Welcome

Introduction to Biostatistics

Prof. Adsul A. A.
Lecturer of Biostatistics
Head,
Department of Botany

Biostatistics

- (a portmanteau word made from biology and statistics)
- The application of statistics to a wide range of topics in biology.

Biostatistics

It is the science which deals with development and application of the most appropriate methods for the:

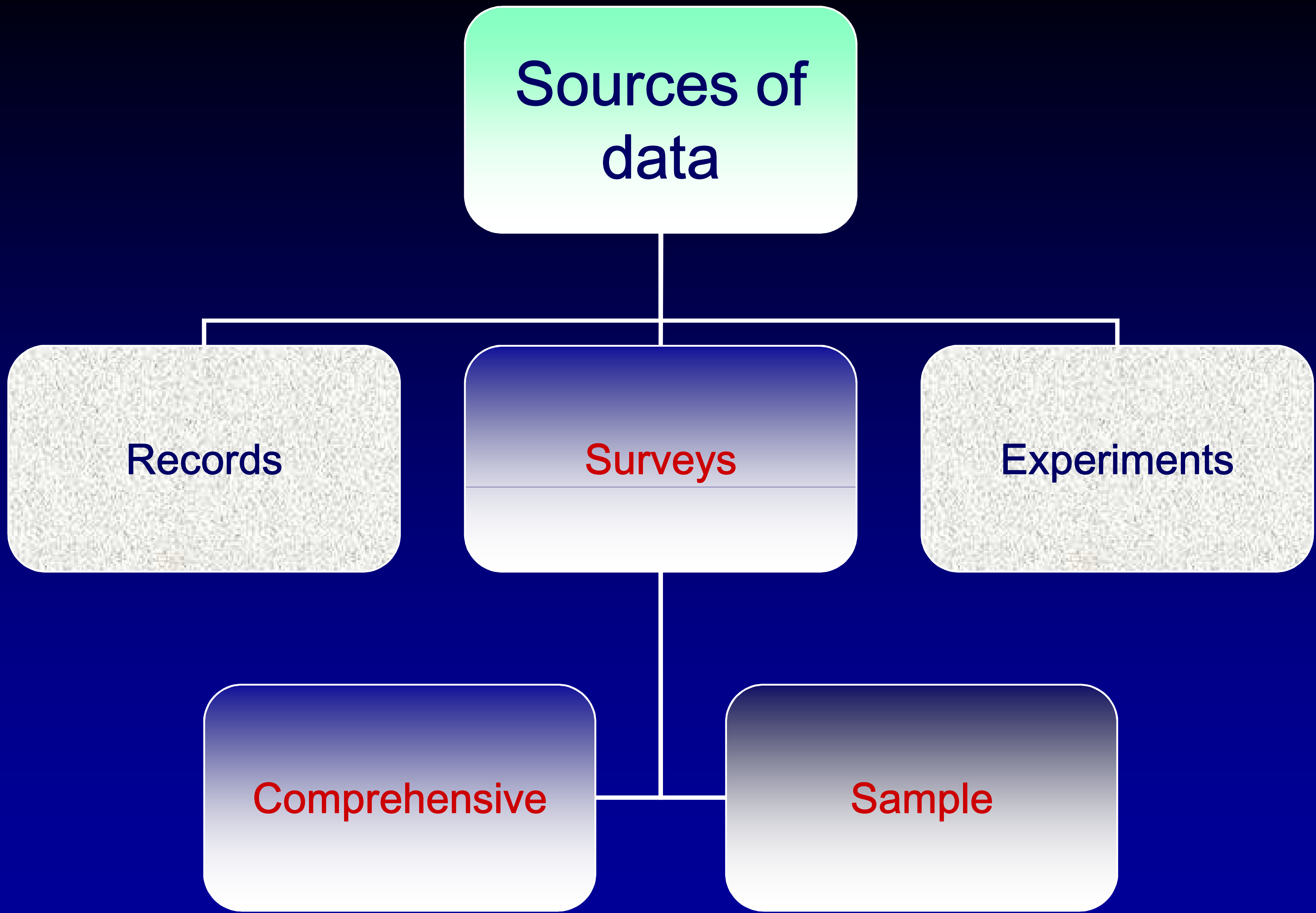
- Collection of data.
- Presentation of the collected data.
- Analysis and interpretation of the results.
- Making decisions on the basis of such analysis

Other definitions for “Statistics”

- Frequently used in referral to recorded data
- Denotes characteristics calculated for a set of data : sample mean

Role of statisticians

- To guide the design of an experiment or survey prior to data collection
- To analyze data using proper statistical procedures and techniques
- To present and interpret the results to researchers and other decision makers


Sources of data
Records
Surveys
Experiments
Comprehensive
Sample

Types of data

Constant

Variables

Types of variables

Quantitative variables

- Quantitative continuous
- Quantitative descrete

Qualitative variables

- Qualitative nominal
- Qualitative ordinal

Methods of presentation of data

1. Numerical presentation
2. Graphical presentation
3. Mathematical presentation

1- Numerical presentation

Tabular presentation (simple – complex)

Simple frequency distribution Table (S.F.D.T.)

Title

Name of variable (Units of variable)	Frequency	%
- - Categories -		
Total		

Table (I): Distribution of 50 patients at the surgical department of Alexandria hospital in May 2008 according to their ABO blood groups

Blood group	Frequency	%
A	12	24
B	18	36
AB	5	10
O	15	30
Total	50	100

Table (II): Distribution of 50 patients at the surgical department of Alexandria hospital in May 2008 according to their age

Age (years)	Frequency	%
20-<30	12	24
30-	18	36
40-	5	10
50+	15	30
Total	50	100

Complex frequency distribution Table

Table (III): Distribution of 20 lung cancer patients at the chest department of Alexandria hospital and 40 controls in May 2008 according to smoking

Smoking	Lung cancer				Total	
	Cases		Control			
	No.	%	No.	%	No.	%
Smoker	15	75%	8	20%	23	38.33
Non smoker	5	25%	32	80%	37	61.67
Total	20	100	40	100	60	100

Complex frequency distribution Table

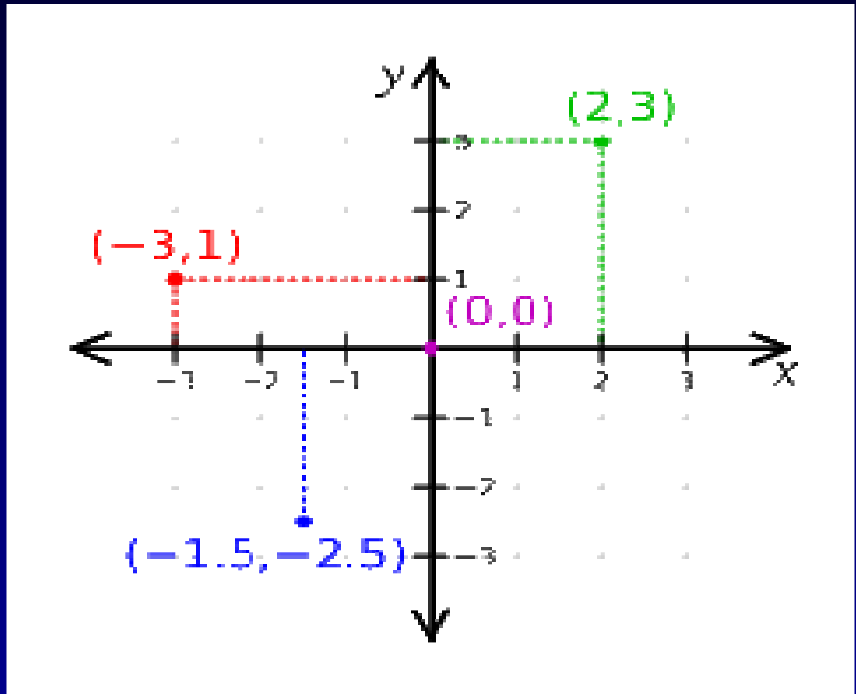
Table (IV): Distribution of 60 patients at the chest department of Alexandria hospital in May 2008 according to smoking & lung cancer

Smoking	Lung cancer				Total	
	positive		negative			
	No.	%	No.	%	No.	%
Smoker	15	65.2	8	34.8	23	100
Non smoker	5	13.5	32	86.5	37	100
Total	20	33.3	40	66.7	60	100

2- Graphical presentation

➊ *Graphs drawn using Cartesian coordinates*

- Line graph
- Frequency polygon
- Frequency curve
- Histogram
- Bar graph
- Scatter plot

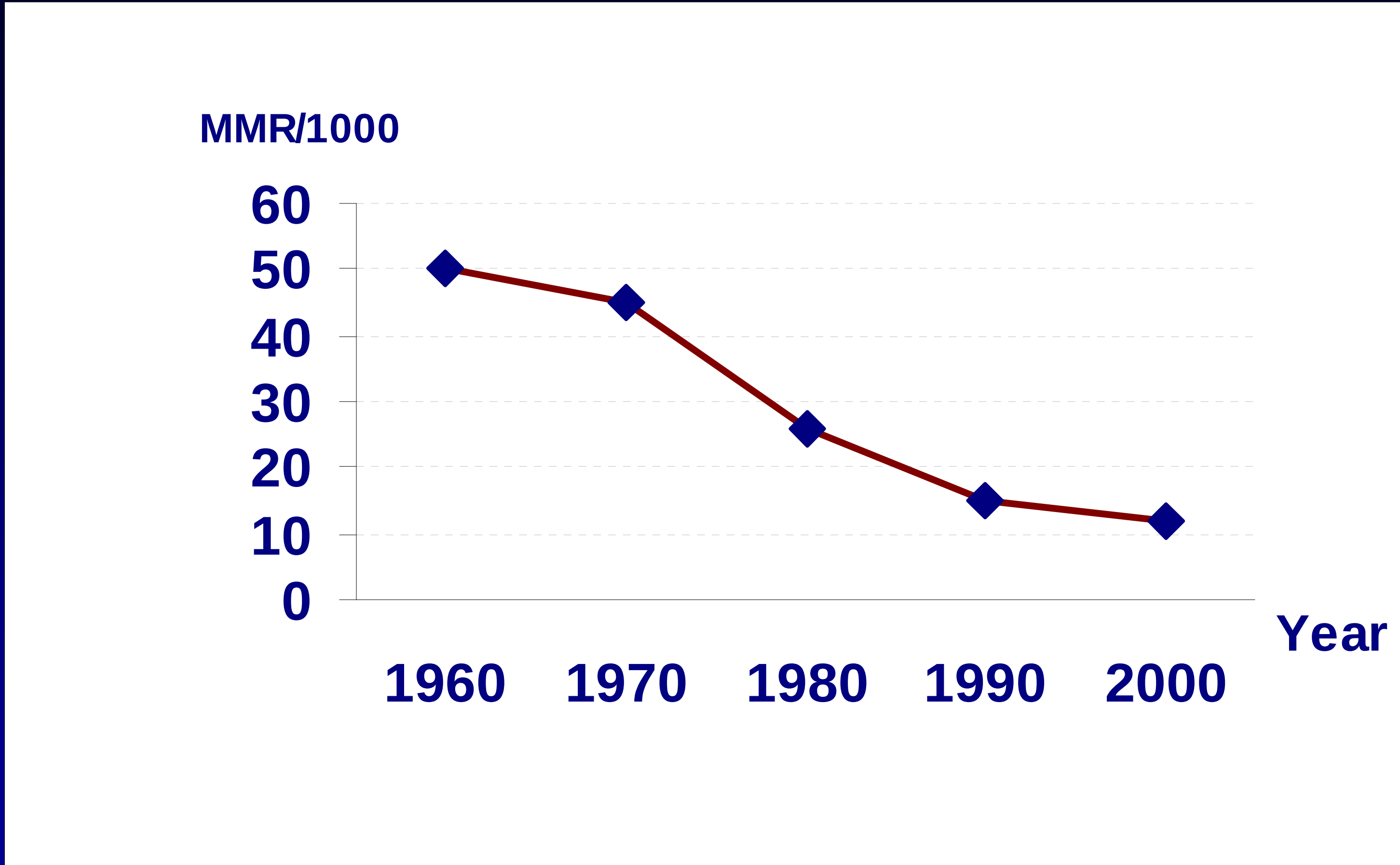


➋ *Pie chart*

➌ *Statistical maps*

rules

Line Graph



Year	MMR
1960	50
1970	45
1980	26
1990	15
2000	12

Figure (1): Maternal mortality rate of (country), 1960-2000

Frequency polygon

Age (years)	Sex		Mid-point of interval
	Males	Females	
20 -	3 (12%)	2 (10%)	(20+30) / 2 = 25
30 -	9 (36%)	6 (30%)	(30+40) / 2 = 35
40-	7 (8%)	5 (25%)	(40+50) / 2 = 45
50 -	4 (16%)	3 (15%)	(50+60) / 2 = 55
60 - 70	2 (8%)	4 (20%)	(60+70) / 2 = 65
Total	25(100%)	20(100%)	

Frequency polygon

Age	Sex		M-P
	M	F	
20-	(12%)	(10%)	25
30-	(36%)	(30%)	35
40-	(8%)	(25%)	45
50-	(16%)	(15%)	55
0-70	(8%)	(20%)	65

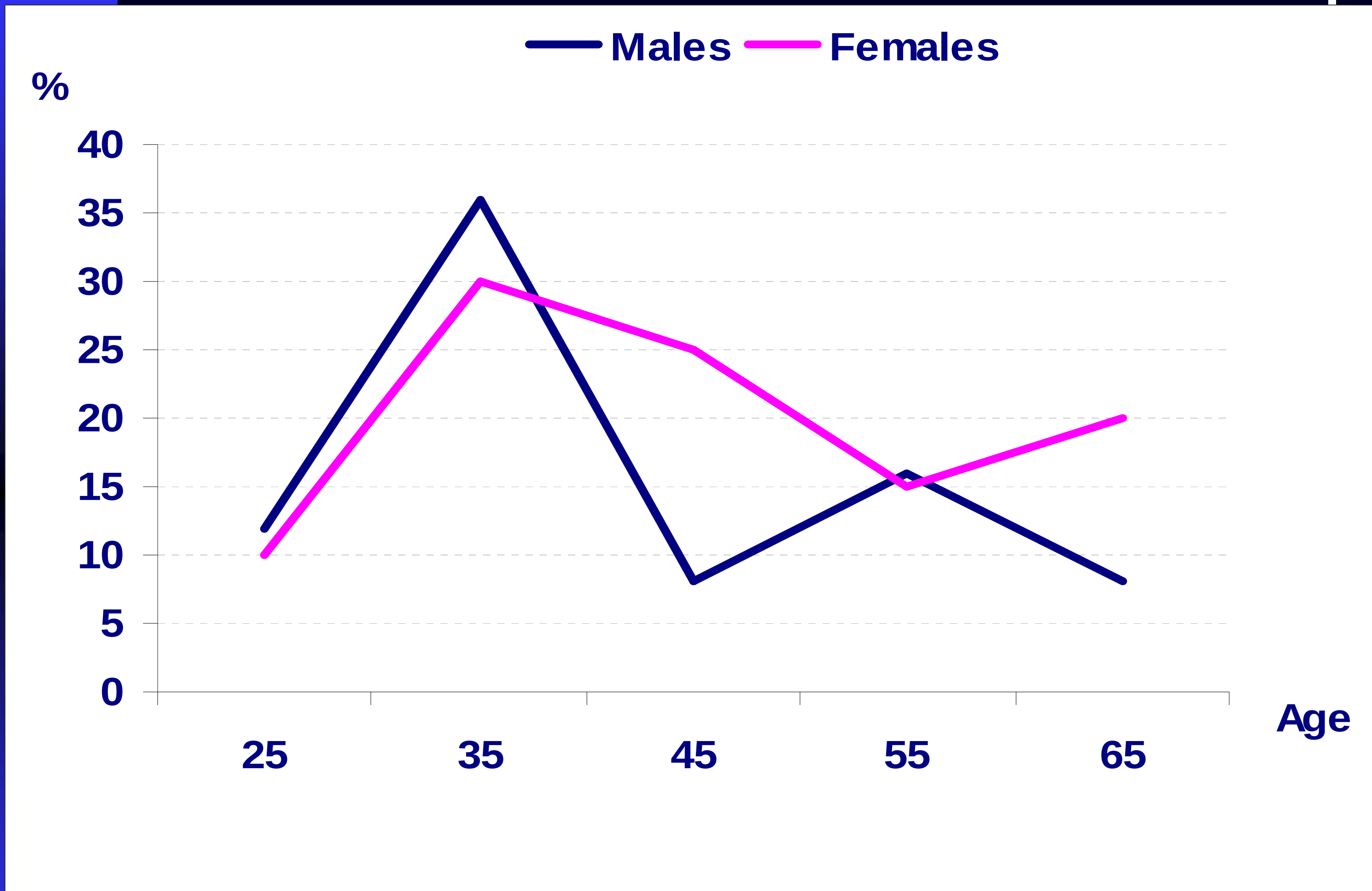
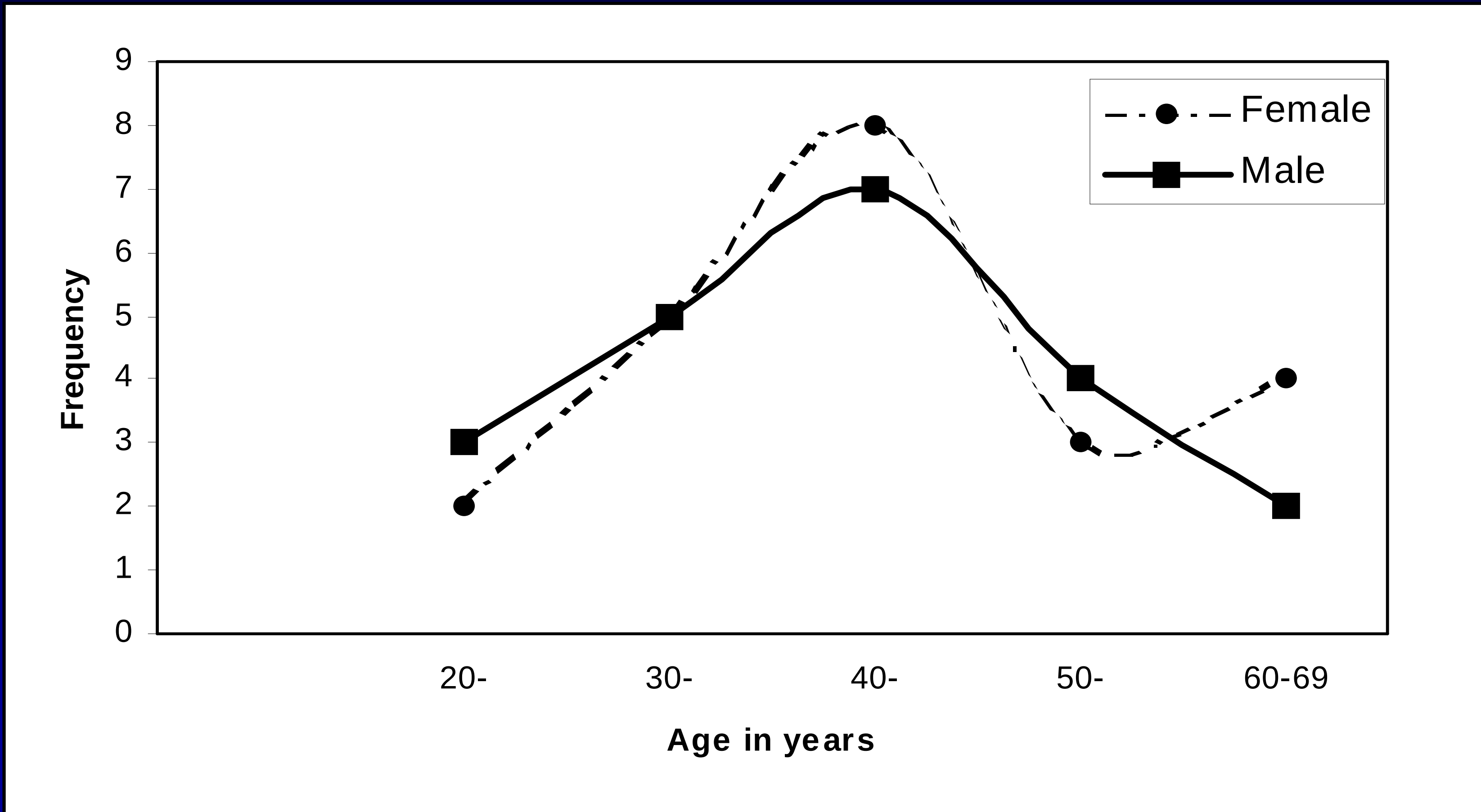


Figure (2): Distribution of 45 patients at (place) , in (time) by age and sex

Frequency curve



Histogram

Distribution of a group of cholera patients by age

Age (years)	Frequency	%
25-	3	14.3
30-	5	23.8
40-	7	33.3
45-	4	19.0
60-65	2	9.5
Total	21	100

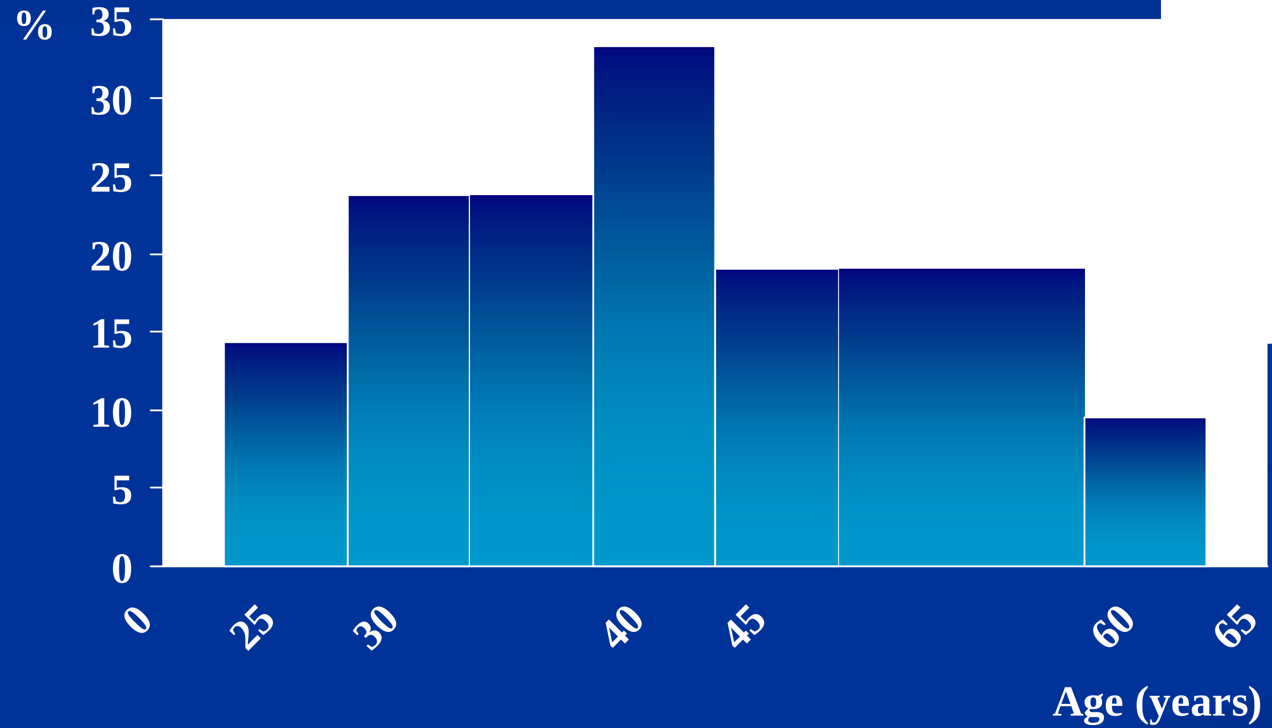
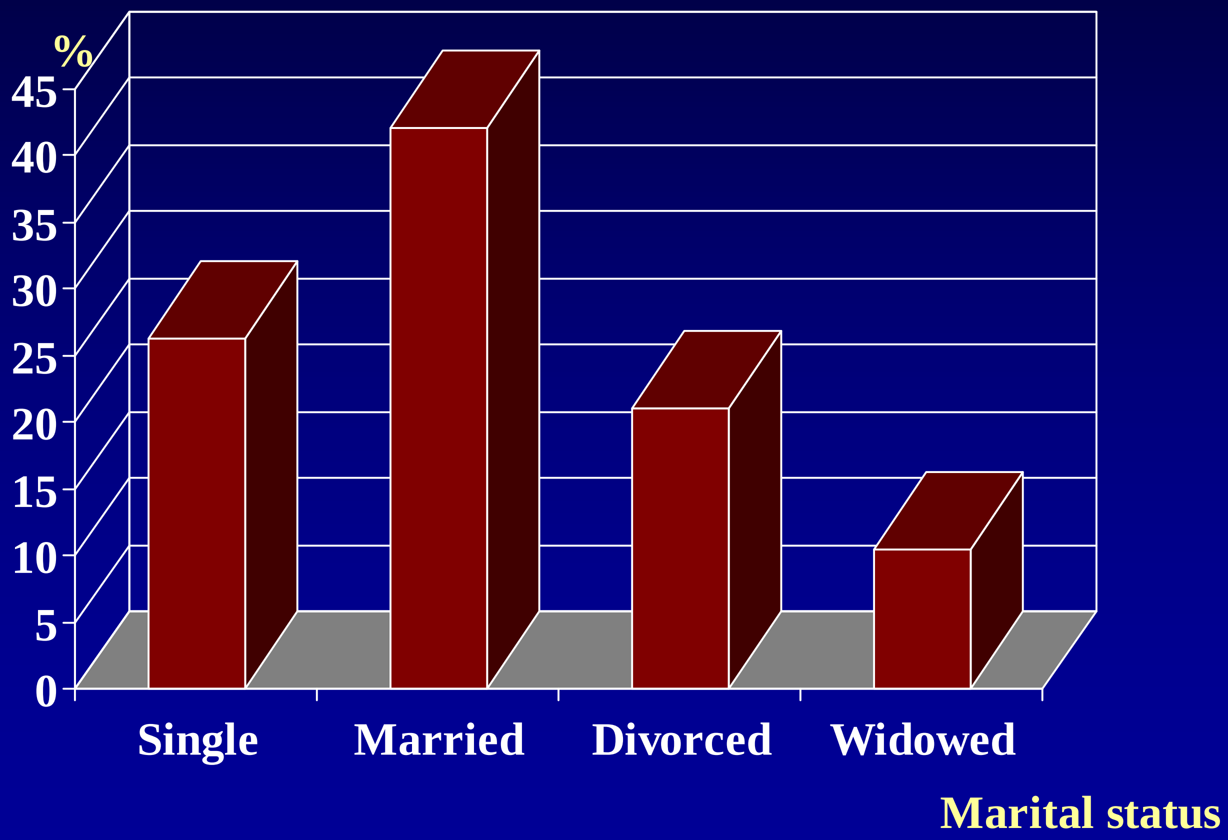


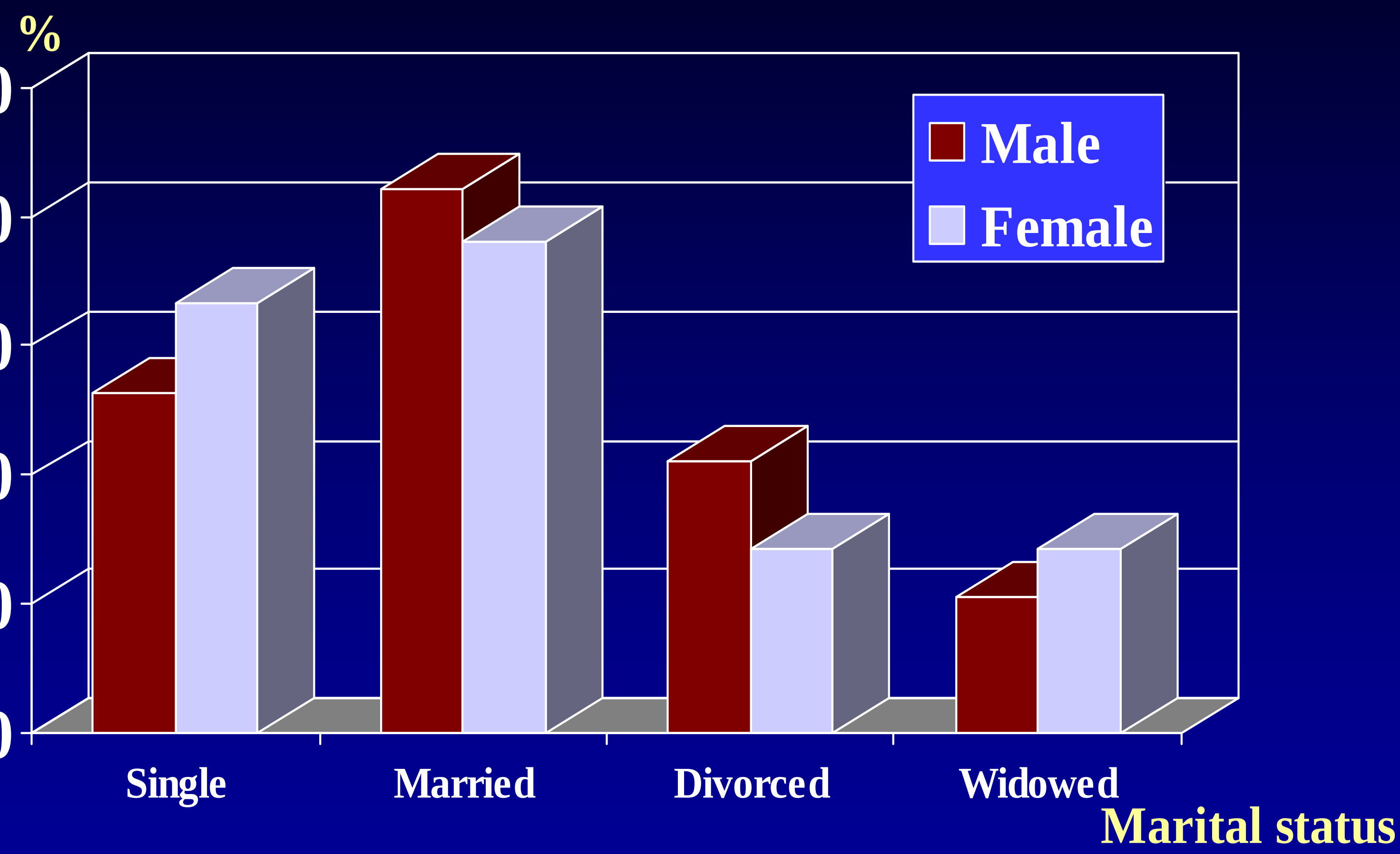
Figure (2): Distribution of 100 cholera patients at (place) , in (time) by age

Bar chart



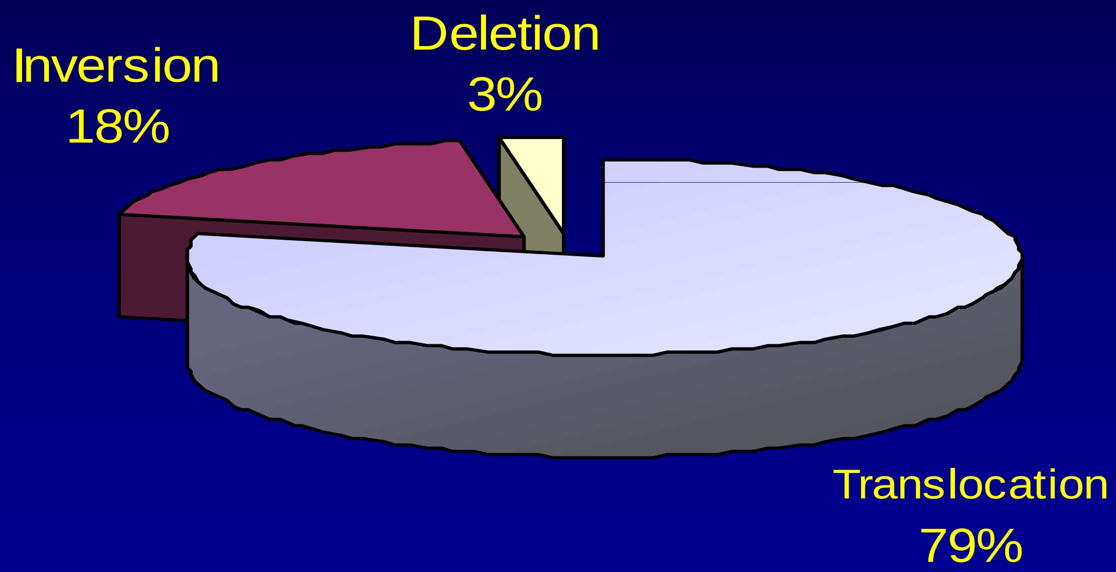
%
45
40
35
30
25
20
15
10
5
0
Single
Married
Divorced
Widowed
Marital status

Bar chart

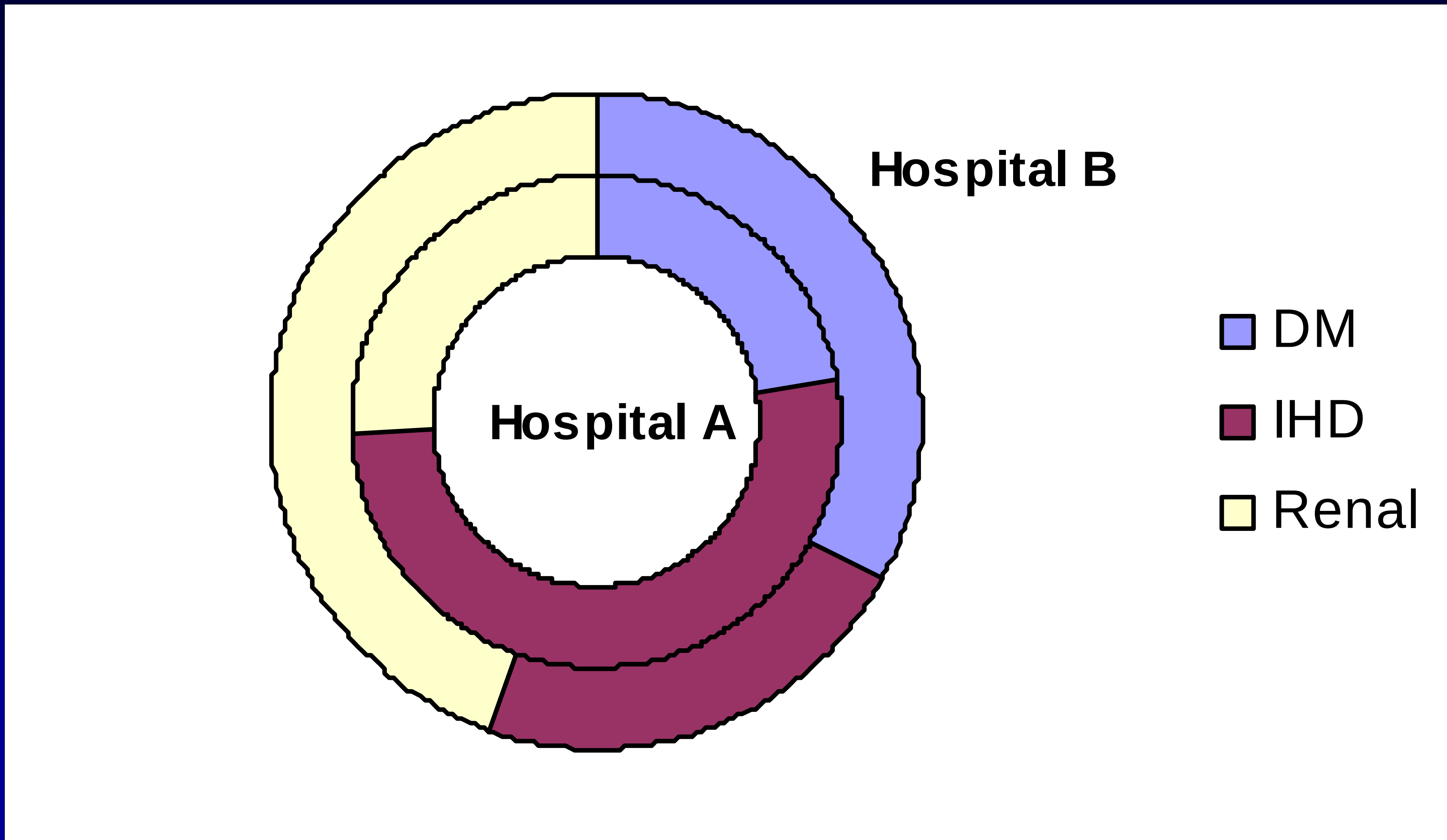


%
50
40
30
20
10
0
Male
Female
Single
Married
Divorced
Widowed
Marital status

Pie chart



Doughnut chart



3-Mathematical presentation

Summery statistics

- Measures of location

  1- Measures of central tendency

  2- Measures of non central locations

  (Quartiles, Percentiles)

- Measures of dispersion

Summery statistics

1- Measures of central tendency (averages)

- **Midrange**

$$\frac{\text{Smallest observation} + \text{Largest observation}}{2}$$

- **Mode**

  the value which occurs with the greatest frequency i.e. the most common value

Summery statistics

1- Measures of central tendency (cont.)

- **Median**

  the observation which lies in the middle of the ordered observation.

- **Arithmetic mean (mean)**

$$\frac{\text{Sum of all observations}}{\text{Number of observations}}$$

Measures of dispersion

- Range
- Variance
- Standard deviation
- Semi-interquartile range
- Coefficient of variation

- "Standard error"

Standard deviation SD

7 7
7 7 7
7

Mean = 7
SD=0

7 8
7 7 7
6

Mean = 7
SD=0.63

3 2
7 8 13
9

Mean = 7
SD=4.04

Standard error of mean SE

A measure of variability among means of samples selected from certain population

$$SE\ (Mean) = \frac{S}{\sqrt{n}}$$

Thank You

WELCOME

EPIDERMAL TISSUE SYSTEM

Prof : Adsul A. A.
Head,
Department of Botany

Introduction :

Define : Epidermis -

" The epidermal tissue system is the outer protective layer in a primary plant body the protecting inner tissue, the outer most covering of the plant organs is known as epidermis".

Epidermal tissue system : All the component of epidermis such as epidermis, epidermal outgrowth like glandular hairs, stomatal complexes and their, thickening are together referred to as epidermal tissue system.

Structure of Epidermal Tissue:

- The epidermis is a single layer of cells. The multilayered epidermis is found in Ficus and Nerium.

- The epidermis is the outermost layer in the different plant organs like root, stem, leaves etc.

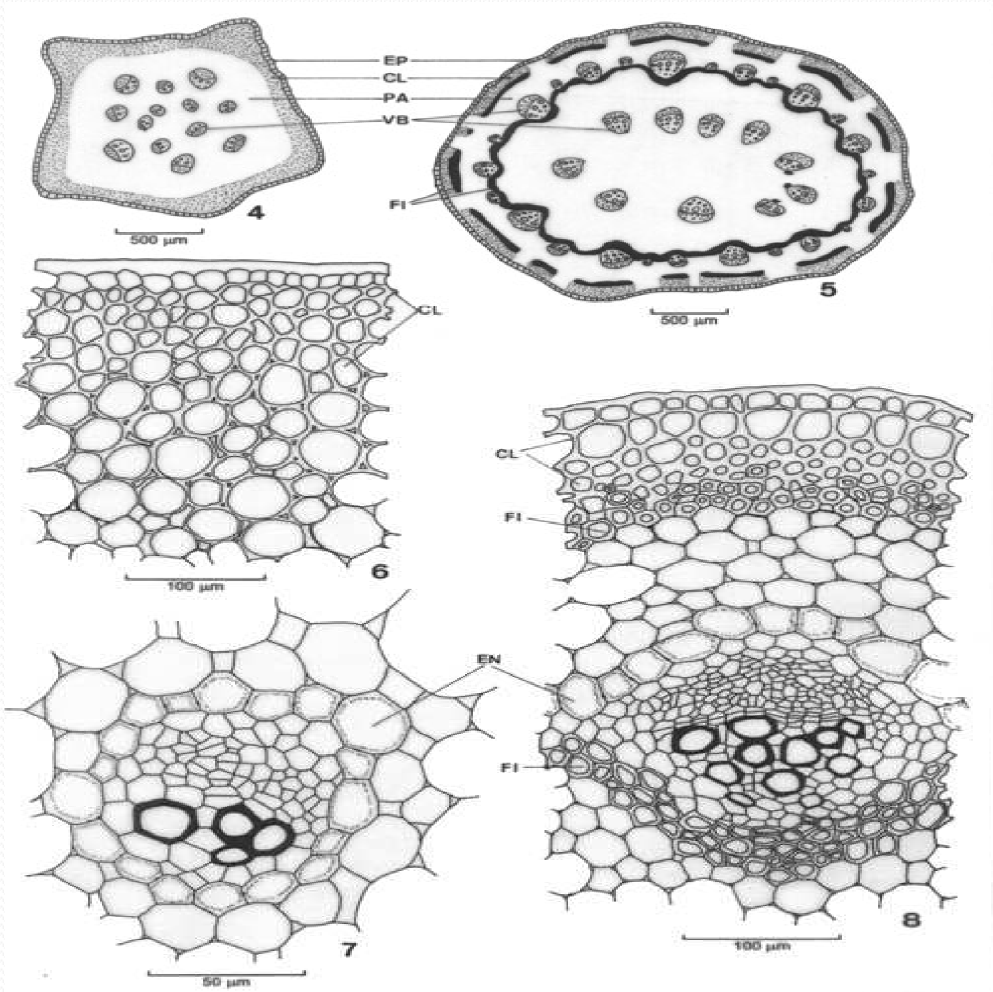
- The epidermis is different types of outgrowth on it.
  Ex. Trichome, Hairs etc.

- The epidermal cell appear polygonal in surface view in irregular in outline. They are found in various shapes in sizes, which are arranged very close to each other.

- Epidermal tissue system is two types :

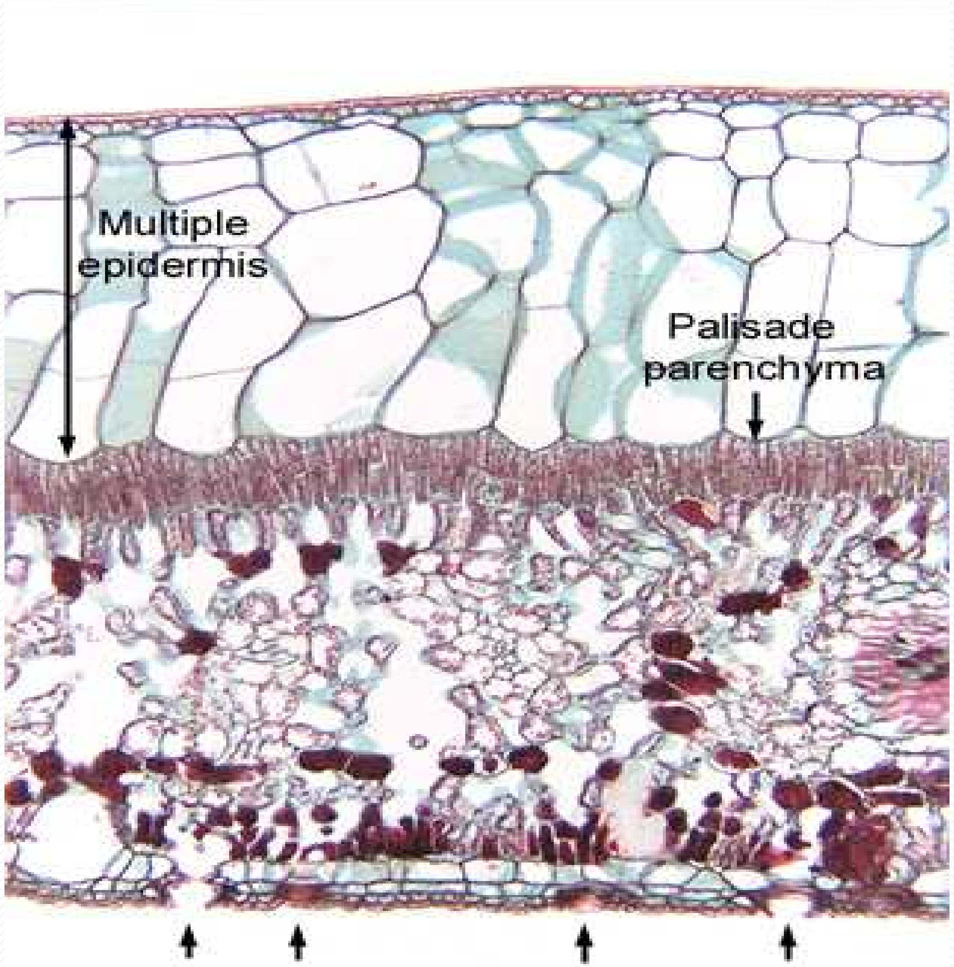
1. Uniserriate Epidermis :

- The epidermis usually consist of a single layer of cells.
- It is continues layer except for numerous small pores are called stomata and lenticells.



Multiple Epidermis (Multiserite) :

- The Multiple Epidermis occurs in the leaves of many plants like Nerium, Ficus, Bignonia etc.
- Epidermis is made up of three to five layers of cells.
- The upper Multiple epidermis of the leaf consist of 14-15 layers of cells.



Functions of Epidermal Tissue :

- The thickly cuticularised epidermis gives protection to the inner tissues from different external forces and provides resistance against insect and pathogen attack.
- The specialised cells help in water storage , unrolling of developing leaves and the opening and closing movements of mature leaves.
- It also helps in photosynthesis.
- It prevents excessive evaporation of water from the internal tissues.
- The mesophyll cells below and helps to reduce transpiration.

Stomata :

- The Stomata are minute natural Pore which occur on the aerial surface of plants.

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- Stomata Occurs on both upper and lower surface of the leaf.

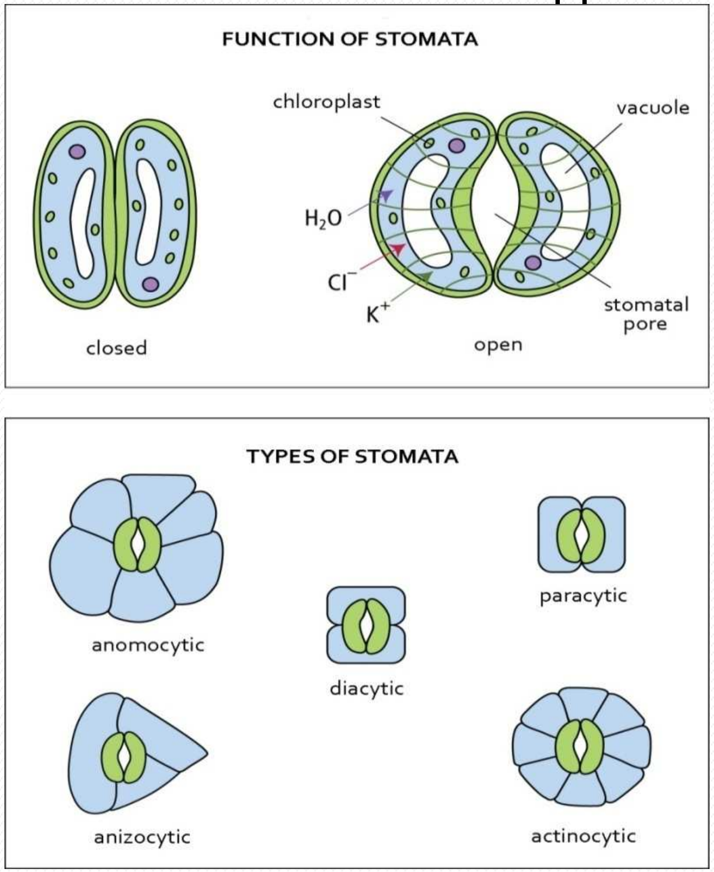


Fig : Dicotyledonus Stomata

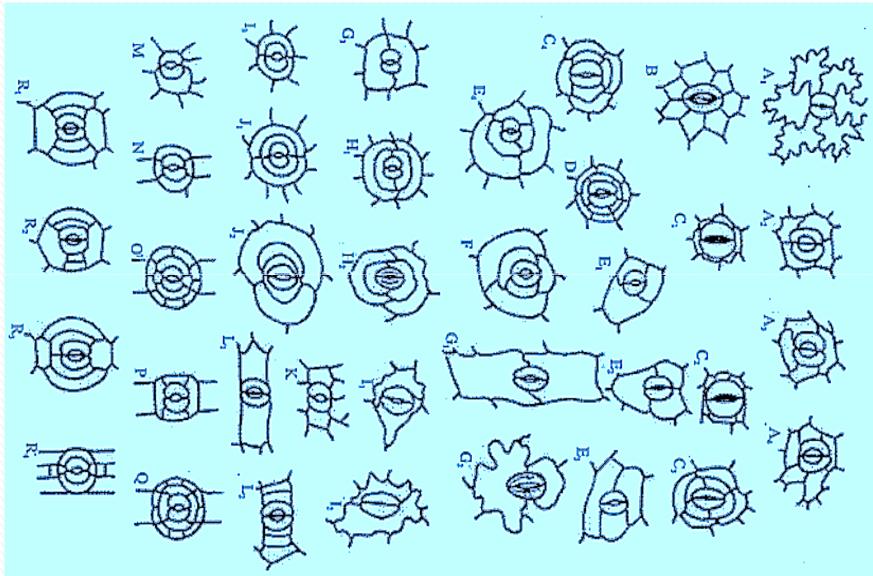


Fig : Monocotyledonus Stomata

Types of Stomata :

Stomata are Classified on the basis of development of guard cell and subsidiary cells are follows.

