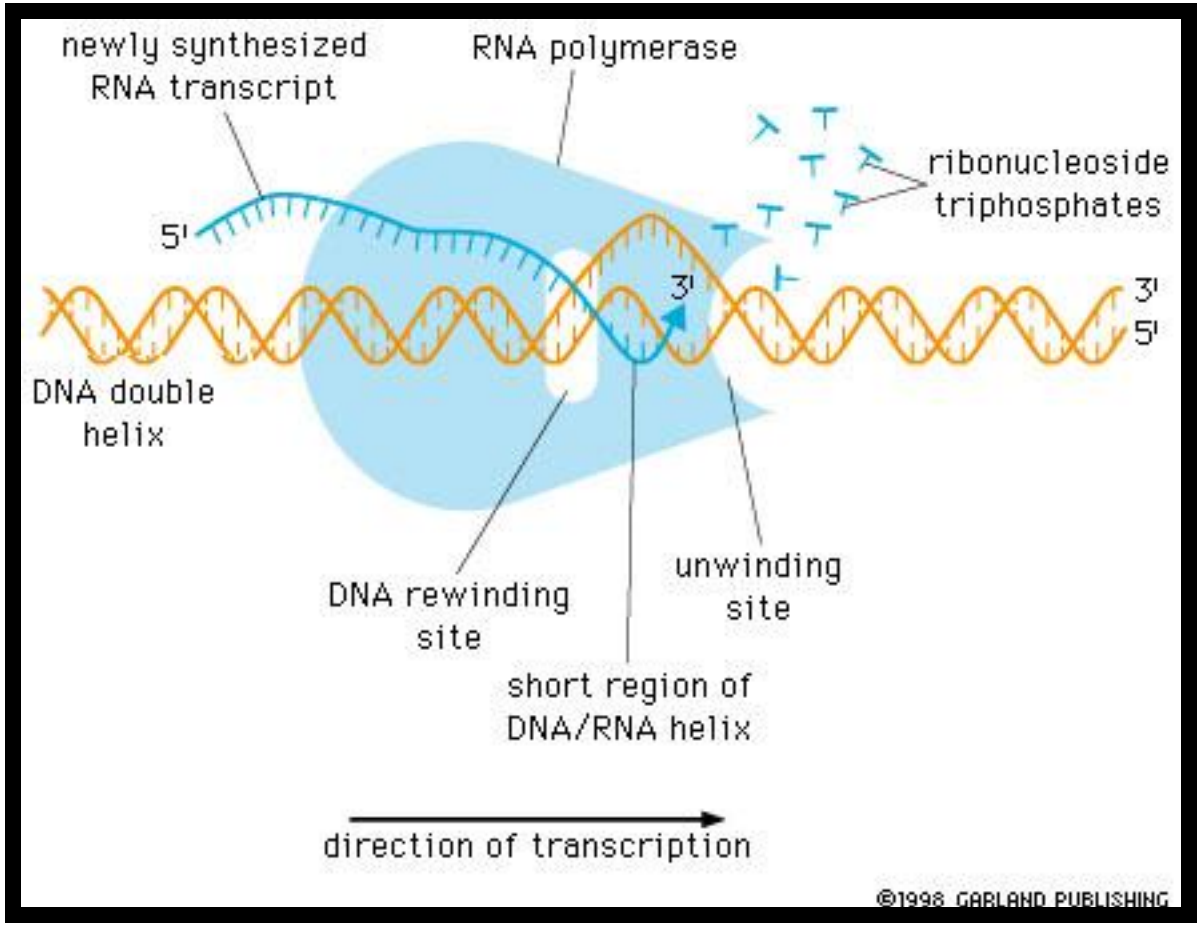


Enzymes used in nucleic acids:

1. **DNA helicase** - enzyme which breaks the weak hydrogen bonds between the two strands of the DNA molecule so that replication can occur