1. Mesogenous Stomata : The both Gurad cell and subsidiary cell are derived from a single meristemoid cell. Ex. Ruiaceae

2. Perigenous Stomata : The type of stomata the guard cell and subsidiary cell have independent origin ex : Cucurbitaceae.

3. Mesoperigenous Stomata : The subsidiary cells are dual origin. ex Caryophyllaceae.

The following types of stomata are commonly found in different plant groups,

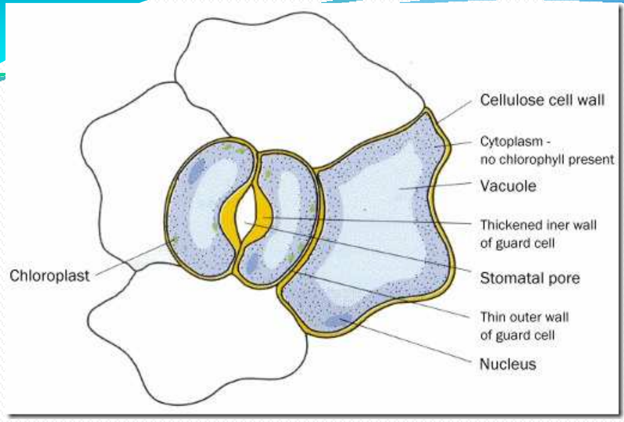
i) Anomocytic Type : The stomata remains surrounded by irregular subsidiary cell ex. *Ranunculus.*

ii) Anisocytic Type : The stomata remains surrounded by three subsidiary cell. Out of the three , one is distinctly smaller or larger in size than the other two cells. Ex. *Brassica*

iii.) Paracytic Type : The stomata remains surrounded by two subsidiary cell which are parallel to the long axis of the pore and the guard cells. Ex. *Ixora*

iv) Diacytic Type : The stomata remains surrounded by a pair of two subsidiary cell. ex. *Dianthus*

v) **Graminaceous Type :** The guard cells are dumb bell shaped or two attached ends are bulbs and the middle parts are much narrower . *ex. Grasses* .



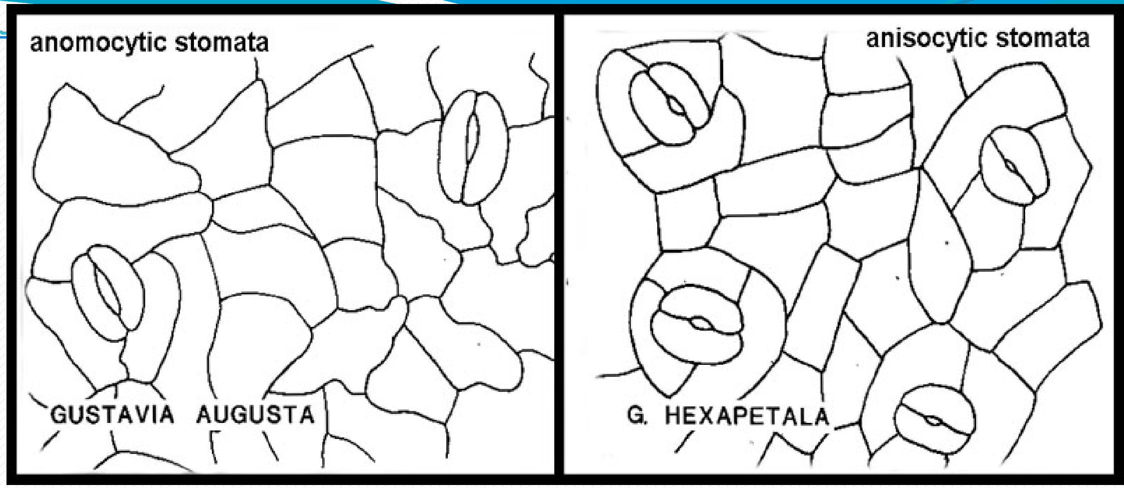


Fig : Anisocytic Type

Fig : Anomocytic Type

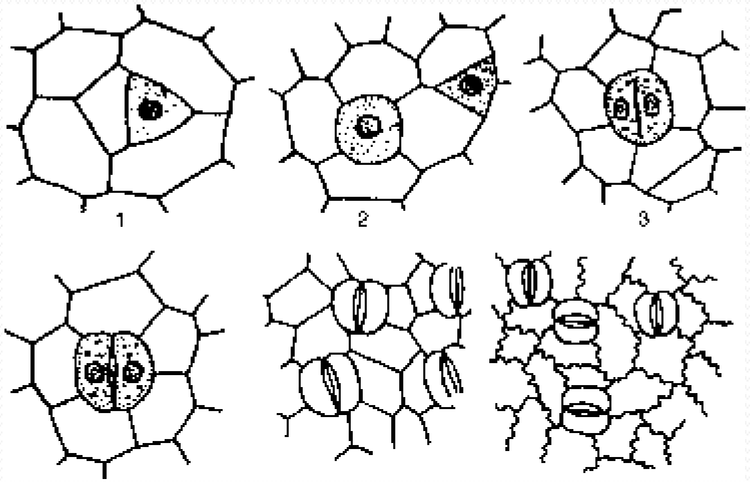


Fig : Paracytic Type

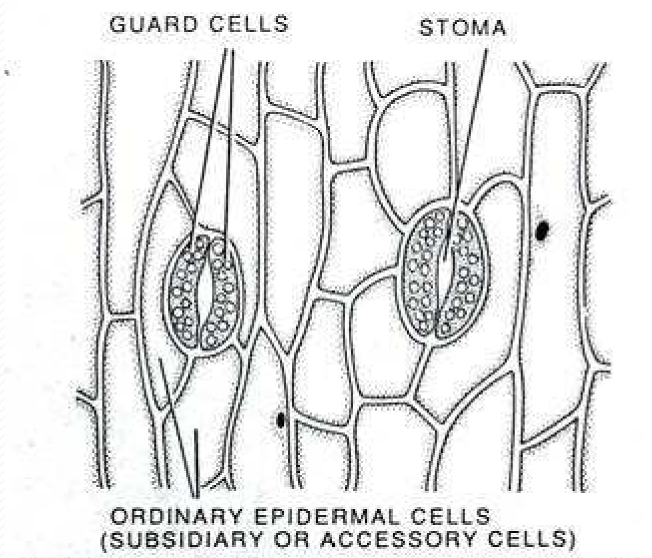


Fig. 37.10. Epidermis. Lower surface of leaf showing stomata.

Fig : Graminaceous Type

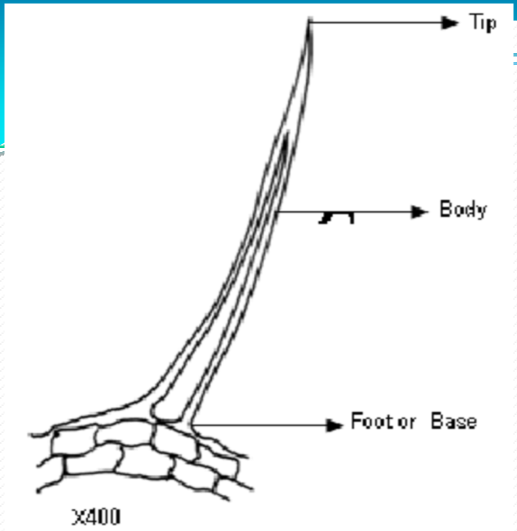


Fig. Unicellular Hair

Fig. Tufted Hairs

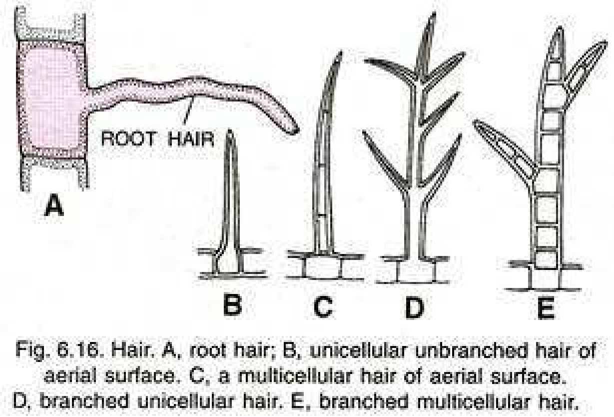


Fig. Branched Unicellular Hair

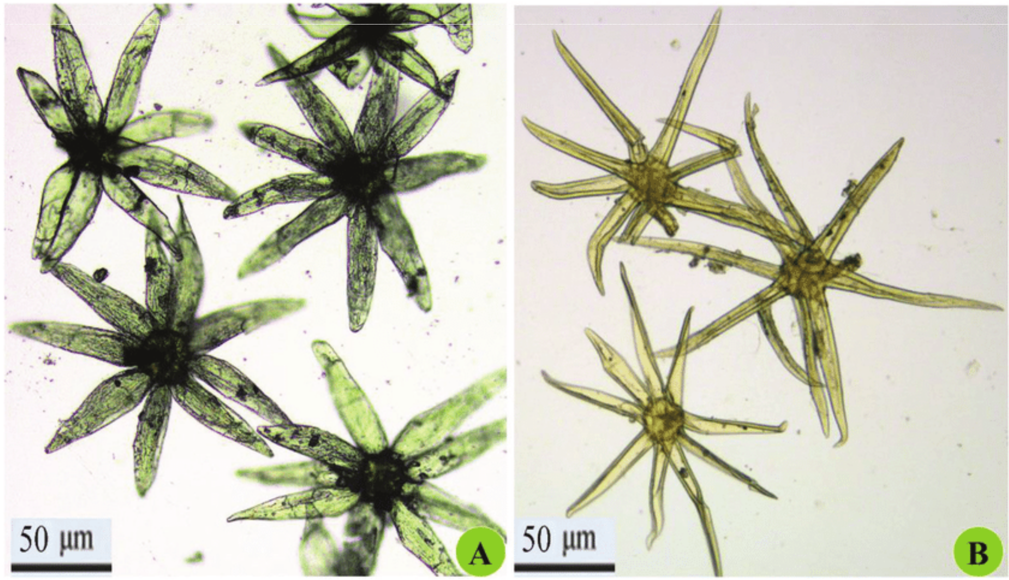


Fig. Stellate hairs

Vi) Coniferous Stomata :

- They are sunken in the epidermis .
- The walls of the guard cells and subsidiary cells are partly lignified and partly non- lignified. Ex . Pinus.

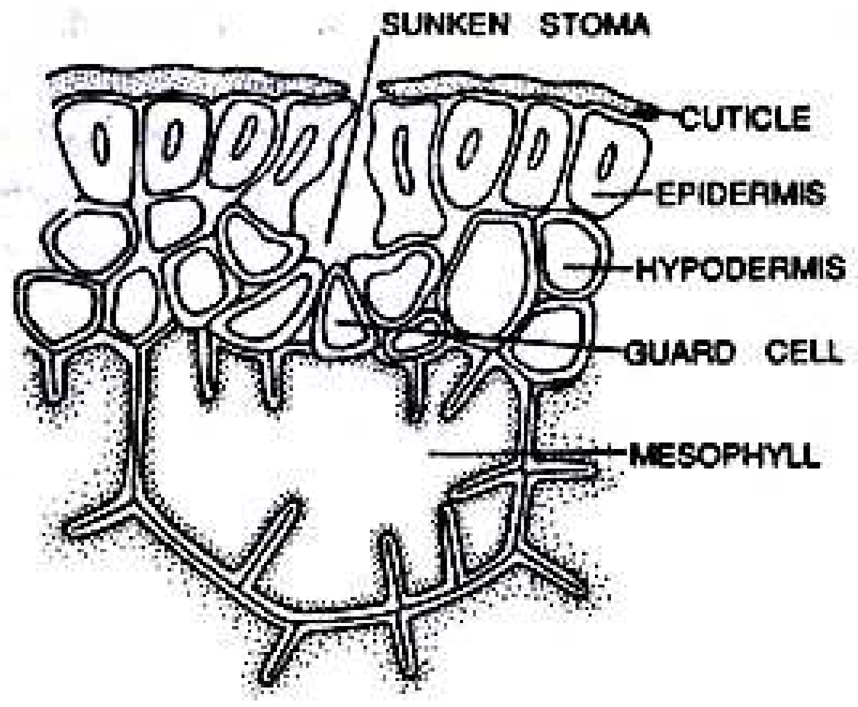


Fig. 37.16. Sunken stoma. Sectional view of a sunken stoma of pine leaf.

Epidermal outgrowth :

- The epidermal cells of most plant grow out in the form of hair or trichome.

- They may be unicellular or multicellular and occur in different forms.

- The cells of the hair may be living or dead.

- The hairs are of many types, Stinging hairs, Non-glandular hair ,glandular hair, stellate glandular hair, non-glandular peltate hair, glandular peltate hair etc.

Non –glandular hair :

- These are hair that originate from the epidermis. It has two regions , the basal part called foot and apical part called as body.
- Trichomea may be unicellular or multicellular . Trichome may occur on all parts of plant. Morphologically unicellular hair are categorised into the following

1.Unicellular unbranched

2..Unicellular branched

- Multcellular hair may consist of a single row of cells known as uniseriate.

Ex. *Lycopersicon*

- Multcellular hairs with more than one row of cell are known as multiserite.

  Ex. *Portulaca.*

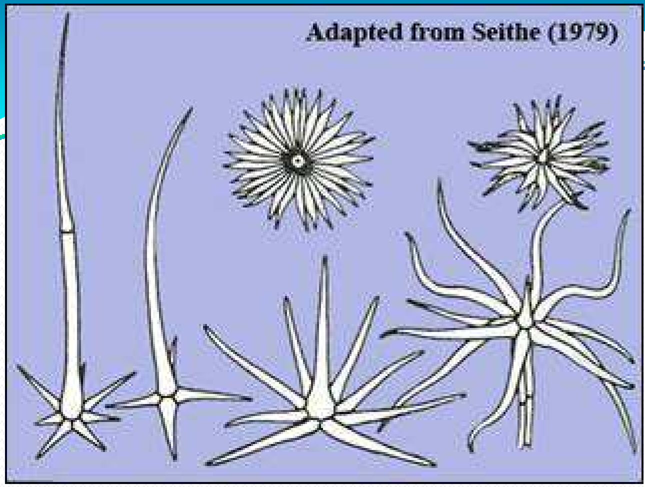


Fig. Stellate hairs

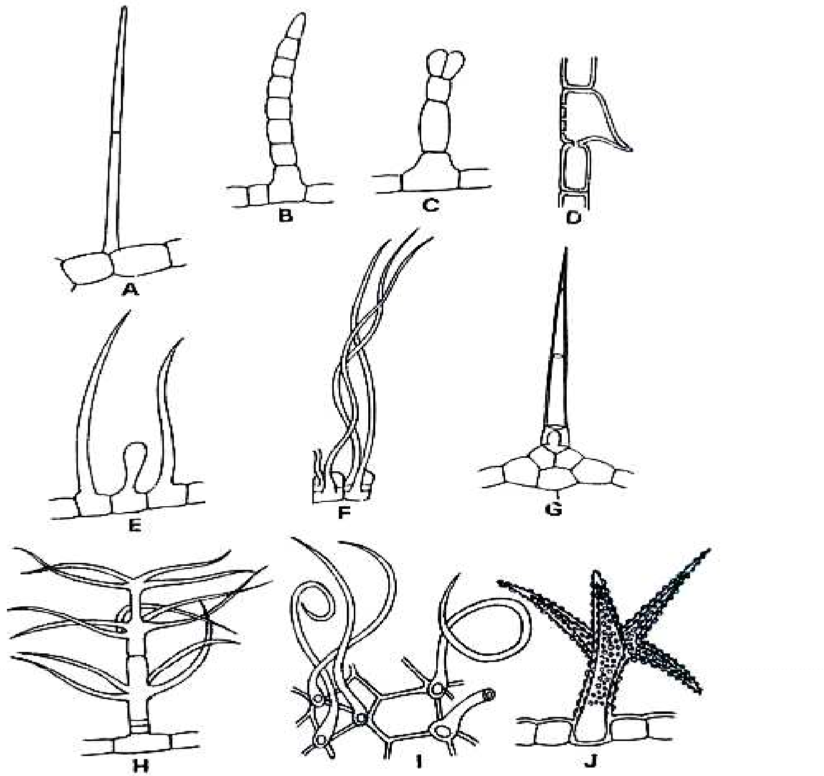


Fig. 37.21. Various types of trichomes (hairs). A, from petal of *Epigaea*; B, from leaf of *Coreopsis*. C, from petal of *Phryma*; D, from leaf of *Avena*; E, from sepal of *Heliotropium*; F, from stem of *Onopordum*; G, from *Cucumis* leaf; H, from *Platanus* leaf; I, from *Rubus* fruit; J, from *Aubrietia* stem. (After E. & M)

Fig. Multicellular Unbranched

Fig. Tufted hairs

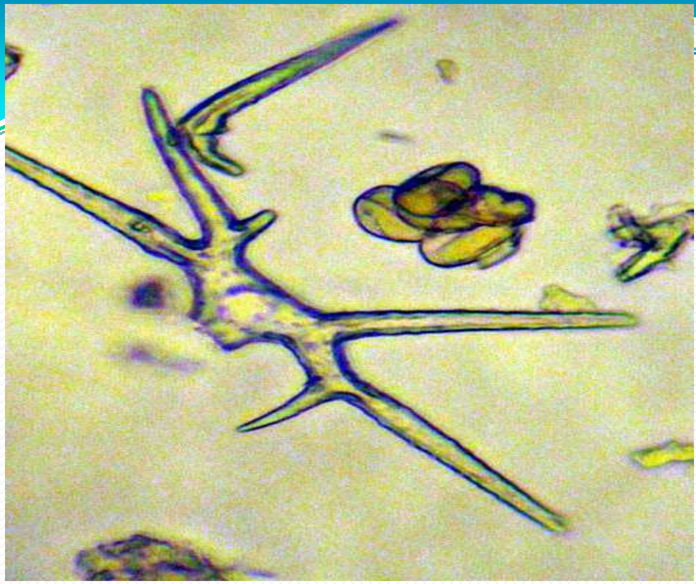


Fig. Unicellular Branched

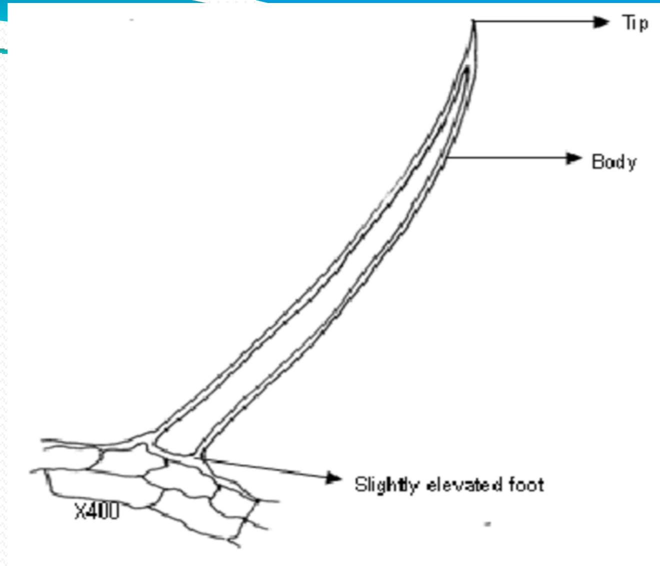


Fig. Unicellular Hair

Glandular hairs :

- The simple multicellular glandular hair consist of a stalk and a unicellular or multicellular head.
- The head of the hair is secretory in function.
- The head region is composed og glandular cells are arranged singly or in a group forming a palisade like layer.

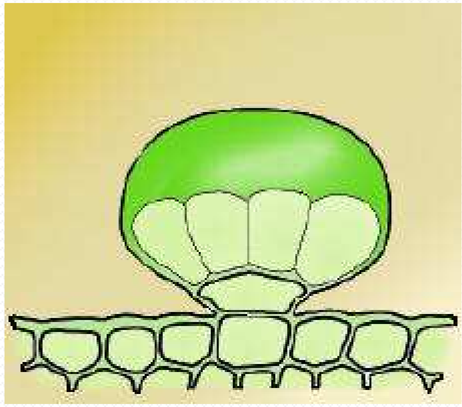


Fig. Peltate Hairs

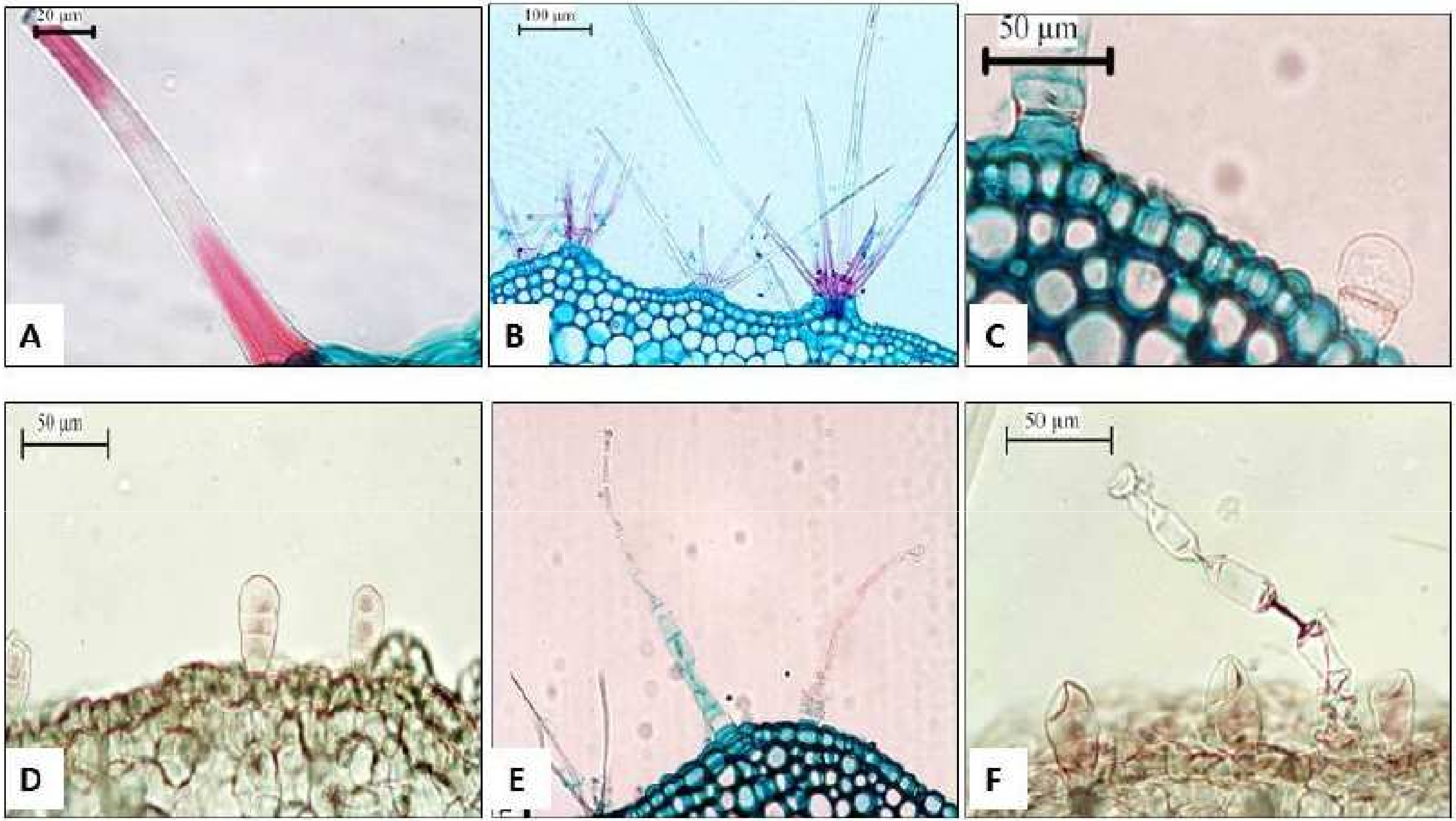


Fig. Multicellular glandular hair

THANK YOU

WELCOME

Prof : Adsul A. A.
Head,
Department of Botany

Microsporangium And Male Gametophyte

Introduction :

- The flower of angiospermic plant is a specialized shoot which bears accessory and essentional whorls.
- The accessory whorls include calyx and carrola whereas essentional whorls or reproductive whorls are androcieum and gynoecieum.
- Androcieum is the male reproductive whorl composed of many microsporophylls or stamens .each stamens consist of three parts i.e filament , anther , and connective.
- Anther is sac like organ bearing two lobes connected together by a connective . Each lobe of the anther bears two chambers which produce microspore or pollens is known as microsporangium.

Structure of Tetrasporangiate Anther :

- Anther has two anther lobe .A Cross section of the anther shows two chambers in each lobe , hence anther is known as tetrasporangiate anther.
- The Process of development of pollen grains from functional pollen mother cells is known as microsporogenesis.
- Each Microsporangium at an early stage possesses sporogenous tissue.which further give rise to microspore mother cell.
- Functional pollen mother cell which are diploid (2n) produce a mass of haploid (n).

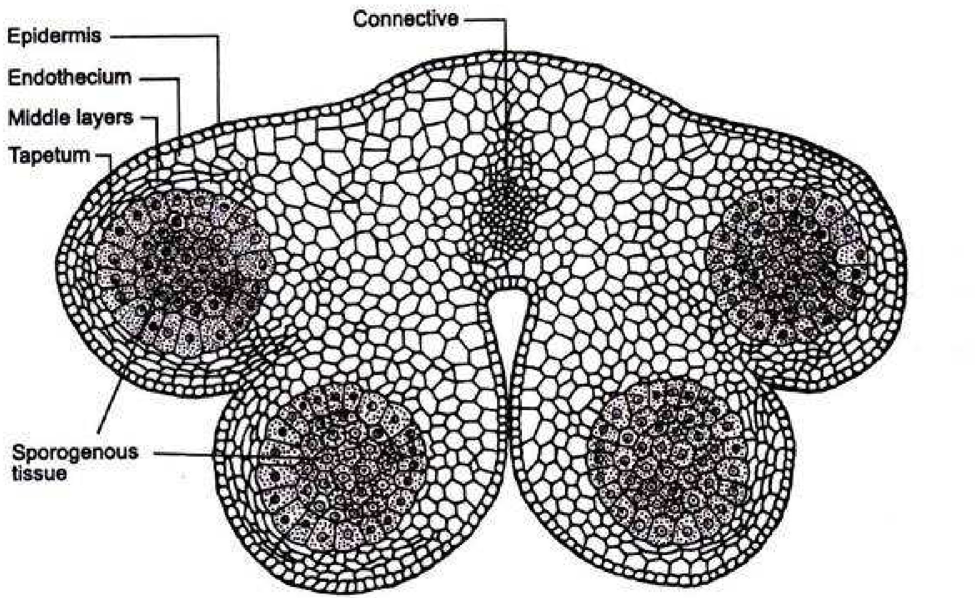


Fig. 1.1 : T.S. of the tetrasporangiate anther showing its various tissues

Wall of the Microsporangium :-

- Wall of the pollen sac is multilayered and differentiated into four region epidermis, endothecium, middle layers and tapetum.
- **Epidermis :** It is the outer most layer composed of a single layer of cell.
- **Endothecium :** It is a single layer of thin walled cells next to the epidermis.. Cells are radial
- **Middle Layer :** y enlarged with typical fibrous thicknings .
- wall layers next to the endothecium composed of thin walled flattened cells arranged in one or two layers are known as middle wall layers.
- **Tapetum :** It is the inner most layer of the microsporangium and is mainly composed of a single layer of large sized cells .

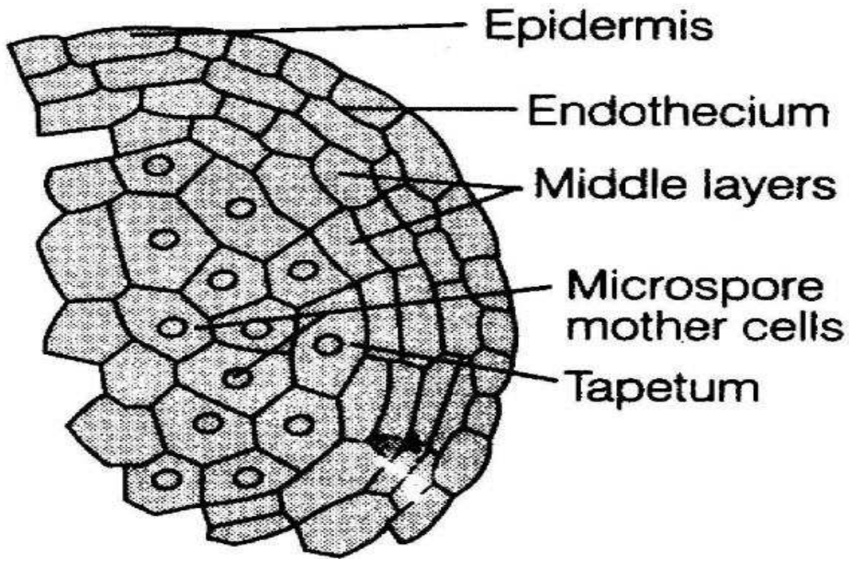


Fig . Wall of Microsporangium.

Cytokinesis and types :

Cytokinesis is a process of formation by partition wallls between the four haploid microspores to form of a microspore tetrad . Walls formation after the meiotic division in pollen mother cells is of two types.

I. Successive Type :

WELCOME

Stat. 2411 Statistical Methods

Chapter 4. Measure of Variation

Prof. Adsul A. A.
Head,
Department of Botany

4.1 The Range

- Difference between the largest and smallest values

3, 4, 6, 2, 1, 9

→

1, 2, 3, 4, 6, 9

Range=9-1=8

4.2 Variance and Standard Deviation

For a population with values

$x_1, x_2, \ldots \ldots, x_n$

The center is the population mean

$$\mu = \frac{\sum x_i}{n}$$

The deviations from the mean are

$$x_1 - \mu, x_2 - \mu, \cdots, x_n - \mu$$

Consider the population – Diameters of all ball bearings produced by machine: $x_1, x_2, \ldots \ldots, x_n$

Let μ = population mean   n = population size

Then

$$\mu = \sum_{i=1}^{n} x_i \Big/ n$$

σ^2 = population variance

$$\sigma^2 = \text{ mean of } (x - \mu)^2 = \sum_{i=1}^{n} (x_i - \mu)^2 \Big/ n$$

Average squared deviation from mean

σ = population standard deviation

$$\sigma = \sqrt{\sigma^2}$$

Many calculators have a function for σ_x

Sample variance

- For a sample of size n, the sample variance is

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2$$

- Why divide by n -1? This makes s^2 an unbiased estimator of σ^2 . Unbiased means on the average correct.

Suppose we have a large population of ball bearings with diameters μ=1cm and

$$\sigma = 0.02 \quad \sigma^2 = 0.0004$$

Sample	$\overline{x}$	s^2
1	0.98	0.00032
2	1.03	0.00031
3	1.01	0.00045
4	1.02	0.00052
.	.	.
.	.	.
∞	------	--------
Mean	1.00	0.0004

If we knew μ we would find $\hat{\sigma}^2 = \sum_{i=1}^{n} (x_i - \mu)^2 \Big/ n$

Fact

$$\min \sum (x_i - m)^2 = \sum (x_i - \overline{x})^2$$

So $\sum (x_i - \overline{x})^2 \le \sum (x_i - \mu)^2$ and $\dfrac{\sum (x_i - \overline{x})^2}{n}$ would be too small for σ^2.

Dividing by n-1 makes s^2 come out right (σ^2)on average.

Sample Standard Deviation

Variance:

$$s^2 = \frac{\sum (x_i - \overline{x})^2}{n-1}$$

Standard Deviation:

$$s = \sqrt{\frac{\sum (x_i - \overline{x})^2}{n-1}}$$

The standard deviation (*s*) measures spread (or variation) by looking at how far observations are from the mean.

Example

On an exam I might ask you to write a numerical expression for s for the data for the sample.

$$x_1 = 8 \qquad x_2 = 9 \qquad x_3 = 4$$

$$\bar{x} = \frac{8+9+4}{3} = 7$$

$$s^2 = \frac{(8-7)^2 + (9-7)^2 + (4-7)^2}{3-1} = \frac{14}{2} = 7$$

$$s = \text{Sample standard deviation}$$

$$= \sqrt{7} = 2.65$$

$$s = \sqrt{\frac{(8-7)^2 + (9-7)^2 + (4-7)^2}{2}}$$

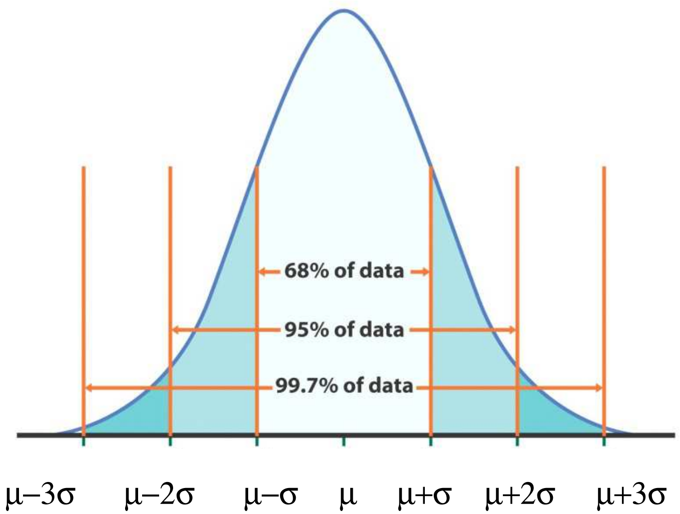
Choosing Measures of Center and Spread

- Use the mean & standard deviation for “bell-shaped” distributions, where data are symmetric and the average score is typical, i.e. no outliers.

- Use the five number summary (Min, Q1, Median, Q3, Max) for skewed data where very large or small observations make the mean less representative and to highlight the range of outliers.

4.3 Application of the Standard Deviation

- Chebyshev's Theorem – skip
- For bell – shaped histograms (or approximately normal distributed, we will talk more about this later)



Approx. 68% of the obs. are between $\mu \pm 1\sigma$
Approx. 95% of the obs. are between $\mu \pm 2\sigma$
Approx. 99.7% of the obs. are between $\mu \pm 3\sigma$
The same is true for s and $\bar{x}$

Standardizing Observations – z-scores

If we measure in units of size σ, about the mean μ, we can transform our data to standard units: # of standard deviations from average.

This is called *standardizing*.

So if x is an observation from a data set that has mean μ and standard deviation σ, the standardized value of x is

$$z = \frac{x - \mu}{\sigma}$$

A standardized value is often called a z-score.

Example

In the US, the systolic blood pressure of men aged 20 has mean 120 and standard deviation 10.

1) We can expect 95% of our observations fall within

2) The systolic bp of a 20-yr old man is 130. Find the z-score for his bp:

Exercise 1: The Standard Deviation (*s*)

26 systolic blood pressure

108	134	100	108	112	112	112	122	116
116	120	108	108	96	114	108	128	114
112	124	90	102	106	124	130	116	

$\overline{X} =$ 113.08 mm Hg

Exercise 2: z-score

In the US, the systolic blood pressure of men aged 20 has mean 120 and standard deviation 10.

Q1. what proportion of the bps have a value outside the range 110 to 130?

Q2. What is the z-score of a blood pressure value of 100?

Thank You

Evidence for Evolution

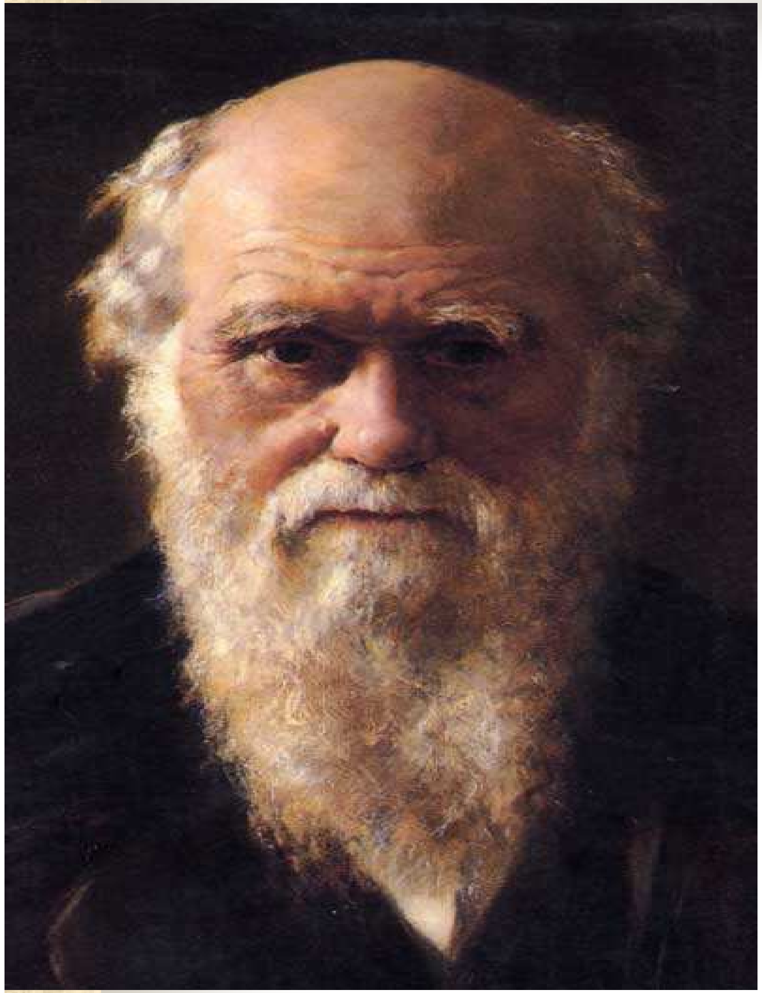
Prof. S.R. Lanke

Department of Botany

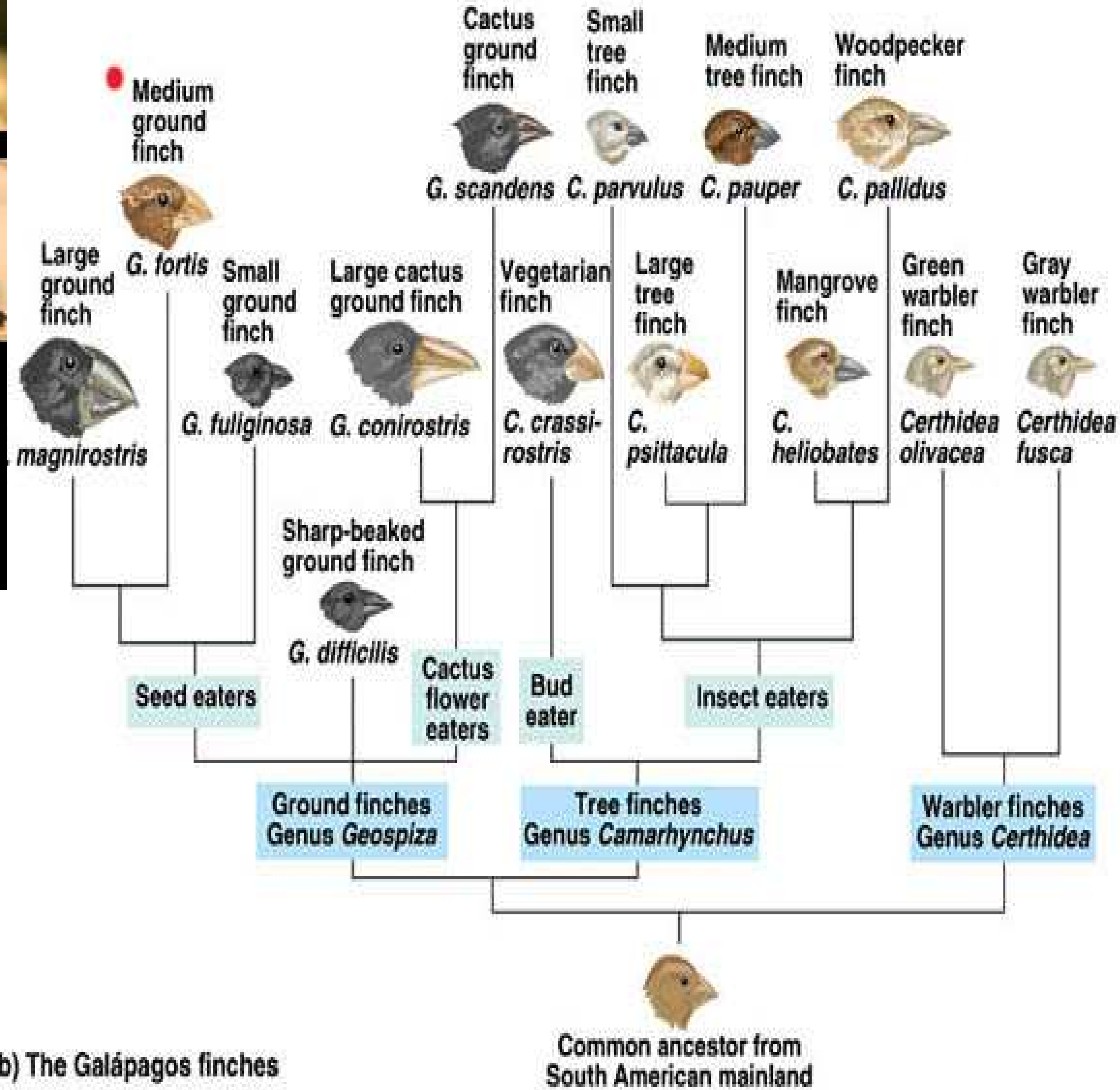
Major Evidence for Evolution

- Fossil record
- Homologous structures
- Vestigial structures
- Biochemical evidence
- Embryological development

Charles Darwin



- 1859 – “*Origin of Species*” published
  1. Argued from evidence that species inhabiting Earth today descended from ancestral species
  2. Proposed a mechanism for evolution → Natural Selection
- Many scientists helped pave the way for Darwin’s Theory



(b) The Galápagos finches


Galapagos Islands
Ecuador
SOUTH AMERICA

Theory of Evolution By Natural Selection

- In each generation of a species, individuals have slight differences.
- Sometimes these variations make an individual more successful in its environment

- (more food, live longer, reproduce more, attract better mates). Then individual may then reproduce and pass this variation on to its offspring.
- Then the individual may reproduce and pass this variation on to its offspring.

Natural Selection

- Variations in individuals are controlled by genes.
- Individuals have no control over what variations they will have.

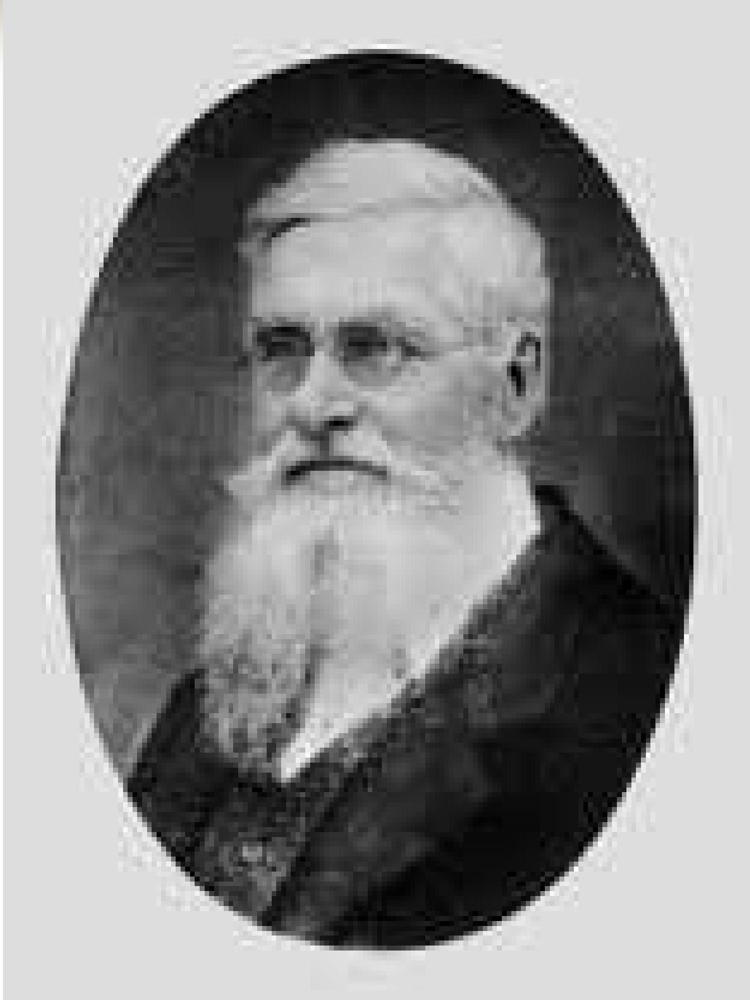
- Useful variations are NOT ALWAYS passed on.
- Variations that are not useful may also be passed on.

Alfred Russel Wallace

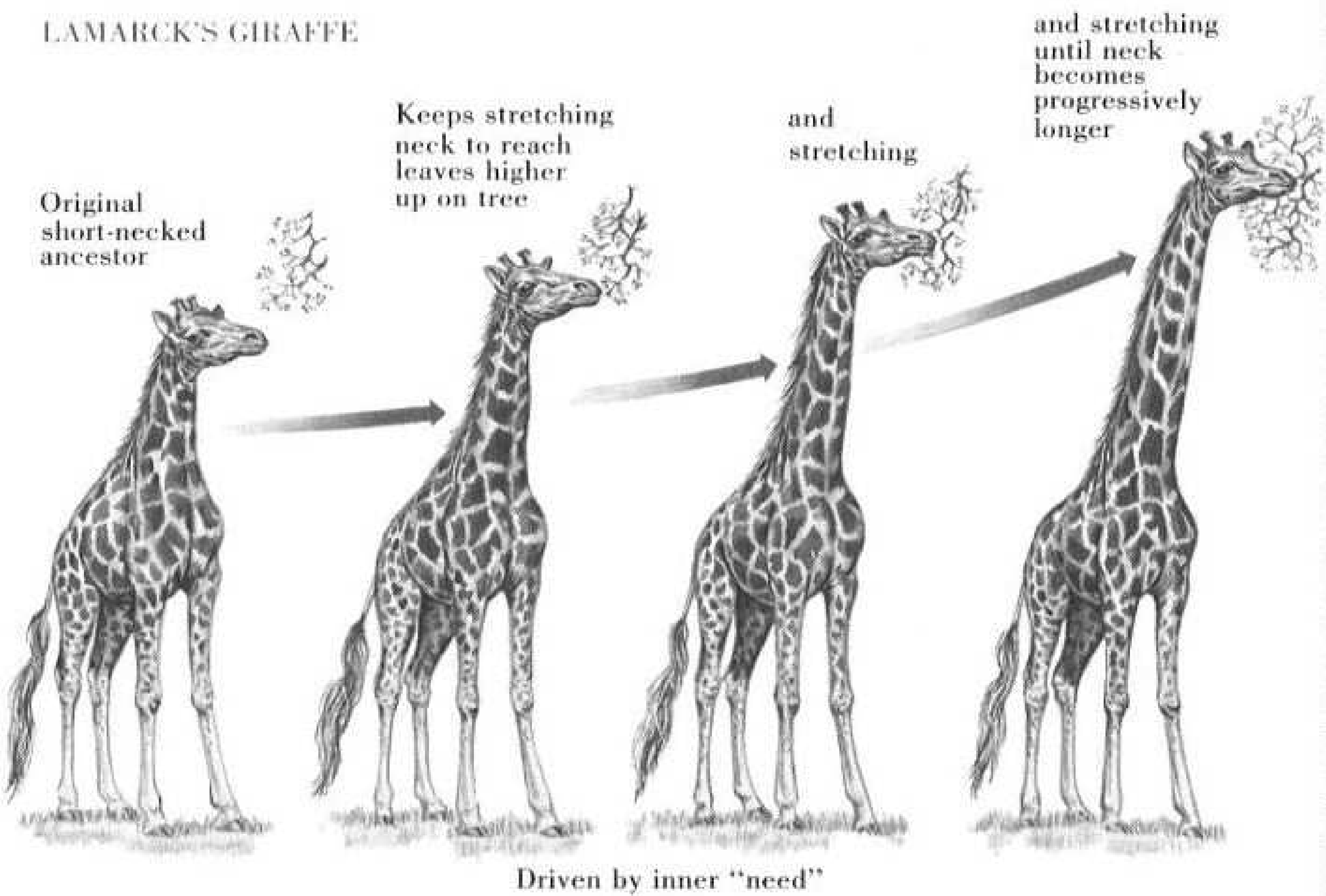
- co-discovered natural selection and prompted Darwin to finally rush his *Origin of Species* to press.

- One of the modern world's greatest scientific adventurer explorers
  - eight-year exploration of Southeast Asia and the Malay Archipelago he wrote *The Malay Archipelago* in 1869,
- *Geographical Distribution of Animals* (1876) is one of the seminal works in the field.

- the workhorse of Darwinian evolution, diverged from Darwin's methodological naturalism (i.e., the notion that scientists *must* invoke *only* natural processes functioning via unbroken natural laws in nonteleological ways) to propose a theory of evolution defined by intelligence and design.



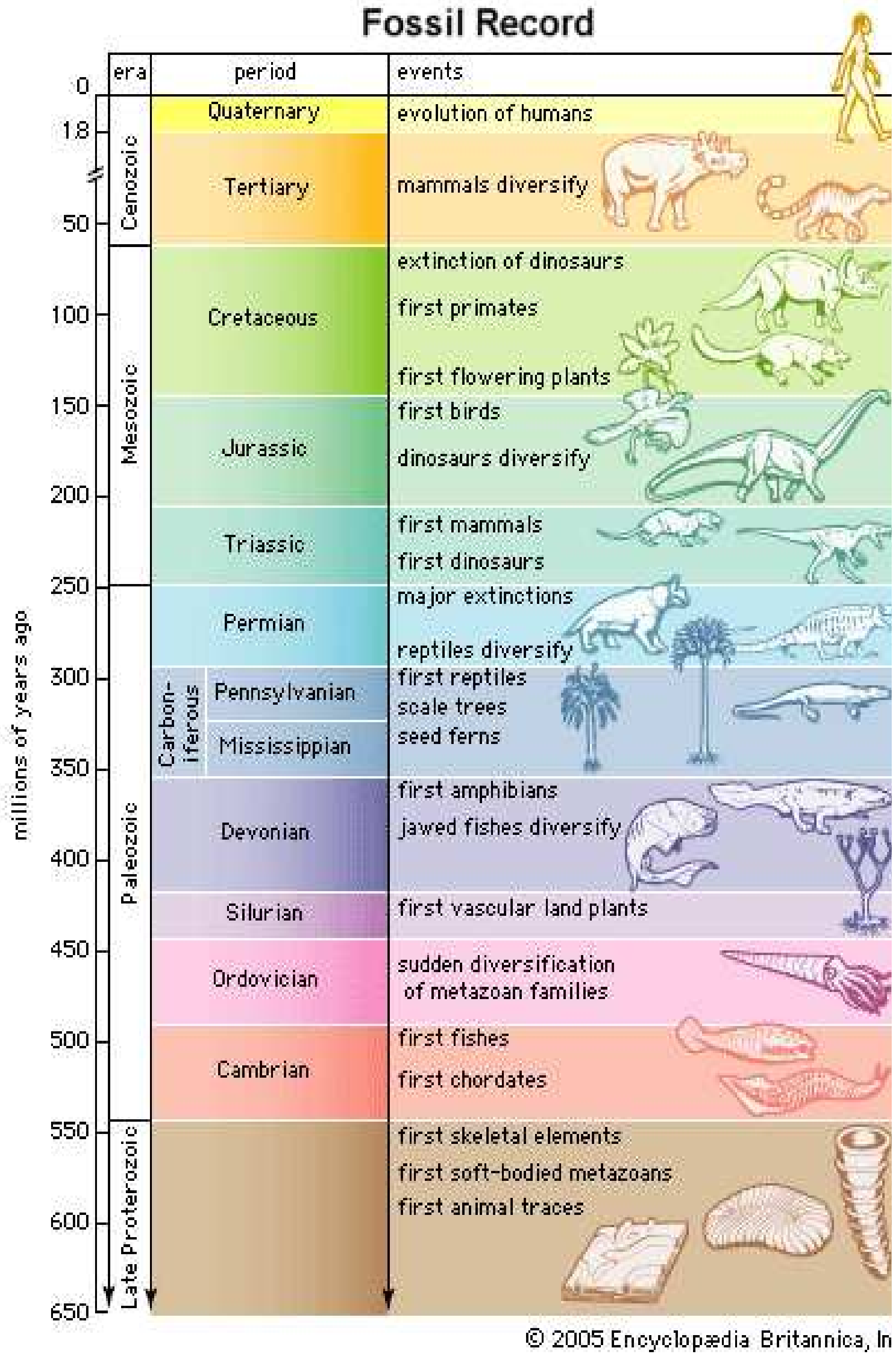
Jean Lamarck



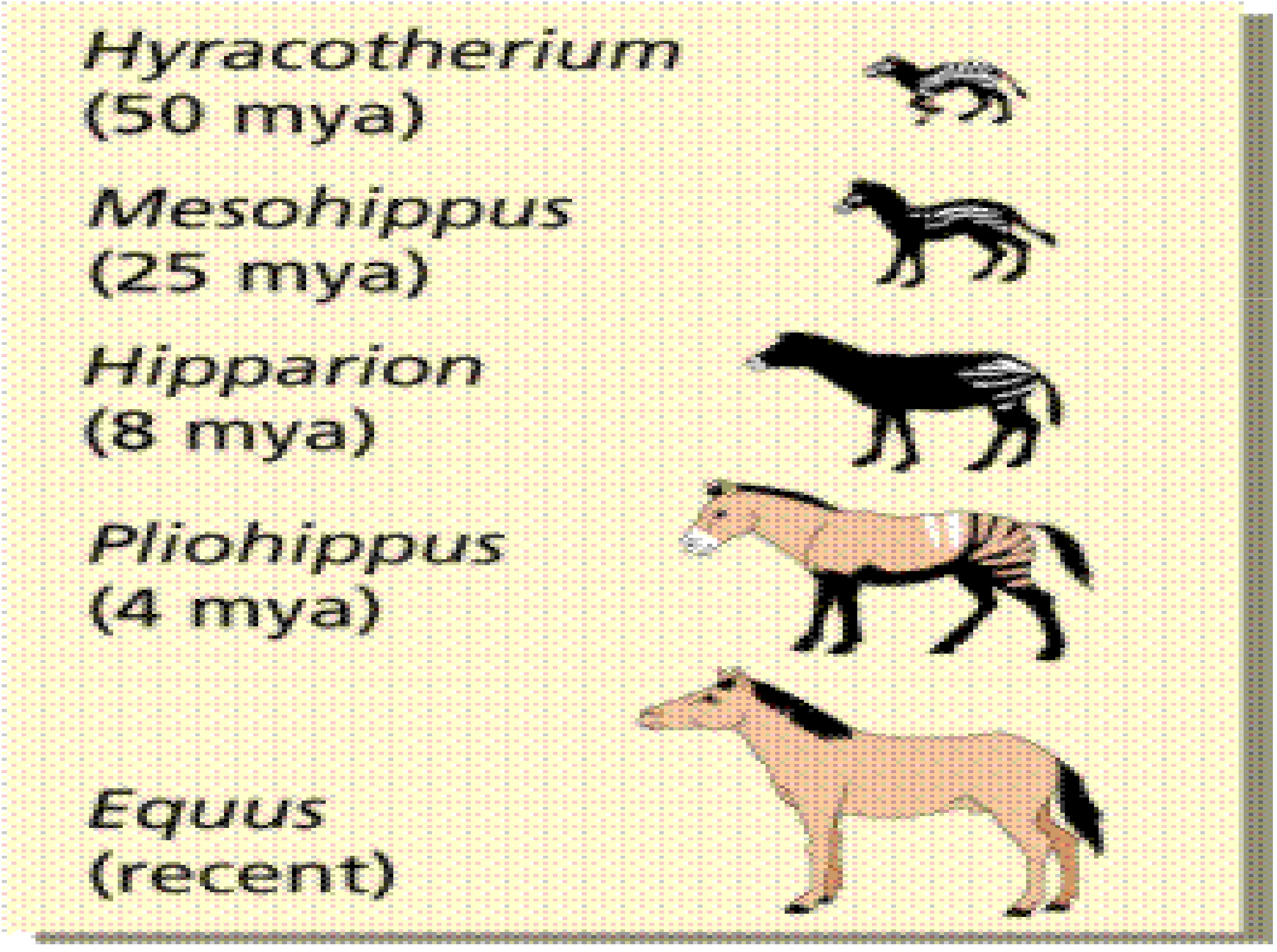
1. Fossil Record

- What does the Fossil Record tell us about organisms?
  - Looks (size, shape, etc.)
  - Where or how they lived
  - What other organisms they lived with

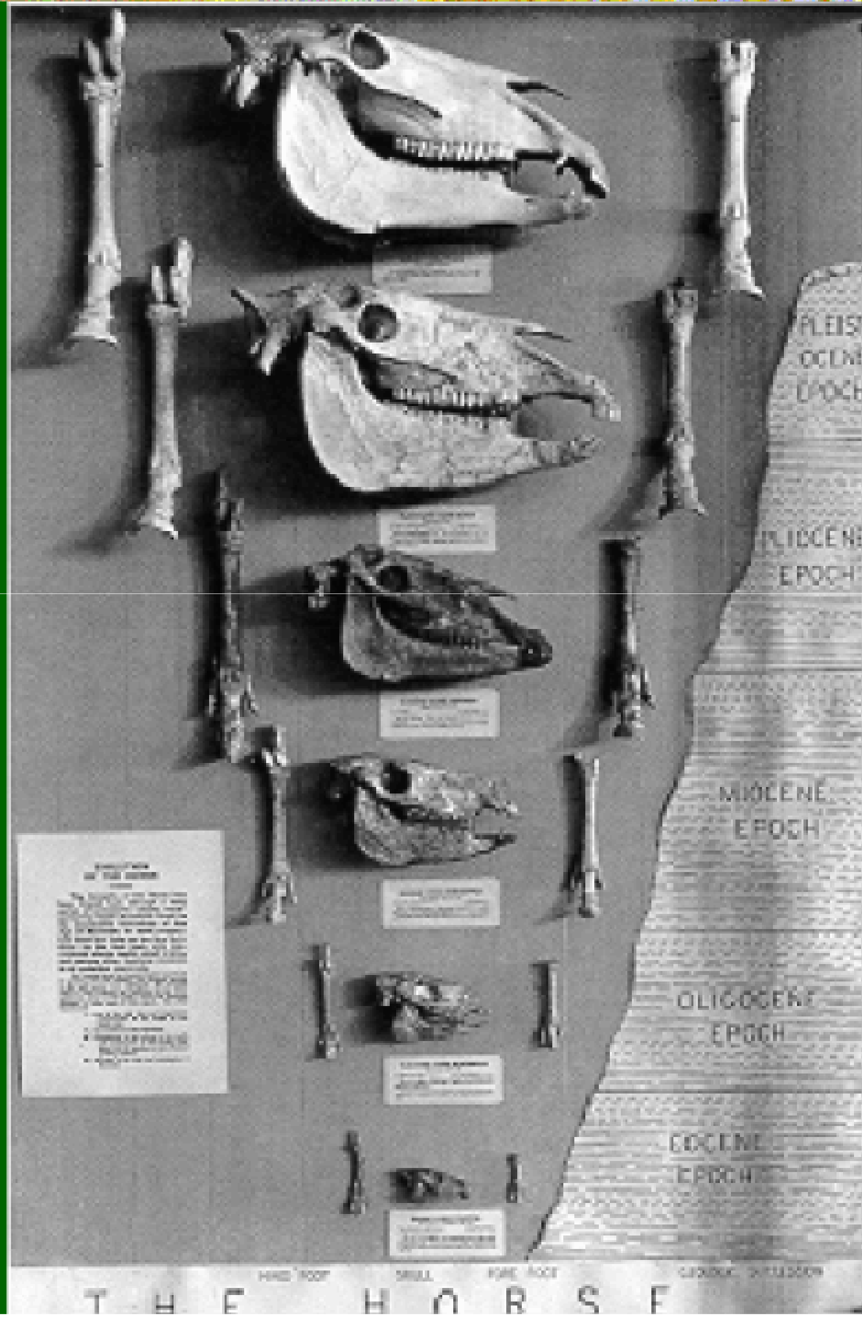
- What time period they lived in (based on location in rock layers)
- What order living things came in (based on location in rock layers)
- Transitional forms
  - Organisms that were intermediate (between) two other major organisms



Example: Horse

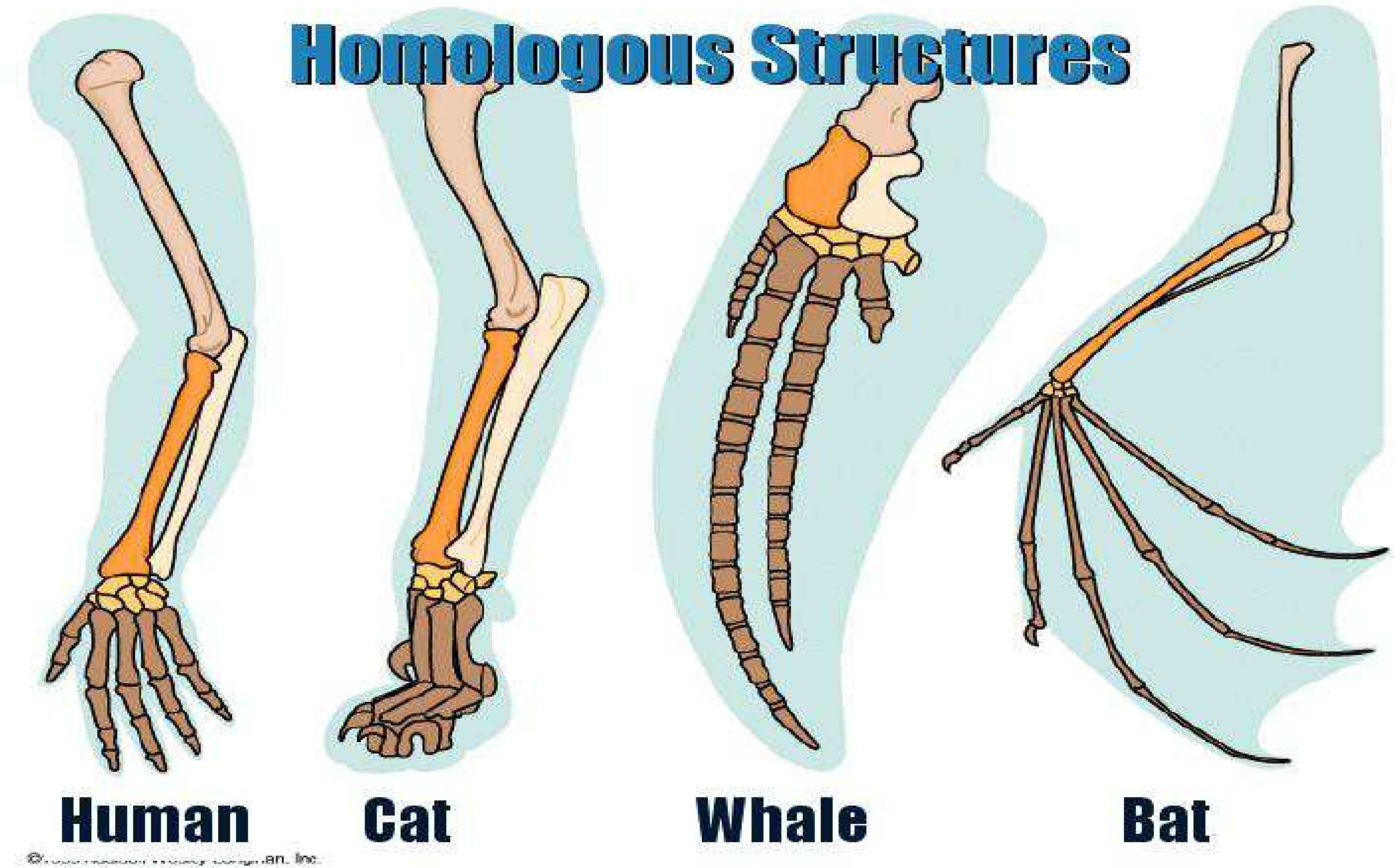


American Museum of Natural History. An exhibit from old mammal halls showing simplistic version of the evolution of the horse. Fossils are arranged chronologically, from oldest to youngest fossil. From Dingus (1996).

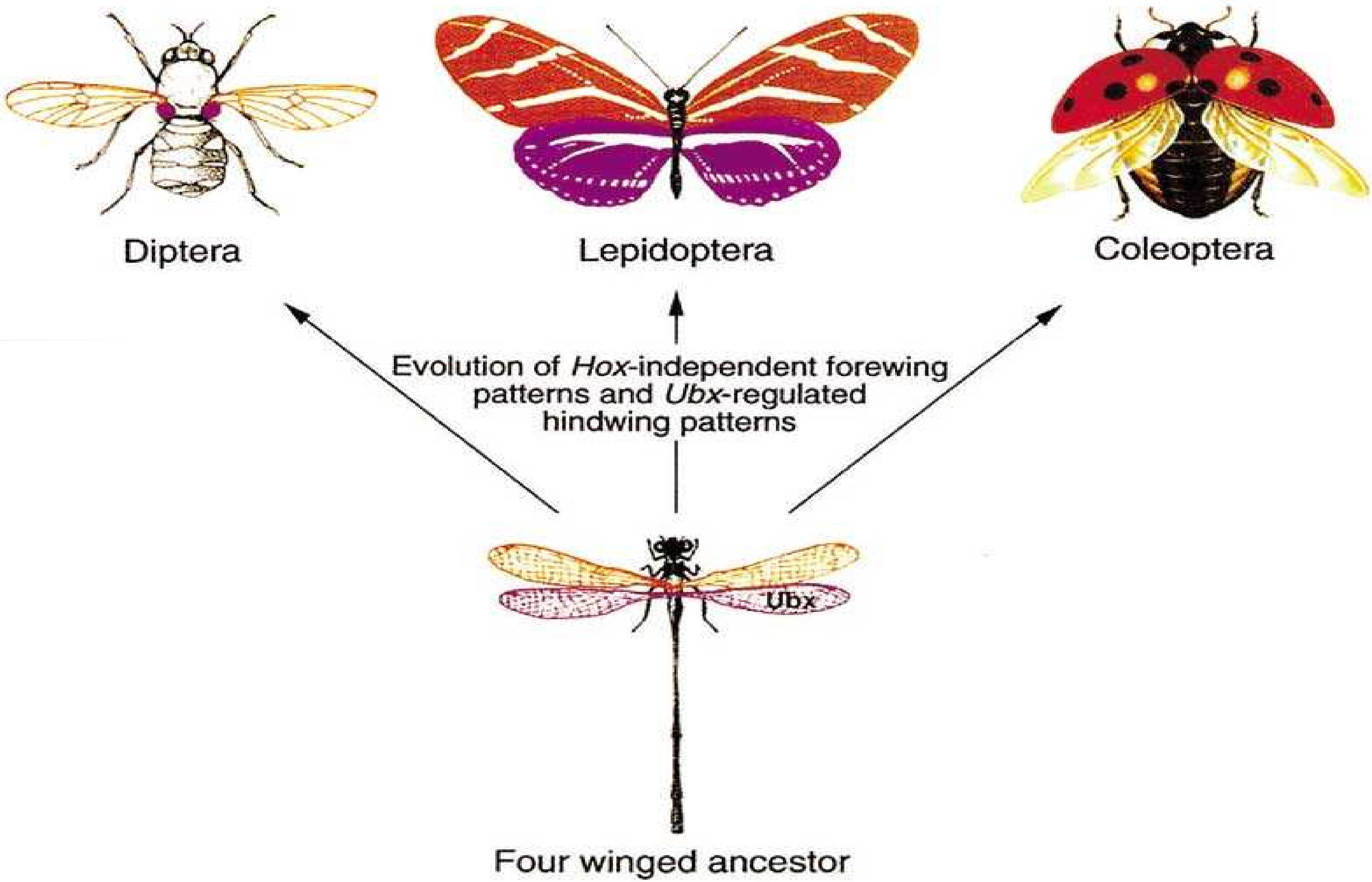


- **Homologous Structures**- bodily structures that are **similar** in structure, but **different** in function, due to sharing a common ancestor

2. Homologous Structures

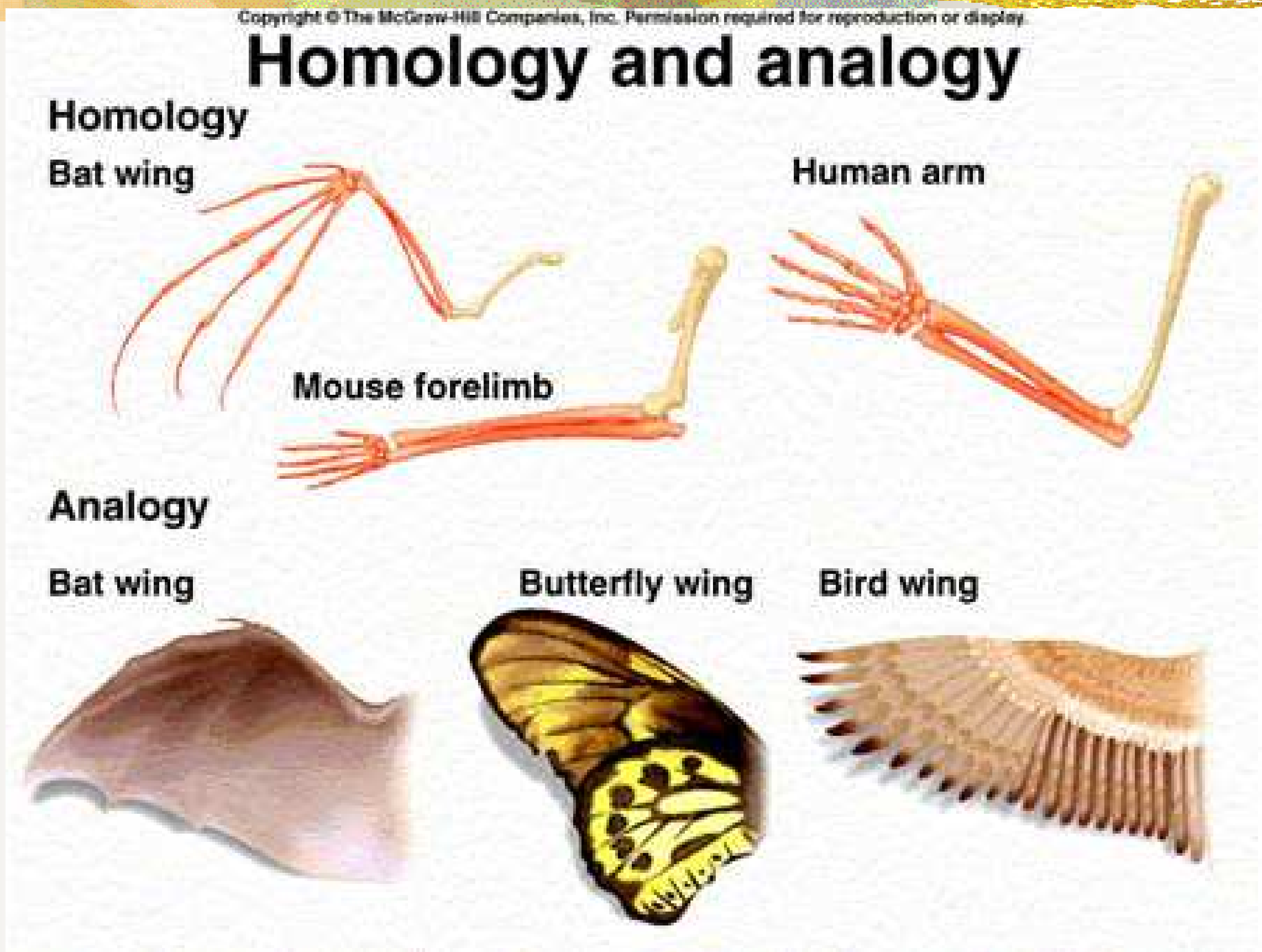


Homologous Structures



Analogous Structures

- Analogous structures- bodily structures that are similar in function, but not in structure. NOT EVIDENCE OF COMMON ANCESTRY.
  - Example: wings of a bee and wings of a bird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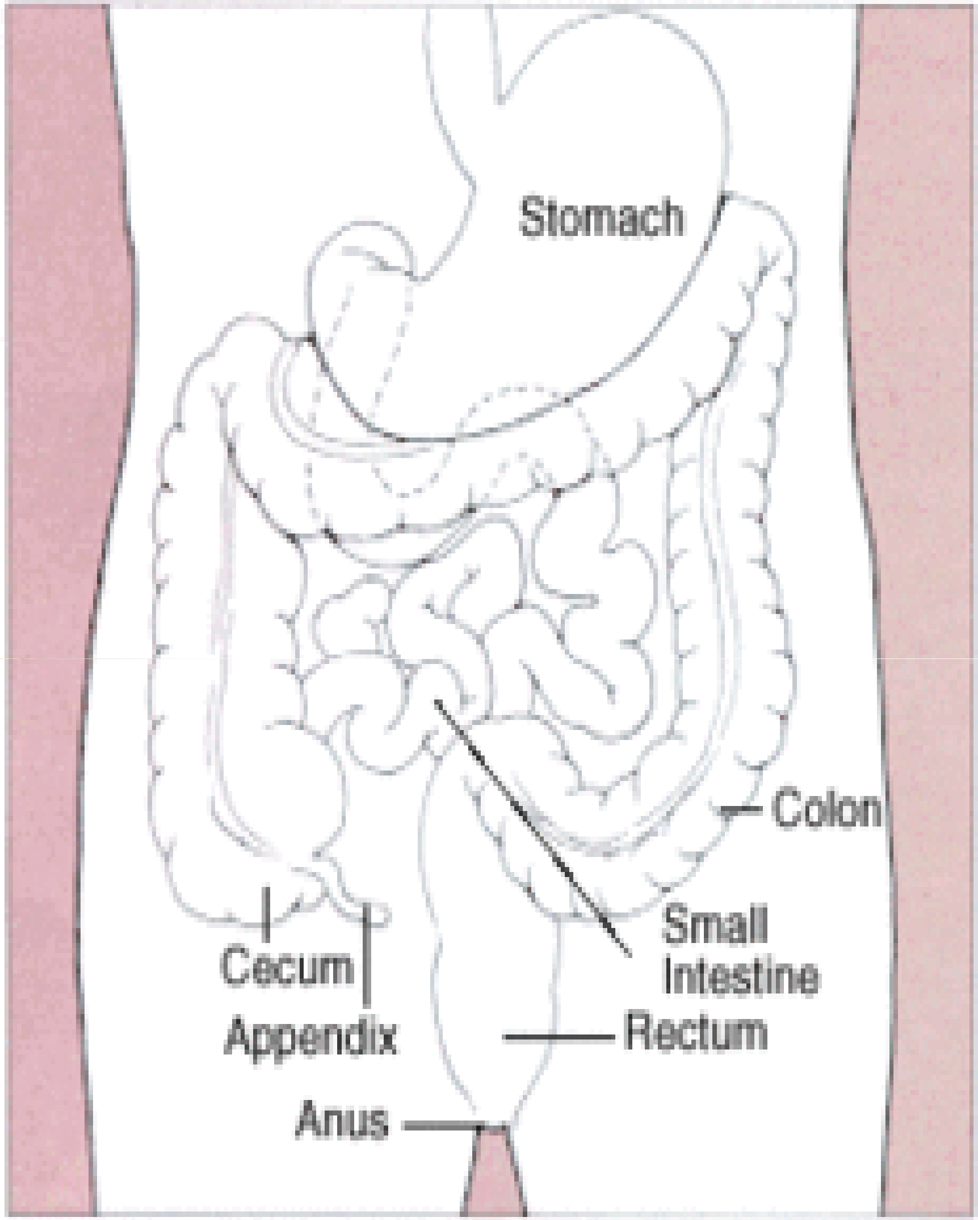
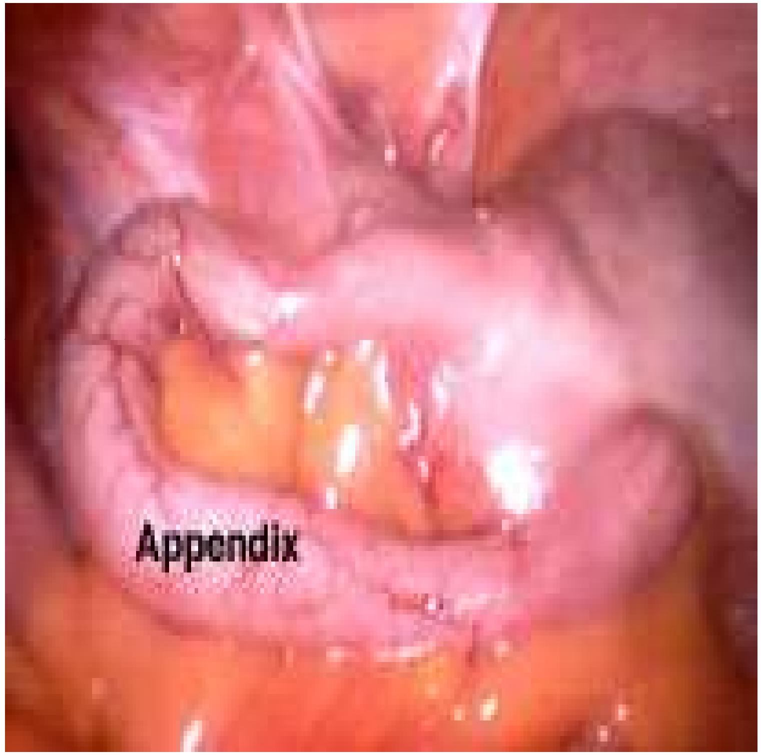
Homology and analogy
Homology
Bat wing
Human arm
Mouse forelimb
Analogy
Bat wing
Butterfly wing
Bird wing

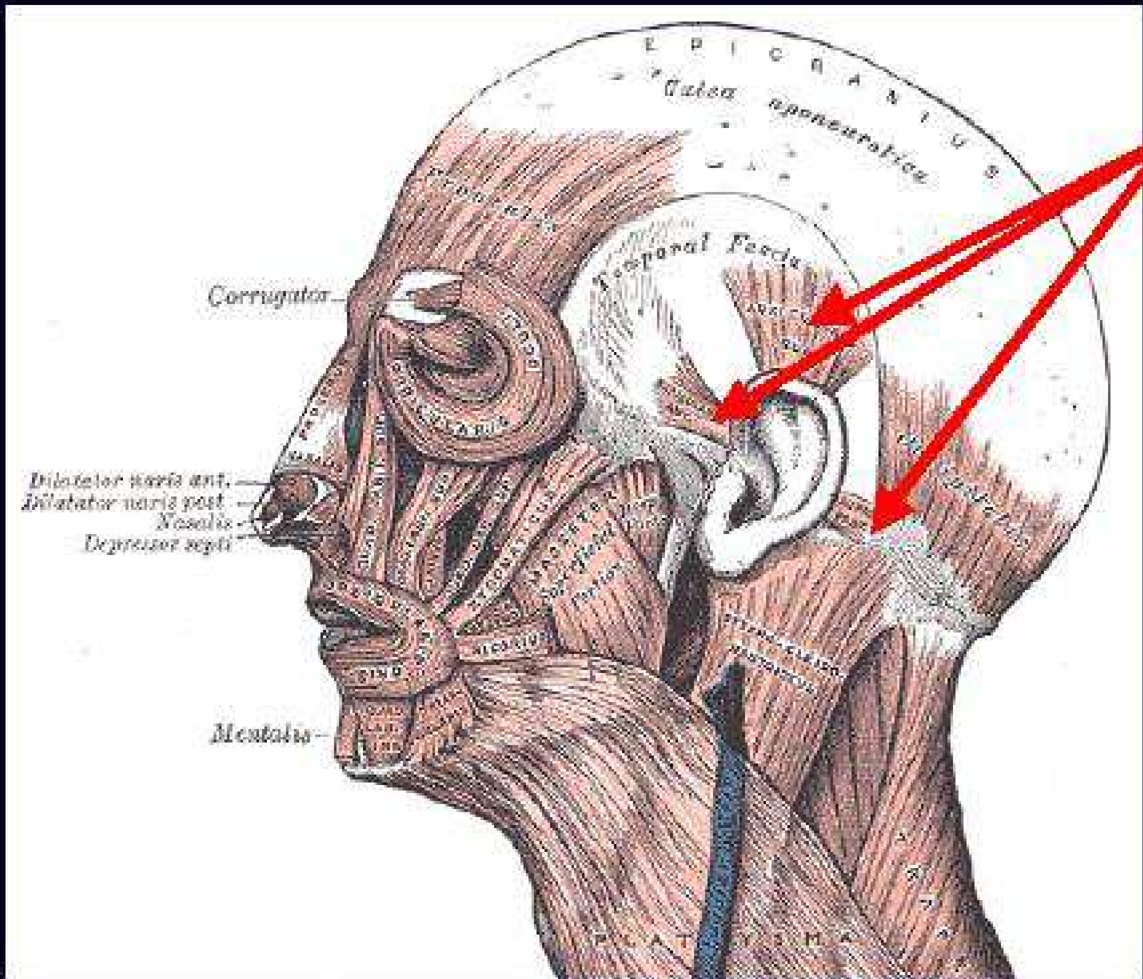
3. Vestigial Structures

- Structures that serve no function but useful structures in earlier ancestors
  - Examples: Ear muscles
  - Human tailbone
  - Appendix


Stomach
Colon
Small
Intestine
Cecum
Appendix
Rectum
Anus


Appendix

Vestigial Structures



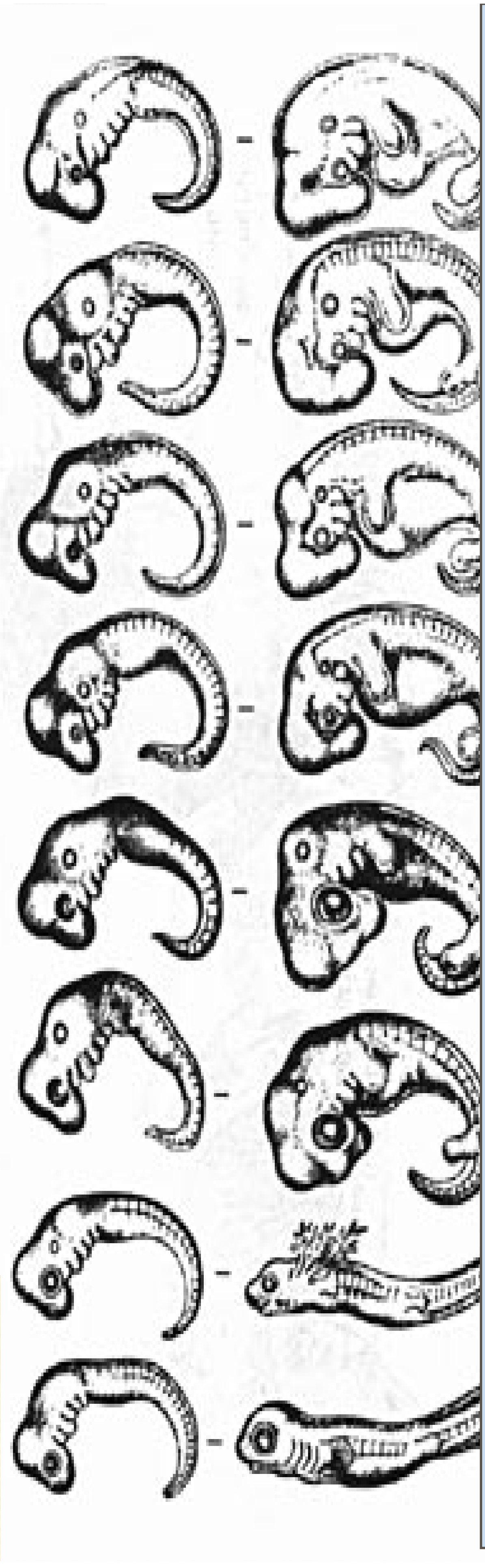
Mammals have muscles that move their external ears. You do, too, but most people never learn to use them, and ear-wiggling doesn't make any difference to your survival. . . so what are the muscles doing there?

Vestigial Organs

4. Embryological Development

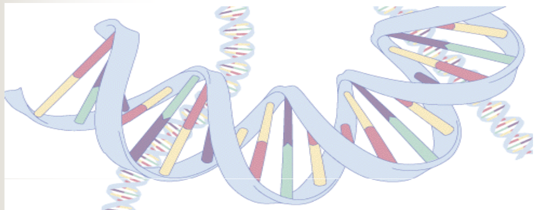
- **Embryo-** fertilized egg that will/is in the process of growing into a new individual

- Closely related organisms go through similar developmental stages early in development
  - All vertebrates have gill pouches sometime during their early development

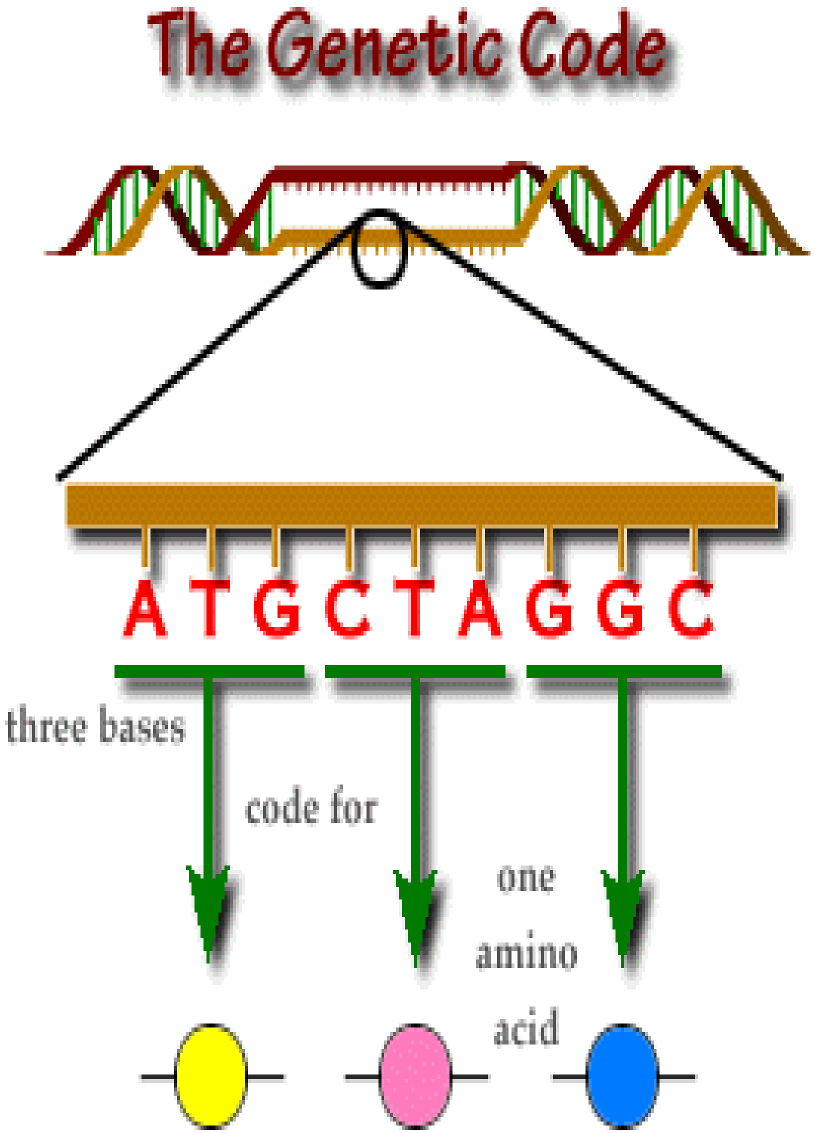


5. Molecular/Biochemical Evidence

- DNA used to translate nucleotide sequences into amino acid is essentially the same in all organisms



- Proteins in all organisms are composed of the same set of 20 amino acids
- Powerful argument in favor of the common descent of the most diverse organisms.



Universal Code

Second Letter

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

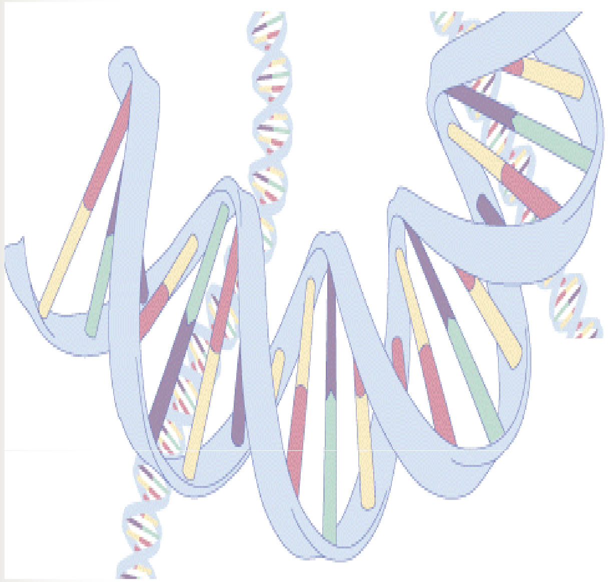
Biochemical Compound Ex

- DNA
- Cyt C
- 20 amino acids
- Some enzymes

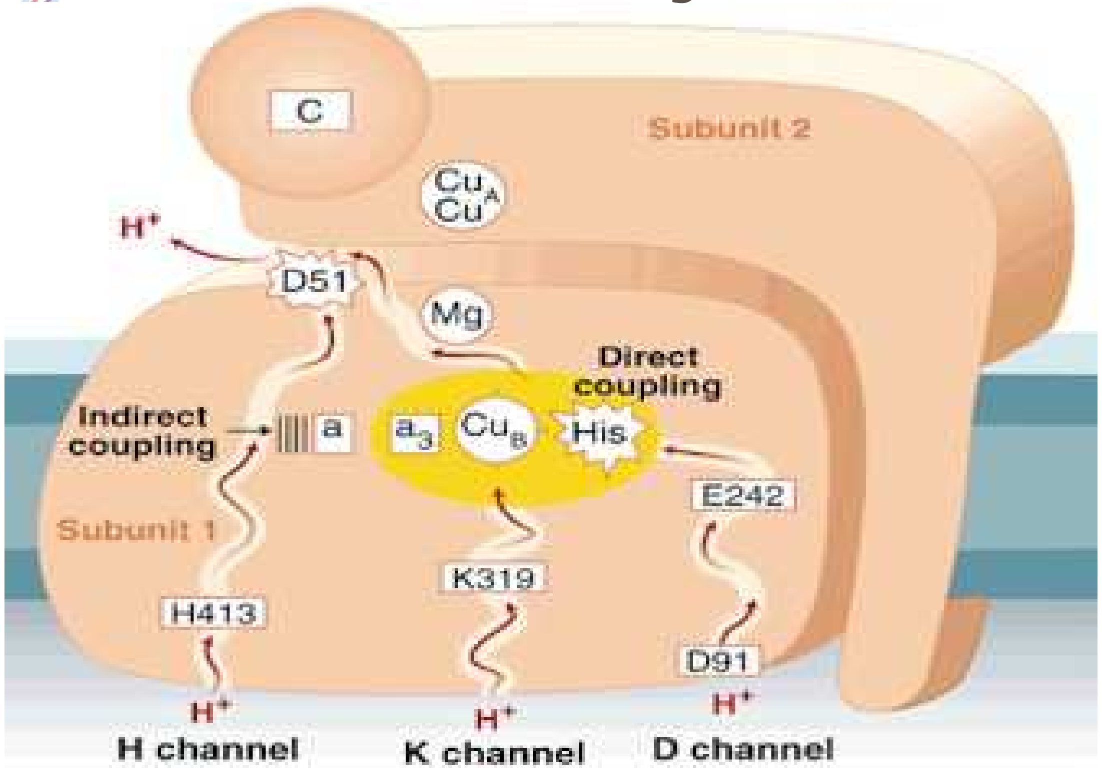
Molecular/Biochemical Evidence

- **Cytochrome c**
  - An ancient protein common to all aerobic (oxygen breathing) organisms
  - Amino acid sequence to make cytochrome c differs increasingly the more distantly related two organisms are (very similar amino acid sequence = closely related)
  - The cytochrome c of humans and chimpanzees is identical

DNA



Cyt C


C
Subunit 2
Cu_A
Cu
H+
D51
Mg
Direct coupling
Indirect coupling
a
a_3
Cu_B
His
E242
Subunit 1
K319
H413
D91
H+
H+
H+
H channel
K channel
D channel

Welcome

Gnetum

Prof. Lanke S.R.
Department of Botany

Gnetum

Systematic Position:

DIVISION : GNETOPHYTA
CLASS : GNETOPSIDA
ORDER : GNETALES
FAMILY : GNETACEAE

Distribution: Represented by 40 species; confined to tropical & humid regions.

According to Bhardwaj (1957),mainly 5 gnetum species in India.

- G.gnemon : Shrubby plant; found in Assam's Naga Hills region.
- G.contractum : Scandent scrub; found in Kerala & Nilgiri Hills.
- G.latifolium : Climber; found in Andaman & Nicobar Islands.
- G.ula: Woody climber with swollen nodal branches.

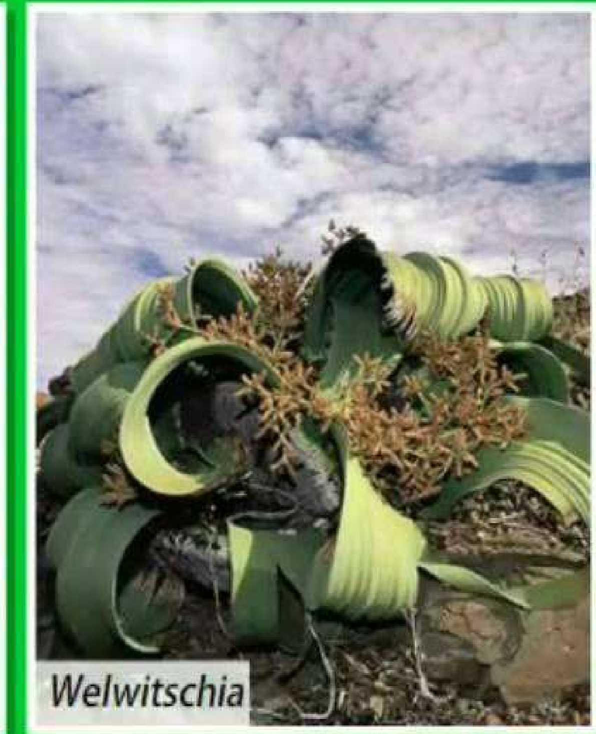
  Locality: Regions of Kerala, Andhra Pradesh, Orissa.
- G.montanum : Climber with slender branches; woven at nodes.

  Locality : Assam, Sikkim & Parts of Orissa.

g. 13.1. The map showing distribution of different species of Gnetum in India, Bangladesh ...

Gnetophyta

Divisions Gnetophyta has 3 genera;



Morphology

- Majority of the Gnetum species are climbers except a few shrubs and trees.
- G. trinerve is apparently parasitic.
- Two types of branches are present on the main stem of the plant, i.e. branches of limited growth and branches of unlimited growth. Each branch contains nodes and intemodes Stem of several species of Gnetum is articulated
- The leaves are large and oval with entire margin and reticulate venation as also seen in dicotyledons. Some scaly leaves are also present.

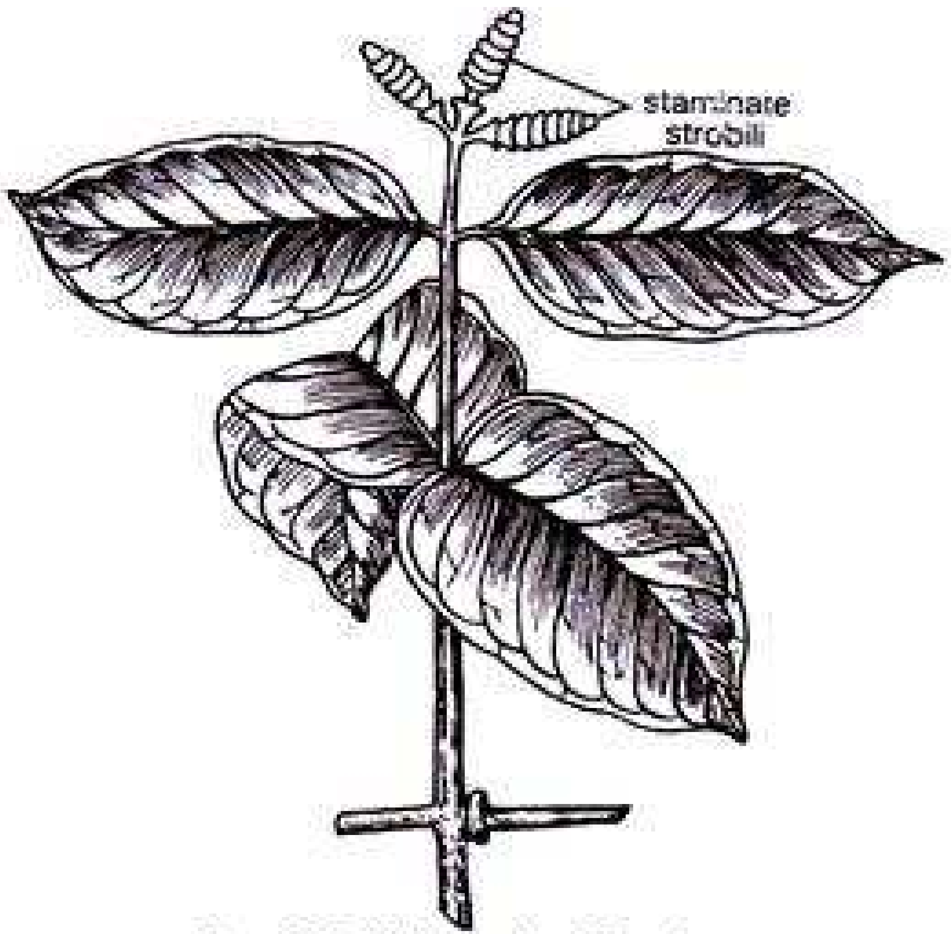


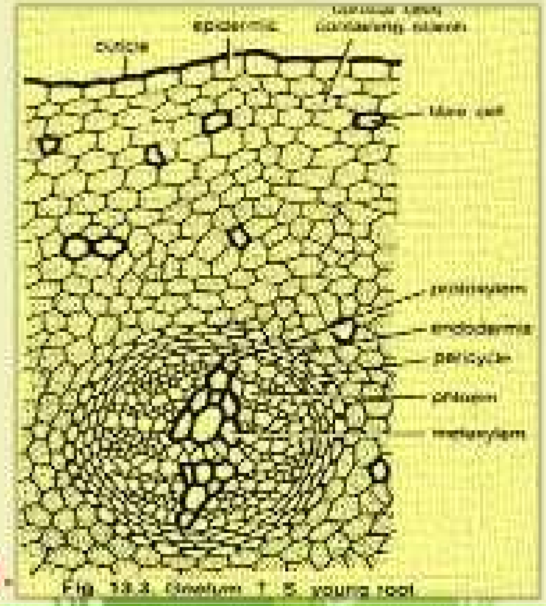
Fig. 13.2. A branch of *Gnetum*.