2. RNA polymerase - enzyme used when DNA makes a molecule of RNA

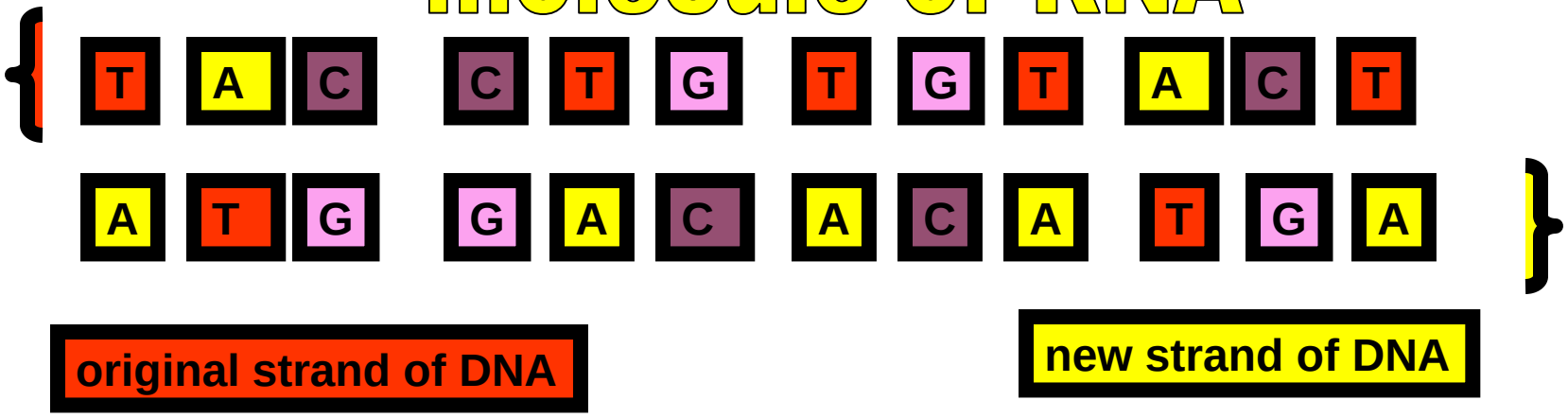


Transcription: occurs in the nucleus

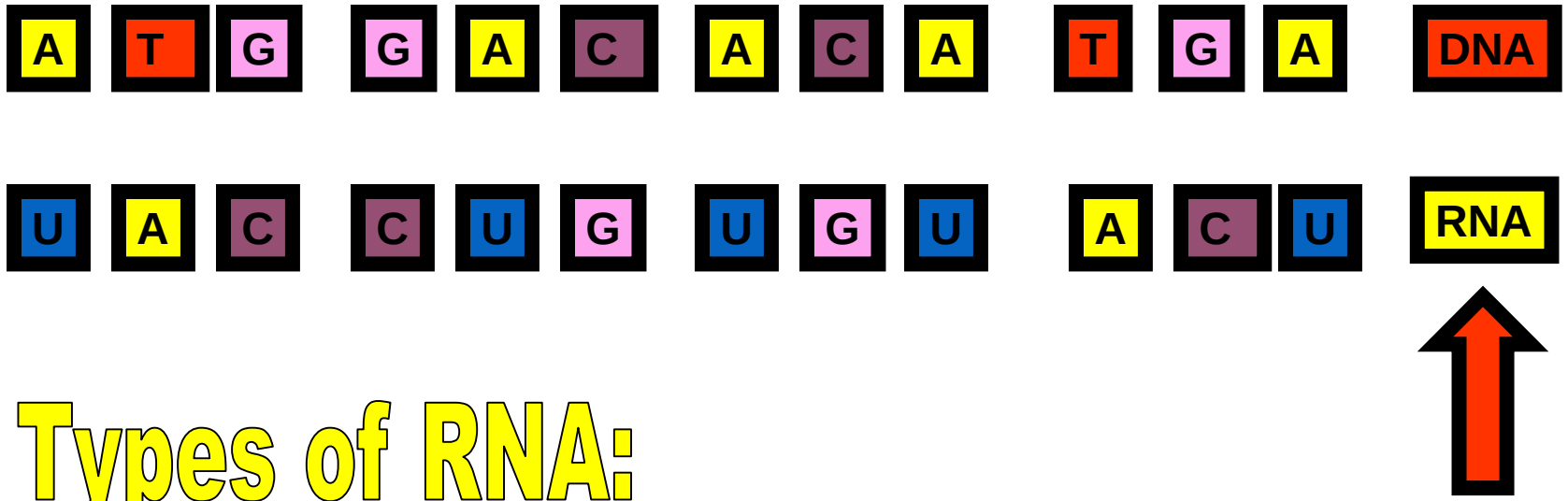
the process in which DNA makes a molecule of RNA.

Why? for use in protein synthesis;

RNA is a single stranded molecule of RNA



In transcription:
DNA makes RNA



3 Types of RNA:

1. messenger RNA (m RNA) - the types of RNA that carries information from DNA in the nucleus out to the ribosomes

("protein factories of the cell")

in the cytoplasm to start

manufacturing a protein

mRNA structure in "linear form"

2. ribosomal RNA (r RNA) - the type of RNA

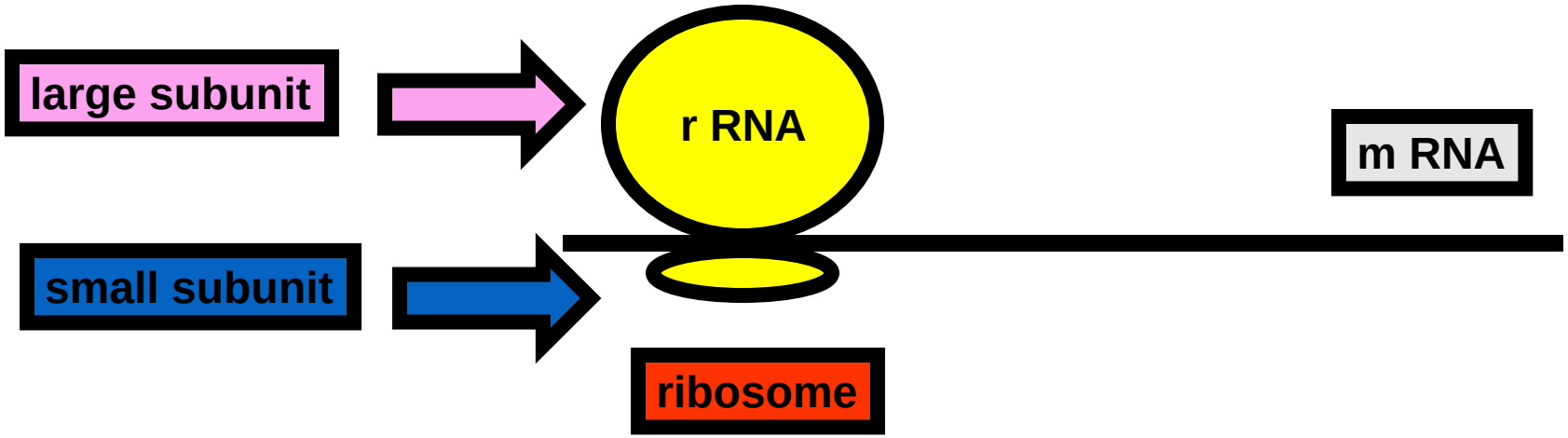
located in ribosomes that

helps to produce enzymes

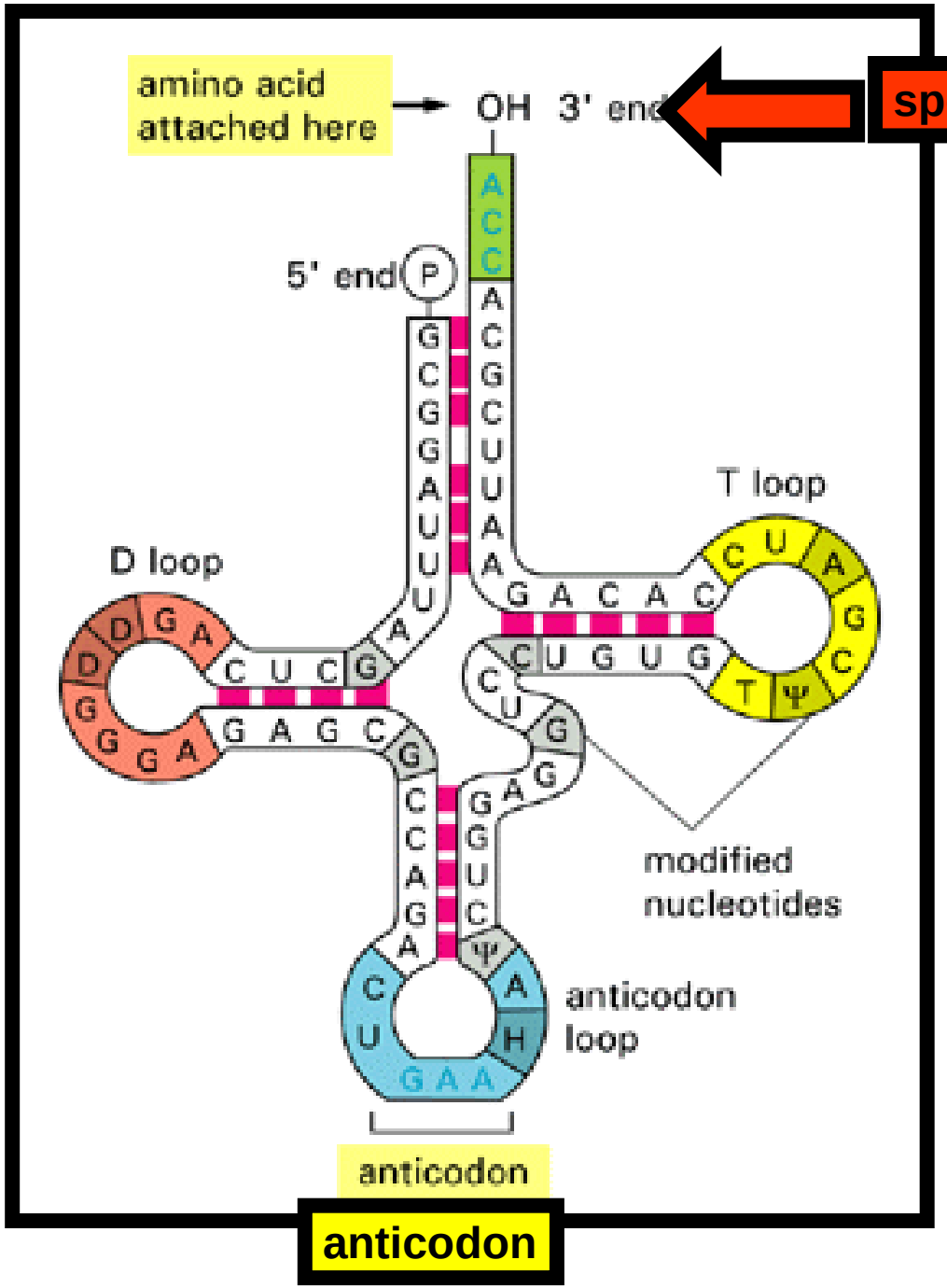
needed to bond amino acids

together during protein synthesis

rRNA structure in "globular form"