Anatomy Of Gnetum

(a) Roots

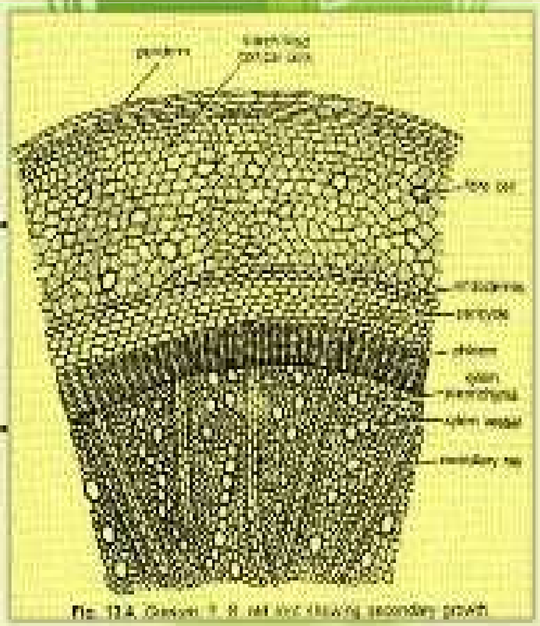
In Young Roots :

1) Layers of starch filled cortical cells.
2) 4-6 layers of pericycle; primary xylem visible.
3) Roots may be Di-arch and Ex-arch (Angiospermic Ch.).



In Older Roots :

1) Primary xylem indistinguishable due to 2ndry growth.
2) Consists of tracheids, vessels & xylem parenchyma.
3) Phloem consists of sieve tubes & phloem parenchyma.
4) "Bars of Sanio" present in tracheids; absent in vessels.



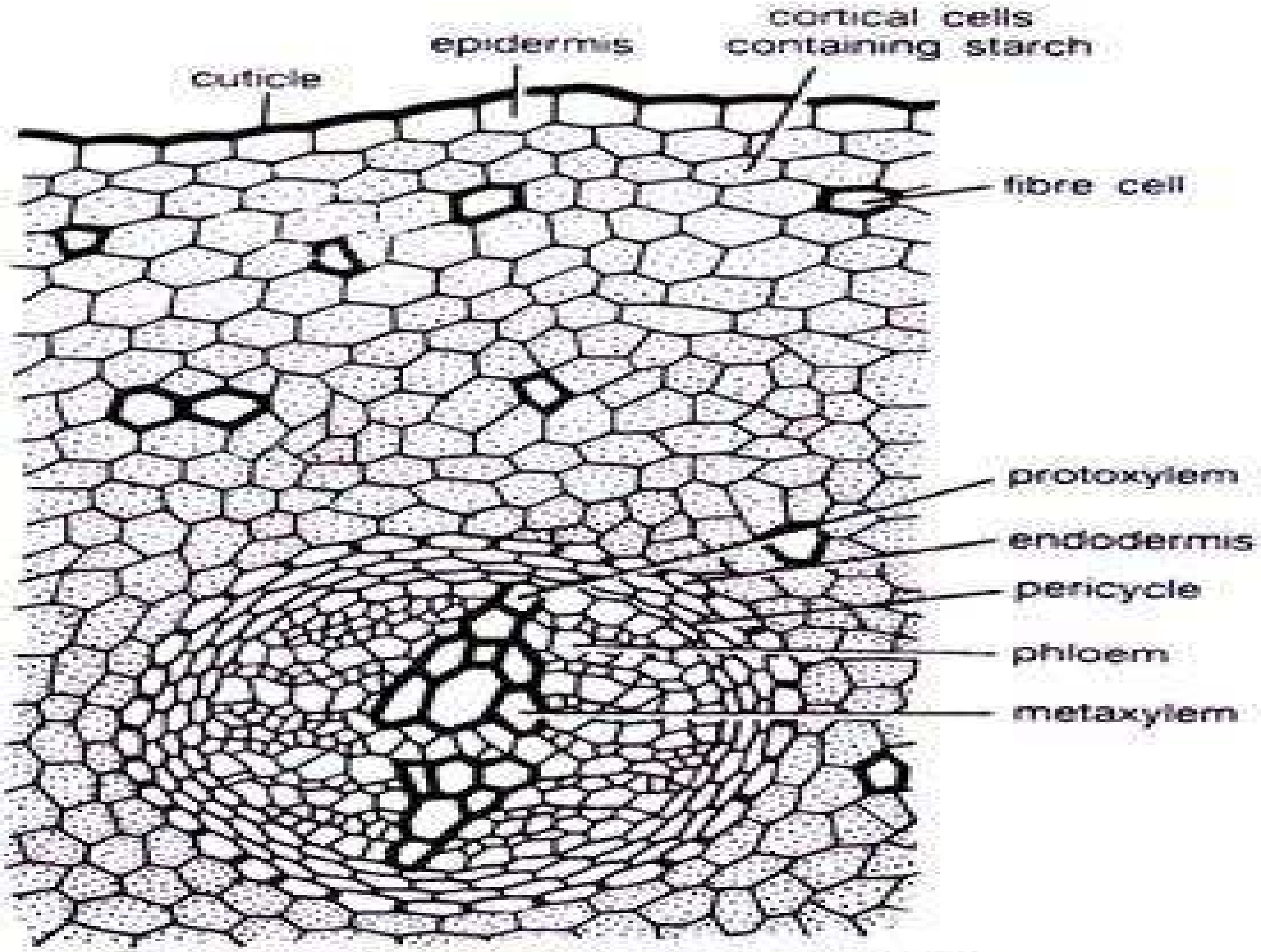


Fig. 13.3. *Gnetum*. T. S. young root.

b) Stem

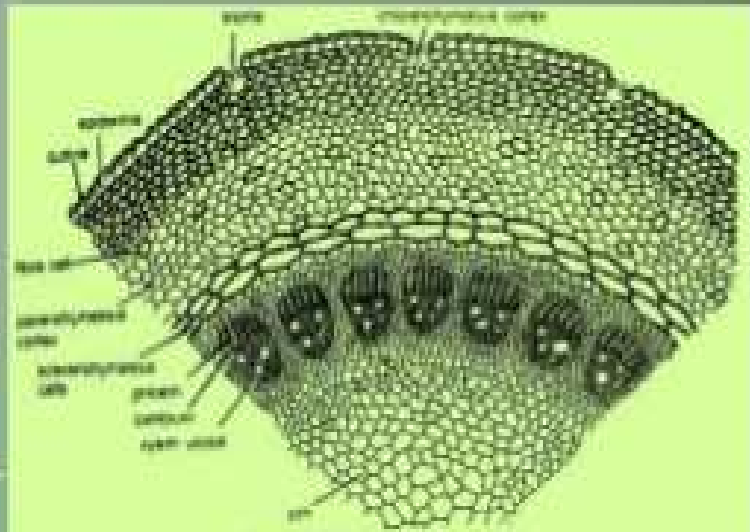


Fig. 13.5. Gnetum T.S. young stem.

In Young Stem : 1) Resembles typical Dicot Stem.

2) Sunken Stomata Present.

3) Cortex : i) 1st few layers – Chlorenchymatous cells.

ii) 2nd few layers – Parenchymatous cells.

iii) 3rd few layers – Sclerenchymatous cells.

4) Endodermis & Pericycle indistinguishable.

5) Vascular Bundles : Conjoint, Collateral Open & End-arch in a ring.

Xylem : Comprises Tracheids & Xylem Vessels.

Phloem : Comprises Sieve cells & Phloem Parenchyma.

In Old Stem : 1) Primary Cambium short-lived.

2) Sclerotic cells present.

3) 2ndry cambium in diff. parts of cortex form rings.

4) 2ndry wood comprises tracheids & vessels.

5) Phloem Sieve cells have oblique, perforated sieve plates.

6) Medullary Rays consist of Polygonal Parenchyma cells.

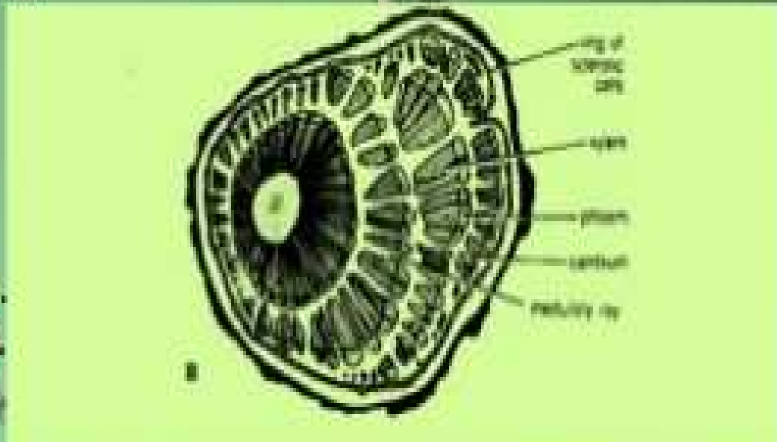


Fig. 13.6. Gnetum ula. T.S. old stem showing number of rings formed because of the anomalous secondary growth (modified after Maheshwari and Vasil, 1961).

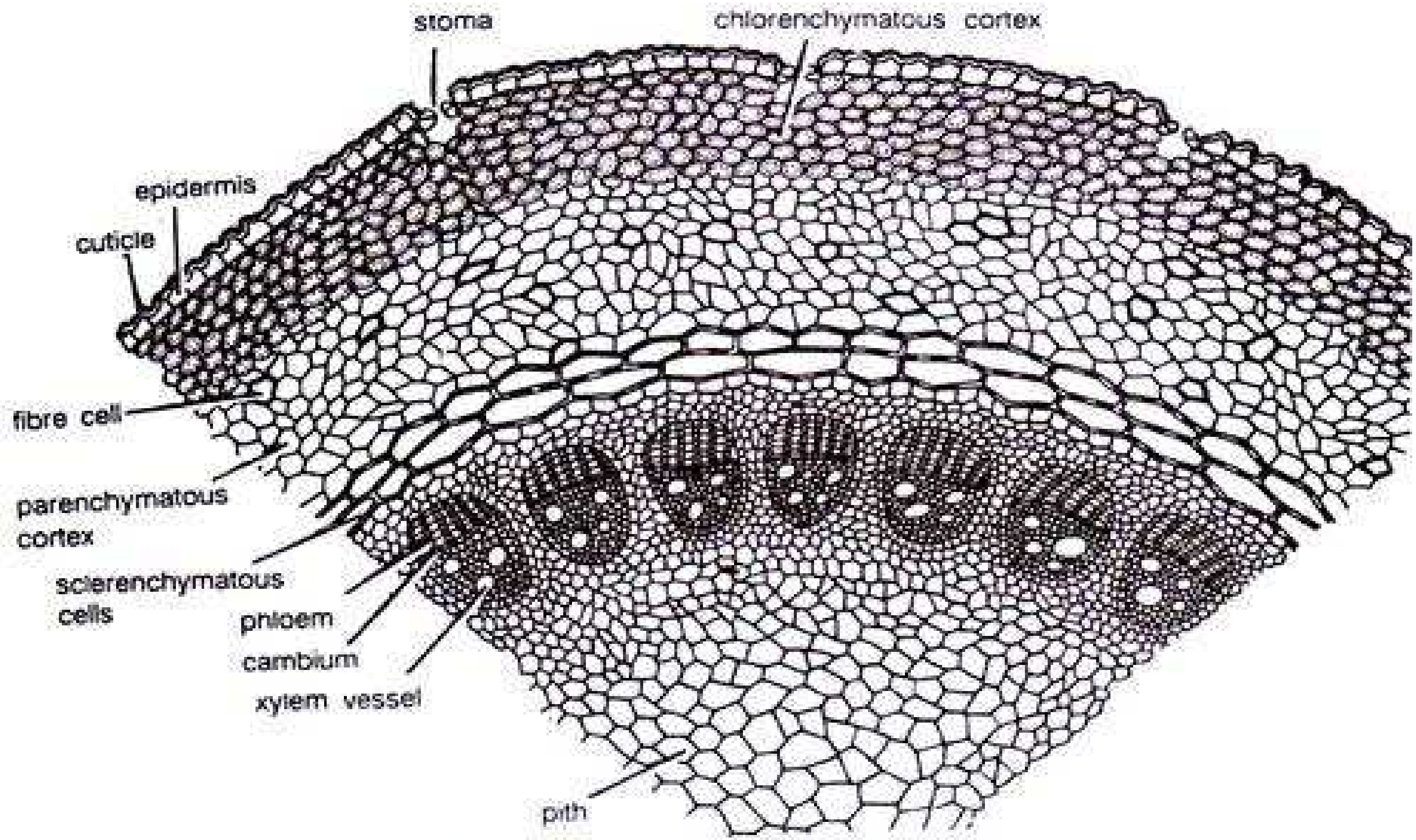


Fig. 13.5. Gnetum. T. S. young stem.

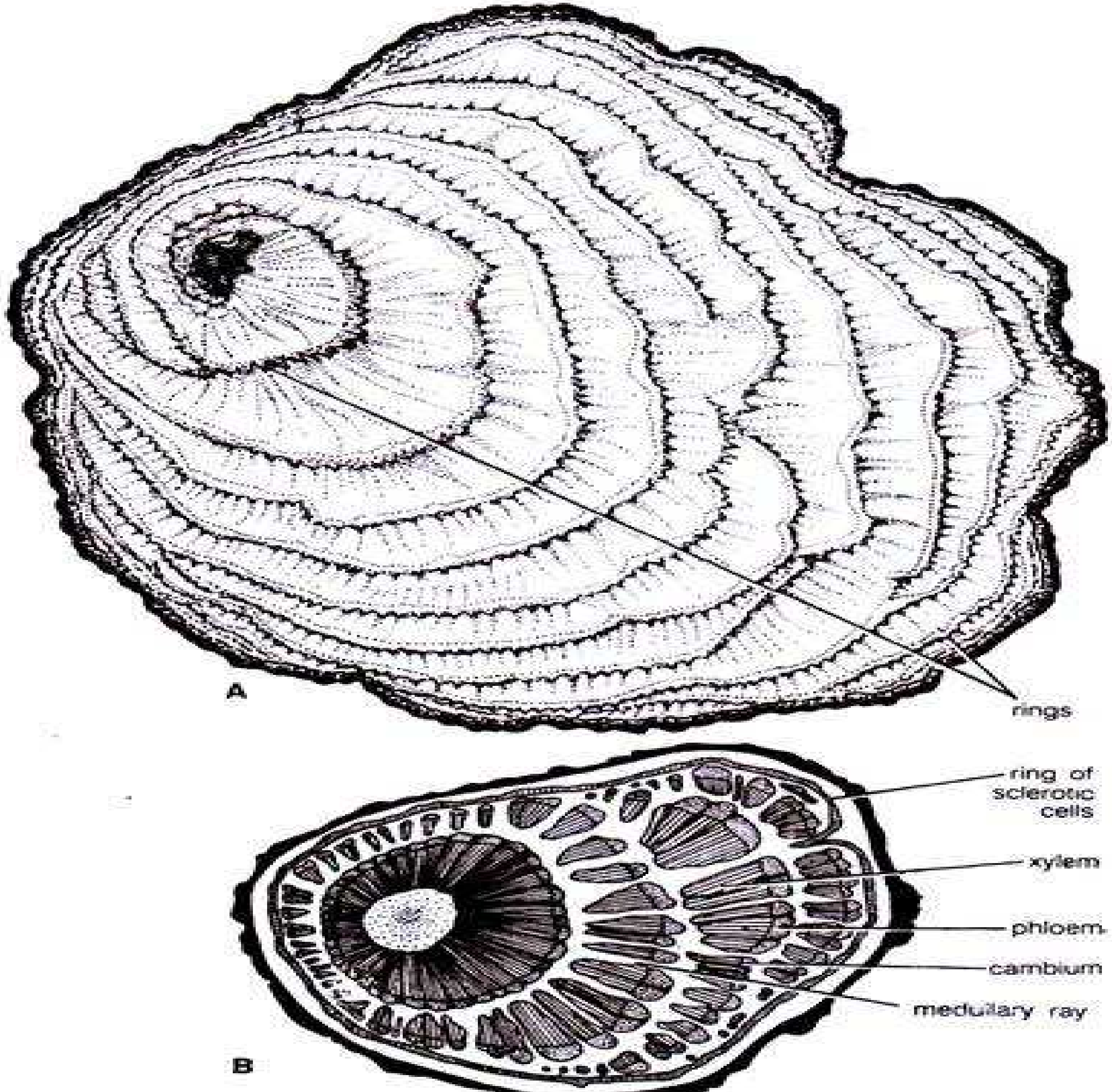


Fig. 13.6. *Gnetum ula.* T.S. old stem showing number of rings formed because of the anomalous secondary growth. (modified after Maheshwari and Vasil, 1961).

c) Leaves

- They resemble dicot leaves with cuticularised epidermis,

  stomata on both side except on veins.

- Mesophylls differentiated into single layered palisade,

  well-developed spongy parenchyma.

- Stone cells & latex tubes present in mid-rib regions.

- Vascular bundles : i) arch/curve form in mid-rib region.

  ii) conjoint, collateral type.

  iii) Xylem: tracheids, vessels &xylem parenchyma.

  iv) Phloem: sieve cells & phloem parenchyma.

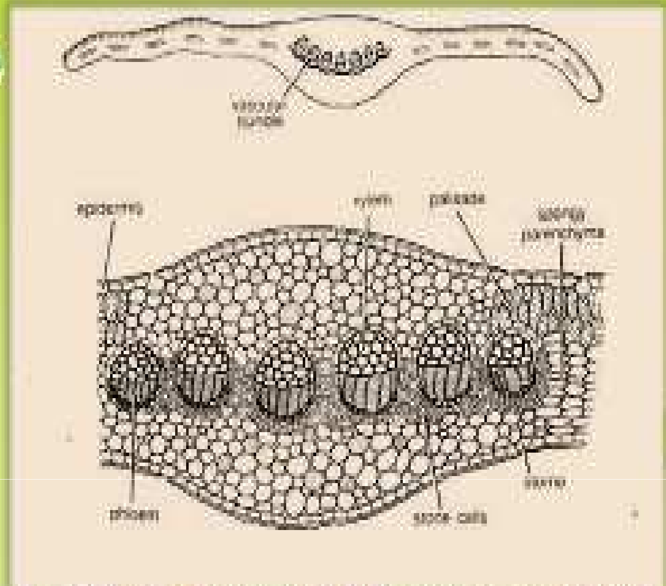
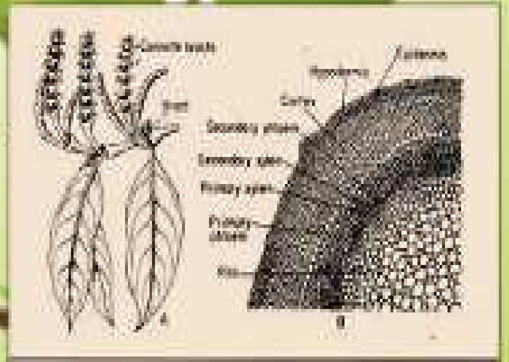


Fig. 13.8 Gnetum. Upper: T.S. leaf (diagrammatic); Lower: T.S. leaf (a part cellular).



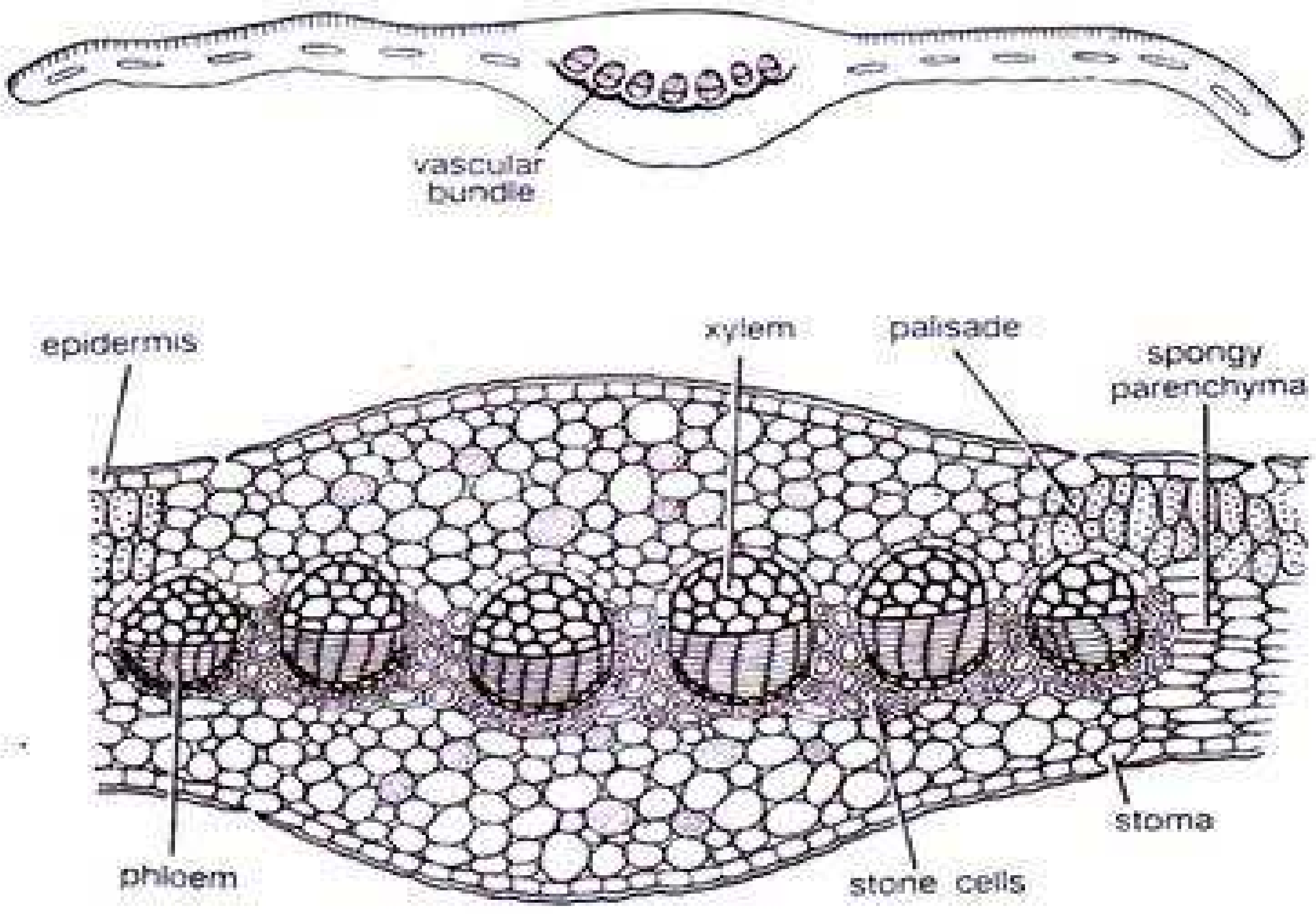


Fig. 13.9. *Gnetum.* Upper-T.S. leaf (diagrammatic) ; Lower-T.S. leaf (a part cellular).

- **Reproduction of Gnetum:**
- Gnetum is dioecious.
- The reproductive organs are organised into well-developed cones or strobili.
- These cones are organised into inflorescences, generally of panicle type. Sometimes the cones are terminal in position.
- A cone consists of a cone axis, at the base of which are present two opposite and connate bracts.
- Nodes and internodes are present in the cone axis. Whorls of circular bracts are present on the nodes.

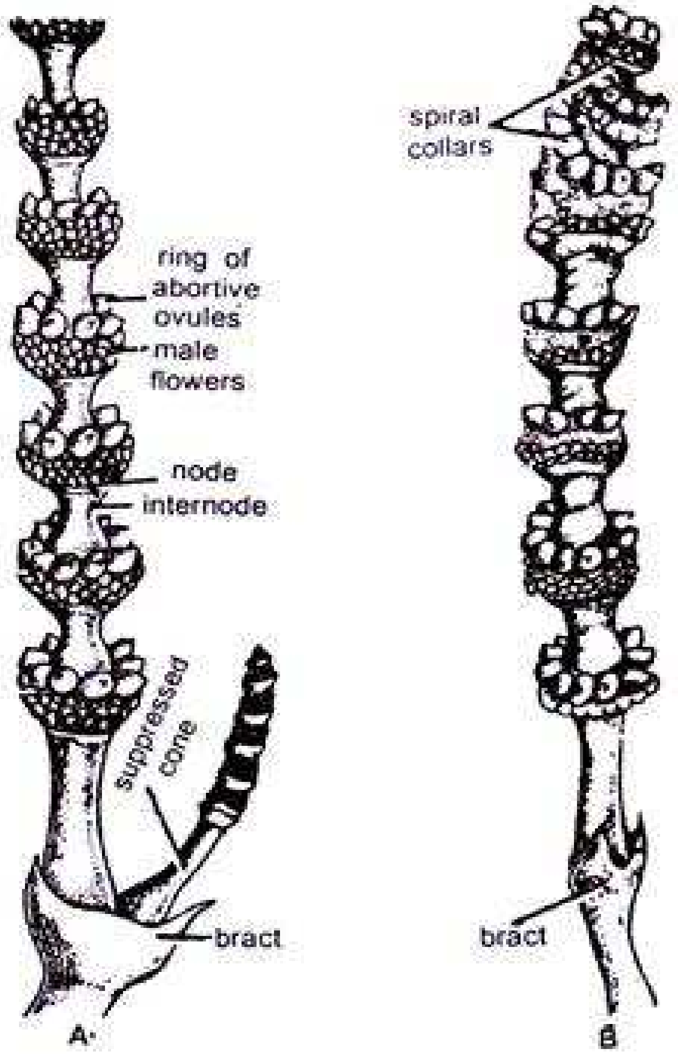


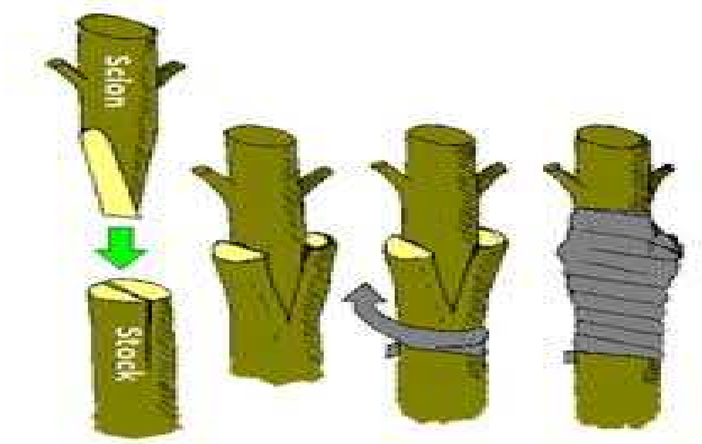
Fig. 13.10. *Gnetum*. A, A branch bearing a panicle of a well-developed male cone and a suppressed cone in *G. ula*; B, An old cone of *G. gnemon* showing spiral collars at the apical end. (Modified after Madhulata, 1960).

“NURSERY MANAGEMENT & HORTICULTURAL PRACTICES”

Prof. S. R. Lanke
Department of Botany

Introduction

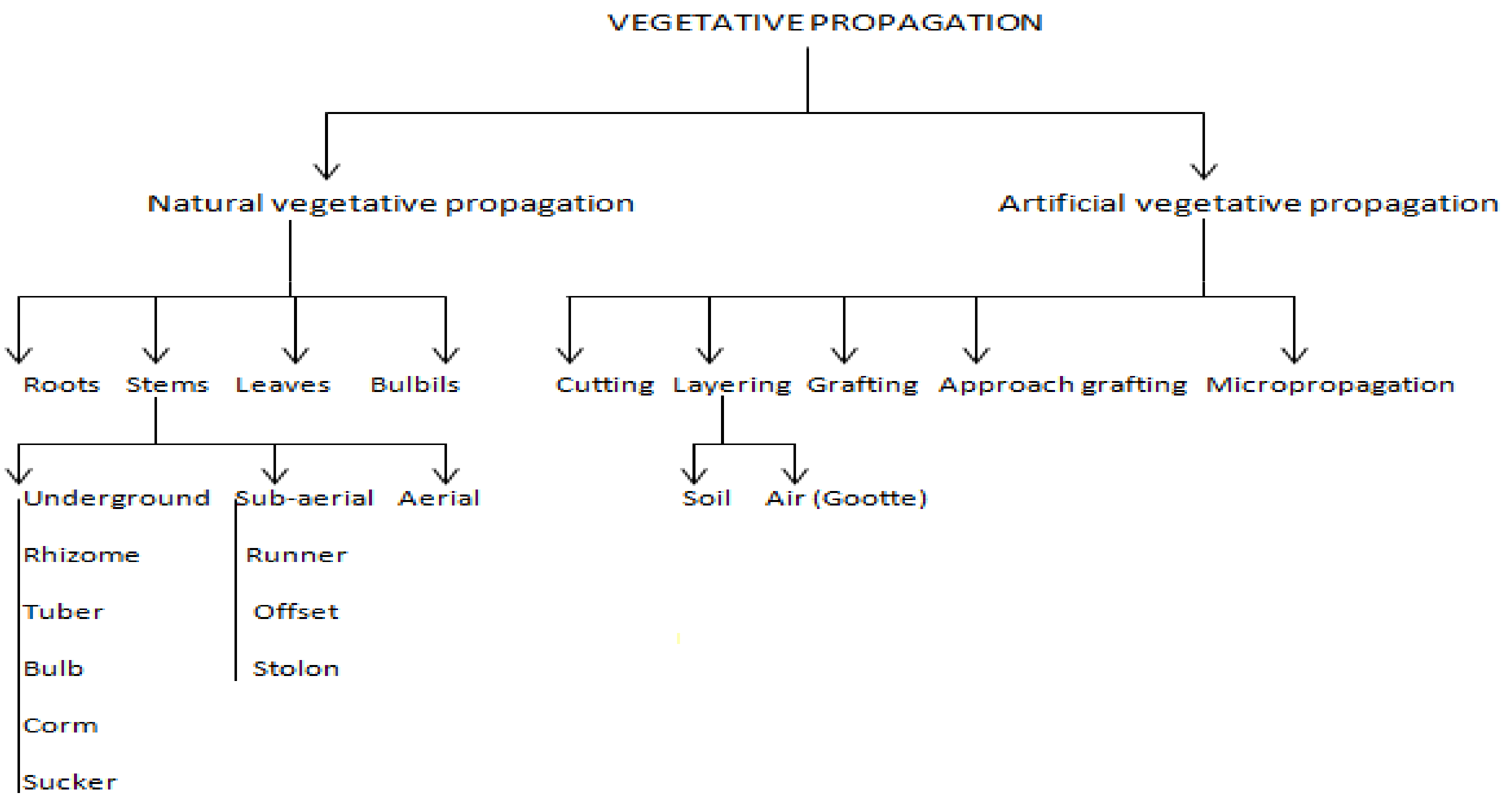
- Agriculture and Horticulture
- Qualitative and Quantitative food
- Plant propagation technique and practices
- Propagation by seeds & Vegetative part
- Mother Plant

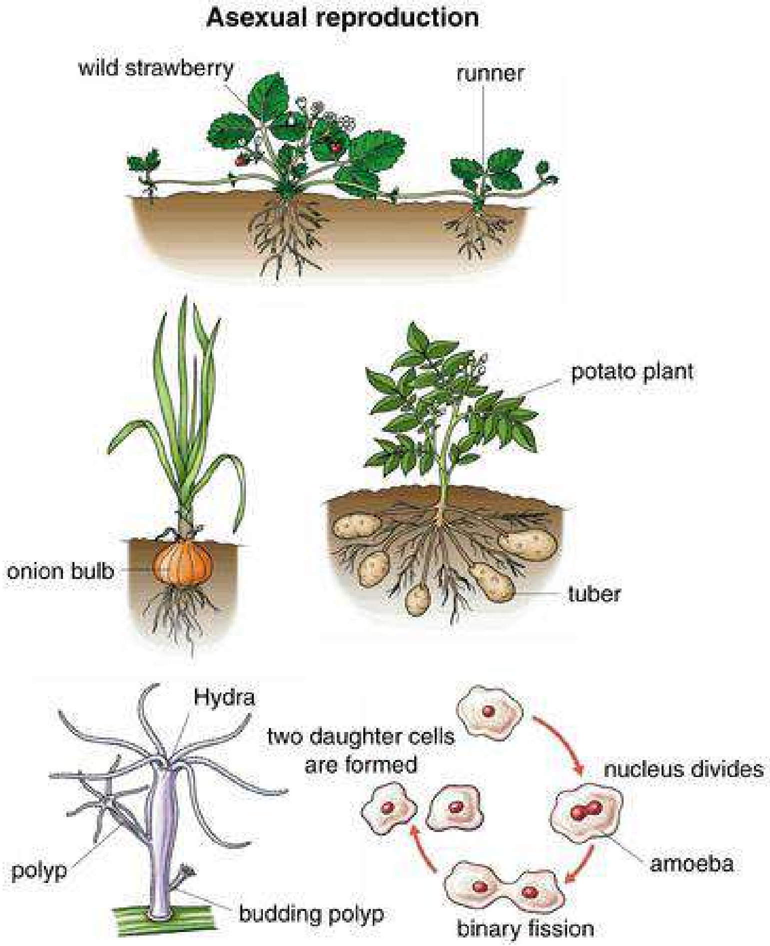


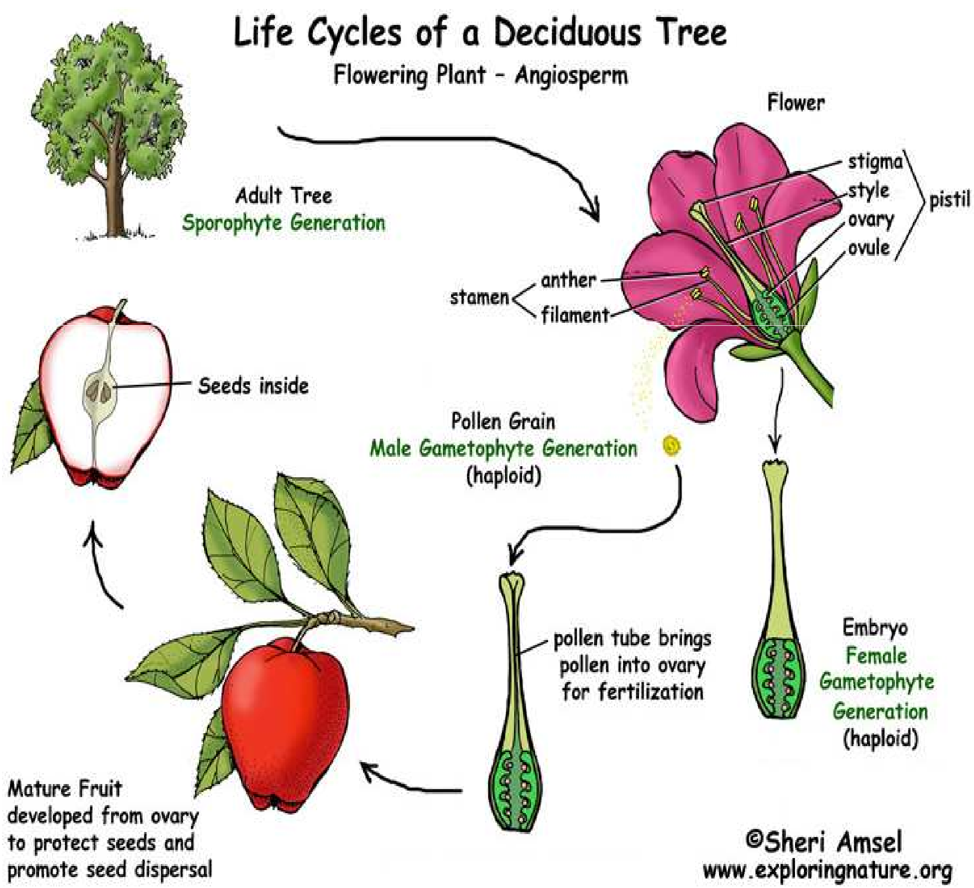
Concept Of Nursery

- Nursery is a place where planting material or sapling are raised with care.
- Nursery business is highly seasonal.
- Affected by environmental and aesthetic factors.

Methods of propagation & Classification




Asexual reproduction
wild strawberry
runner
potato plant
onion bulb
tuber
Hydra
two daughter cells are formed
nucleus divides
polyp
amoeba
budding polyp
binary fission


Life Cycles of a Deciduous Tree
Flowering Plant - Angiosperm
Flower
Adult Tree
Sporophyte Generation
stigma
style
ovary
ovule
pistil
stamen
anther
filament
Seeds inside
Pollen Grain
Male Gametophyte Generation
(haploid)
pollen tube brings pollen into ovary for fertilization
Embryo
Female Gametophyte Generation
(haploid)
Mature Fruit developed from ovary to protect seeds and promote seed dispersal
©Sheri Amsel
www.exploringnature.org

Artificial Vegetative Propagation

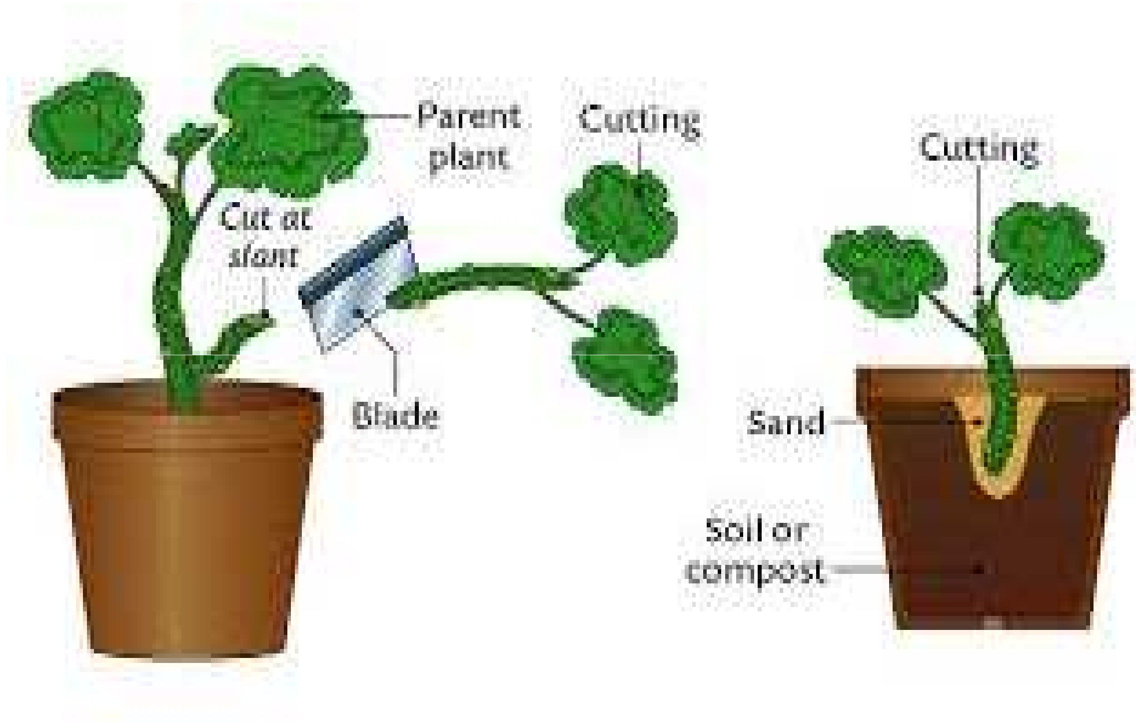
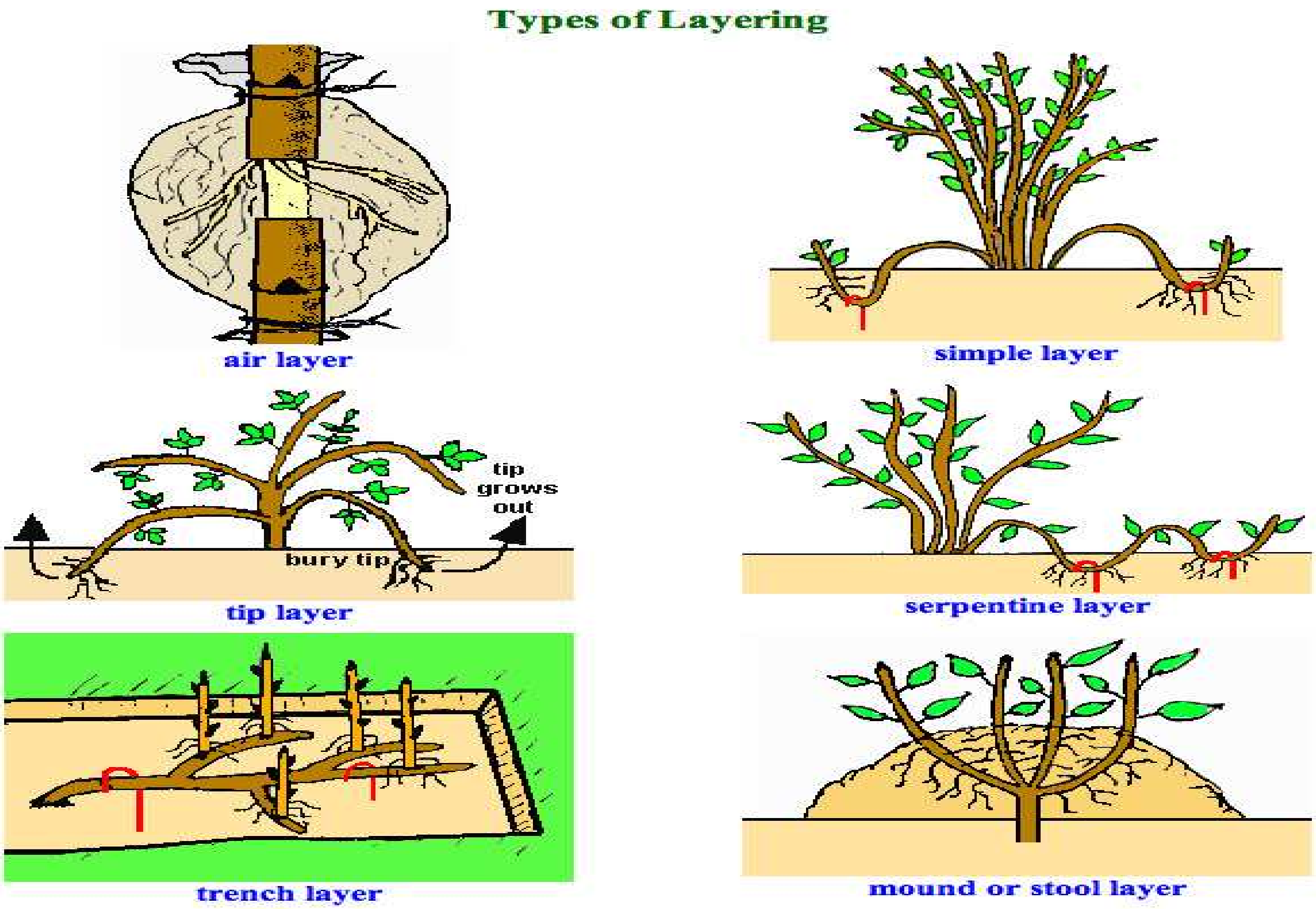
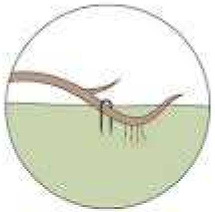
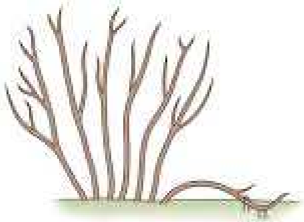
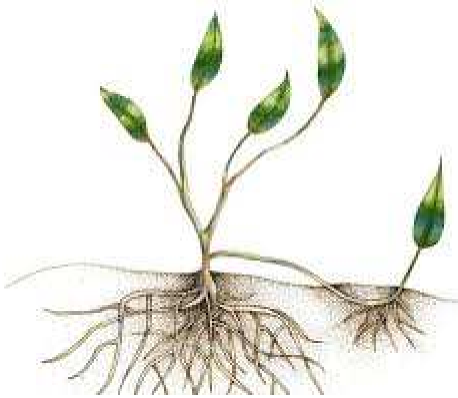
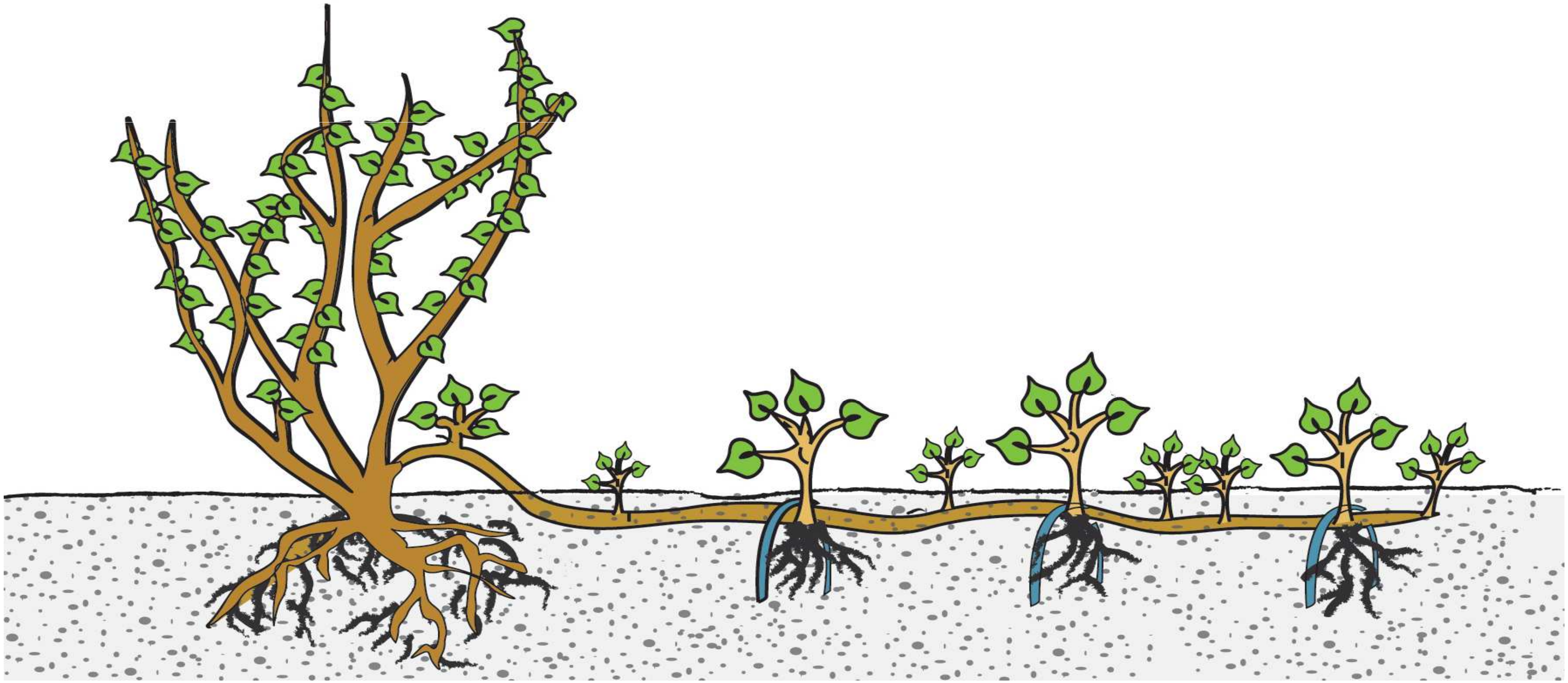