3. transfer RNA (t RNA) - the type of RNA which picks up specific amino acids in the cytoplasm and brings them to the m RNA located on the surface of the ribosomes


amino acid attached here
OH 3' end
specific amino acid
5' end
P
D loop
T loop
modified nucleotides
anticodon loop
anticodon
anticodon

Overall Summary

DNA establishes a template for the formation of all three types of RNA

RNA establishes a template for the specific amino acids

amino acids establishes a template for the formation of a protein

therefore, DNA establishes a template for the formation of a protein

Basic differences between DNA and RNA:

1. DNA has one less oxygen than RNA
2. DNA has the sugar deoxyribose

RNA has the sugar ribose

3. DNA is a double stranded molecule

RNA is a single stranded molecule

4. DNA has the base thymine

RNA has the base uracil

5. DNA is made by the process of replication

RNA is made by the process of transcription

6. DNA is of one type

RNA is of three types
(messenger RNA,
ribosomal RNA, and
transfer RNA)

7. DNA remains in the nucleus

RNA leaves the nucleus and travels
to the ribosomes in the cytoplasm

Translation: occurs in the ribosomes

the process of converting the information in a sequence of nitrogen bases in messenger RNA into a sequence of amino acids that make up a protein

In translation:

DNA makes protein

protein synthesis

the formation of proteins using information coded on DNA and carried out by RNA;

pro = " first "

codon

a group of three sequential bases of messenger RNA; each codes for a specific amino acid;

64 possible codons

code = "on"

Codon Chart

First Position (5′)	Second Position: U	Second Position: C	Second Position: A	Second Position: G	Third Position (3′)
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic acid	Glycine	U
	Valine	Alanine	Aspartic acid	Glycine	C
	Valine	Alanine	Glutamic acid	Glycine	A
	Valine	Alanine	Glutamic acid	Glycine	G

$^{5'}$AGAUCGAGU$^{3'}$ → $^{5'}$A<u>C</u>AUCGAGU$^{3'}$

Special codons required for protein synthesis:

1. "start" codon (initiation or initiator codon) - indicates where a ribosome will start reading a messenger RNA; where the protein begins

methionine - start codon - AUG

2. "stop" codon (nonsense codon) - indicates where a ribosome will stop reading a messenger RNA molecule; where the protein stops

A. UGA

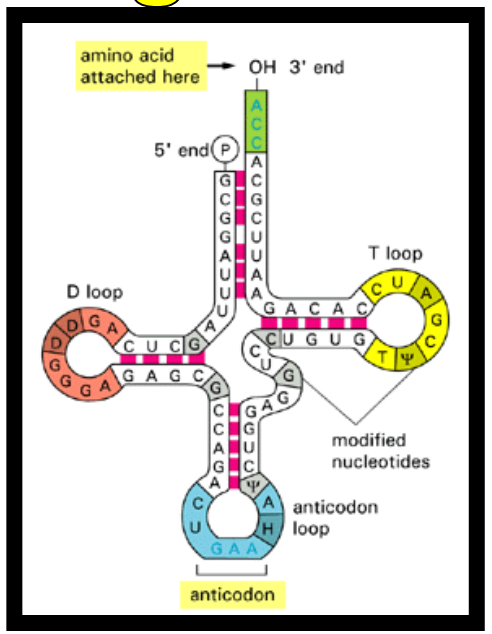
B. UAA

C. UAG

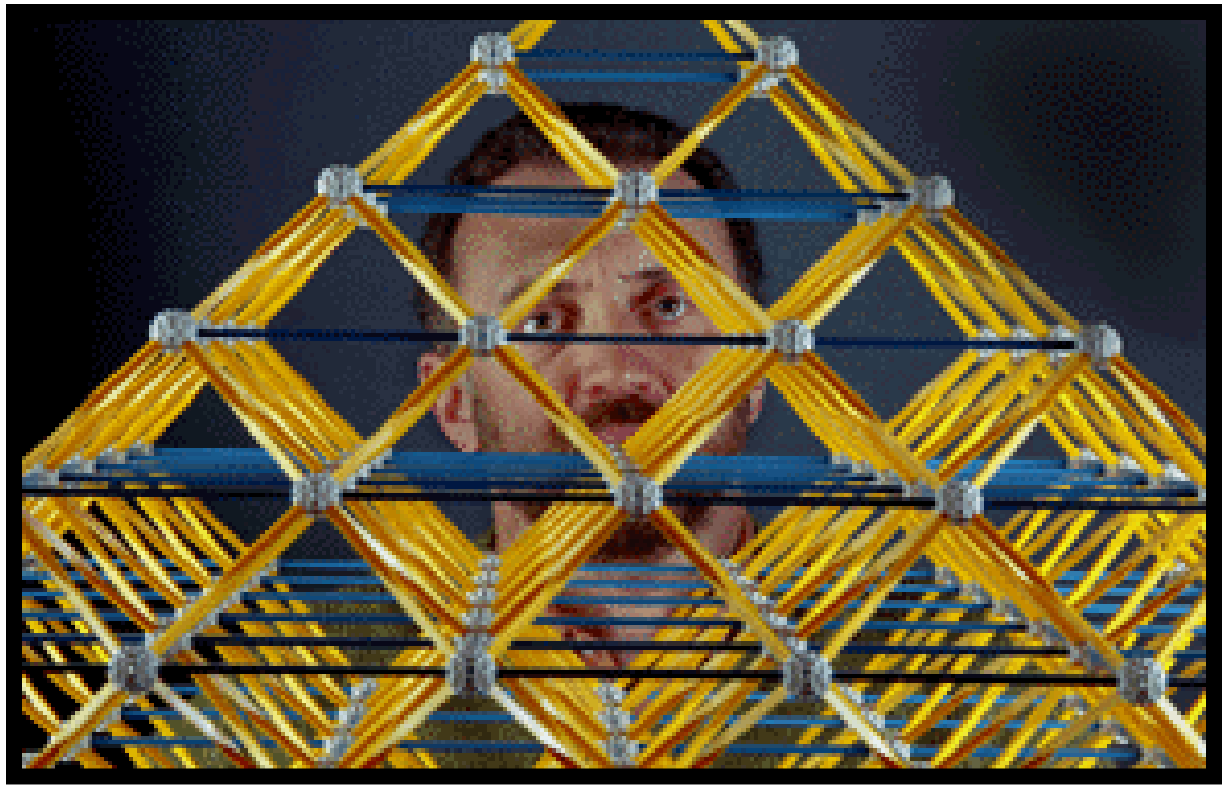
anticodon

the three sequential bases on a region of the transfer RNA complementary to the codons on messenger RNA

anti = " opposite "



The sequence of amino acids in a protein determines the characteristics of that protein.



Use of a lattice to determine the folding patterns of different proteins.

Computer scientist Soren Istrail

protein

an organic compound
composed
of two or more chains of
polypeptides, which in turn,
are formed from amino acids

polypeptide

a long chain of amino acids,
hooked together by peptide bonds

poly = "many "

peptide bond

type of bond which forms between amino acids in a protein; covalent bond between a nitrogen and a carbon atom

gene

a segment of DNA located on
a chromosome;
directs the protein
production that controls
the cell activities;

"hereditary units"

MUTATIONS

“Section 11.3"

Mutations

Two types of mutations (Chromosomal/Gene Mutations:

1. **chromosomal mutations – mutation that occurs at the chromosome level resulting in changes in the gene distribution to gametes during meiosis; caused when parts of chromosomes break off or rejoin incorrectly**

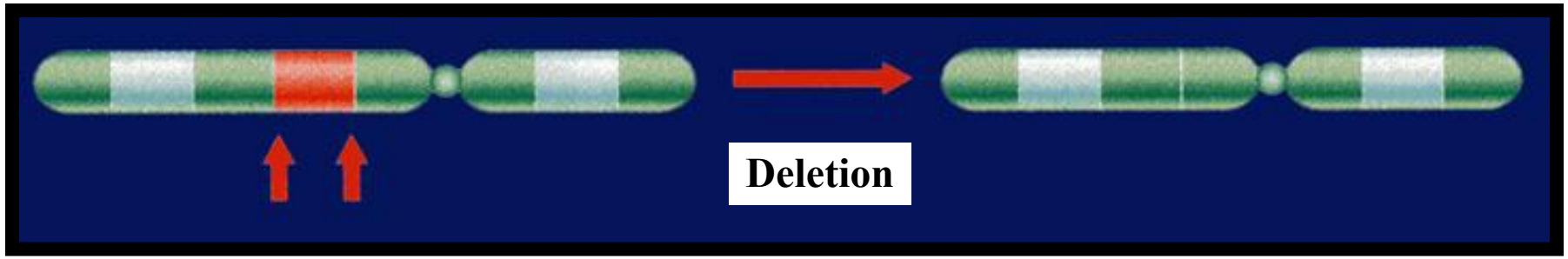
A. Division often occurs during cell division.

B. Can change the structure of the chromosome.

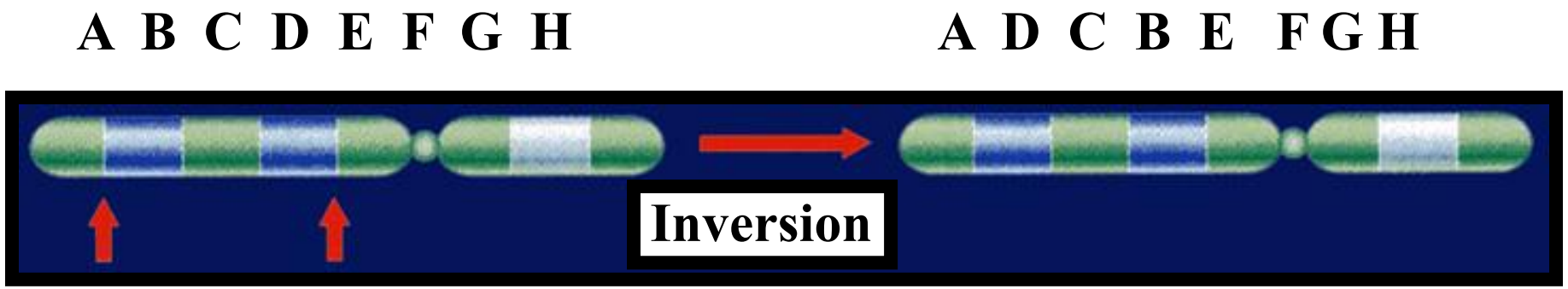
C. Cause loss of an entire chromosome.