Parent plant
Cutting
Cut at slant
Blade
Cutting
Sand
Soil or compost

Fig:- Cutting

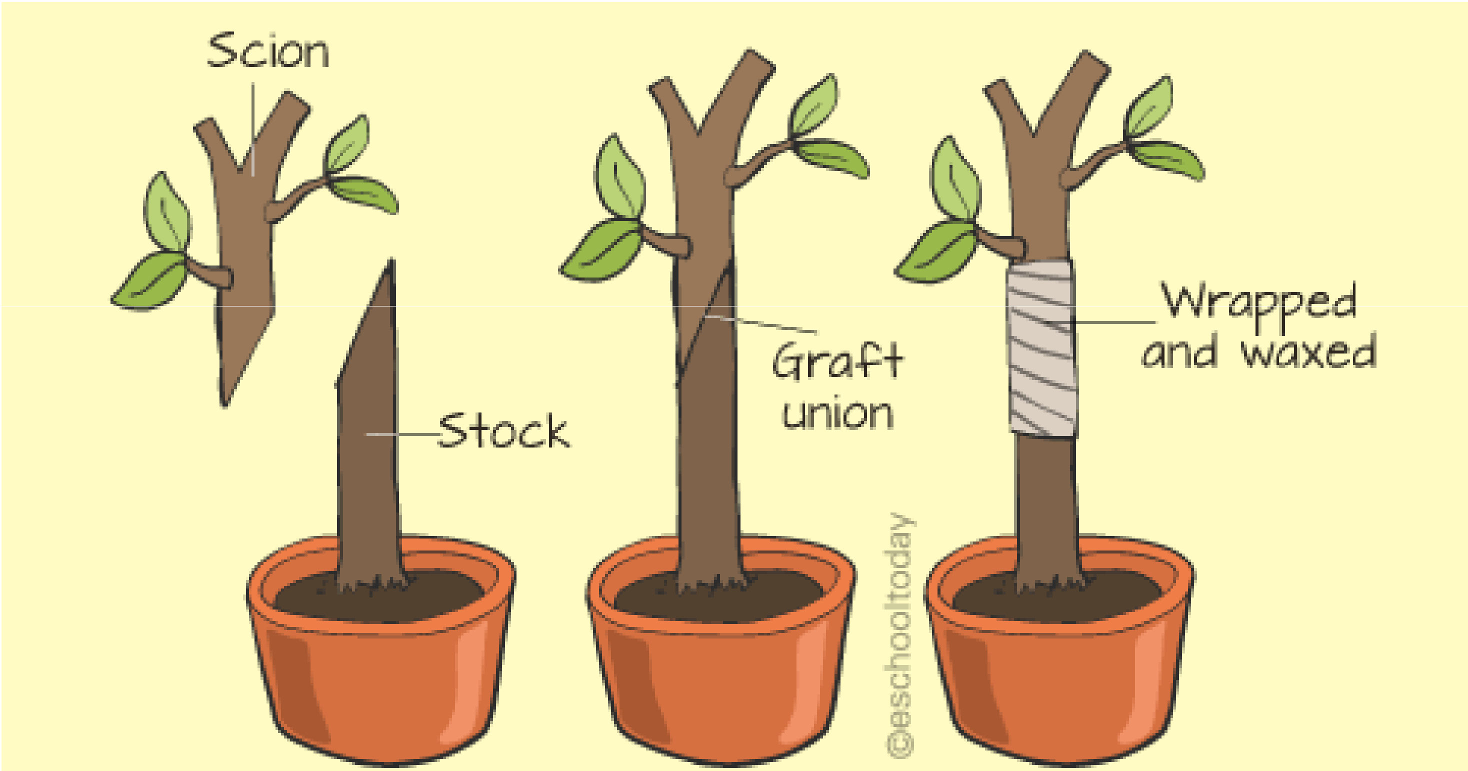
Layering

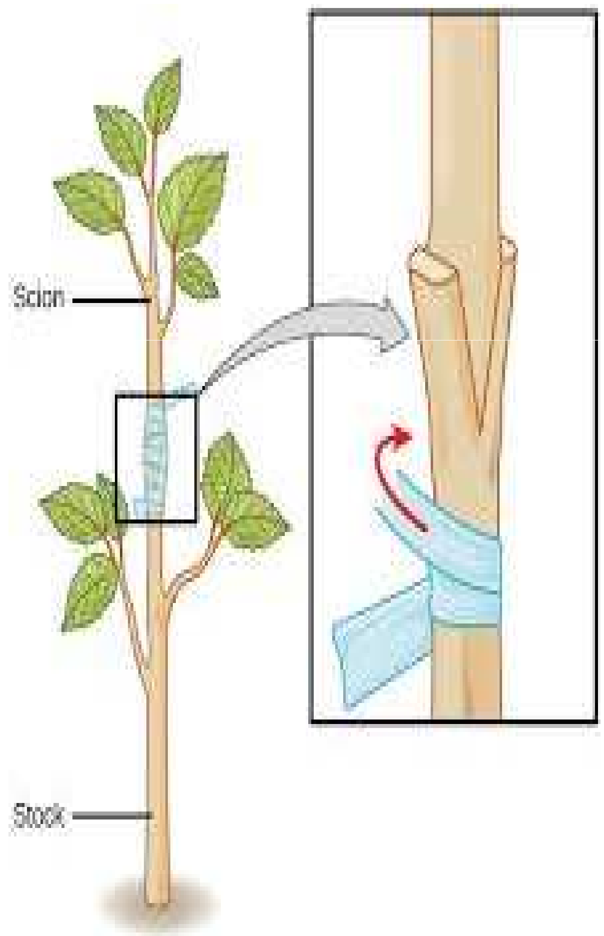

Types of Layering
air layer
simple layer
tip
grows
out
bury tip
tip layer
serpentine layer
trench layer
mound or stool layer

Simple Layering

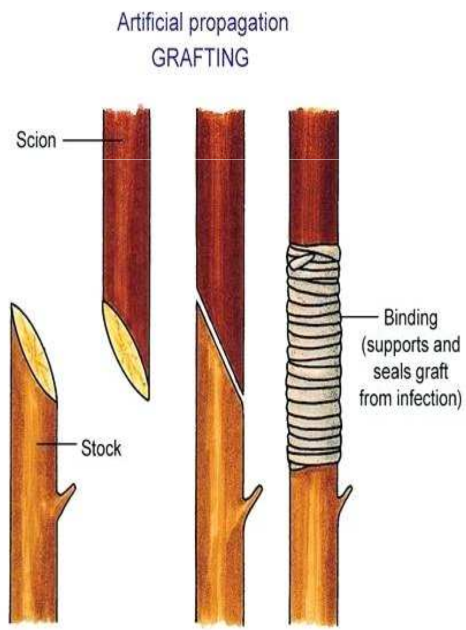
Grafting



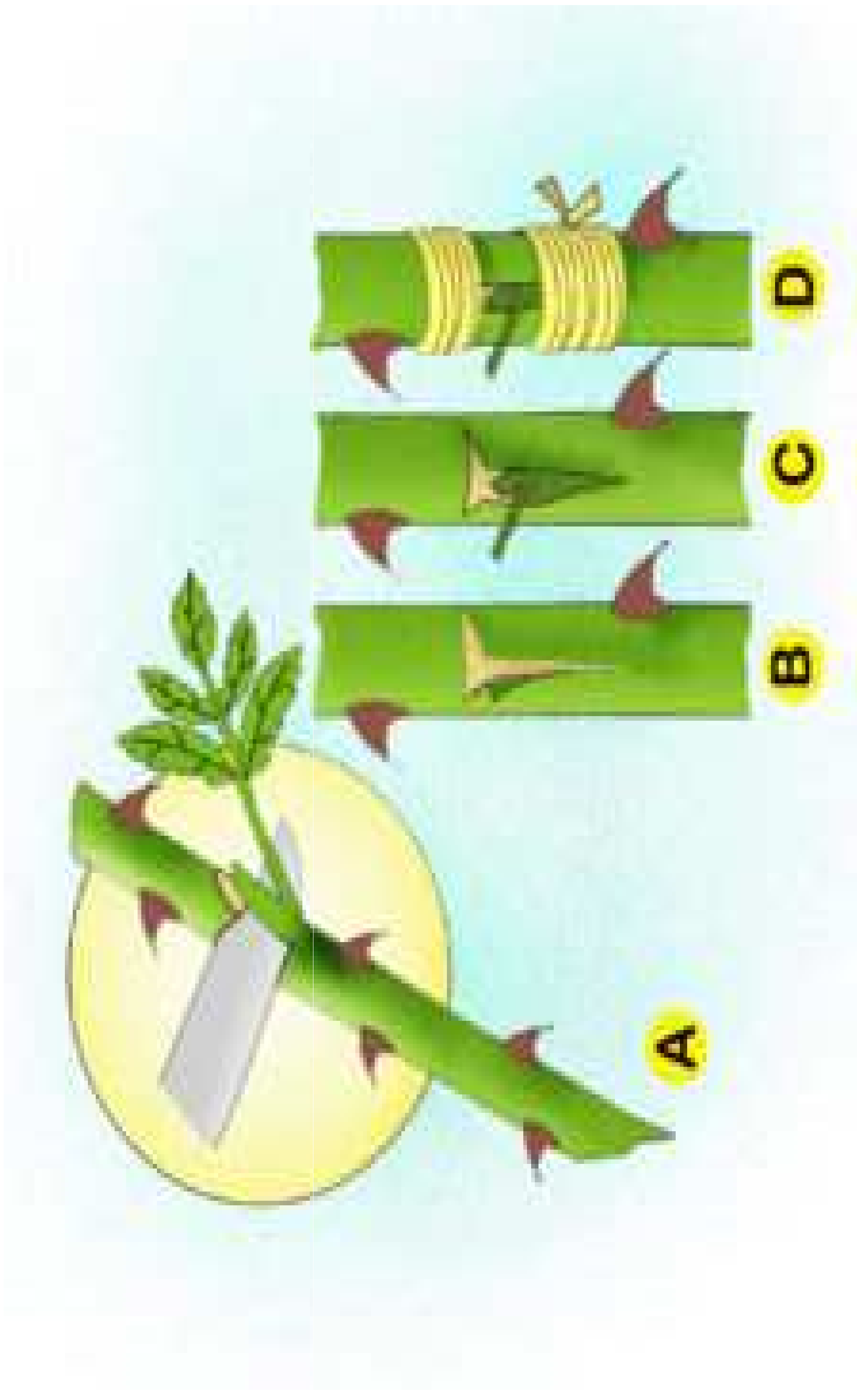


Grafting

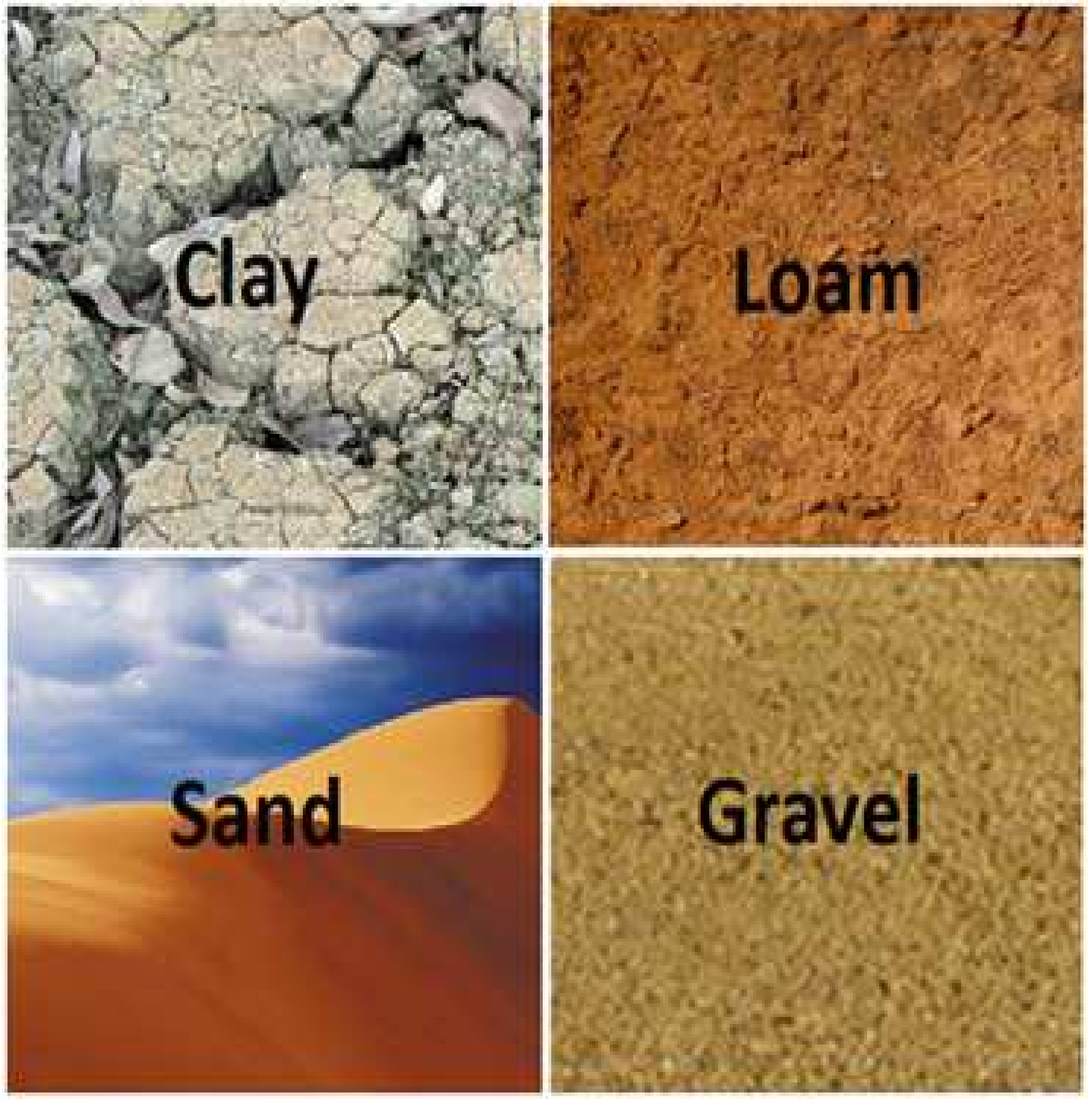
- Part of one plant (scion) is removed and attached to a healthy, rooted part of a second plant (stock)
- Useful qualities from both plants combined into one e.g. rose flower and thorn-less stem
- e.g. apple trees



Budding


A
B
C
D

Soil Type


Clay
Loam
Sand
Gravel


Red Soil
Black Soil
Alluvial Soil
Laterite Soil

Soil Testing

Types Of Nursery

- Irrigation Basis

1.Dry Nursery:-

Dry nursery

2. Wet Nursery:-

Wet nursery

- Size Of Seedlings Basis:-

1.Seedling Nursery:-

Transplant Nursery

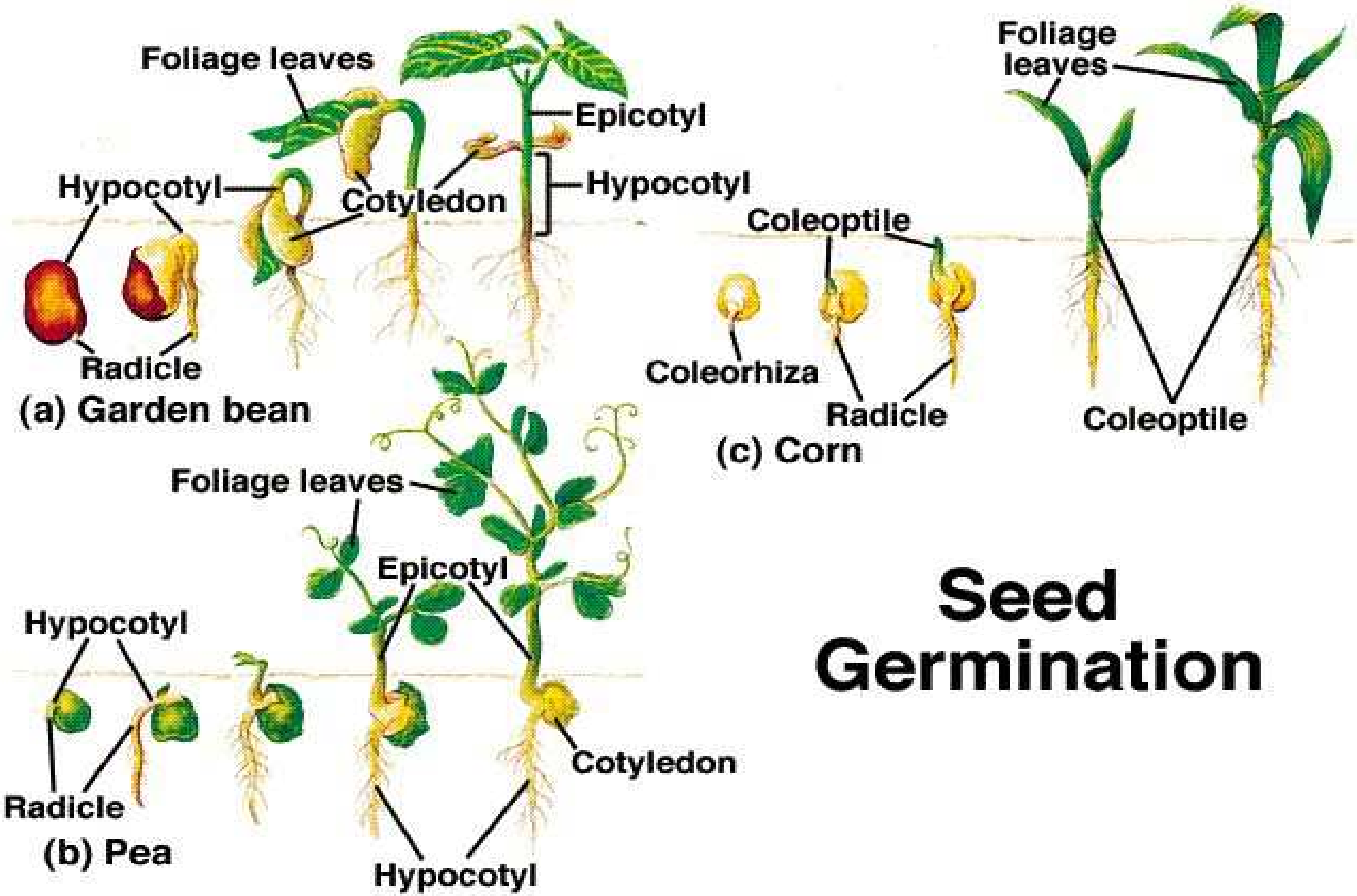
Duration Basis Nurseries

1.Temporary Nursery:-

Permanent Nursery:-

Seed Propagations

- Germination Of Seeds:-



A New plant emerging from the seed during germination

Factors affecting Germination :-

1. Water:-

A)Absorption of water

B)Great absorbing power due to nature of seed coat.

C) Available water in the germination medium affects the uptake of water.

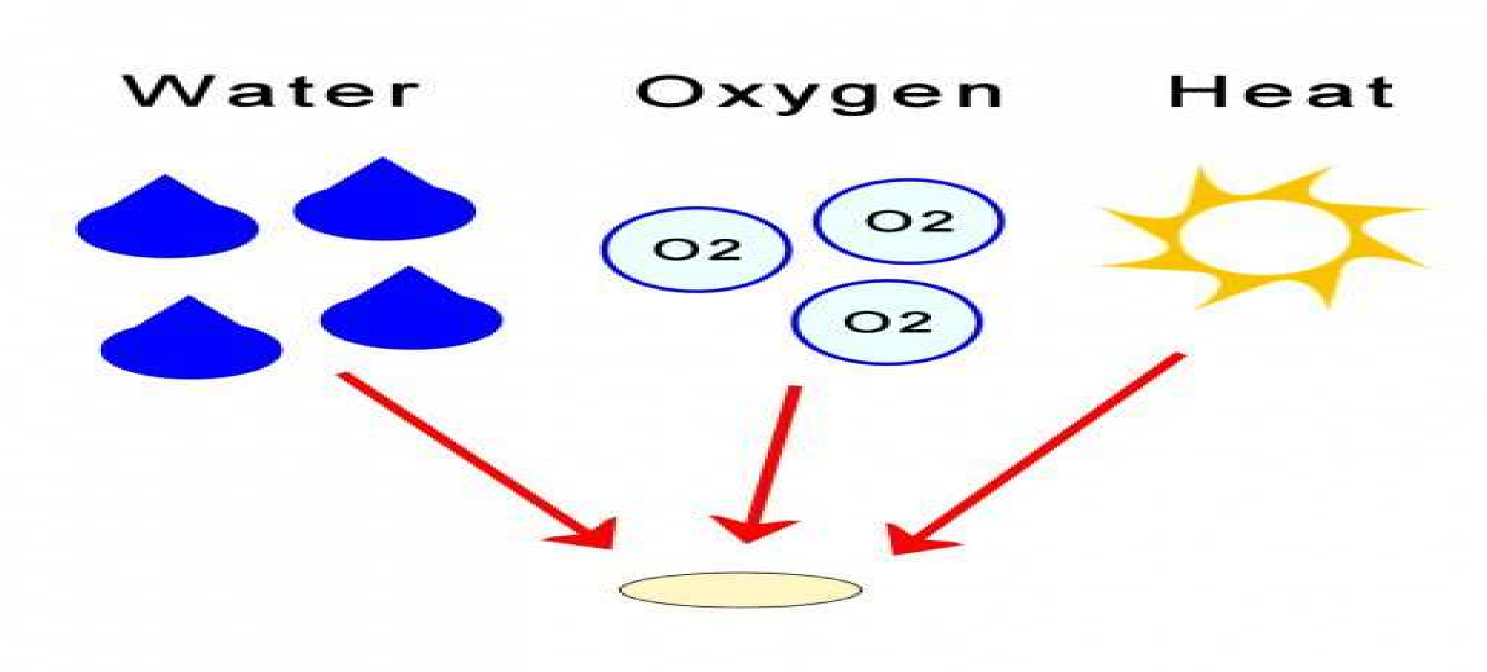
D) A dry period will cause the death of embryo if germination start.

2.Light:-

- Light is stimulate or inhibit germination of seeds.
- Ex. Verbena and Vinca (germinate best in Dark).

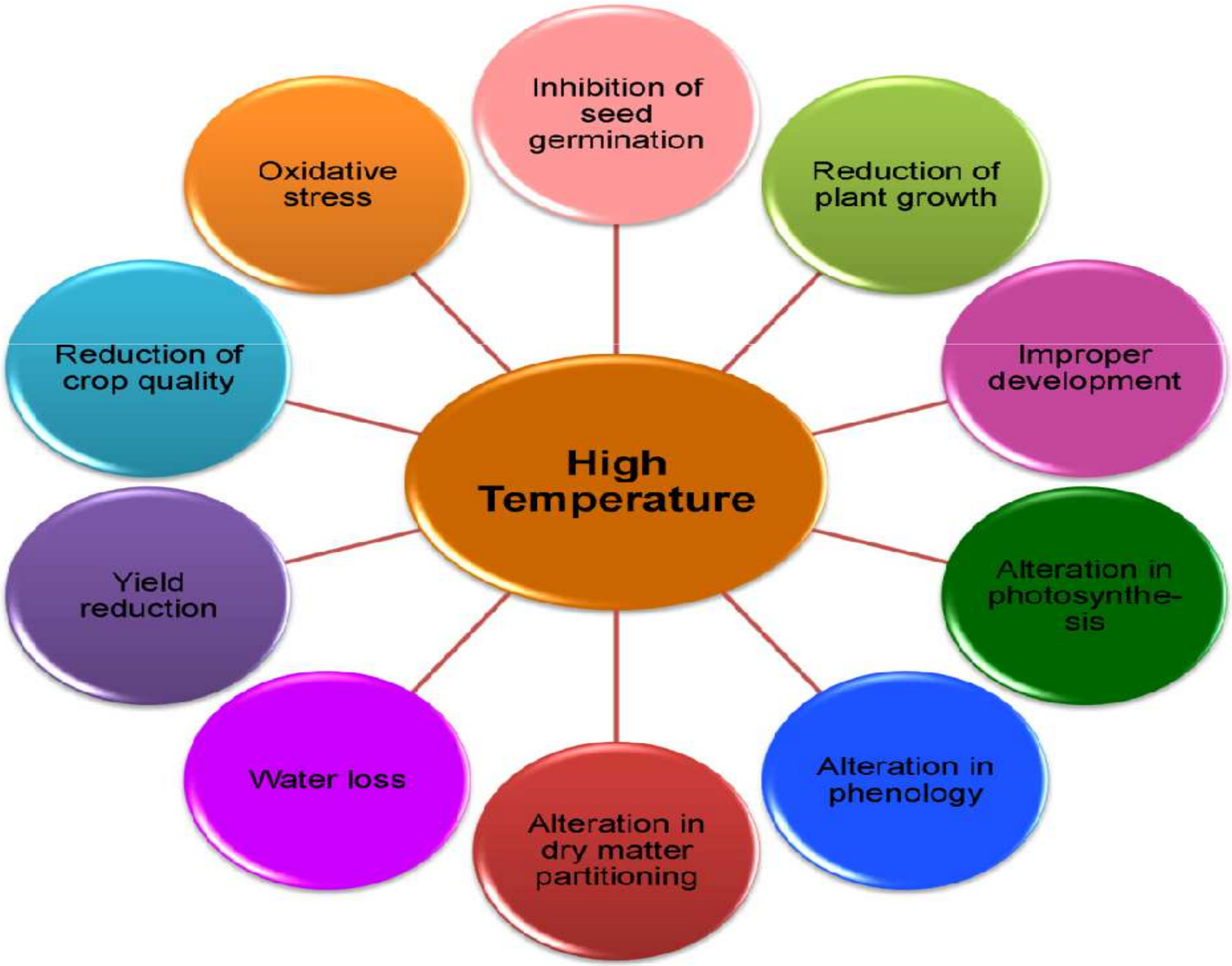
3.Oxygen:-

- The respiration rate increases during germination so the seeds are being loose and well –aerated.
- Low oxygen supply inhabited germination.

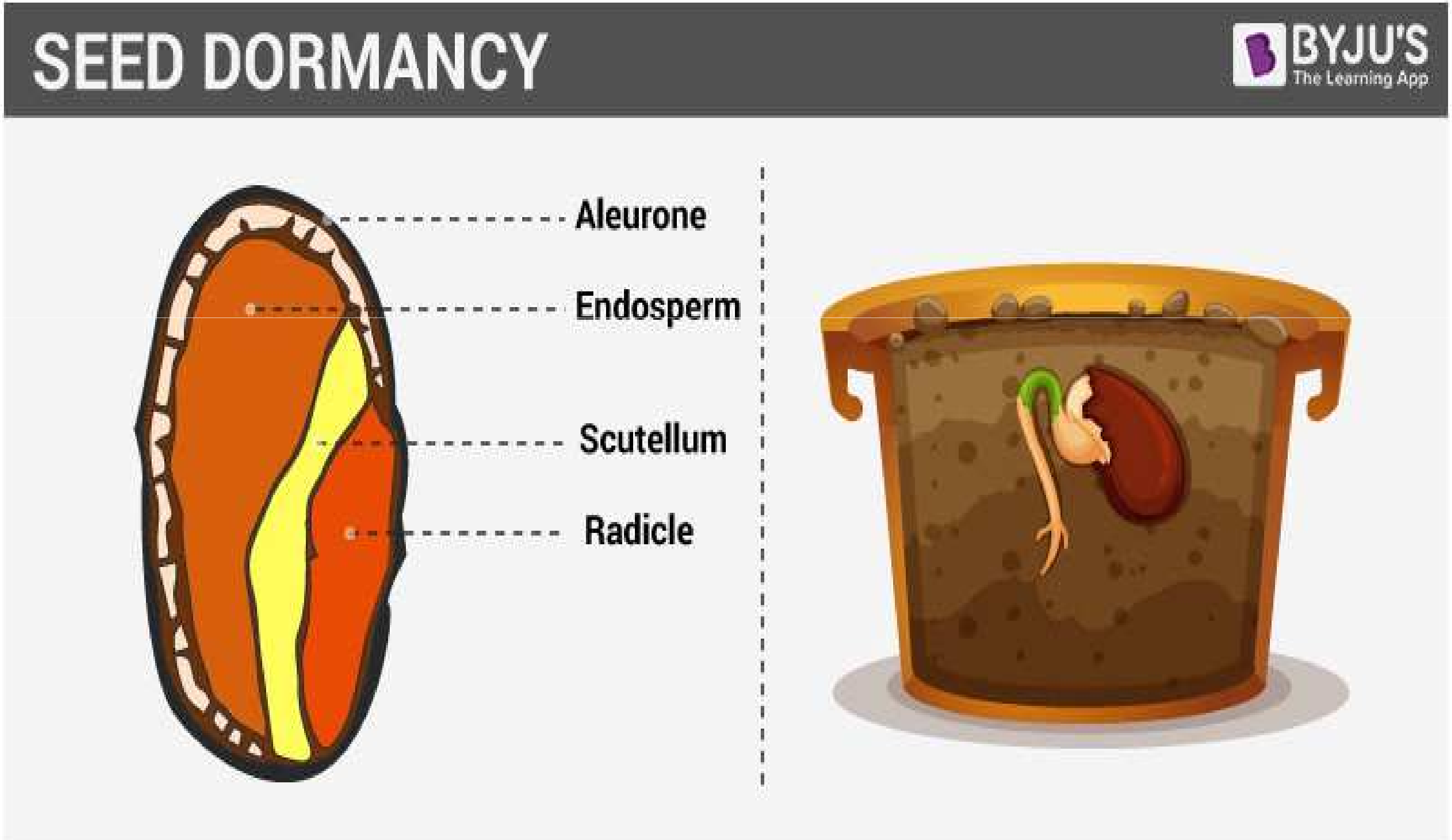


4.Heat:-

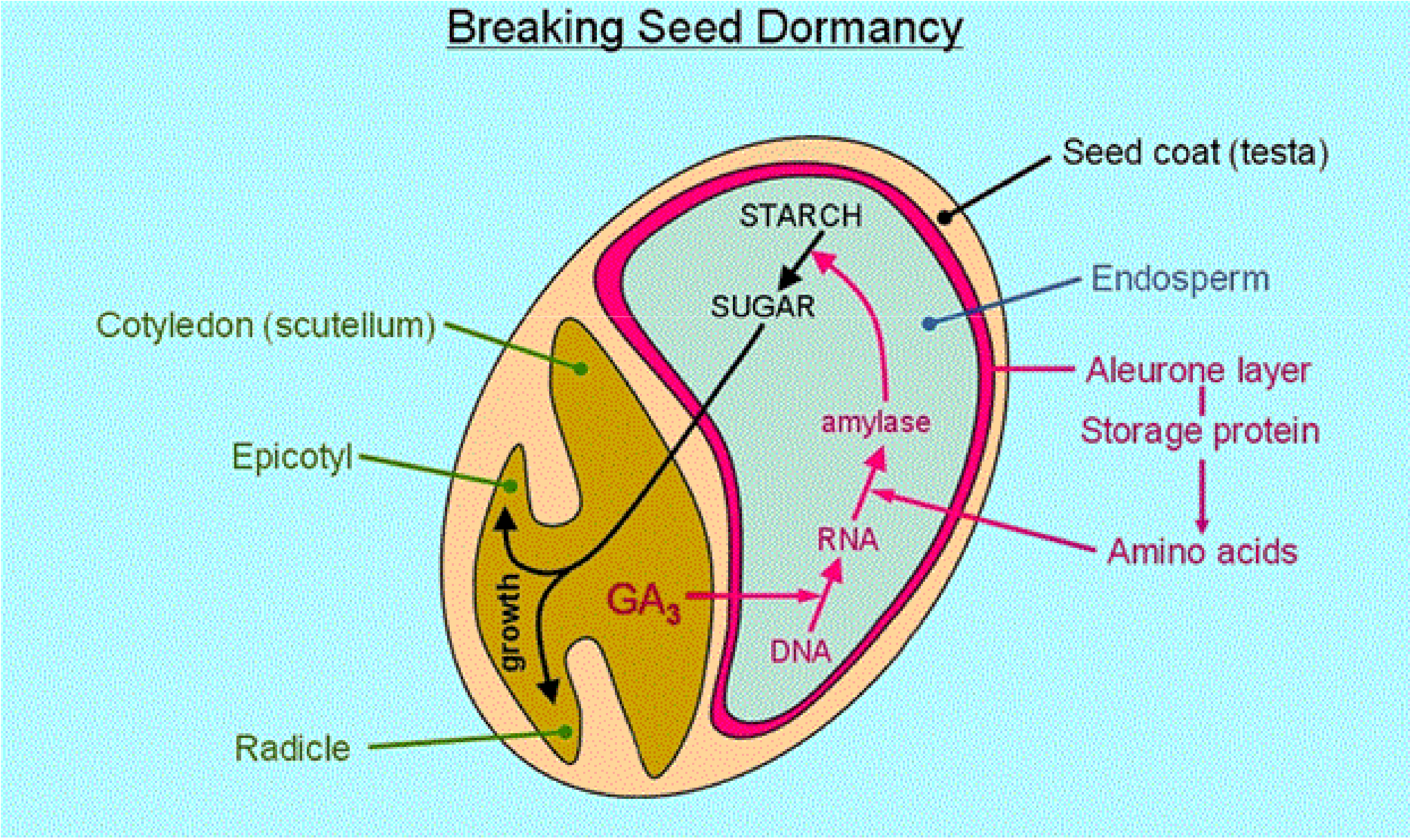
- Generally , 18^0 C- 24^0 C Temprature showed best germination in many plant seeds.
- Ex. Tomato required 10^0 C min temp. 35^0 C max temp.
- Temp. affect rate of germination .

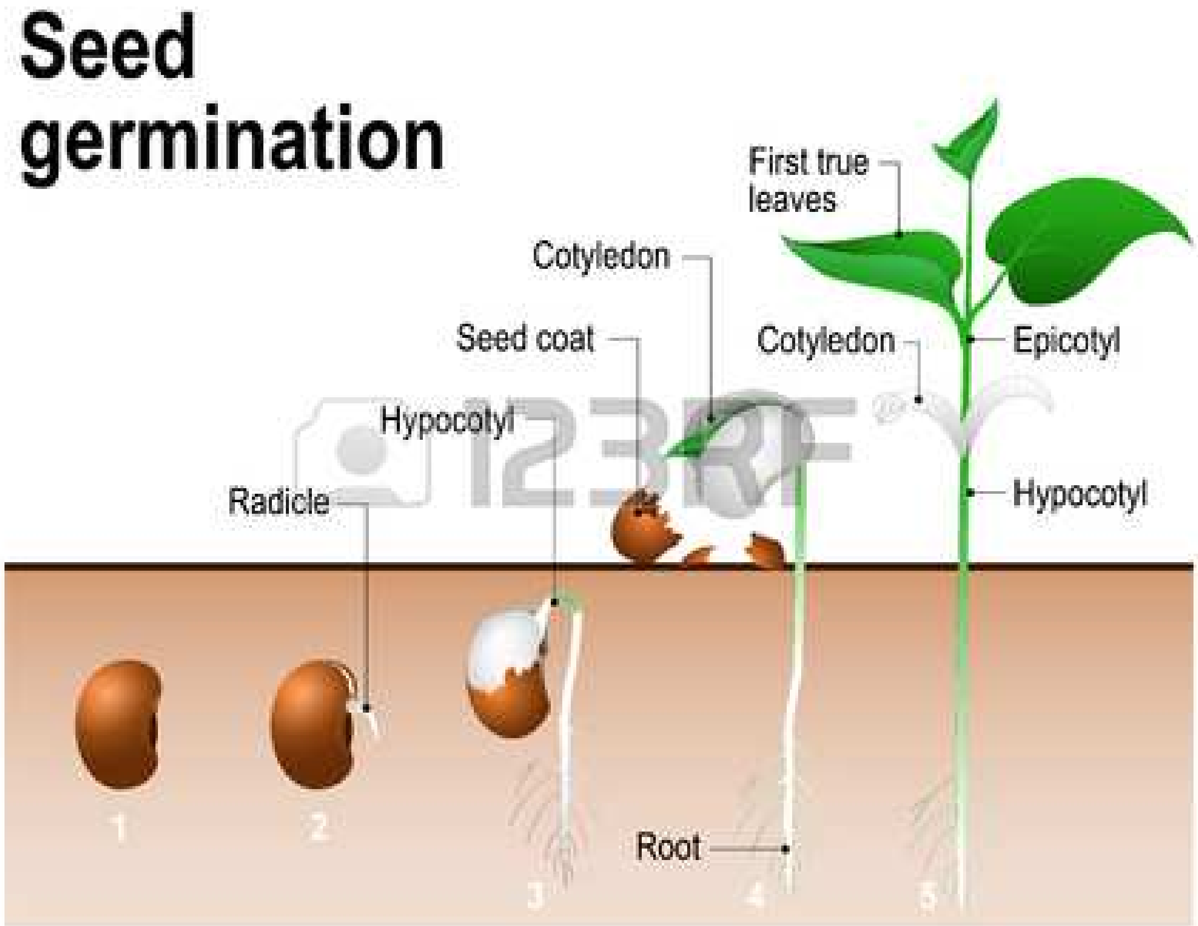

High Temperature
Inhibition of seed germination
Reduction of plant growth
Improper development
Alteration in photosynthe-sis
Alteration in phenology
Alteration in dry matter partitioning
Water loss
Yield reduction
Reduction of crop quality
Oxidative stress

Seed Dormancy And Viability:-



Methods of breaking seed dormancy:-





Seed
germination
First true
leaves
Cotyledon
Seed coat
Cotyledon
Epicotyl
Hypocotyl
Radicle
Hypocotyl
Root
1
2
3
4
5

1. Seed Scarification:-


© mekshat.com

2. Seed Stratification:-

Germination Rate and Germination Capacity:-

Germination Percentage (GP):

$$GP = \frac{\text{Number of Total Germinated Seeds}}{\text{Total Number of Seeds Tested}} \times 100$$

Germination Rate (GR):

$$GR = \frac{\text{Number of Germinated Seeds}}{\text{Day of First Count}} + \text{---------------} + \frac{\text{Number of Germinated Seeds}}{\text{Day of Final Count}}$$

Seed Production:-

Seed production process of rice

1. Seed selection

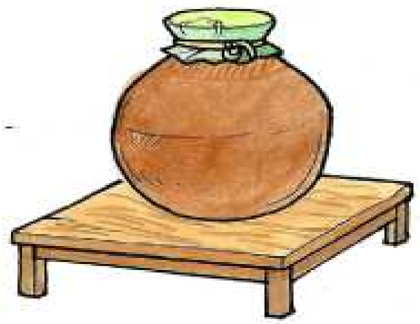
Select only fully mature, uniform, healthy and disease free panicles.

2. Drying

Dry under shade, protected from direct sun.

3. Storage

Store seeds in a cool, dry place in an airtight container, e.g. a clay pot or tin.




Seed Production Cycle
Wildland Seed Collection
Collecting grass seed
Field Establishment
Seed Increase Field
Seed Production
Seed Cleaning/Testing
Seed Extraction
Seed Storage and Use
Seed bank

Objective of seed production:-

- 1.High Agricultural Production:-

  20% production increased.

  2.Rapid Multiplication:-

  Improved seed variety results into rapid multiplication.

RMM & VCM Technique To Boost Black pepper production in Kerala

Rapid multiplication method (RMM)

- Rapid multiplication rate (1:40)
- Well-developed root system,
- Higher field establishment and
- Vigorous growth as a result of better root system

M.Ajmiah.M

3.Seed Quality:-

Seed Quality

Seed quality is the sum of all properties contributing to seed performance. The quality of seed can decide whether a farmer's crop will be good, bad or indifferent. Seed quality is determined by the following characteristics:

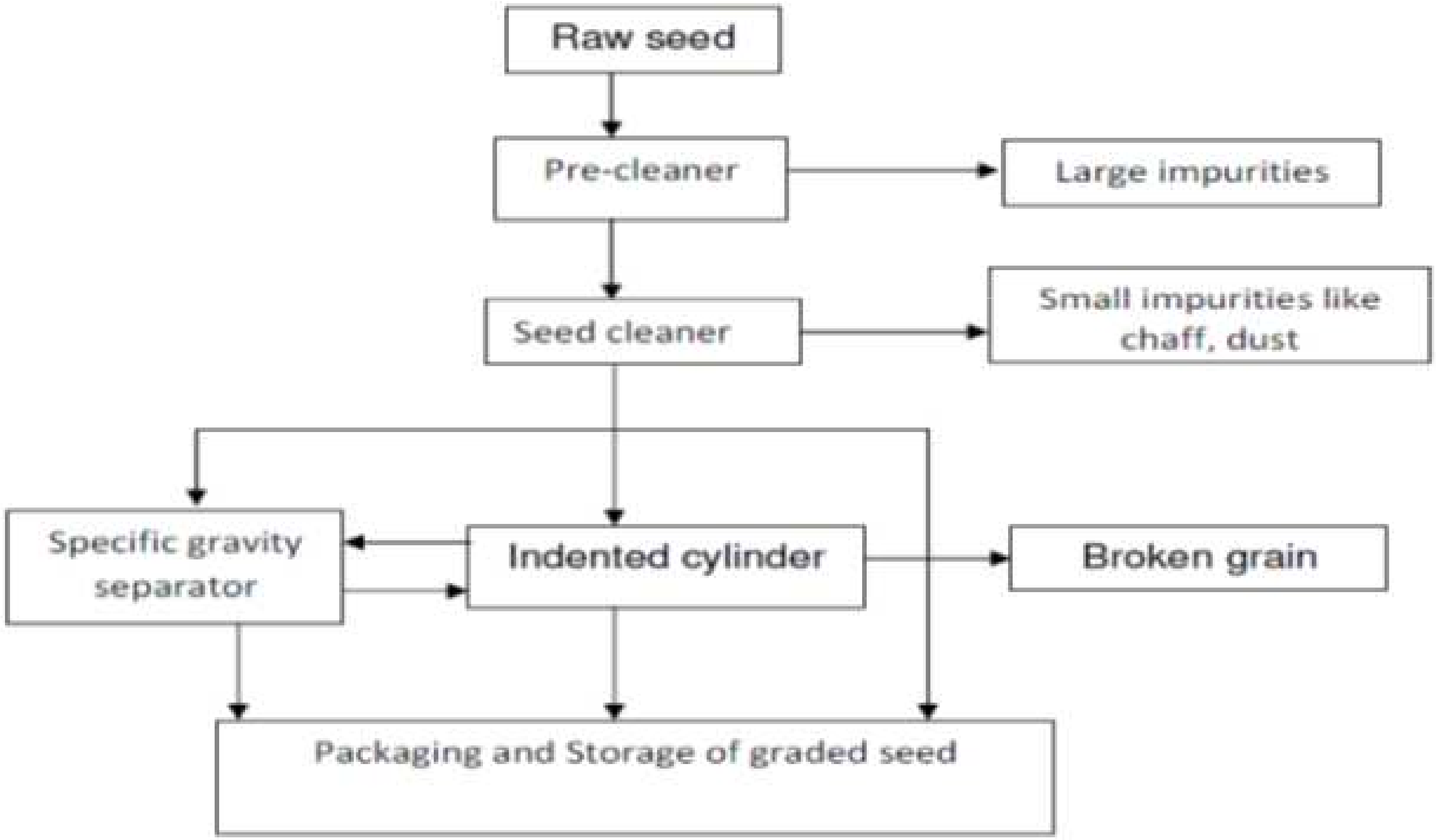
1. Physical Attributes
2. Physiological Attributes
3. Genetic Attributes
4. Storability

- 4. Reasonable Price:-

Seed Certification Process:-

What is Seed certification?

- A legally sanctioned system to maintain quality of seeds during seed production, post harvest operation and distribution of seeds.
- Seed certification is a quality assurance process. Seeds intended for domestic and international markets is controlled and inspected by official sources in order to guarantee consistent high quality for consumers.
- It includes field inspection, seed quality tests and pre & post quality check.
- Certification is a voluntary process but labelling is compulsory.



Process flow chart of Paddy & wheat seed processing

Phases of seed certification or Seed certification procedures

1. Receipt & Scrutiny of application
2. Verification of seed source
3. Field inspection
4. Post harvest supervision of seed crops
5. Seed sampling & testing
6. Labelling, tagging, sealing and grant of certificate.

THANK YOU

Spermatophyta And Paleobotany

Prof. Lanke.S.R

Gymnosperm

- **Introduction :-**

1. Gymnosperms are seed bearing vascular plants.
2. Gymnosperm means NAKED SEED .

(Gymnos=naked ; sperm=seed)

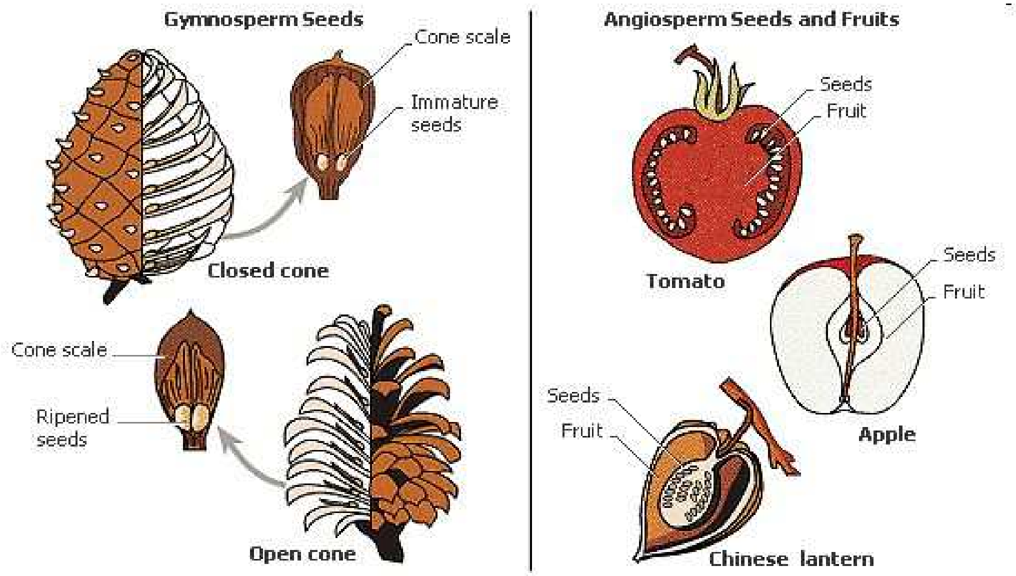
3. Seeds are formed naked.
4. The seeds of the gymnosperms lack a protective enclosure (Unlike flowering plants which have flowers and fruit.)
5. Seeds are produced on the scales of cones.
6. More advanced than ferns because they do not have spores , they have seeds.

Introduction

- Gymnosperms are woody seed-bearing plants differing from the other group of seed plants.
- The term "gymnosperm" comes from word gymnospermos, meaning "naked seeds", after the unenclosed condition of theirseeds (called ovules in their unfertilized state).
- There are between 700 and 900 extant* or currently living species of Gymnosperms.
- They grow in xerophytic conditions and posses xerophytic adaptations.
- Gymnosperms are heterosporous which means that they produce different male and female spores. The microspores develop into pollen grainsand the megasporesare in an ovule

Gymnosperm vs. Angiosperm

- **Gymnosperm**: plants with “naked seed:
  - Seeds are not enclosed in chambers.
- **Angiosperm**: Seeds develop inside chambers
  - 90% of living plants
  - Consists of all flowering plants.



General Characters

- Most of the gymnosperms are trees.
- Some are evergreen i.e.pine
- All gymnosperms have exposed seeds.
- All of the don’t posses flowers.
- Mostly massive

Scientific Classification

- Gymnosperm belongs to 4 different phyla which are

1. Coniferophyta
2. Cycadophyta
3. Ginkgophyta and
4. Gnetophyta

- Chamberlain (1935) classified gymnosperms into:

Gymnosperms

Cycadophytes

Gymnosperms with fern-like pinnatifid leaves, weakly branched large globose or columnar trunks, having large conspicuously developed pith and cortical zones in stem. Secondary xylem cylinder small, composed mainly of tracheids and abundant parenchyma (manoxylic wood). Group well represented in fossil record. The only surviving representatives are the modern cycads.

Orders 1. Cycadofilicales 2. Bennettitales 3. Cycadales

Coniferophytes

Gymnosperms with profusely branched trunks, leaves simple (needle-like, scale-like or laminate), stems with small pith and cortex. Secondary xylem cylinder massive and less parenchymatous (pycnoxylic wood). The group includes extinct as well as extant orders like

Orders: 1. Cordaitales 2. Voltziales 3. Coniferales 4. Ginkgoales 5. Gnetales

Economic importance of gymnosperms

- **As food**
- Seeds of some species are edible: Cycas, Ginko, Pinus, Gnetum
- The seeds and stems of cycas yield 'sago' which is a starch and is also called "arrow root".
- *Zamia* is a rich source of starch.
- Seeds and stem of *Cycas revoluta* u
  wine.
- young leaves of Cycas cooked as ve

kaffir bread' prepared from the stem p

Encephalartos.

- **As ornaments**
- Species of Cycas are used for decoration purposes.
- *Ginkgo bioloba* possess beautiful ornamental leaves.

Significance of gymnosperms

- <u>Ecological importance:</u>
- Provide food and habitat for wildlife
- Forests prevent soil erosion
- Reduce greenhouse-effect gasses
- <u>Economic and commercial importance</u>
- Lumber for wood, paper, etc.
- Resins – wood, furniture, etc.
- Ornamental plants (trees, landscaping)
- Food – pine nuts (pesto-pine nut, bacil, garlic, sold, cheese, olive oil)

- **Sporophyte of Pinus:**
- Pinus is a tall evergreen tree giving rise to a series of widespread horizontal branches .
- The tree a pyramid-like appearance.
- The main stem is cylindrical and covered with scaly bark.
- The branches are dimorphic, bearing two types of shoots: long shoots and dwarf shoots
- The plants are monoecious where the male and female cones are borne on separate bran-ches in the same plant.

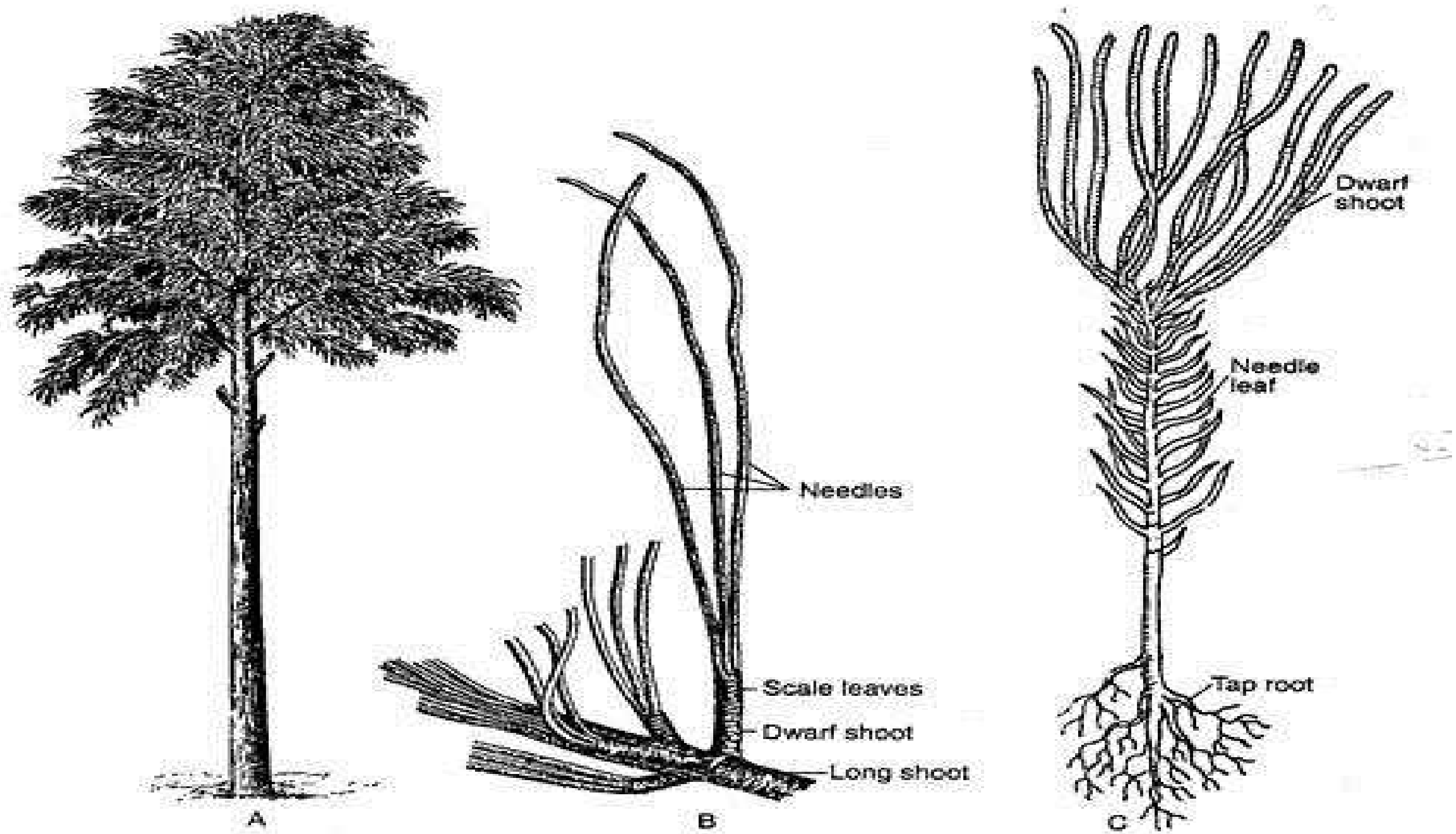


Fig. 1.57 : A. A *Pinus* tree, B. Long shoot and dwarf shoots of *Pinus*, C. A *Pinus* seedling

- **Reproduction:**
- Pinus reproduces sexually. Pinus is mono-ecious, but the male and the female cones are produced on separate branches of the same plant.
- The number of male cones in a cluster varies considerably from 15 (P. wallichiana) to 140 (P. roxburghii).
- The female cones grow very slowly and the growth may persist for several years.

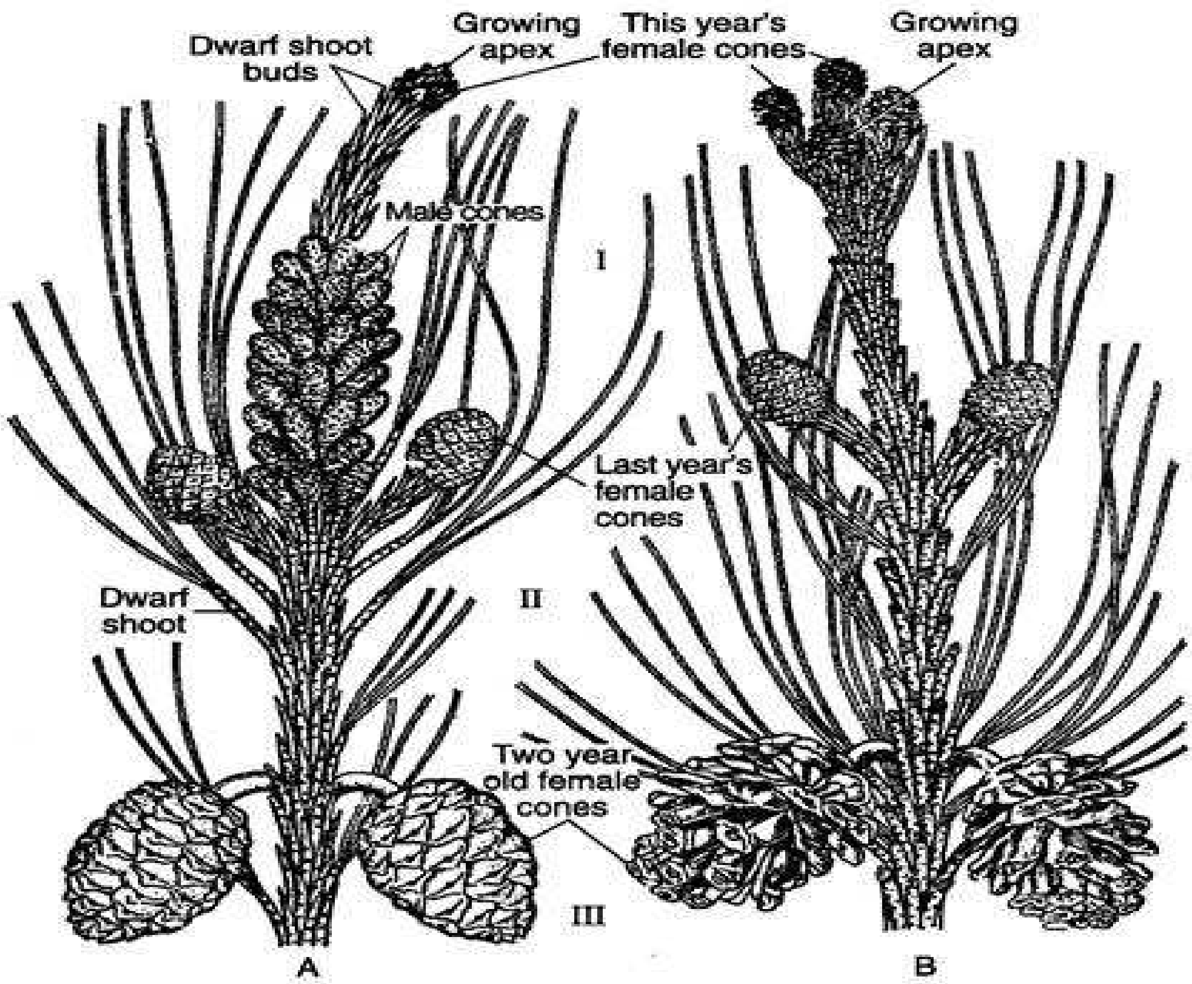


Fig. 1.61 : *Pinus* : Male and female cones : A. At early spring, B. At the end of spring (rains)

- **i. Male Cone:**

- The male cone is small (2-4 cm in length) and oval in shape that develops in the axil of scale leaves. The male cone has a central axis on which 60-150 microsporophylls are spirally arranged around the axis
- A single microsporophyll is a membranous stalked struc-ture with a distal expanded roughly triangular sterile part called apophysis .
- The development of microsporangia is of eusporangiate type, i.e., it develops from a group of hypodermal cells of the microsporophyll.
- Each microspore mother cell — by meiotic division — produces four microspores or pollen grains.
- Thus, at maturity, a single micro-sporangium contains numerous pale yellow pollen grains. The wall layers: the outer thick exine and the inner thin intine .
- The dehiscence of sporangia takes place by longitudinal slit in dry and warm envi-ronment.
- Pinus is wind-pollinated (anemophilous). The pale-yellow pollen gains are released into the air in a large quantity, so that a pine forest appears yellow at the time of pollination. This is popularly called ‘sulphur showers’ which occurs specially in the spring when pine trees are shaken by strong winds.

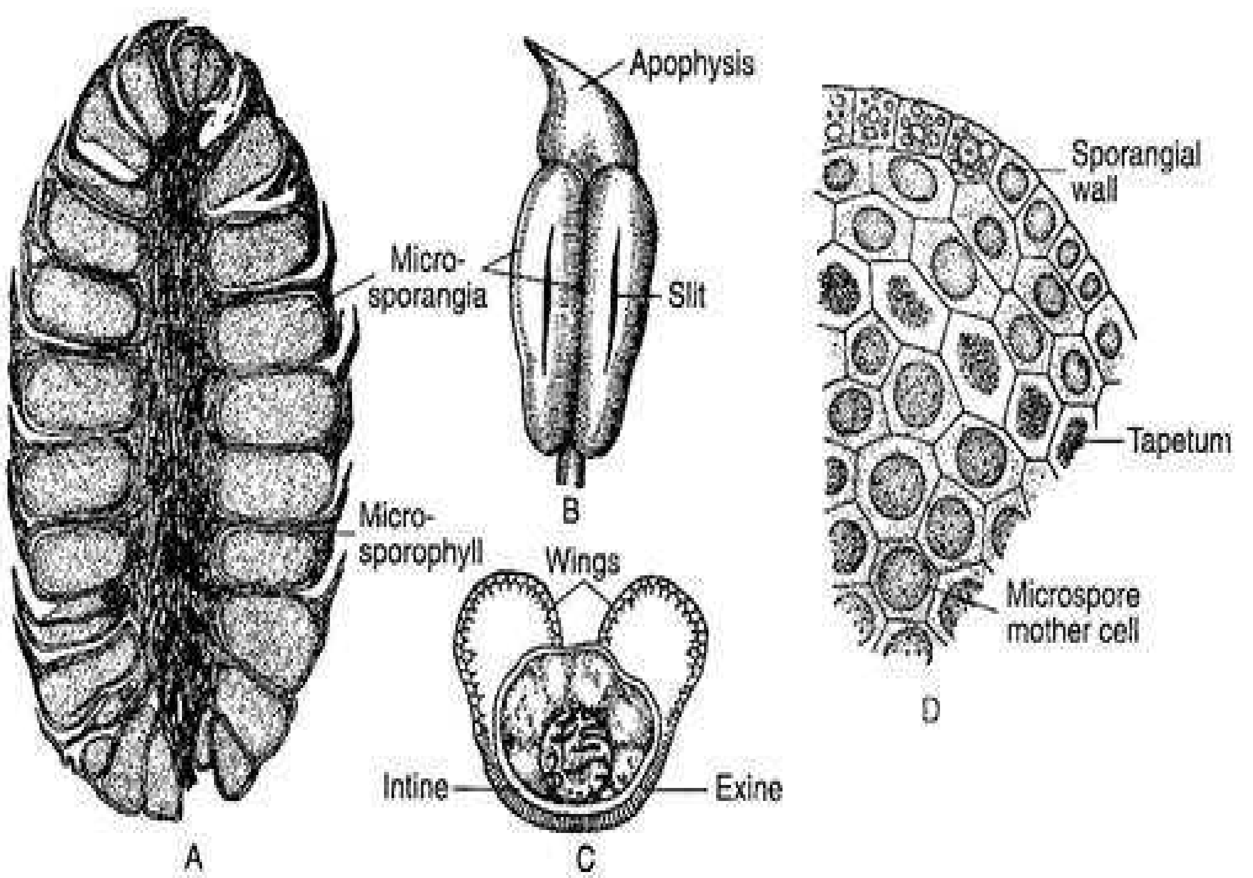


Fig. 1.62 : *Pinus* : A. Median L.S. of male cone, B. A microsporophyll, C. A pollen, D. T.S. of a microsporangium

- **ii. Female Cone:**

- Female cones are produced in pairs or in clusters in the axil of the scale leaves. The female cones mature very slowly.
- The first year young cone is small (1-2 cm in length), soft, compact and red-green in colour.
- The fully matured third year cone is much larger (15-60 cm in length), woody, loose and brown in colour.
- The female cone of Pinus represents a com-pound shoot; it is a complicated structure.
- The bract scale and ovuliferous scale thus form a seed-scale complex.

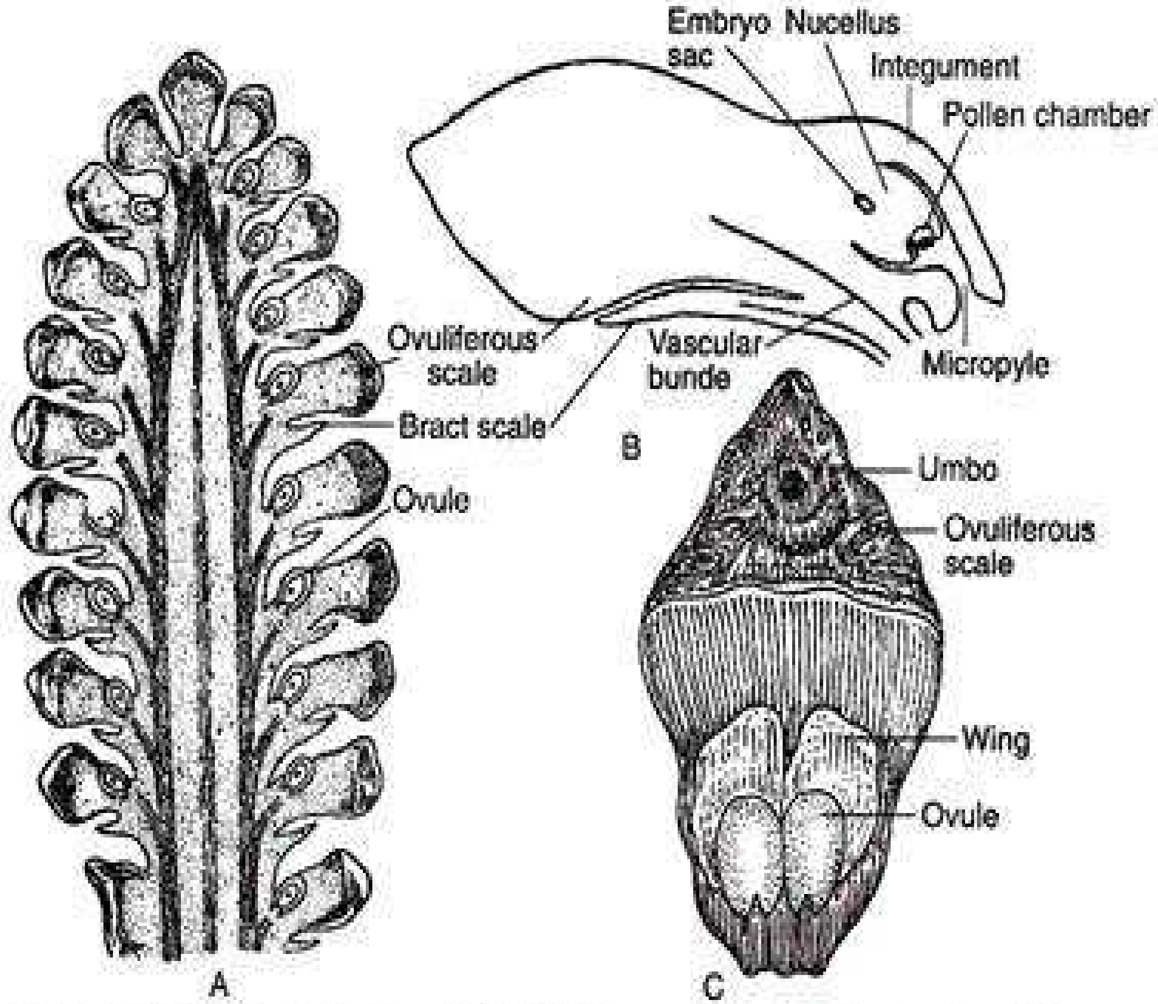


Fig. 1.63 : *Pinus* : A. Median L.S. of female cone, B. V.L.S. of an ovuliferous scale, C. An ovuliferous scale bearing two seeds (fertilized ovules)

- **Ovule:**
- The ovules of Pinus are anatropous, unitegmic and crassinucellate .
- The sin-gle integument is free from the nucellus except at the chalazal end.

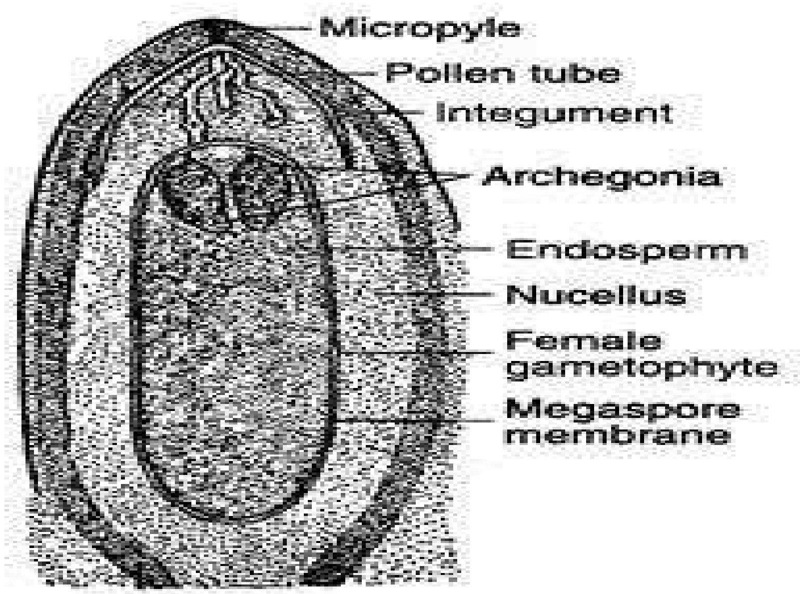
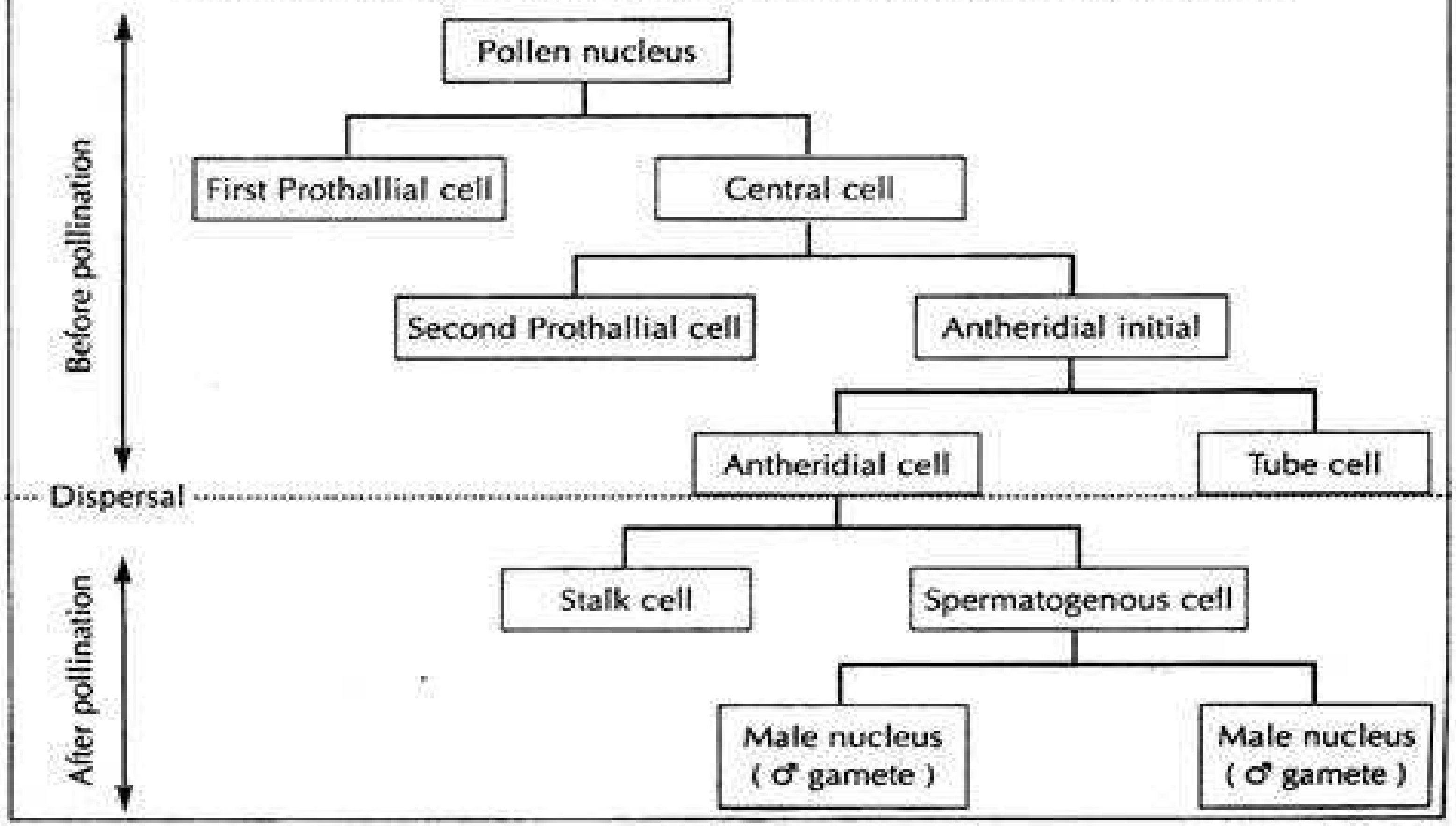


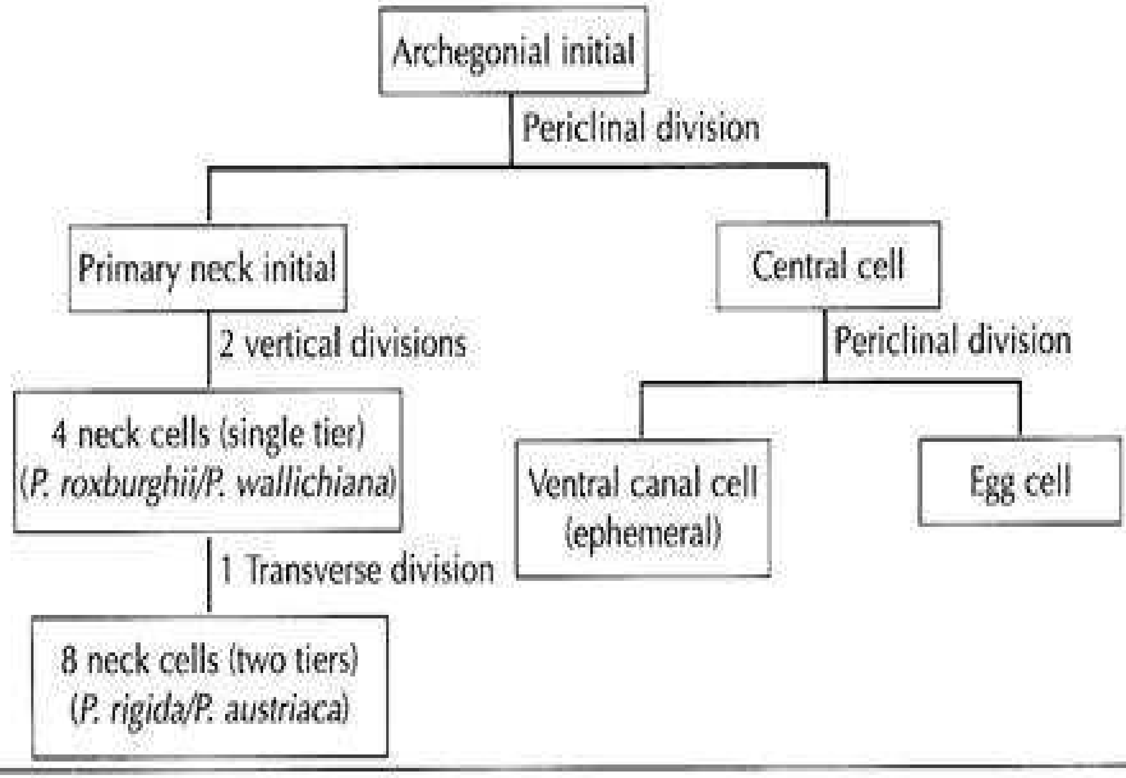
Fig. 1.64 : *Pinus* : Median L.S. of a mature ovule

- **Gametophyte of Pinus:**
- The spore is the first phase of gametophyte generation.
- The microspore or pollen grain represents the male gametophyte, while the megaspore represents the first stage of female gametophyte which develops into a female gametophyte.

Schematic representation in the development of male gametophyte of *Pinus*



Schematic representation in the development of archegonium in *Pinus*



- **v. Pollination:**
- Pinus is anemophilous i.e., wind-pollinated. The pollen grains are dispersed and remain sus-pended in the air for some time.
- The pollen grains are caught in the pollination drop and are collected in the pollen chamber as a result of drying off the fluid.
- The mouth of the micro-pyle is then sealed from the outer environment.

- **Fertilisation:**
- The fertilisation takes place after one year of pollination.
- The pollen tube enters the tip of the archegonium by forcing itself between the cells of the nucellus.
- One of the male nuclei fuses with the egg cell and thus a zygote is formed.

- **Embryogeny**:
- The developing embryonal cells are deeply embedded into the gametophyte by the seven-fold elongation of embryonal suspensor.
- The cells of the embryonal tier are separated from each other at the time of embryonal suspensor elongation, thus four independent embryos are formed . This phenomenon is known as polyembryony, because more than one embryo is formed from a zygote .
- The proembryo divides transversely to form two cells which by further repeated divisions form an embryo.

- **Seeds of Pinus:**
- The seeds are endowed with a well-developed wing which is thin and papery and is easily detachable at maturity .
- The outer fleshy layer of integument and part of ovuliferous scale contribute to the wing forma-tion .
- The seeds are usually dispersed by wind.
- The embryo remains embedded within the endosperm.

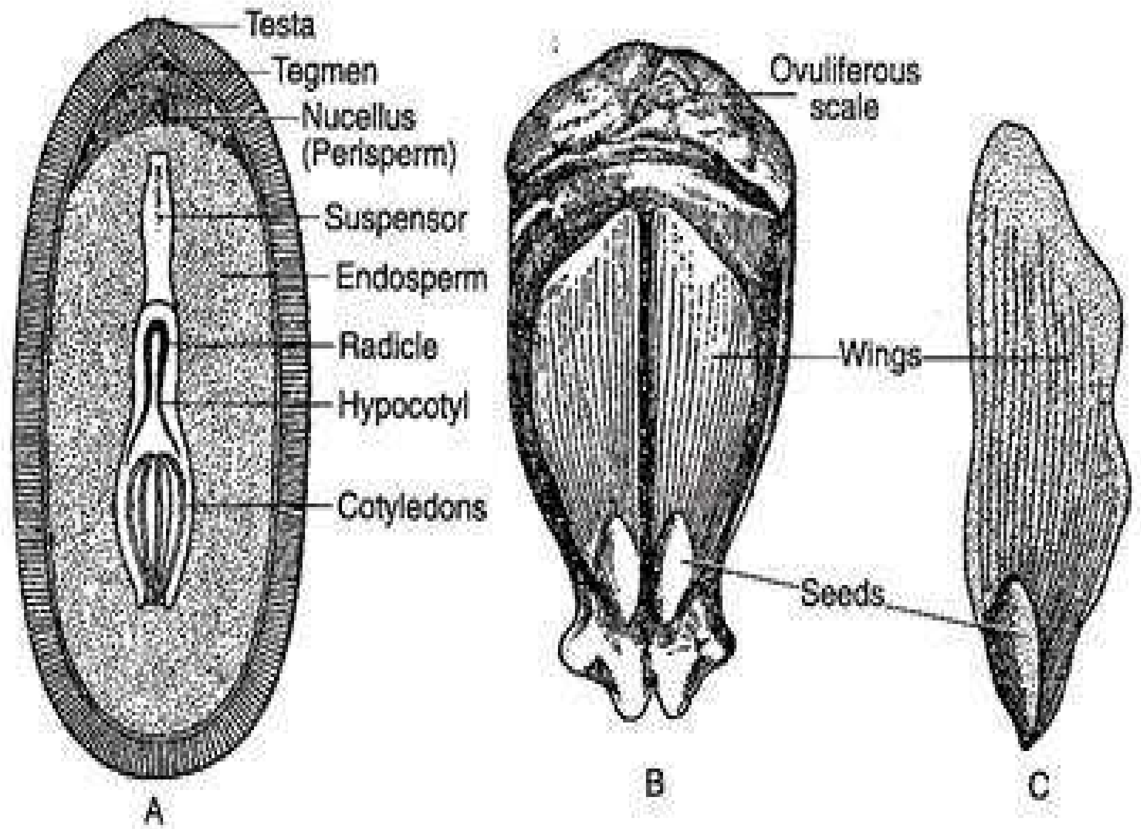


Fig. 1.68 : *Pinus* : A. L.S. of seed, B. An ovuliferous scale bearing seeds, C. A seed with wing

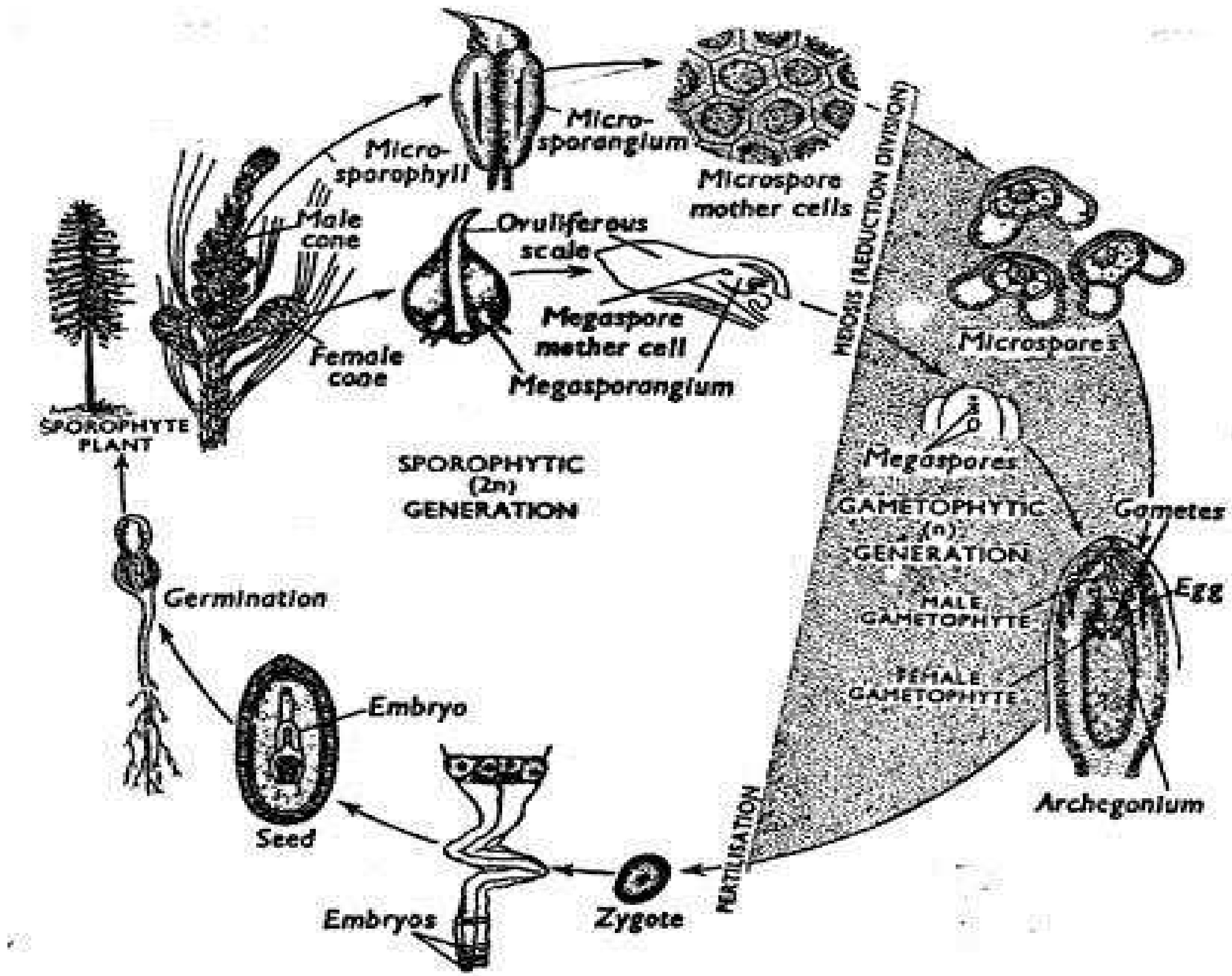


Fig. 1.70 : Life cycle of *Pinus*

THANK YOU

Welcome

Chromosomes, Mapping, and the Meiosis–Inheritance Connection

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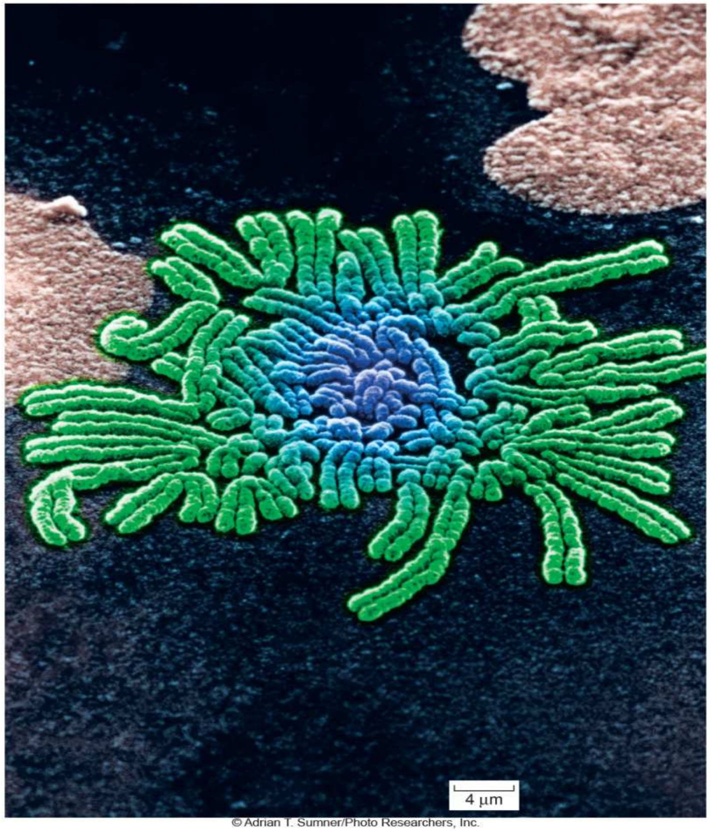

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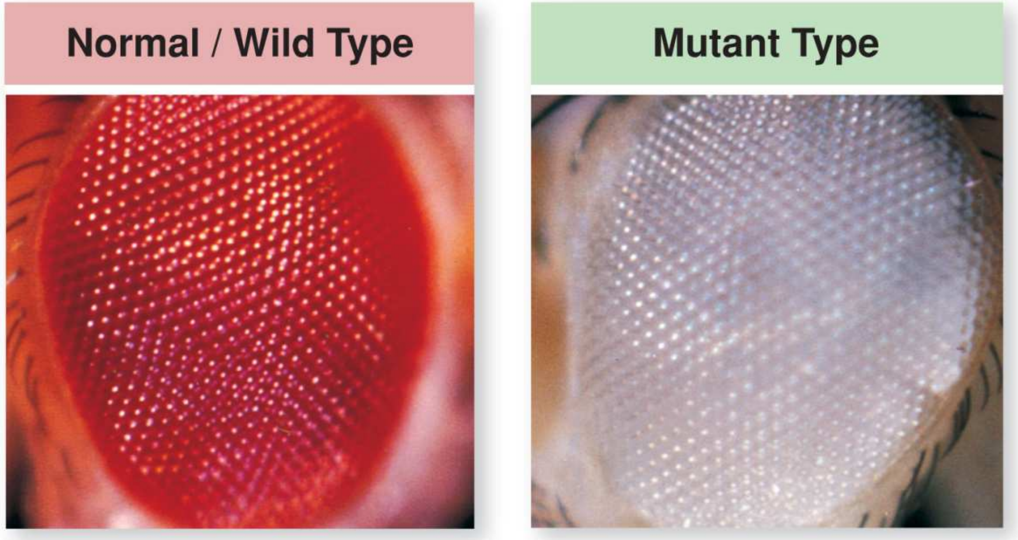
Prof. S.R. Lanke
Department of Botany

- **Carl Correns – 1900**
  - First suggests central role for chromosomes
  - One of papers announcing rediscovery of Mendel’s work
- **Walter Sutton – 1902**
  - Chromosomal theory of inheritance
  - Based on observations that similar chromosomes paired with one another during meiosis



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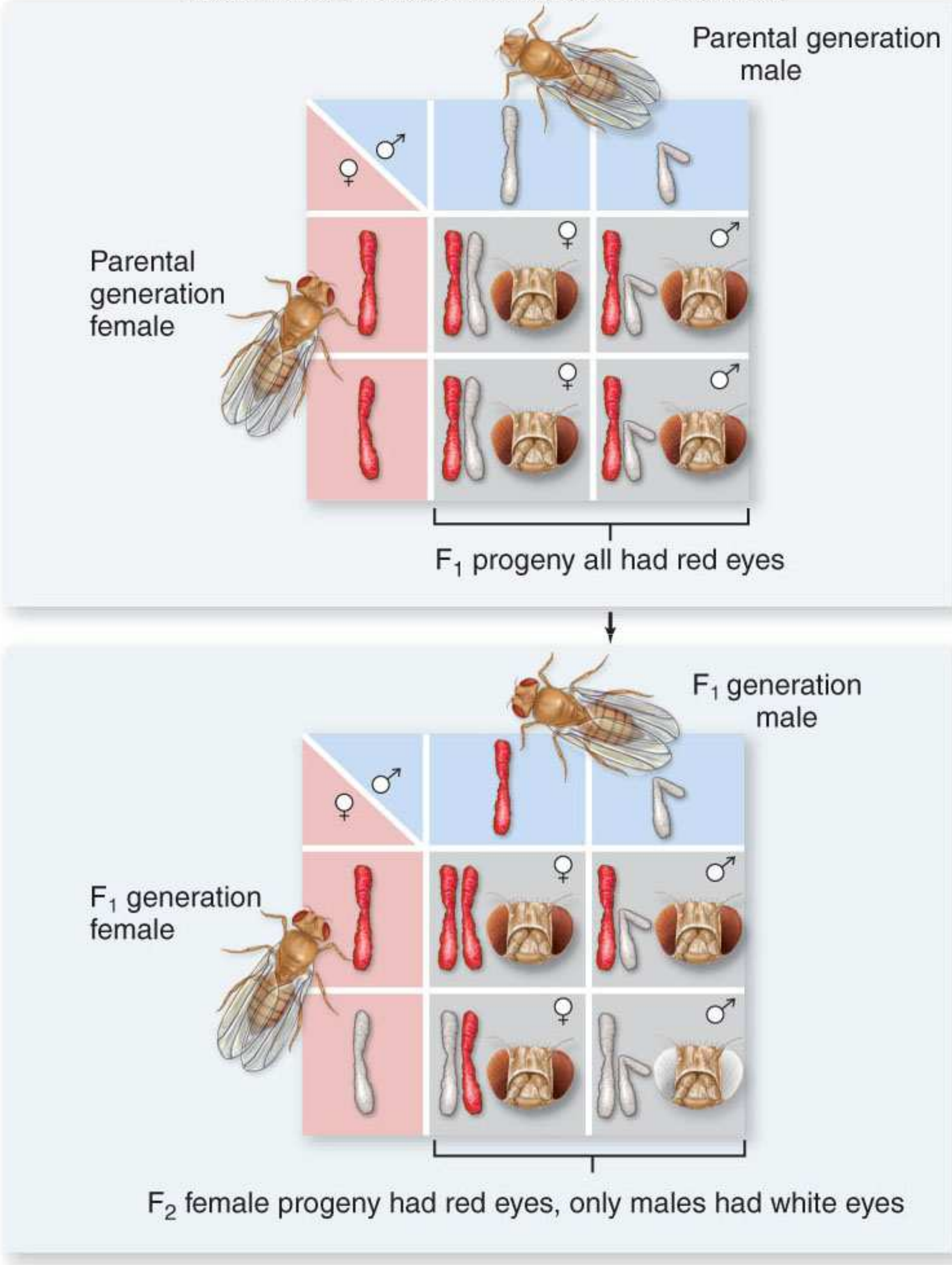
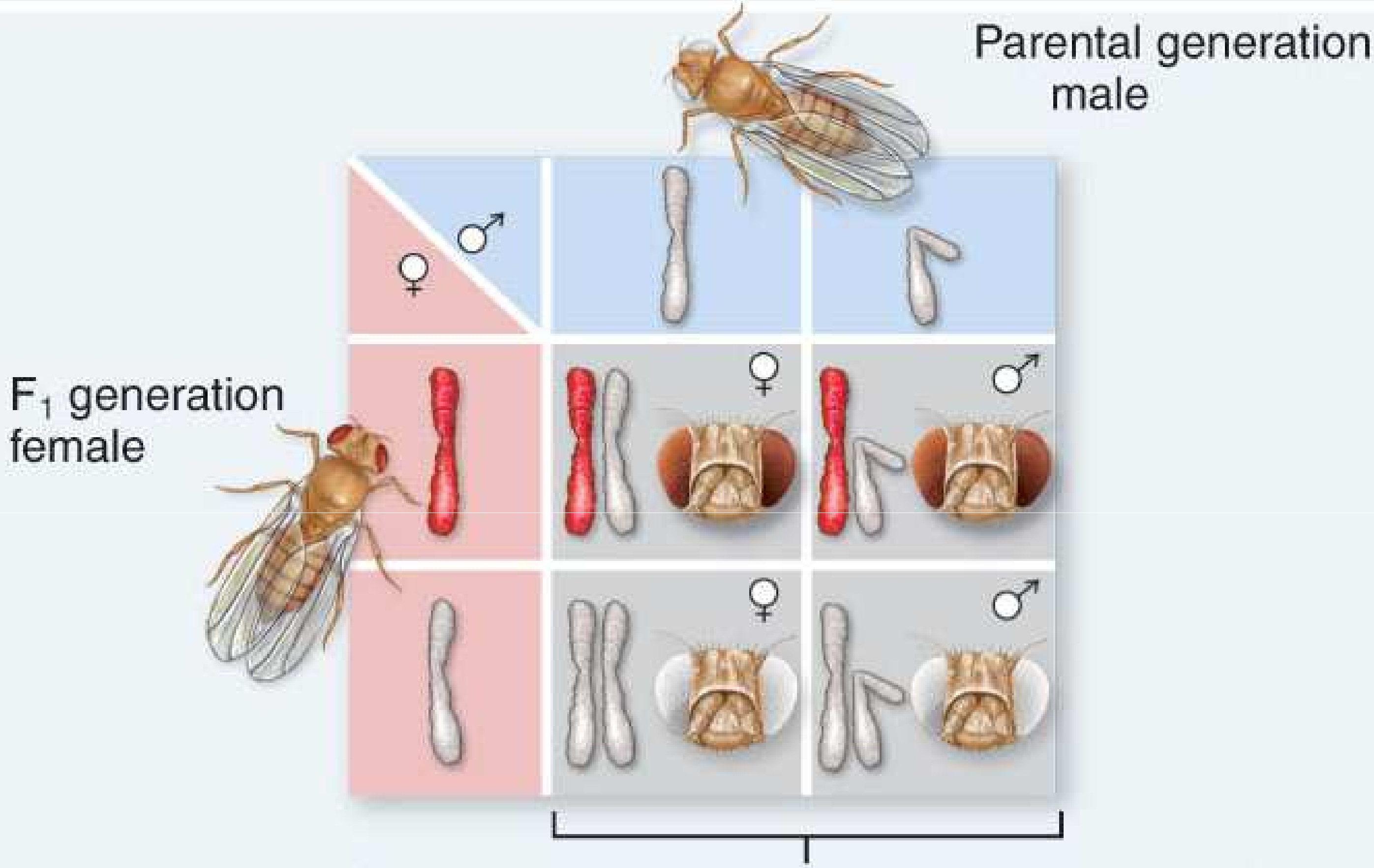
- **T.H. Morgan – 1910**
  - – Working with fruit fly, *Drosophila melanogaster*
  - – Discovered a mutant male fly with white eyes instead of red
  - – Crossed the mutant male to a normal red-eyed female
    - All F_1 progeny red eyed = dominant trait

- Morgan crossed F_1 females x F_1 males
- F_2 generation contained red and white- eyed flies
  - But all white-eyed flies were male
- Testcross of a F_1 female with a white-eyed male showed the viability of white-eyed females
- Morgan concluded that the eye color gene resides on the X chromosome


Parental generation male
♀
♂
Parental generation female
F₁ progeny all had red eyes
F₁ generation male
F₁ generation female
F₂ female progeny had red eyes, only males had white eyes

Testcross



The testcross revealed that white-eyed females are viable. Therefore eye color is linked to the X chromosome and absent from the Y chromosome

Sex Chromosomes

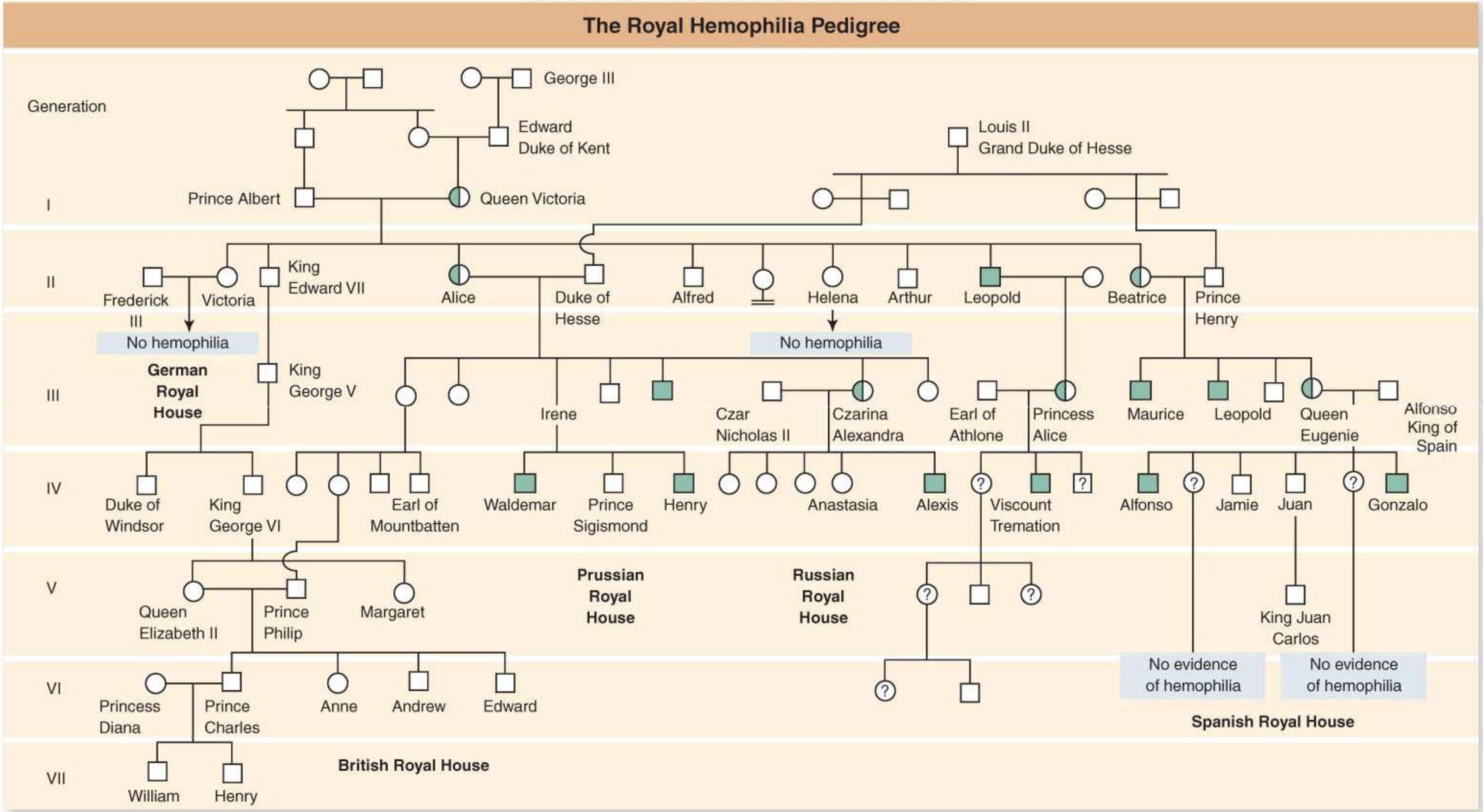
- Sex determination in *Drosophila* is based on the number of X chromosomes
  - 2 X chromosomes = female
  - 1 X and 1 Y chromosome = male