Types of chromosomal mutations:

1) **deletion – results when a piece of a chromosome breaks off**

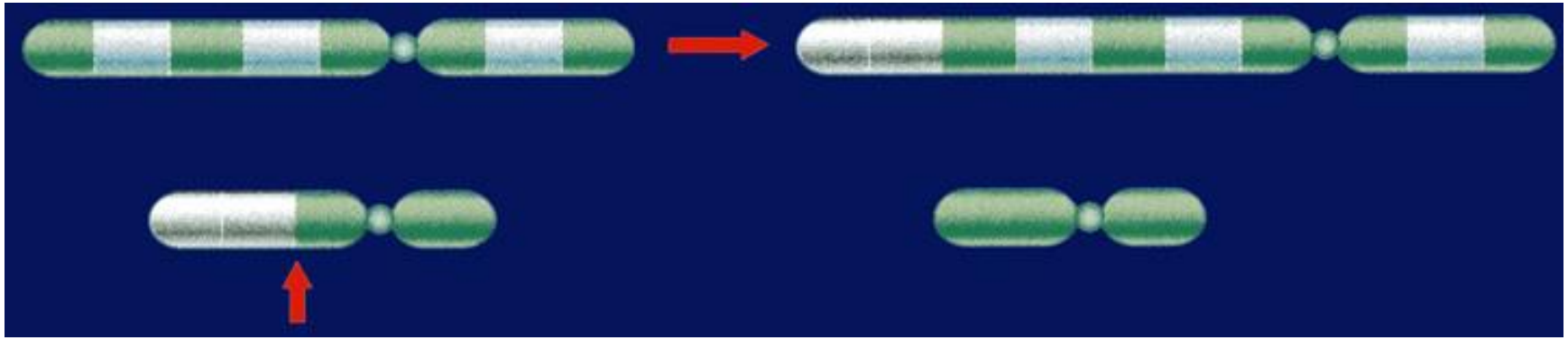


2) inversion – results when a piece of a chromosome breaks off and reattaches itself in reverse order



3) translocation – results when a broken piece attaches itself to a nonhomologous chromosome

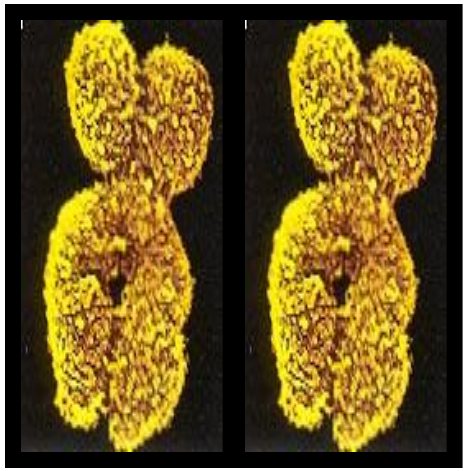
A B C D E F G H W X A B C D E F G H



W X Y Z **Translocation** Y Z

4) nondisjunction – results when a replicated chromosome fails to separate during cell division

Parent cell:



2 chromosomes

Daughter cells:

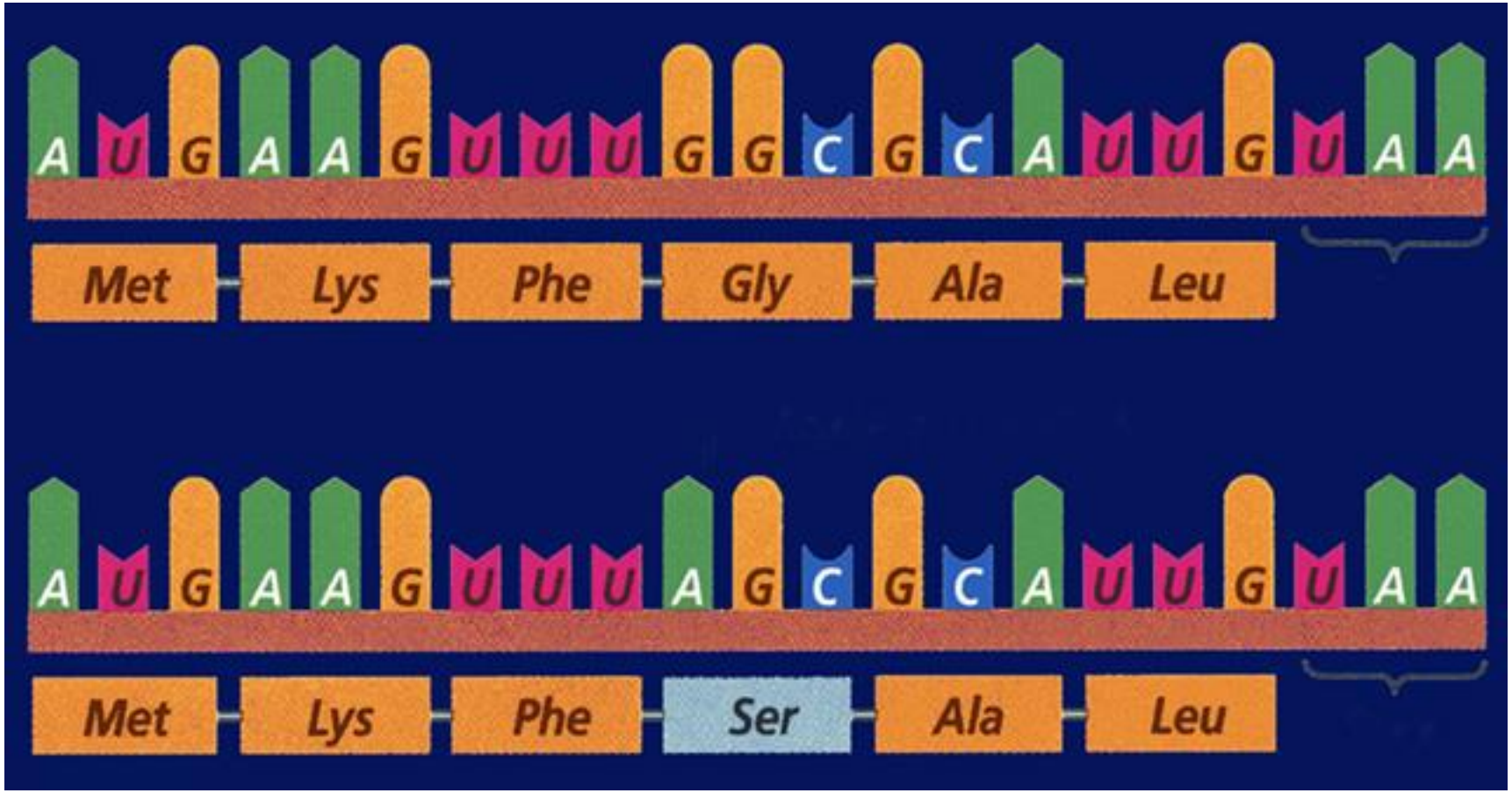
2 chromosomes

0 chromosomes

2. gene mutations - mutation that may involve a single nitrogen base or large segments of DNA depending on the type of mutation

Types of gene mutations:

1) point mutation - mutation in a DNA sequence; occurs from a change in a single base pair



a substitution of a single nitrogen base

Point Mutation

DNA → mRNA → Nucleic Acid

Normal

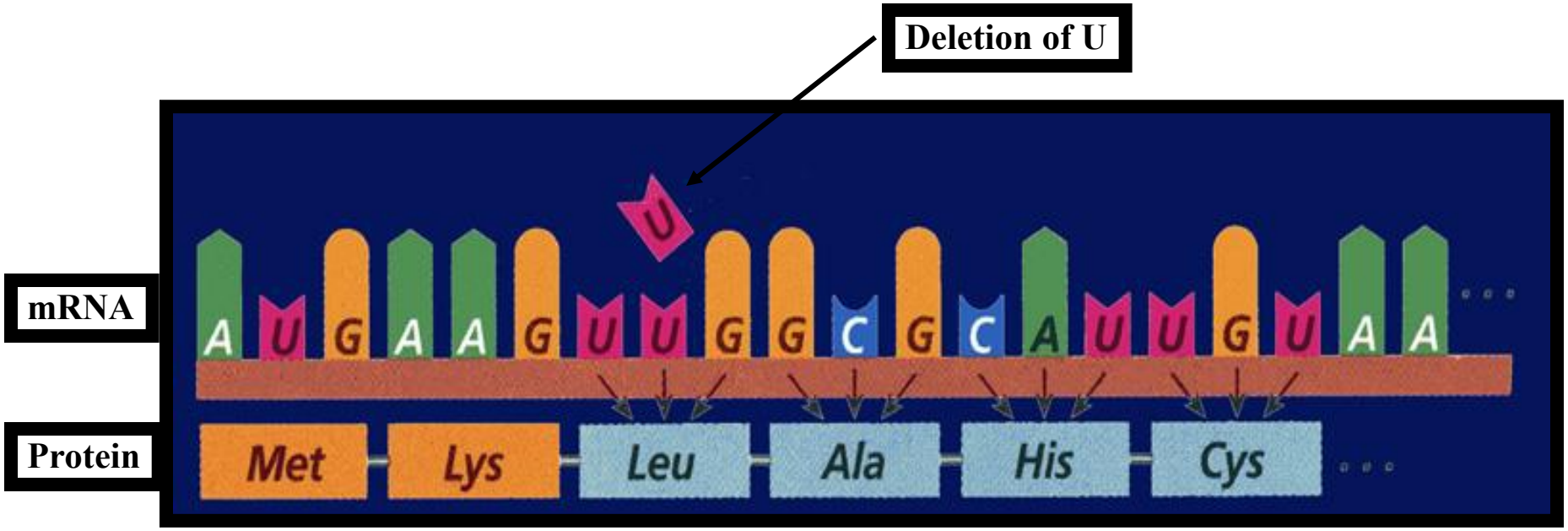
C	-	G	Glutamic Acid
T	-	A	
T	-	A	

Substitution

C	-	G	Valine
A	-	U	
T	-	A	

Base substitution:

2) frameshift mutation - mutation that occurs when a single base is added or deleted from DNA; causes a shift in the reading of codons by one base



the addition or deletion of one or more nitrogen bases

Frame Shift Mutations

DNA → mRNA → Nucleic Acid

Normal

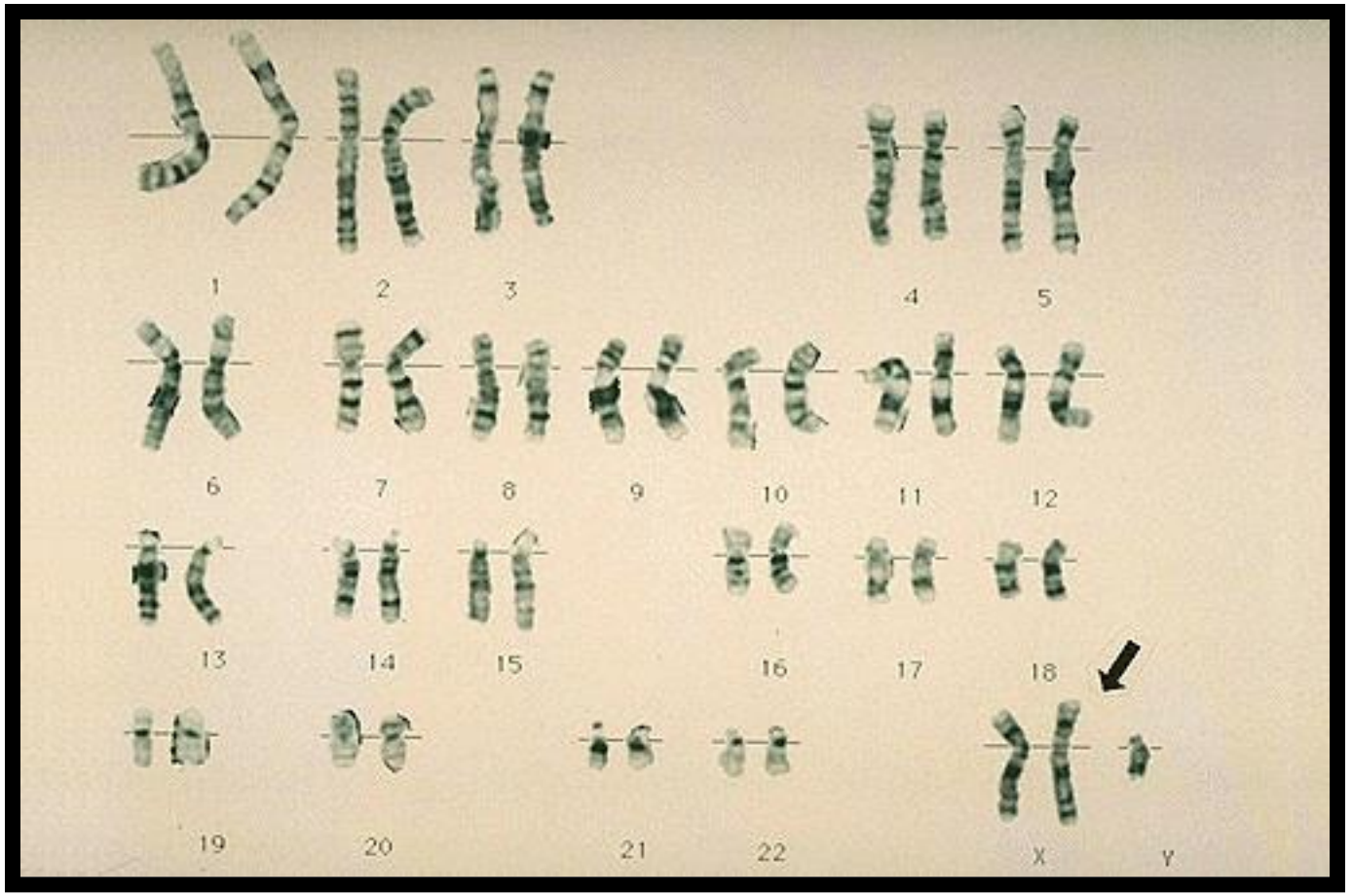
A	-	T	
C	-	G	Tryptophane
C	-	G	
C	-	G	
T	-	A	Glutamic Acid
C	-	G	

Frame shift: (deletion of a nitrogen base)

A	-		
C	-	G	
C	-	G	Glycine
C	-	G	
T	-	A	
C	-	G	

Karyotyping

Technique used to diagnose genetic disorders
Used to learn more about chromosome shape, structure, and size.



Pedigrees

A chart used to show how a trait and the genes that control it are inherited within a family.
Involves interviews with family members and friends of the family to collect information about the family's genetic history and traits.