- Sex determination in humans is based on the presence of a Y chromosome
  - 2 X chromosomes = female
  - Having a Y chromosome (XY) = male

- Humans have 46 total chromosomes
  - 22 pairs are autosomes
  - 1 pair of sex chromosomes
  - Y chromosome highly condensed
    - Recessive alleles on male's X have no active counterpart on Y
  - "Default" for humans is female
    - Requires *SRY* gene on Y for "maleness"

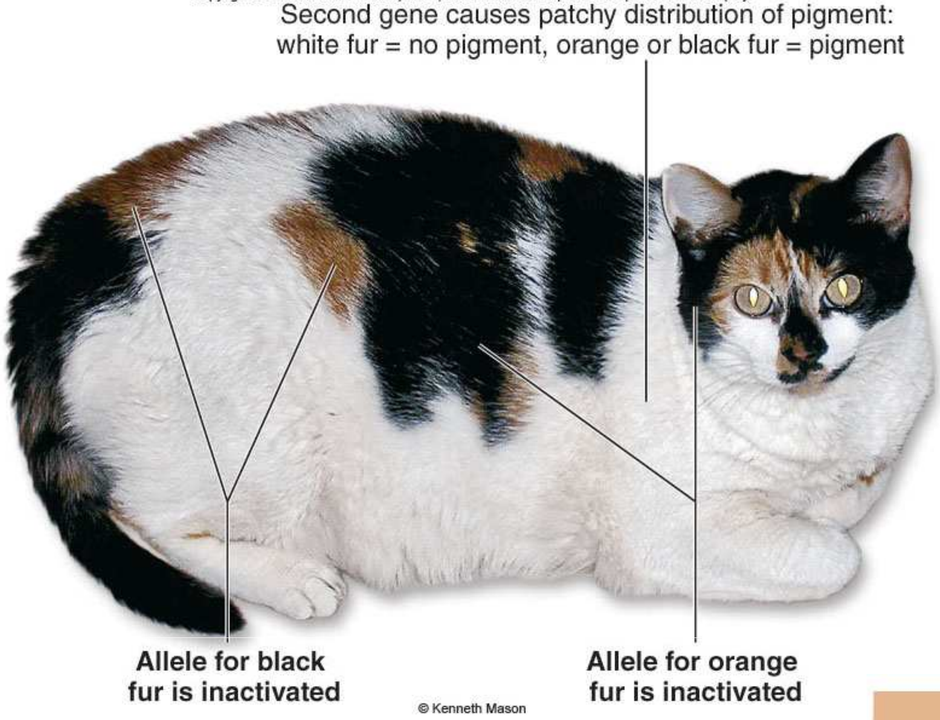
Hemophilia

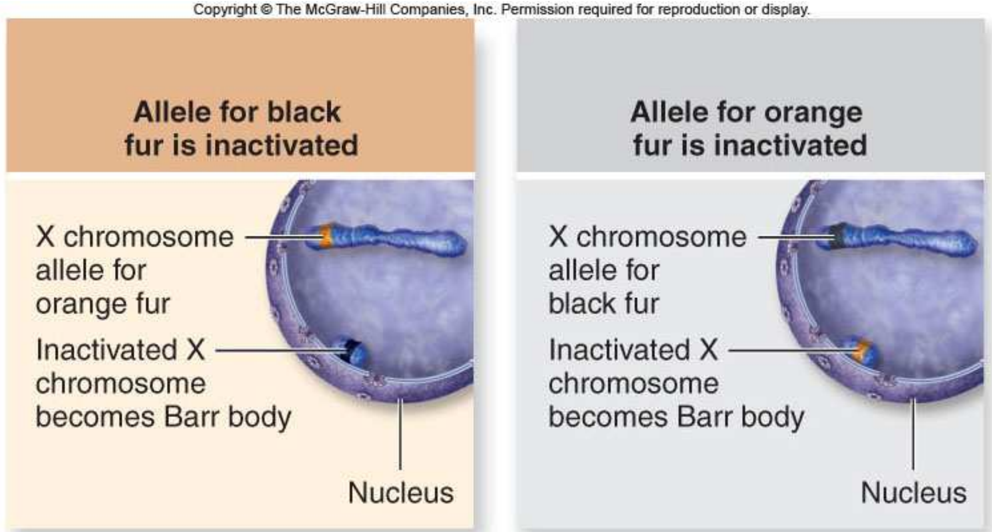
- Disease that affects a single protein in a cascade of proteins involved in the formation of blood clots
- Form of hemophilia is caused by an X-linked recessive allele
  - Heterozygous females are asymptomatic carriers
- Allele for hemophilia was introduced into a number of different European royal families by Queen Victoria of England


The Royal Hemophilia Pedigree
Generation
I
II
III
IV
V
VI
VII
George III
Edward Duke of Kent
Louis II Grand Duke of Hesse
Prince Albert
Queen Victoria
Frederick III
Victoria
King Edward VII
Alice
Duke of Hesse
Alfred
Helena
Arthur
Leopold
Beatrice
Prince Henry
No hemophilia
German Royal House
King George V
Irene
Czar Nicholas II
Czarina Alexandra
Earl of Athlone
Princess Alice
Maurice
Leopold
Queen Eugenie
Alfonso King of Spain
Duke of Windsor
King George VI
Earl of Mountbatten
Waldemar
Prince Sigismond
Henry
Anastasia
Alexis
Viscount Tremation
Alfonso
Jamie
Juan
Gonzalo
Queen Elizabeth II
Prince Philip
Margaret
Prussian Royal House
Russian Royal House
King Juan Carlos
No evidence of hemophilia
Princess Diana
Prince Charles
Anne
Andrew
Edward
Spanish Royal House
British Royal House
William
Henry

Dosage compensation

- Ensures an equal expression of genes from the sex chromosomes even though females have 2 X chromosomes and males have only 1
- In each female cell, 1 X chromosome is inactivated and is highly condensed into a Barr body
- Females heterozygous for genes on the X chromosome are genetic mosaics


Second gene causes patchy distribution of pigment:
white fur = no pigment, orange or black fur = pigment
Allele for black
fur is inactivated
Allele for orange
fur is inactivated
© Kenneth Mason

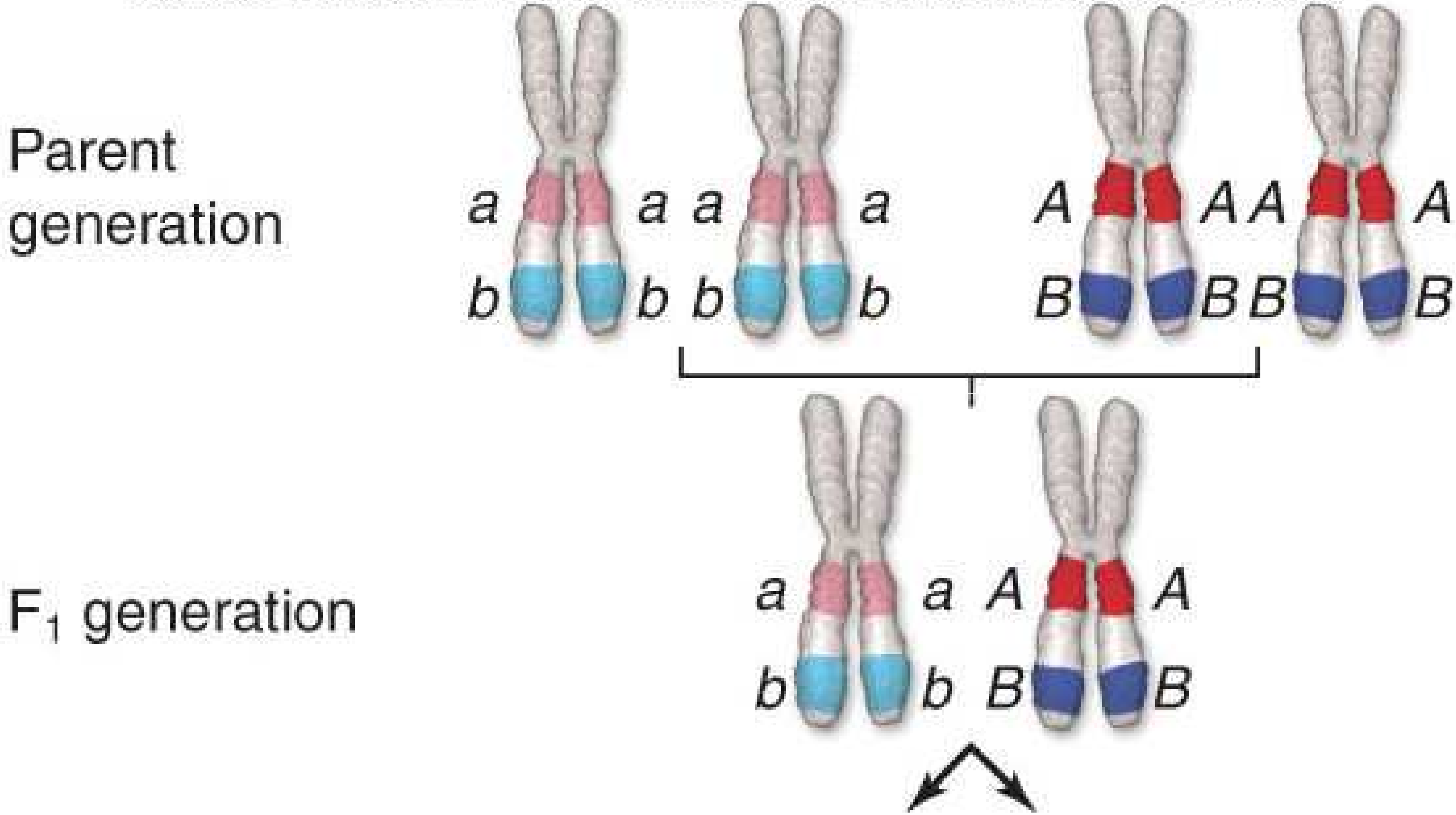

Allele for black
fur is inactivated
X chromosome
allele for
orange fur
Inactivated X
chromosome
becomes Barr body
Nucleus
Allele for orange
fur is inactivated
X chromosome
allele for
black fur
Inactivated X
chromosome
becomes Barr body
Nucleus

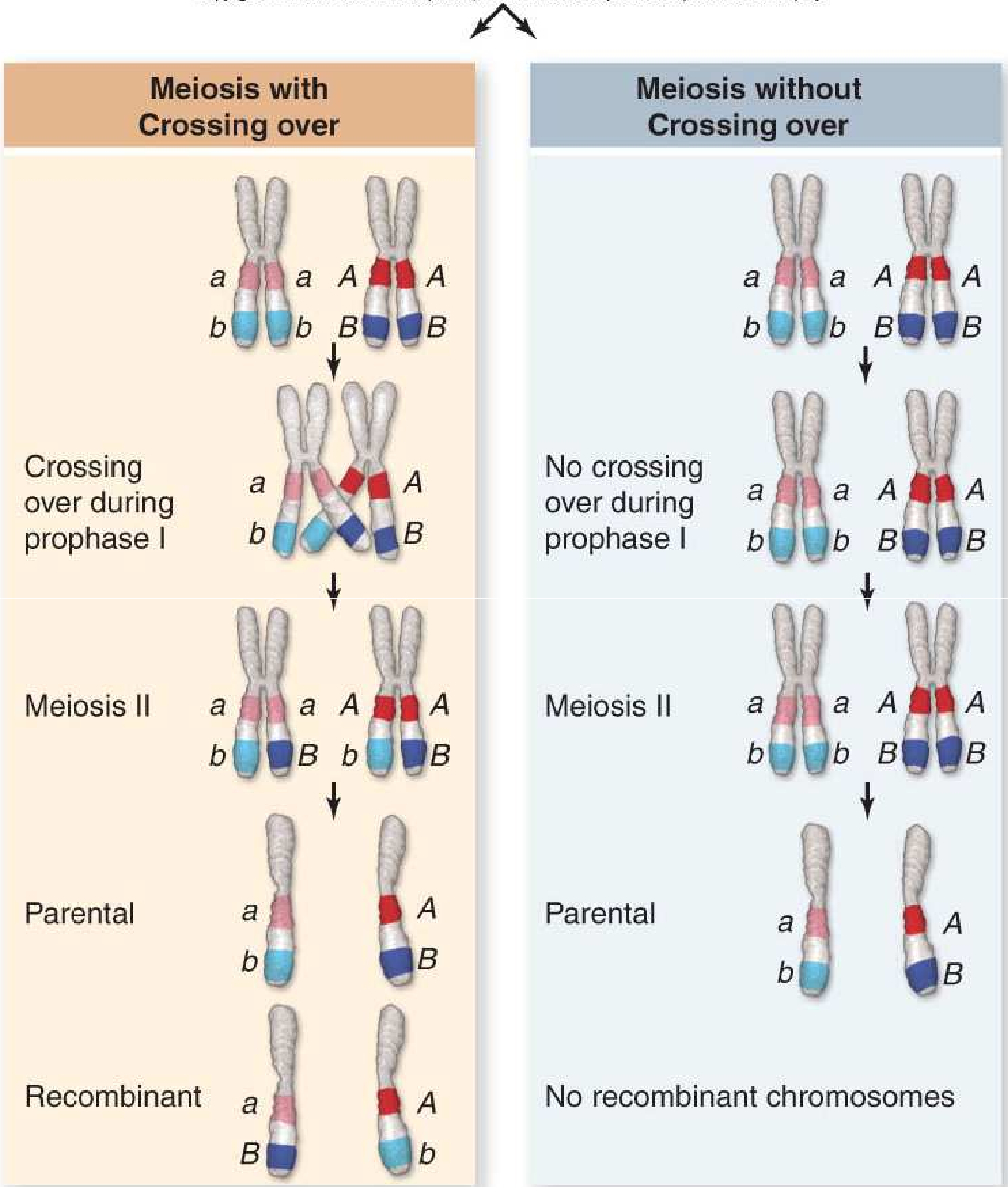
Chromosome theory exceptions

- Mitochondria and chloroplasts contain genes
- Traits controlled by these genes do not follow the chromosomal theory of inheritance
- Genes from mitochondria and chloroplasts are often passed to the offspring by only one parent (mother)
  - Maternal inheritance
- In plants, the chloroplasts are often inherited from the mother, although this is species dependent

Genetic Mapping

- Early geneticists realized that they could obtain information about the distance between genes on a chromosome
- Based on genetic recombination (crossing over) between genes
- If crossover occurs, parental alleles are recombined producing recombinant gametes


Parent generation
a a a a
b b b b
A A A A
B B B B
F_1 generation
a a A A
b b B B


Meiosis with Crossing over
a a A A
b b B B
Crossing over during prophase I
a A
b B
Meiosis II
a a A A
b B b B
Parental
a A
b B
Recombinant
a A
B b
Meiosis without Crossing over
a a A A
b b B B
No crossing over during prophase I
a a A A
b b B B
Meiosis II
a a A A
b b B B
Parental
a A
b B
No recombinant chromosomes

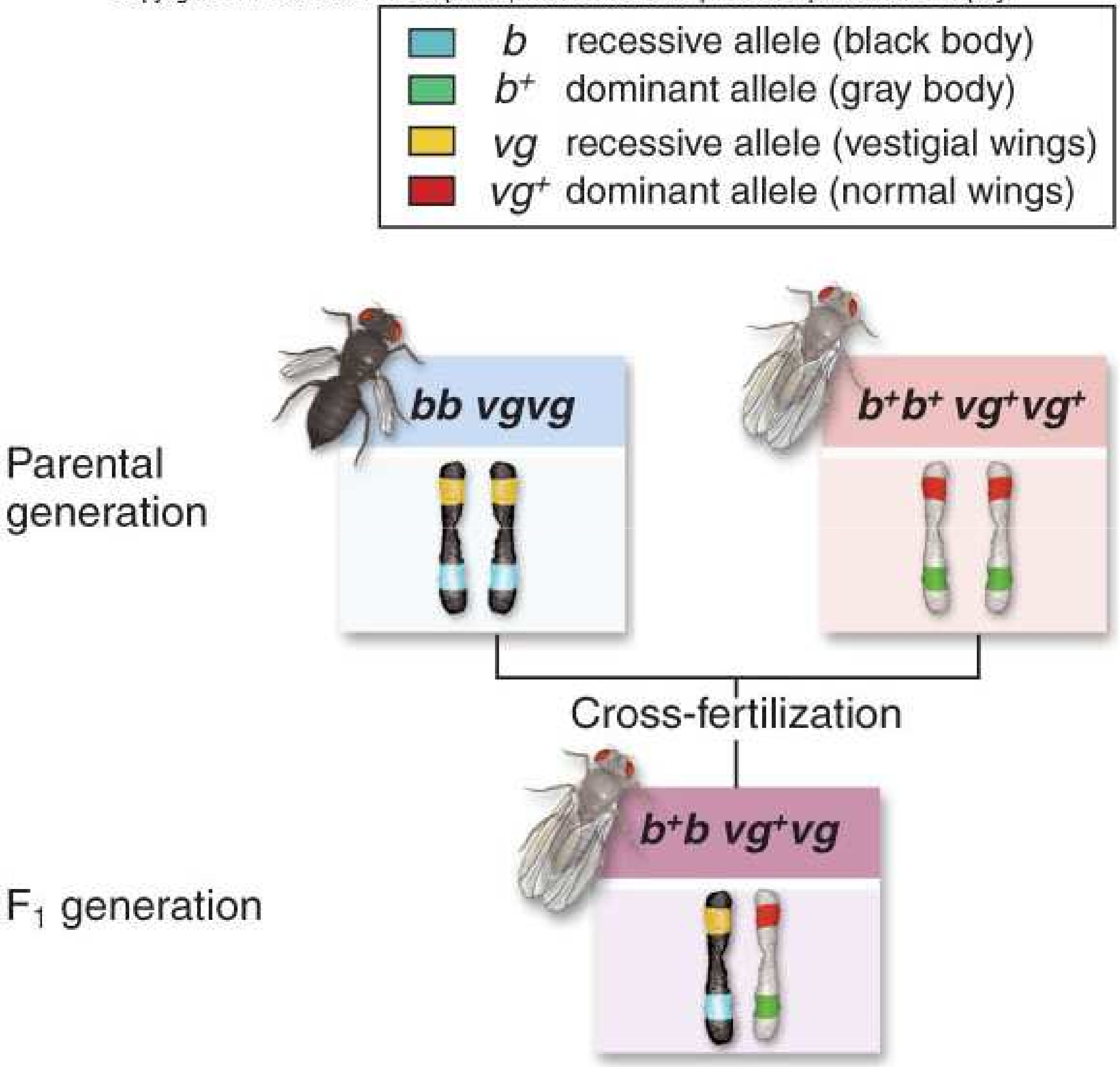
- **Alfred Sturtevant**
  - Undergraduate in T.H. Morgan's lab
  - Put Morgan's observation that recombinant progeny reflected relevant location of genes in quantitative terms
  - As physical distance on a chromosome increases, so does the probability of recombination (crossover) occurring between the gene loci

Constructing maps

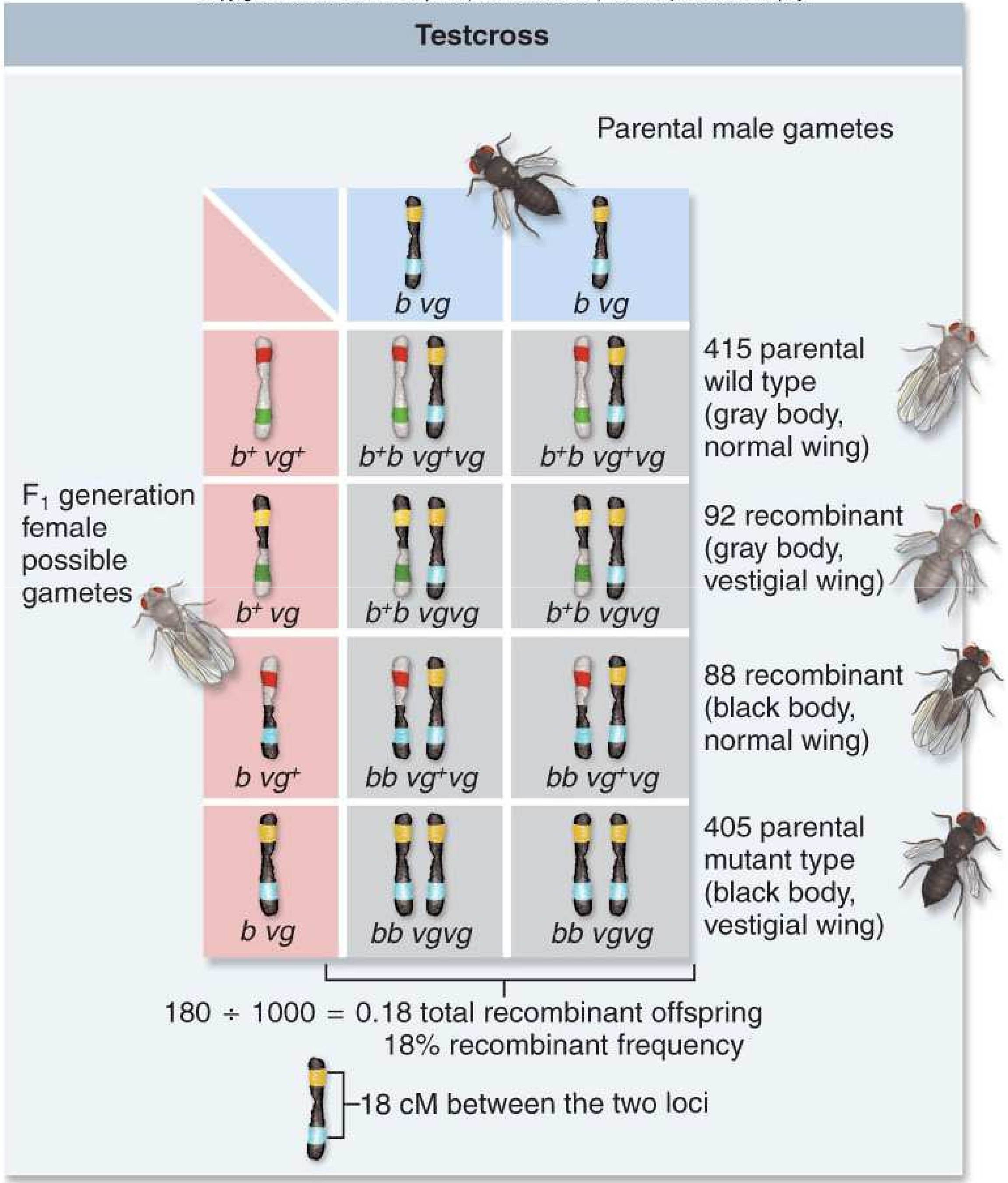
- The distance between genes is proportional to the frequency of recombination events

$$\text{recombination frequency} = \frac{\text{recombinant progeny}}{\text{total progeny}}$$

- 1% recombination = 1 map unit (m.u.)
- 1 map unit = 1 centimorgan (cM)

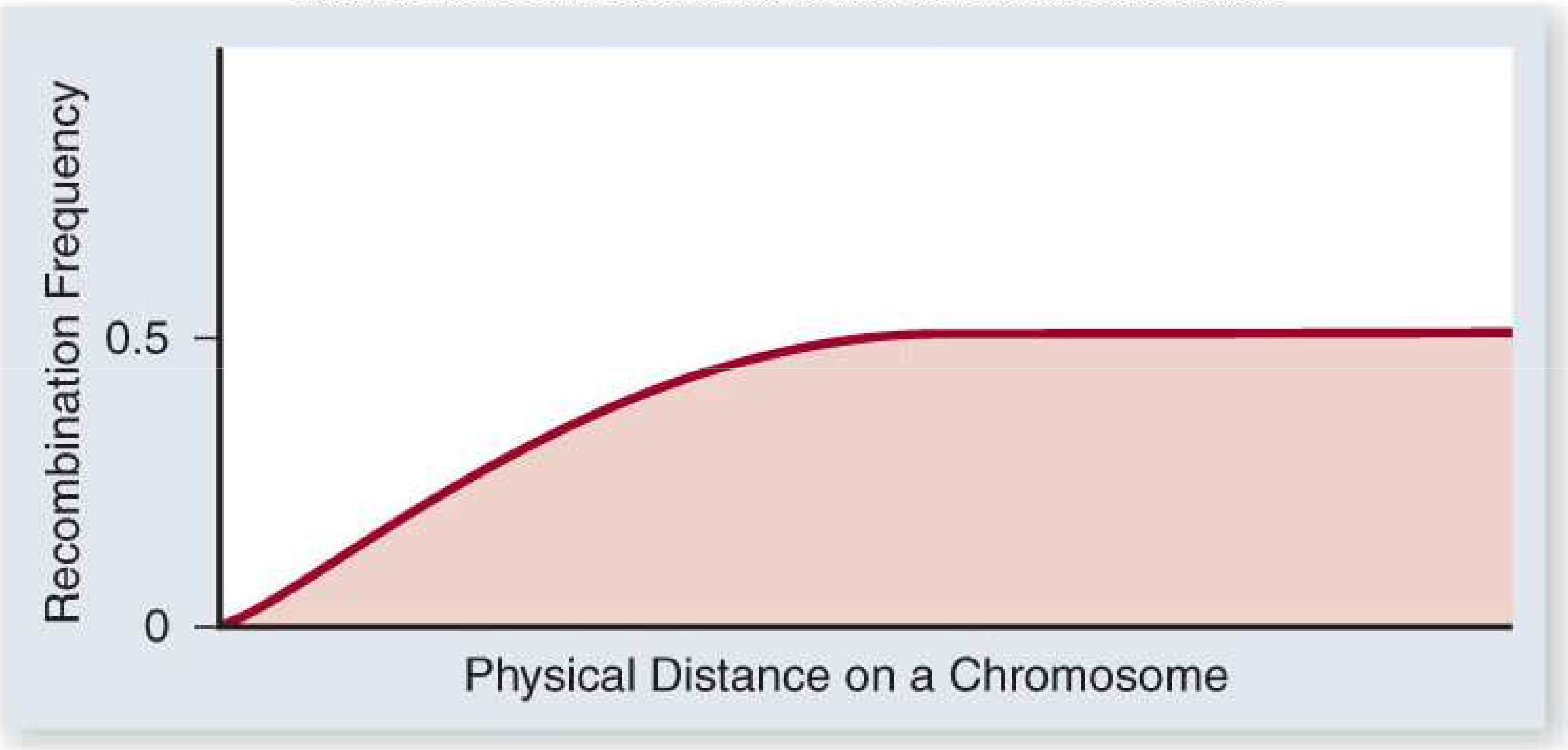


b recessive allele (black body)
b+ dominant allele (gray body)
vg recessive allele (vestigial wings)
vg+ dominant allele (normal wings)
bb vgvg
b+b+ vg+vg+
Parental generation
Cross-fertilization
b+b vg+vg
F1 generation


Testcross
Parental male gametes
b vg
b vg
F1 generation female possible gametes
b+ vg+
b+b vg+vg
b+b vg+vg
b+ vg
b+b vgvg
b+b vgvg
b vg+
bb vg+vg
bb vg+vg
b vg
bb vgvg
bb vgvg
415 parental wild type (gray body, normal wing)
92 recombinant (gray body, vestigial wing)
88 recombinant (black body, normal wing)
405 parental mutant type (black body, vestigial wing)
180 ÷ 1000 = 0.18 total recombinant offspring
18% recombinant frequency
18 cM between the two loci

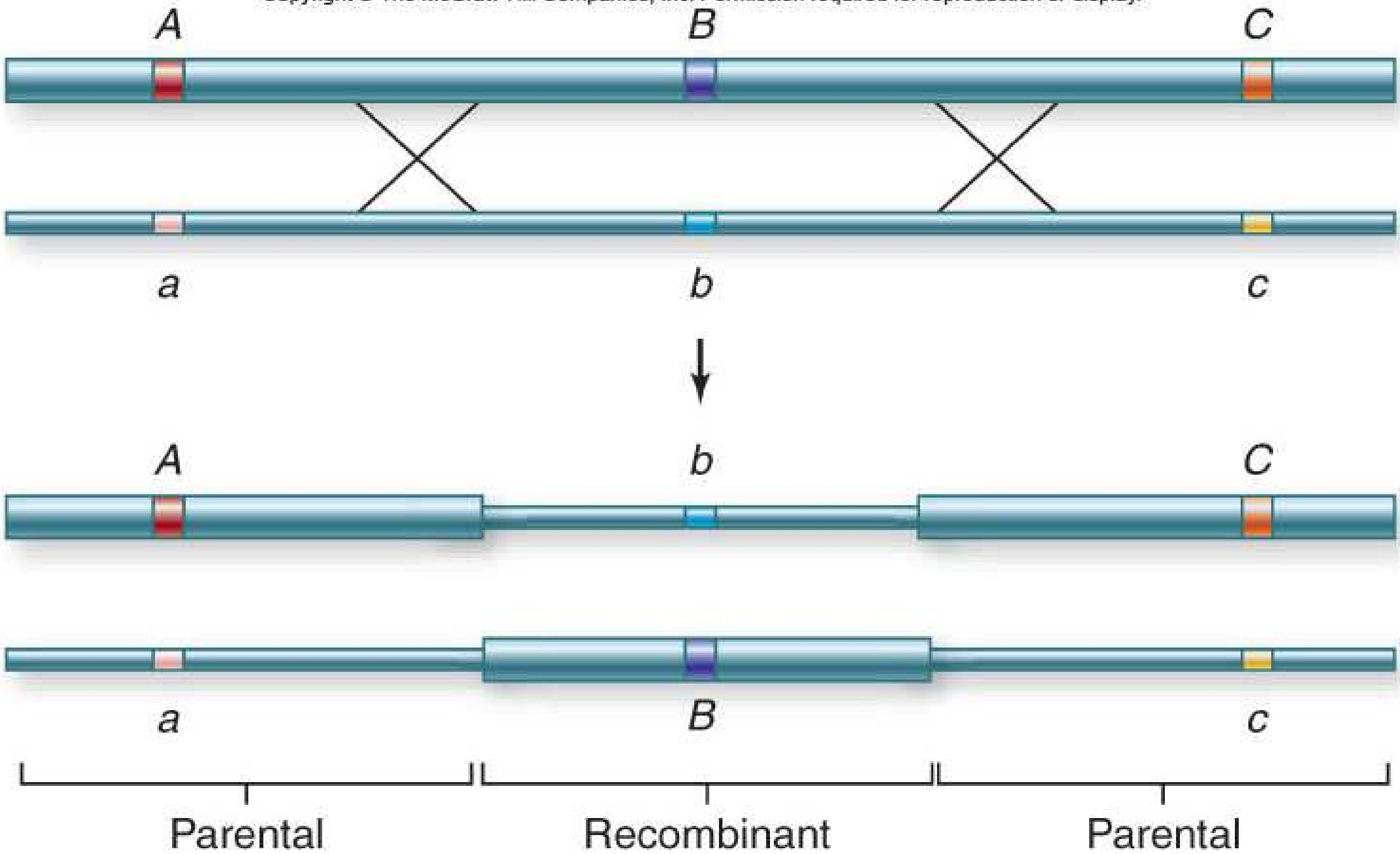
Multiple crossovers

- If homologues undergo two crossovers between loci, then the parental combination is restored
- Leads to an underestimate of the true genetic distance
- Relationship between true distance on a chromosome and the recombination frequency is not linear


Recombination Frequency
0.5
0
Physical Distance on a Chromosome

Three-point testcross

- Uses 3 loci instead of 2 to construct maps
- Gene in the middle allows us to see recombination events on either side
- In any three-point cross, the class of offspring with two crossovers is the least frequent class
- In practice, geneticists use three-point crosses to determine the order of genes, then use data from the closest two-point crosses to determine distances

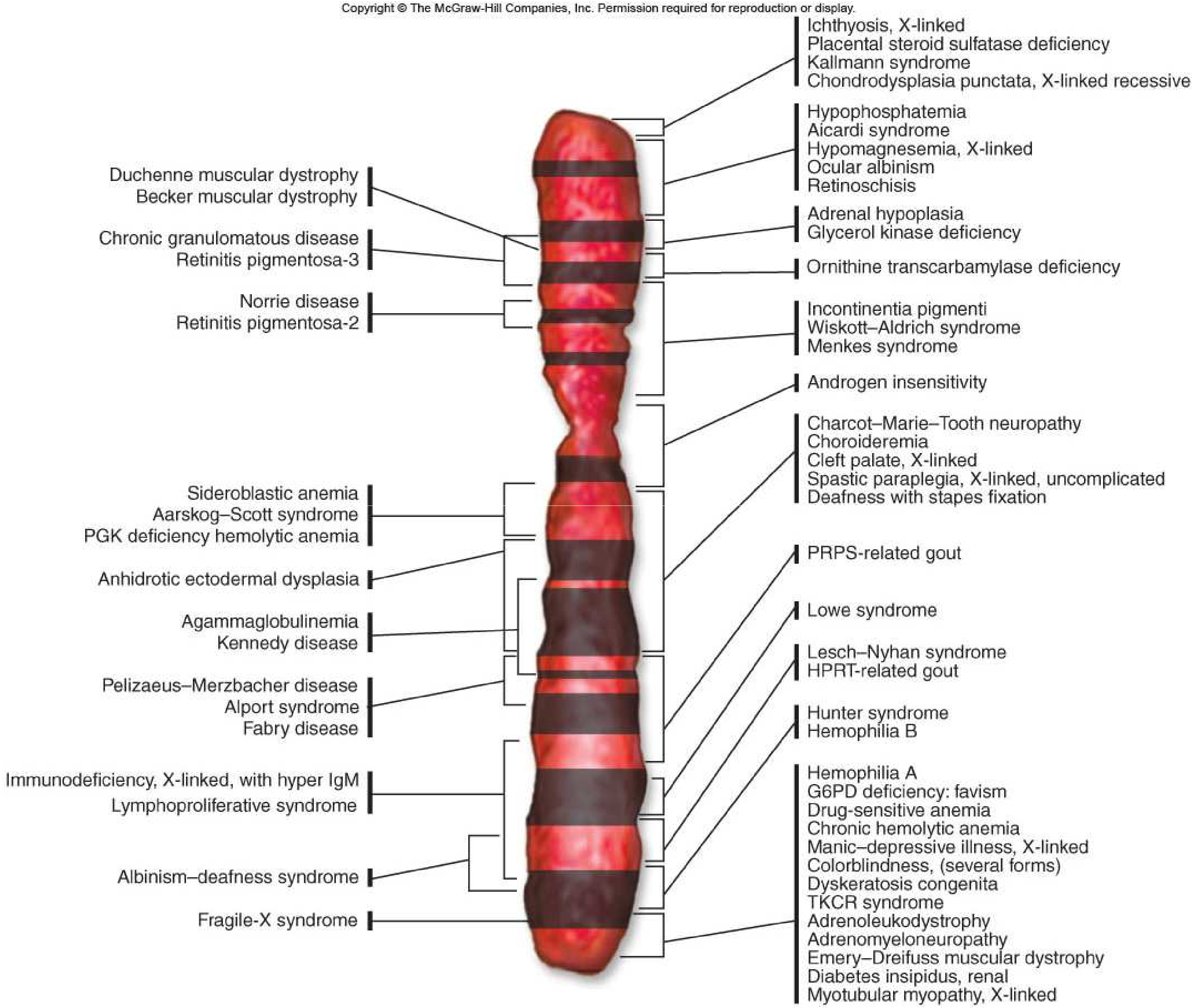

A
B
C
a
b
c
A
b
C
a
B
c
Parental
Recombinant
Parental

Human genome maps

- Data derived from historical pedigrees
- Difficult analysis
  - Number of markers was not dense enough for mapping up to 1980s
  - Disease-causing alleles rare
- Situation changed with the development of anonymous markers
  - Detected using molecular techniques
  - No detectable phenotype

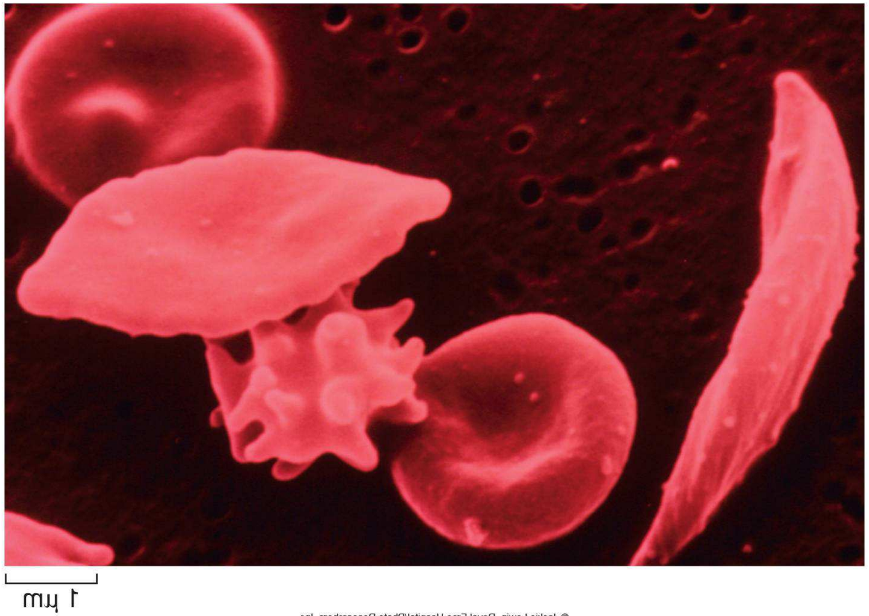
SNPs

- Single-nucleotide polymorphisms
- Affect a single base of a gene locus
- Used to increase resolution of mapping
- Used in forensic analysis
  - Help eliminate or confirm crime suspects or for paternity testing


Ichthyosis, X-linked
Placental steroid sulfatase deficiency
Kallmann syndrome
Chondrodysplasia punctata, X-linked recessive
Hypophosphatemia
Aicardi syndrome
Hypomagnesemia, X-linked
Ocular albinism
Retinoschisis
Adrenal hypoplasia
Glycerol kinase deficiency
Ornithine transcarbamylase deficiency
Incontinentia pigmenti
Wiskott–Aldrich syndrome
Menkes syndrome
Androgen insensitivity
Charcot–Marie–Tooth neuropathy
Choroideremia
Cleft palate, X-linked
Spastic paraplegia, X-linked, uncomplicated
Deafness with stapes fixation
PRPS-related gout
Lowe syndrome
Lesch–Nyhan syndrome
HPRT-related gout
Hunter syndrome
Hemophilia B
Hemophilia A
G6PD deficiency: favism
Drug-sensitive anemia
Chronic hemolytic anemia
Manic–depressive illness, X-linked
Colorblindness, (several forms)
Dyskeratosis congenita
TKCR syndrome
Adrenoleukodystrophy
Adrenomyeloneuropathy
Emery–Dreifuss muscular dystrophy
Diabetes insipidus, renal
Myotubular myopathy, X-linked
Duchenne muscular dystrophy
Becker muscular dystrophy
Chronic granulomatous disease
Retinitis pigmentosa-3
Norrie disease
Retinitis pigmentosa-2
Sideroblastic anemia
Aarskog–Scott syndrome
PGK deficiency hemolytic anemia
Anhidrotic ectodermal dysplasia
Agammaglobulinemia
Kennedy disease
Pelizaeus–Merzbacher disease
Alport syndrome
Fabry disease
Immunodeficiency, X-linked, with hyper IgM
Lymphoproliferative syndrome
Albinism–deafness syndrome
Fragile-X syndrome

Sickle cell anemia

- First human disease shown to be the result of a mutation in a protein
- Caused by a defect in the oxygen carrier molecule, hemoglobin
  - Leads to impaired oxygen delivery to tissues



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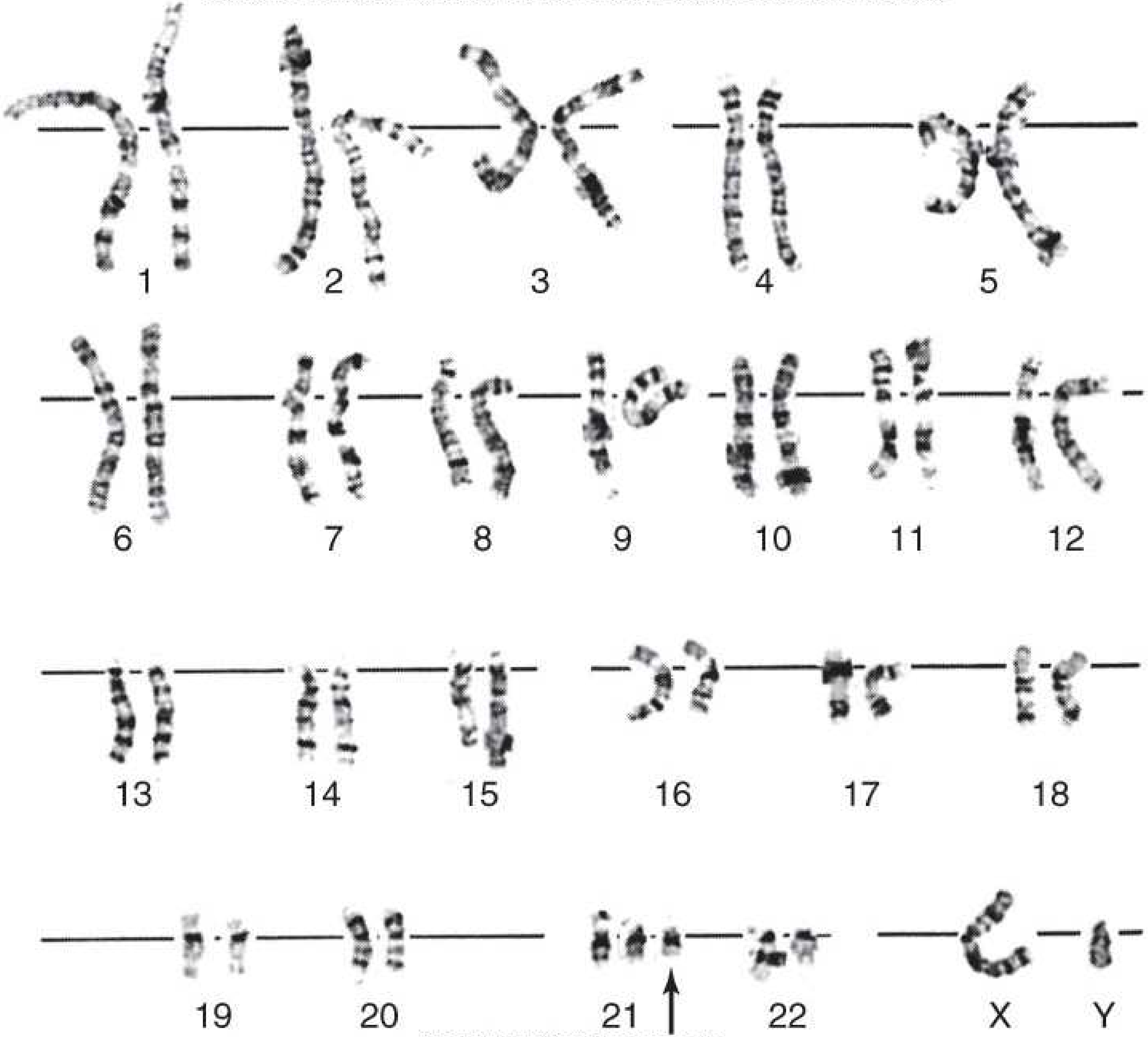
- Homozygotes for sickle cell allele exhibit intermittent illness and reduced life span
- Heterozygotes appear normal
  - Do have hemoglobin with reduced ability
- Sickle cell allele is particularly prevalent in people of African descent
  - Proportion of heterozygotes higher than expected
  - Confers resistance to blood-borne parasite that causes malaria

Nondisjunction

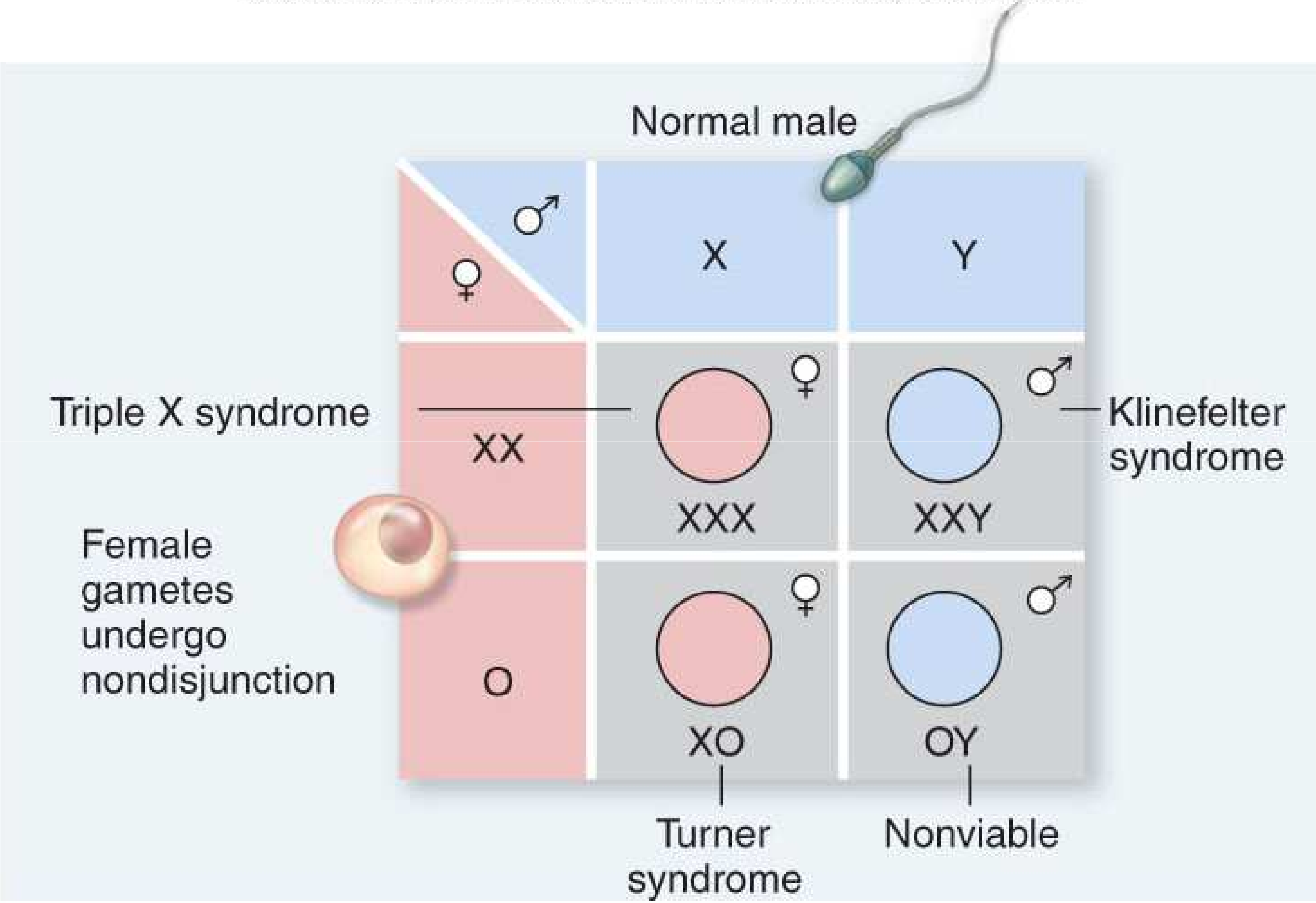
- Failure of homologues or sister chromatids to separate properly during meiosis
- Aneuploidy – gain or loss of a chromosome
  - Monosomy – loss
  - Trisomy – gain
  - In all but a few cases, do not survive

- Smallest autosomes can present as 3 copies and allow individual to survive
  - 13, 15, 18, 21 and 22
  - 13, 15, 18 – severe defects, die within a few months
  - 21 and 22 – can survive to adulthood
  - Down Syndrome – trisomy 21
    - May be a full, third 21^{st} chromosome
    - May be a translocation of a part of chromosome 21
    - Mother’s age influences risk


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
X
Y

Non disjunction of sex chromosomes

- Do not generally experience severe developmental abnormalities
- Individuals have somewhat abnormal features, but often reach maturity and in some cases may be fertile
- XXX – triple-X females
- XXY – males (Klinefelter syndrome)
- XO – females (Turner syndrome)
- OY – nonviable zygotes
- XYY – males (Jacob syndrome)

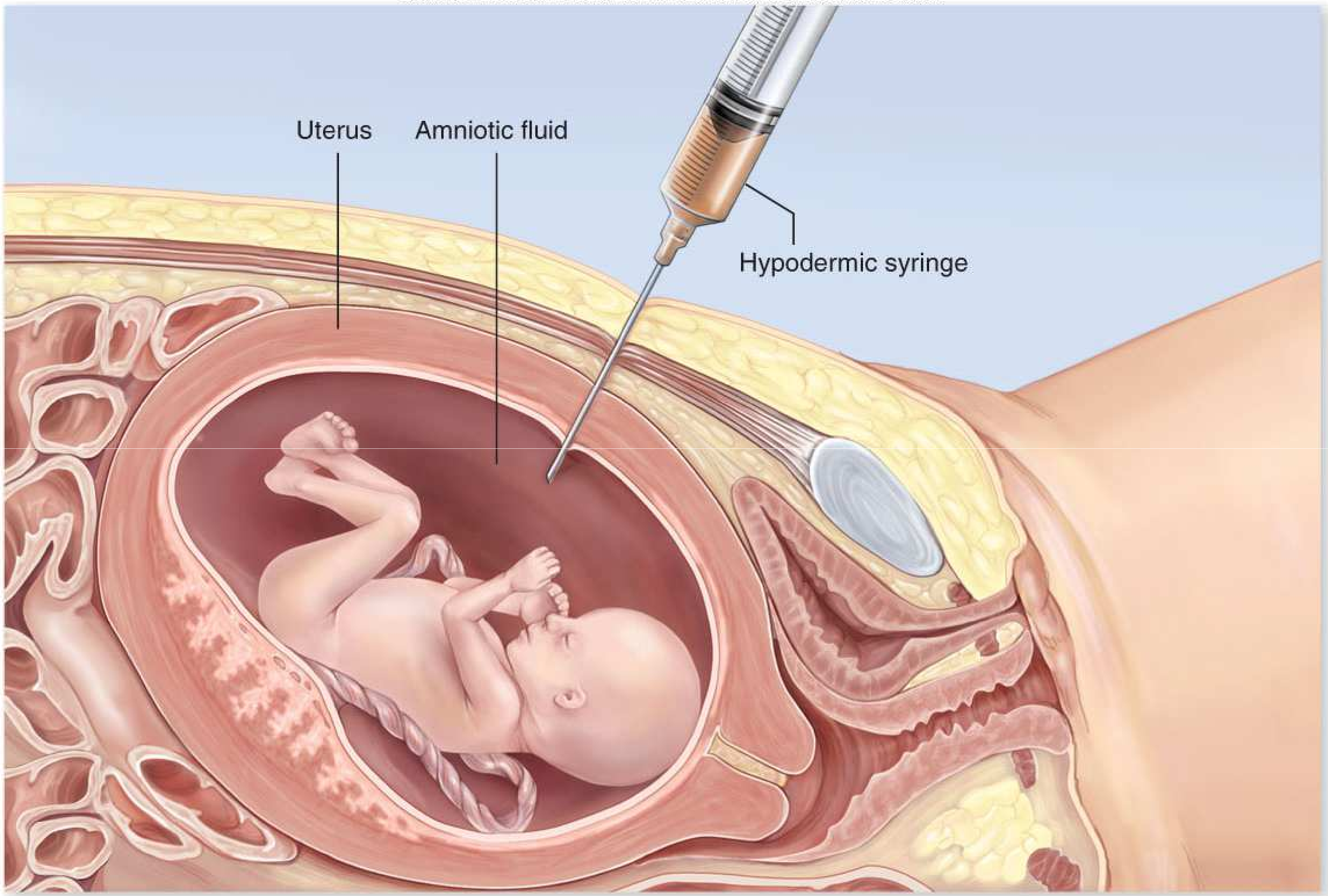

Normal male
♂
♀
X
Y
Triple X syndrome
XX
♀
♂
Klinefelter syndrome
XXX
XXY
Female gametes undergo nondisjunction
O
♀
♂
XO
OY
Turner syndrome
Nonviable

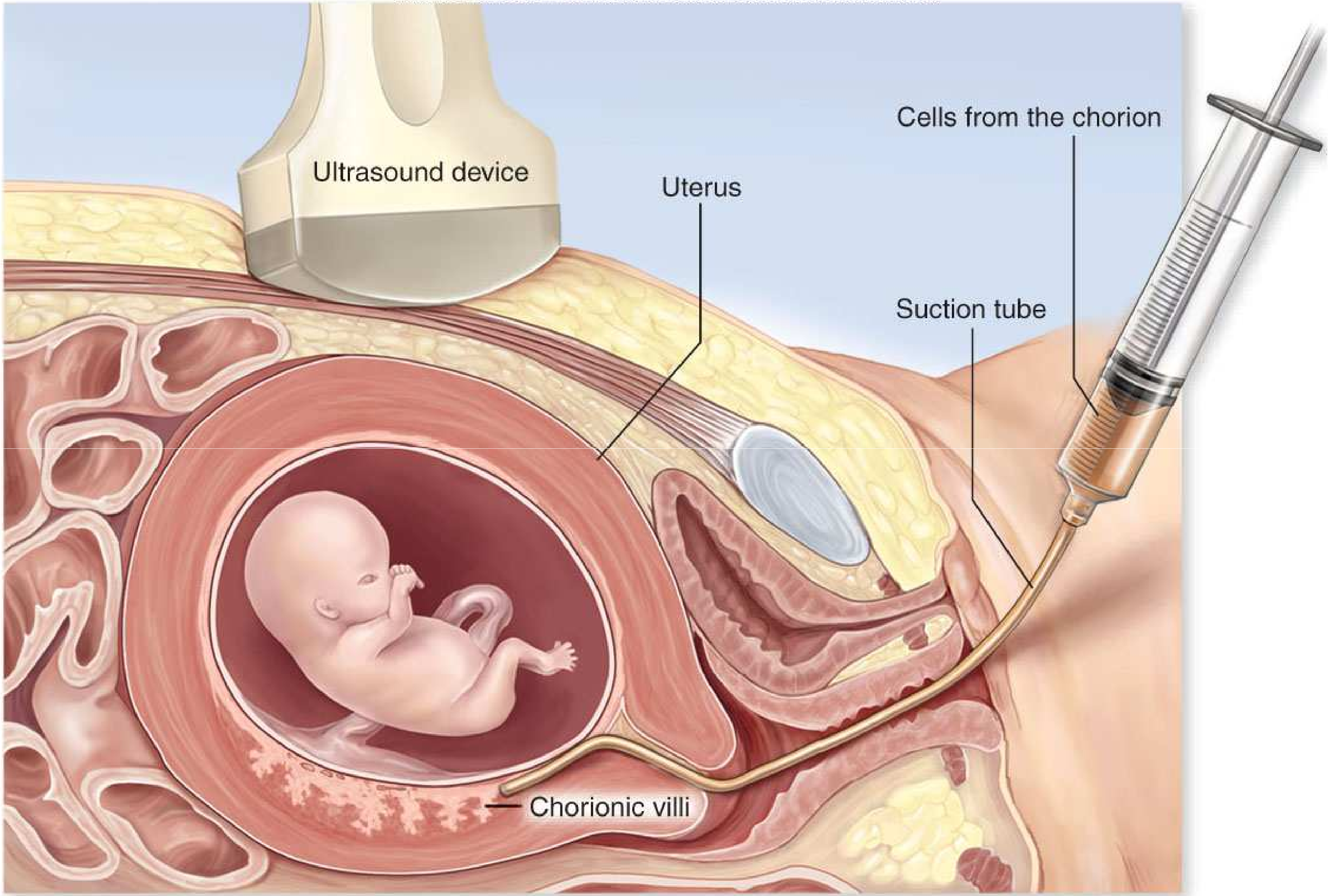
Genomic imprinting

- Phenotype exhibited by a particular allele depends on which parent contributed the allele to the offspring
- Specific partial deletion of chromosome 15 results in
  - Prader-Willi syndrome if the chromosome is from the father
  - Angelman syndrome if it’s from the mother

Detection

- Pedigree analysis used to determine the probability of genetic disorders in the offspring
- Amniocentesis collects fetal cells from the amniotic fluid for examination
- Chorionic villi sampling collects cells from the placenta for examination


Uterus
Amniotic fluid
Hypodermic syringe


Ultrasound device
Uterus
Cells from the chorion
Suction tube
Chorionic villi

Thank You

Amino Acids And Protein

Prof: Shelke P.D.

Department of Botany

INTRODUCTION

- Twenty percent of the human body is made up of proteins. Proteins are the large, complex molecules that are critical for normal functioning of cells.

- They are essential for the structure, function, and regulation of the body's tissues and organs.

- Proteins are made up of smaller units called amino acids, which are building blocks of proteins. They are attached to one another by peptide bonds forming a long chain of proteins.

AMINO ACID

- **Amino acids** are organic compounds containing amine ($-NH_2$) and carboxyl ($-COOH$) functional groups, along with a side chain(R group) specific to each amino acid. The key elements of an amino acid are carbon (C), hydrogen (H), oxygen (O), and nitrogen (N), although other elements are found in the side chains of certain amino acids.

- About 500 naturally occurring amino acids are known (though only 20 appear in the genetic code) and can be classified in many ways.

- In the form of proteins amino acid residues form the second-largest component (water is the largest) of human muscles and other tissues .

- Beyond their role as residues in proteins, amino acids participate in a number of processes such as neurotransmitter transport and biosynthesis.

DEFINATION

- An amino acid is a type of organic acid that contains a carboxyl functional group (-COOH) and an amine functional group ($-NH_2$) as well as a side chain (designated as R) that is specific to the individual amino acid.
- Amino acids are considered to be the building blocks of polypeptides and proteins. The elements found in all amino acids are carbon, hydrogen, oxygen, and nitrogen. Amino acids may contain other elements on their side chains.

Synthesis of Amino Acid

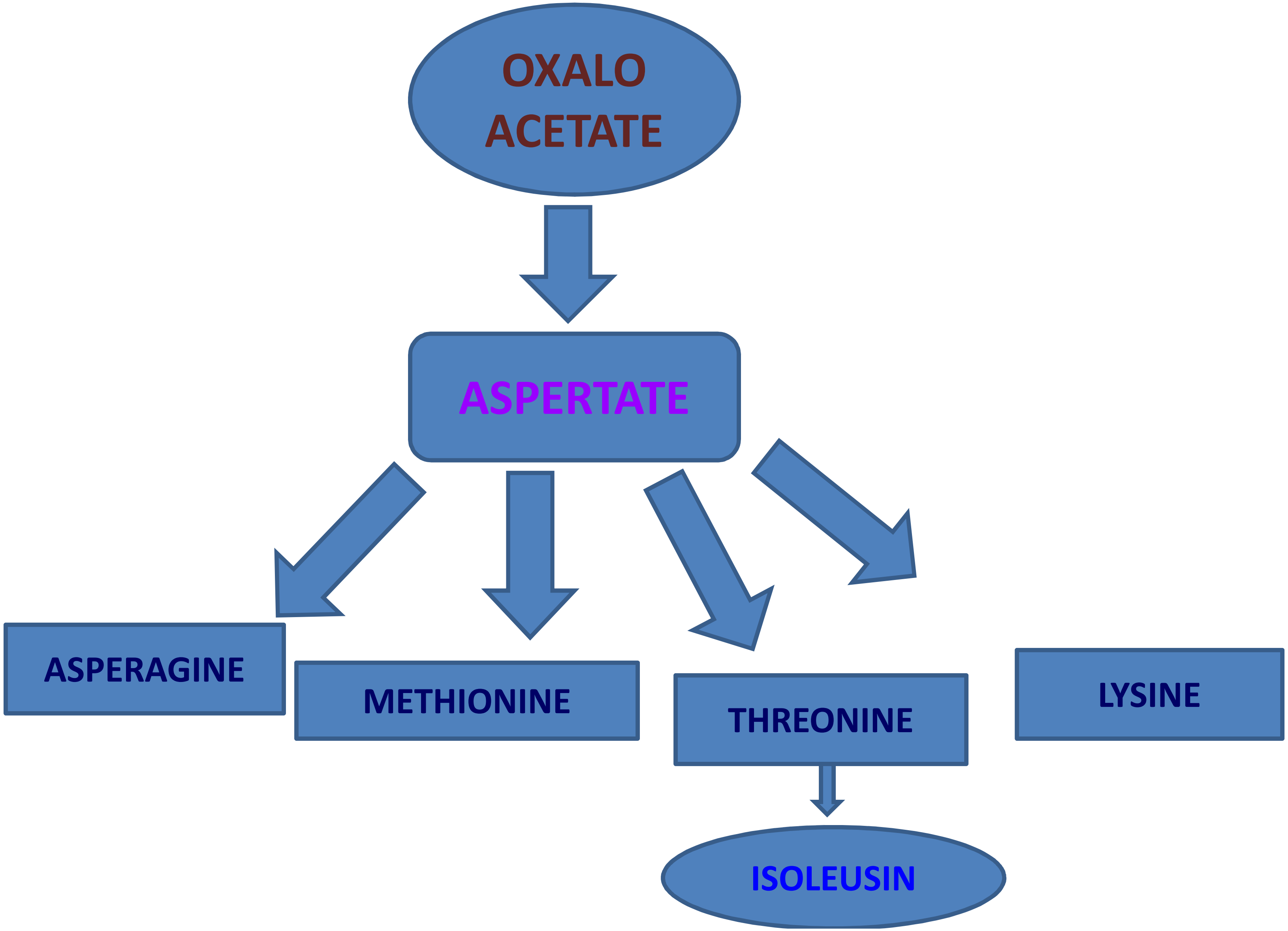
- **Amino acid synthesis** is the set of biochemical processes (metabolic pathways) by which the various amino acids are produced from other compounds.

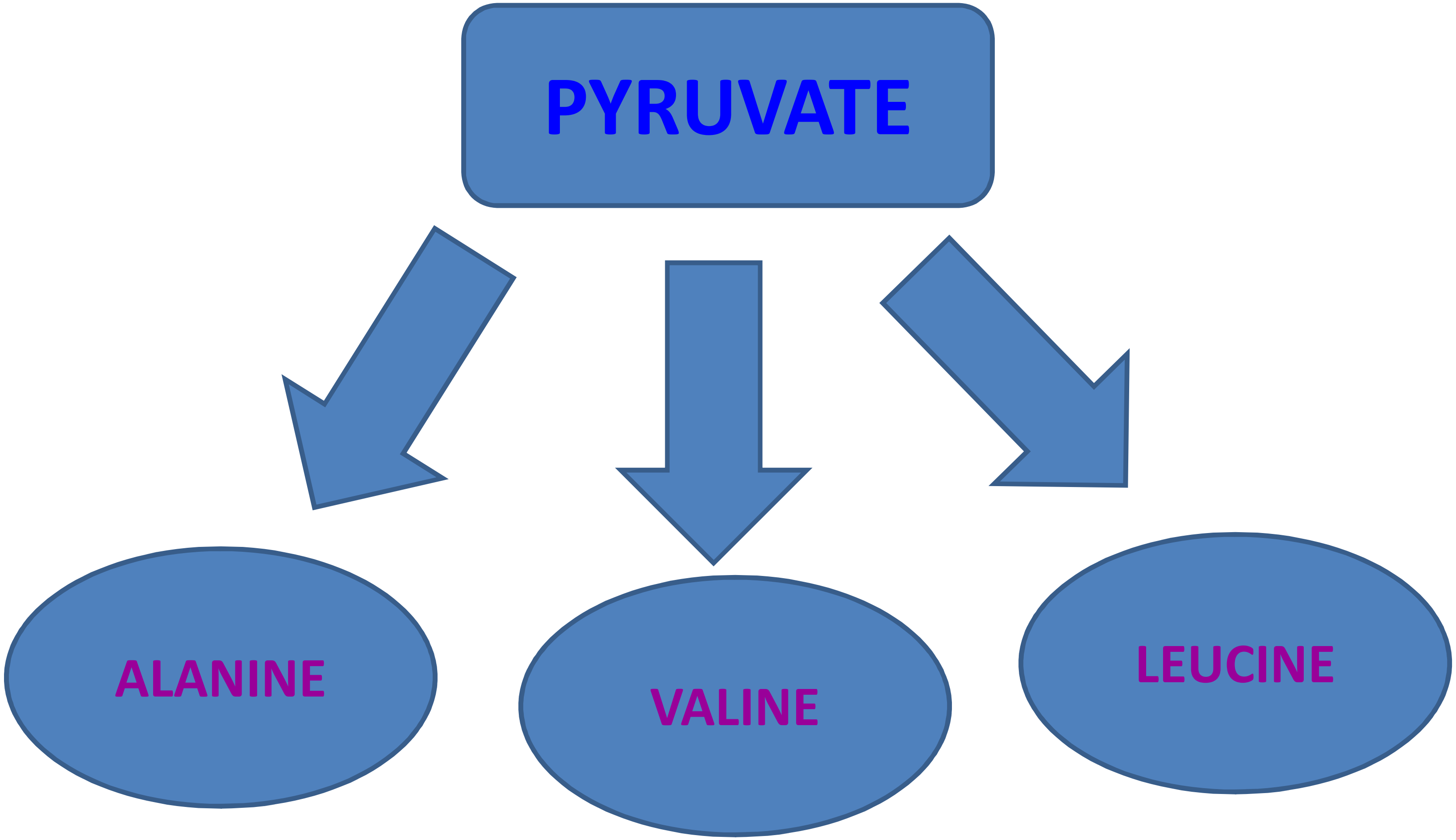
- The substrates for these processes are various compounds in the organism's diet or growth media. Not all organisms are able to synthesize all amino acids.

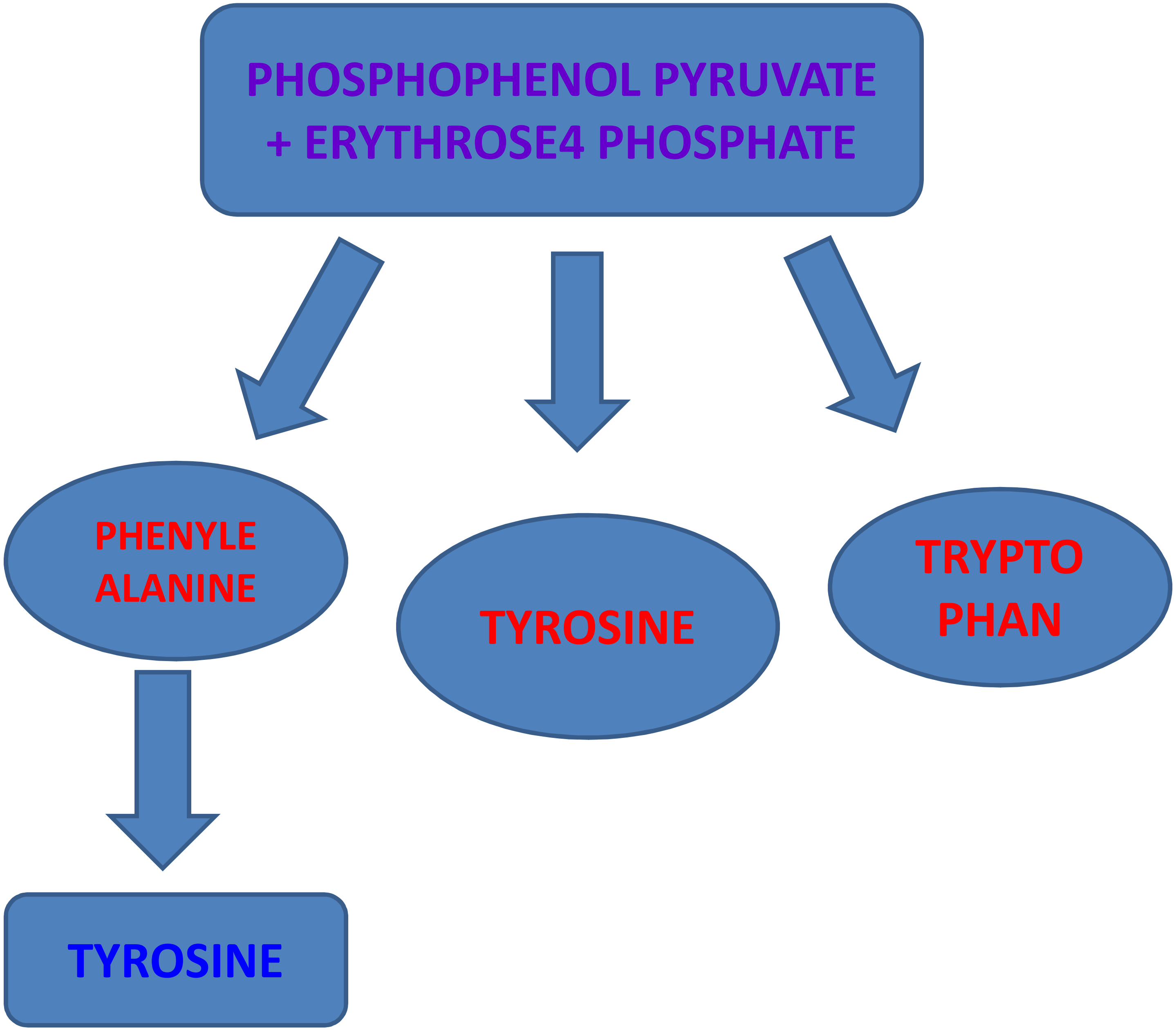
- Humans are an excellent example of this, since humans can only synthesize 11 of the 20 standard amino acids (a.k.a. non-essential amino acid), and in time of accelerated growth, histidine, can be considered an essential amino acid.

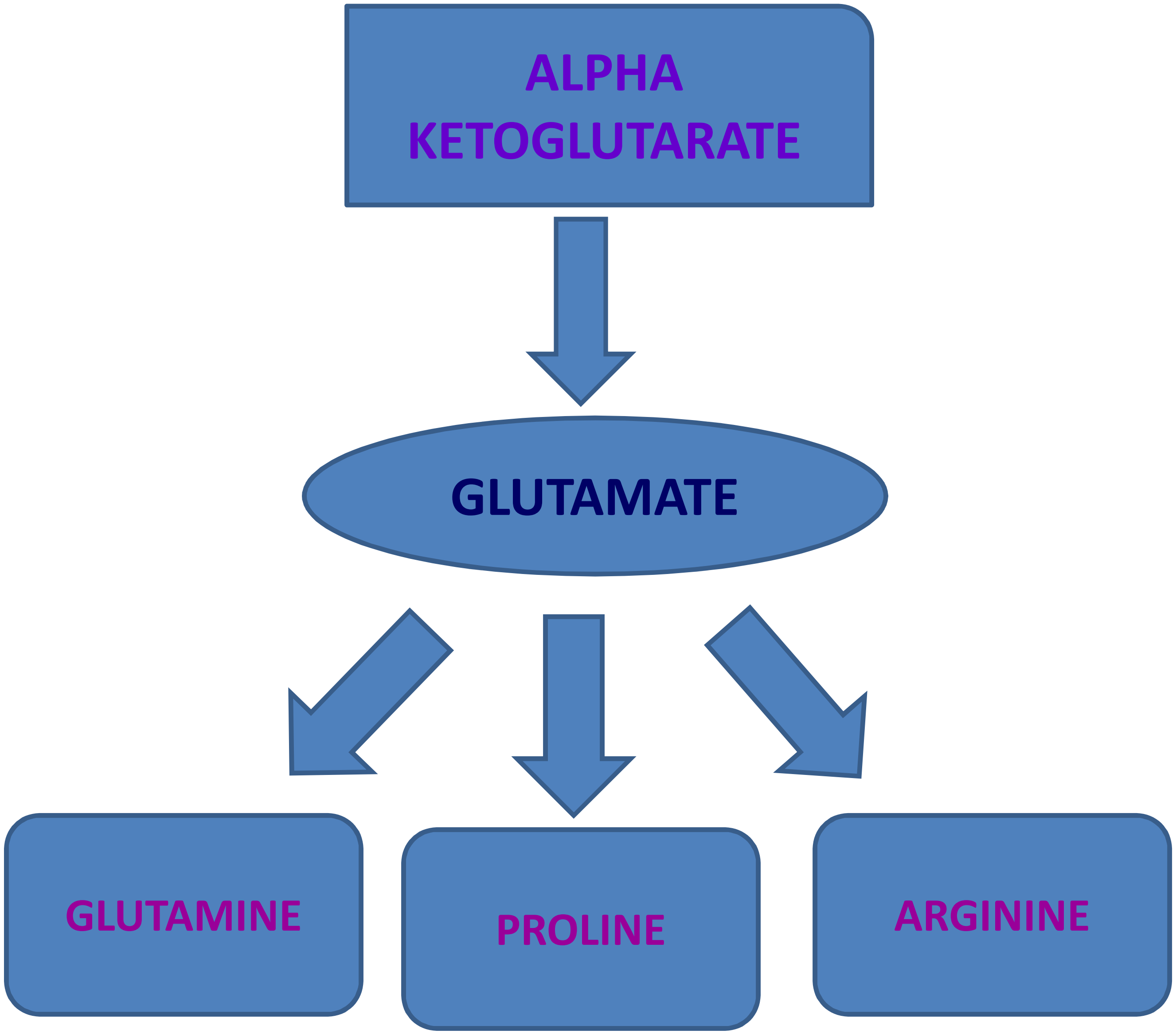
- Ignoring tyrosine (as it's immediate precursor is phenylalanine, an essential amino acid), all of the nonessential amino acids (and we will include arginine here) are synthesized from intermediates of major metabolic pathways.
- Furthermore, the carbon skeletons of these amino acids are traceable to their corresponding a-ketoacids.
- Therefore, it could be possible to synthesize any one of the nonessential amino acids directly by transaminating its corresponding a-ketoacid, if that ketoacid exists as a common intermediate.
- A "transamination reaction", in which an amino group is transferred from an amino acid to the a-carbon of a ketoacid, is catalyzed by an aminotransferase.

Synthesis From Metabolites




PYRUVATE
ALANINE
VALINE
LEUCINE


PHOSPHOPHENOL PYRUVATE
+ ERYTHROSE4 PHOSPHATE
PHENYLE
ALANINE
TYROSINE
TRYPTO
PHAN
TYROSINE


ALPHA KETOGLUTARATE
GLUTAMATE
GLUTAMINE
PROLINE
ARGININE

PROPERTIES OF AMINO ACID

❑ MELTING POINT-

- The amino acids are crystalline solidswith high melting point.
- For the size of the molecules ,this is very high.
- In general structure of an amino acid has both a basic amino group and an acidic carboxylic group.

- **Solubility** :

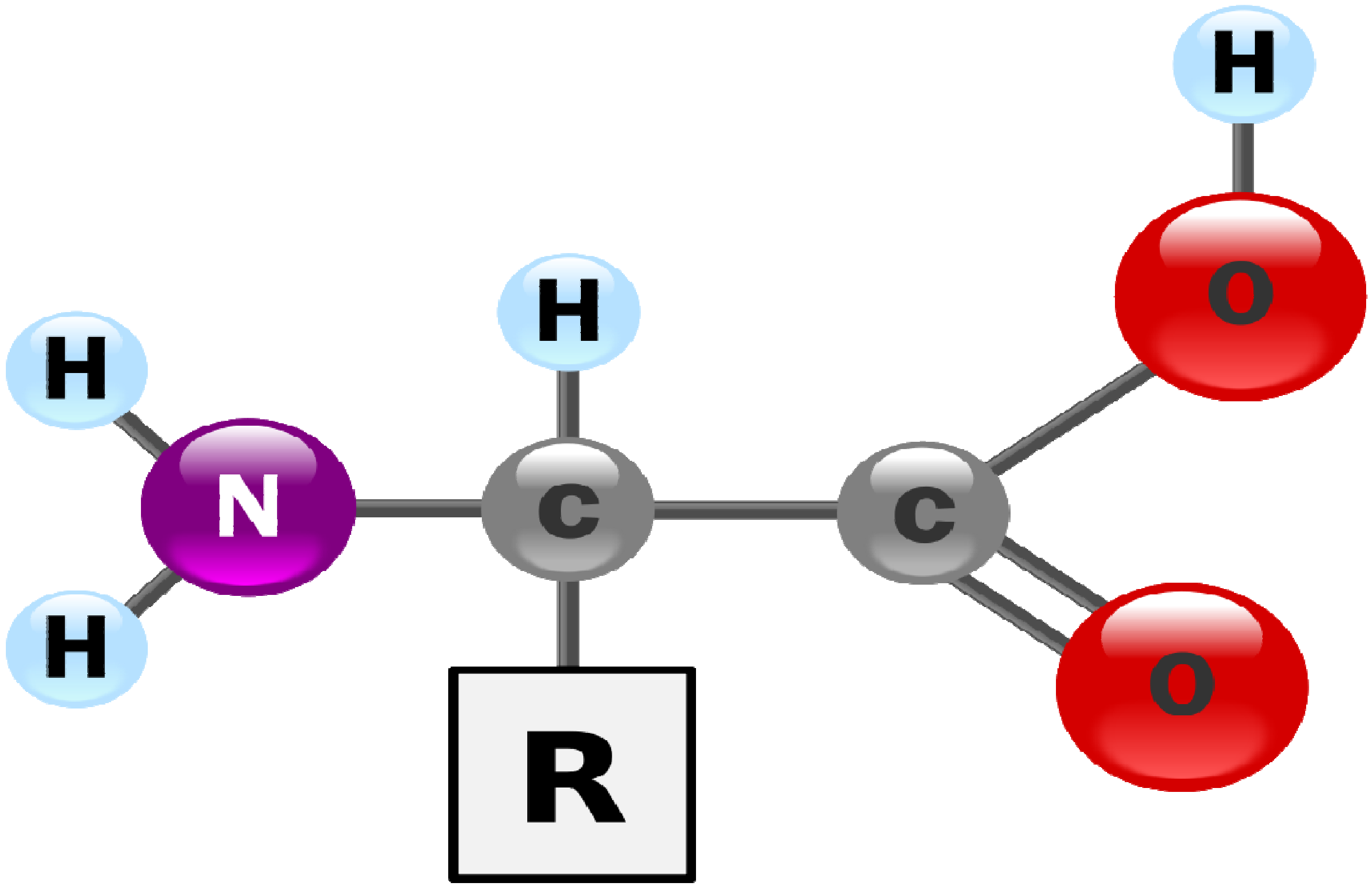
- Amino acids are generally soluble in water and insoluble in non polar organic solvents such as hydrocarbons.
- The lack of solubility in non polar solvents is because of the lack of attraction between the solvent molecules and zwitterions.
- a **zwitterion**, meaning formerly called a **dipolar ion**, is a molecule with two or more functional groups, of which at least one has a positive and one has a negative electrical charge and the net charge of the entire molecule is zero. Because they contain at least one positive and one negative charge.

❑ Optical activity:

- Optical activity in organic compounds refer to how molecules rotate plane-polarized light.
- When you shine a beam of light at a sample, the molecules then rotate the light in a clockwise direction (dextrorotatory) or in a counter-clockwise direction .
- A molecule can exhibit optical activity only if its chiral. A molecule can be chiral only if it’s carbon atom(s) are bonded to 4 different substituent's.

- **STERIOISOCHEMISTRY :**
- **Stereochemistry**, a subdiscipline of chemistry, involves the study of the relative spatial arrangement of atoms that form the structure of molecules and their manipulation.
- The study of stereochemistry focuses on stereoisomers, which by definition have the same molecular formula and sequence of bonded atoms (constitution), but differ in the three-dimensional orientations of their atoms in space.
- For this reason, it is also known as 3D chemistry—the prefix "stereo-" means "three-dimensionality".

STRUCTURE OF AMINO ACID



Classification of amino acid

- Amino acids with aliphatic side chain .
- Hydroxyl group containing amino acids.
- Sulfur containing amino acid.
- Basic amino acid.
- Aromatic amino acid.

•There are 4 main classes of amino acids based on polarity, i.e. the interaction of the R group with water molecules at physiological pH.

Amino acids with non-polar (hydrophobic) side chain.

•These amino acids have a non–polar hydrophobic side chain. They do not provide protons or participate in hydrogen or ionic bonding. E.g.: alanine, valine, leucine, isoleucine, proline, phenylalanine, tryptophan and methionine.

Amino acids with uncharged polar side chains (- R group)

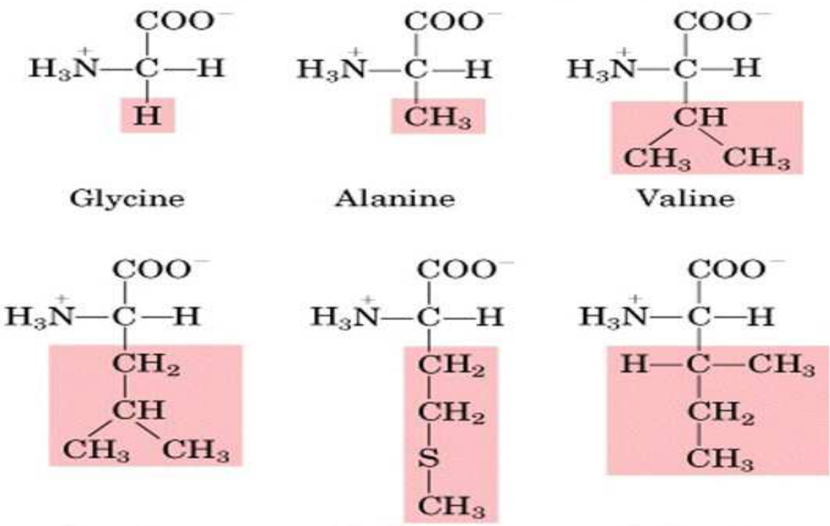
- The polarity of serine, threonine is due to the presence of hydroxyl groups; the polarity of asparagine and glutamine is due to the amide group and the sulfhydryl group.
- These amino acids are more soluble in water. They are hydrophilic in nature. The functional groups can make hydrogen bonds with water.

- E.g.: glycine, serine, threonine, tyrosine, cysteine, asparagine and glutamine.

- **Amino acids with uncharged polar side chains (-R group)**
- These amino acids are more soluble in water. They are hydrophilic in nature. The functional groups can make hydrogen bonds with water. E.g.: glycine, serine, threonine, tyrosine, cysteine, asparagine and glutamine.
- The polarity of serine, threonine is due to the presence of hydroxyl groups; the polarity of asparagines and glutamine is due to the amide group and the sulfhydryl group is responsible for cytosine.

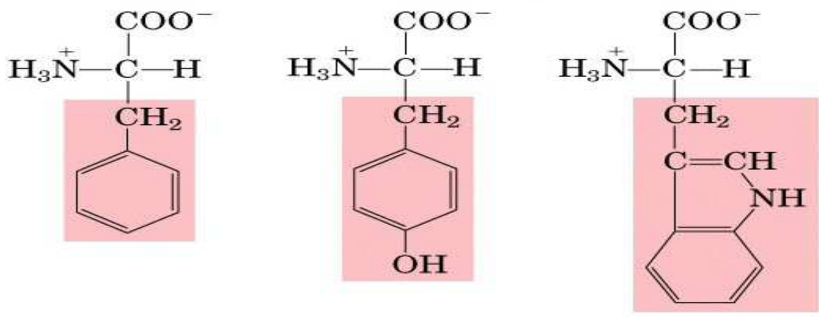
- **Amino acids with polar, positively charged side chain**
- These amino acids will have a net positive charge at pH 7. They accept protons.
- E.g.: lysine, arginine and histidine.
- Lysine contains a second amino group at ε -position on the aliphatic side chain. Arginine contains a positively charged guanidino group and histidine.

Nonpolar, aliphatic R groups



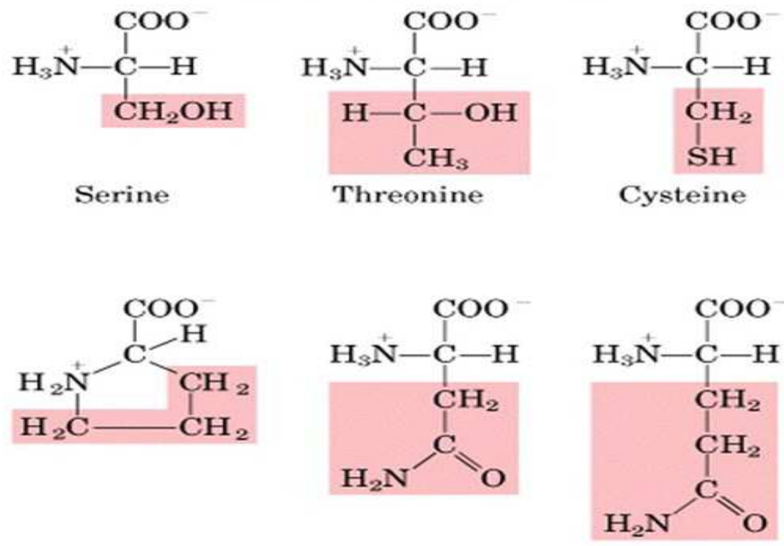
Glycine, Alanine, Valine, Leucine, Methionine, Isoleucine

Aromatic R groups



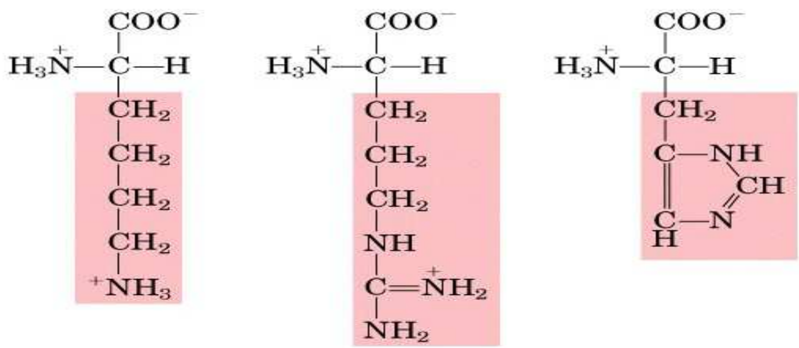
Phenylalanine, Tyrosine, Tryptophan

Polar, uncharged R groups



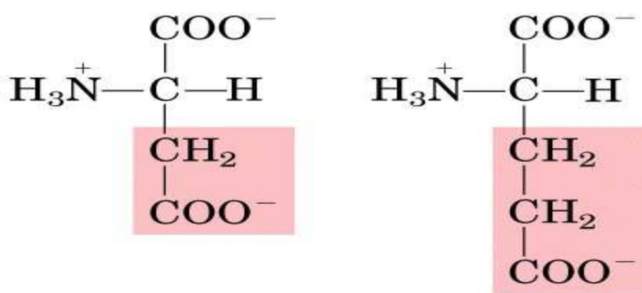
Serine, Threonine, Cysteine, Proline, Asparagine, Glutamine

Positively charged R groups



Lysine, Arginine, Histidine

Negatively charged R groups



Aspartate, Glutamate

FUCTIONS

- Amino acids are a source of energy; like proteins, they can provide about 4 Calories per gram.
- In the human body, certain amino acids can be converted to other amino acids, proteins, glucose, fatty acids or ketones.
- Chemical messengers (neurotransmitters) in the nervous system: aspartate, GABA, glutamate, glycine, serine
- Tyrosine is a precursor of dopamine, epinephrine, norepinephrine and thyroxine.

- Tryptophan is a precursor of melatonin and serotonin and nicotinic acid (vitamin B3)

- Histidine is a precursor of histamine.
- Glycine is a precursor of heme, a part of hemoglobin.
- Aspartate, glutamate and glycine are precursors of nucleic acids, which are parts of DNA.
- Tryptophan is a precursor of melatonin and serotonin and nicotinic acid (vitamin B3)

THANK YOU

Welcome

Mitochondria

Prof. Shelke P. D.
Department of Botany

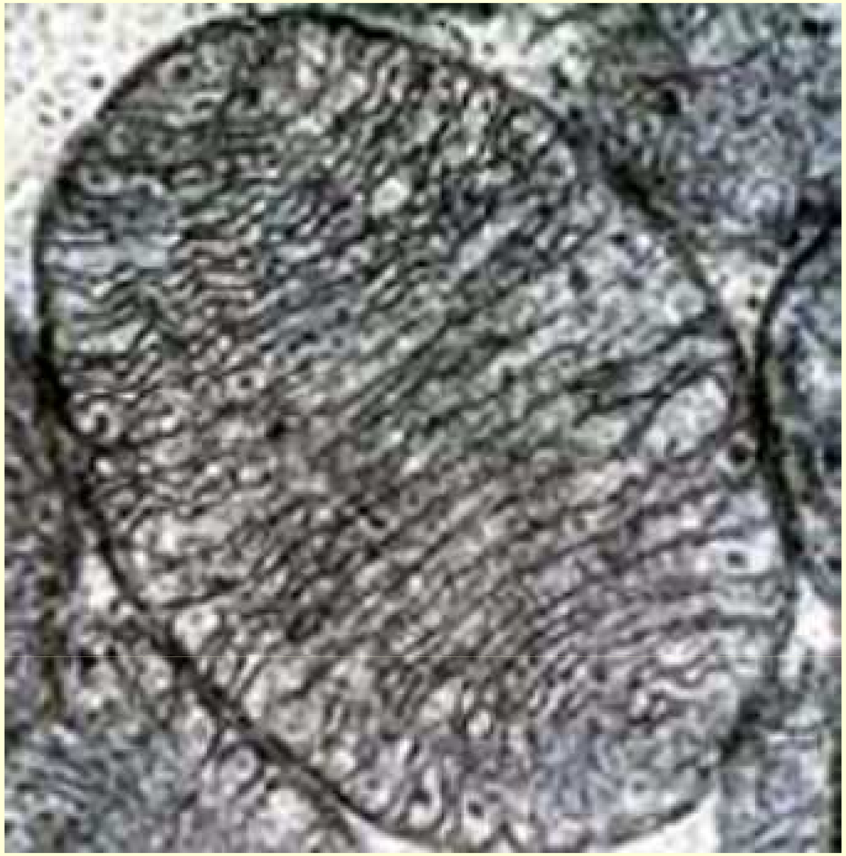
Introduction

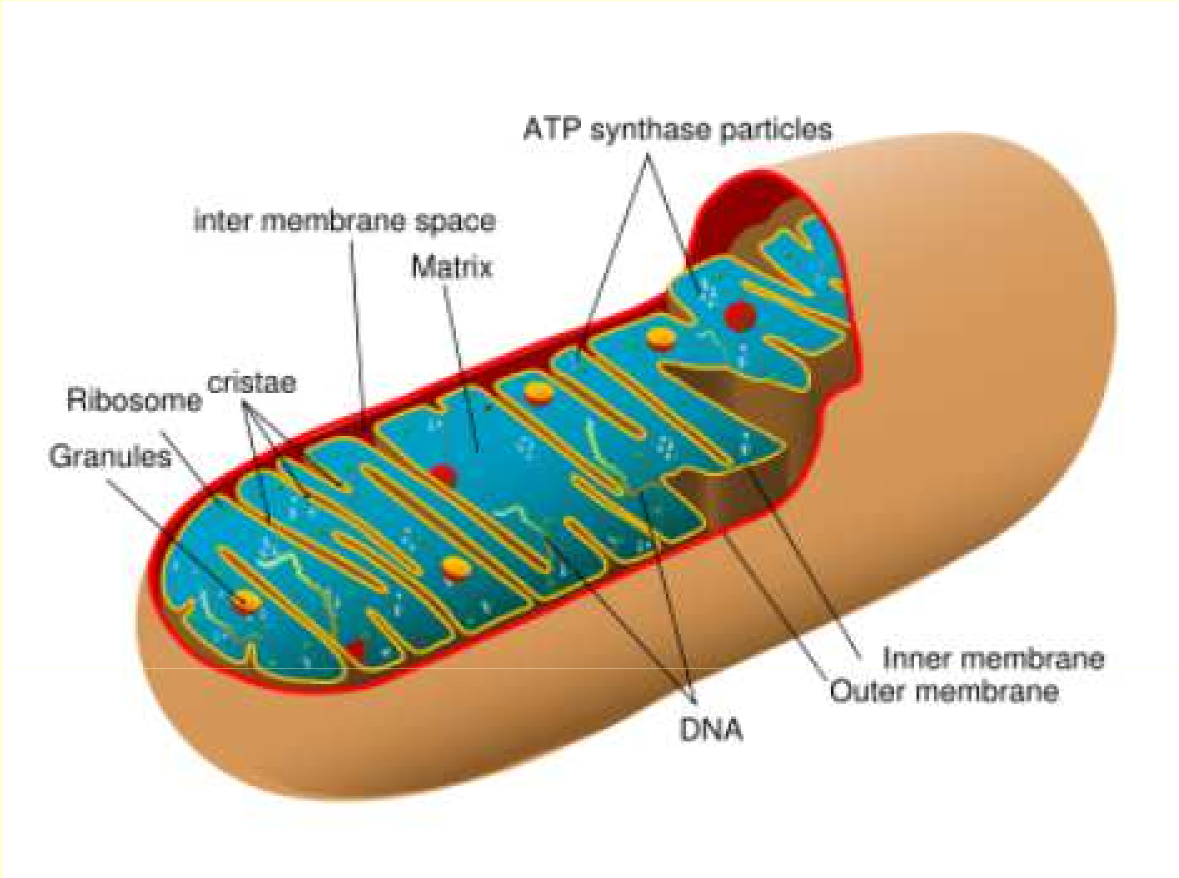
- Mitochondria were first seen by **kollicker** in 1850 in muscles and called them ‘**sarcosomes**’
- **Flemming** (1882) described these organelles as **‘filia’**
- **Altmann** (1890) observed these structures and named them **‘bioblasts**’.
- **Benda** (1898)stained these organelles with **crystal violet** and renamed them **‘mitochondria**’
- Michaelis (1900) used **janus green** B as a vital stain to observe mitochondria in living cells.

Morphology

- The shape of mitochondria is highly variable ranges from short rod shape to elongate filamentous form .
- The size of mitochondria is variable ,they generally measures about 0.5 to 2um in diameter.
- Mitochondria have an average length of 3 to 4um.
- The number of mitochondria varies from one cell type to another.
- Mitochondria are not found in prokaryotes.

Structure of Mitochondria





Ultra Structure

- A mitochondria is enclosed by a double membrane envelope composed of lipid and protein.
- The two membranes are separated by a narrow fluid – filled space called the **outer compartment**.
- The outer membrane is smooth, it is more permeable to small molecules, contains some enzymes but is poorer in proteins.
- The inner membrane surrounds a central cavity or **matrix (inner compartment)** filled with a fluid.
- Folds of inner wall of mitochondria are called **cristae**.

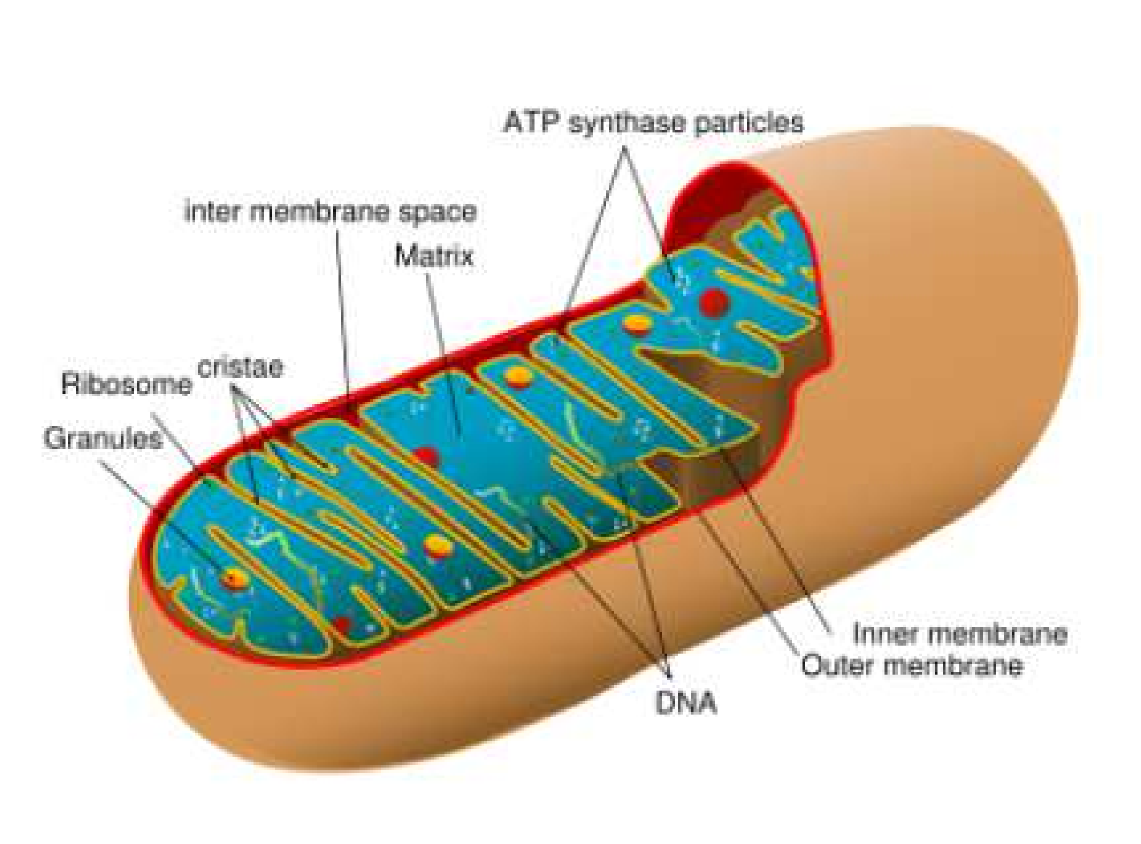
Inner Membrane

- Inner membrane is the site of the e^- transport chain, across which the proton pump occurs and contains ATP synthase.

- Inner membrane is highly folded – called cristae – increasing the surface area on which the above reactions can take place

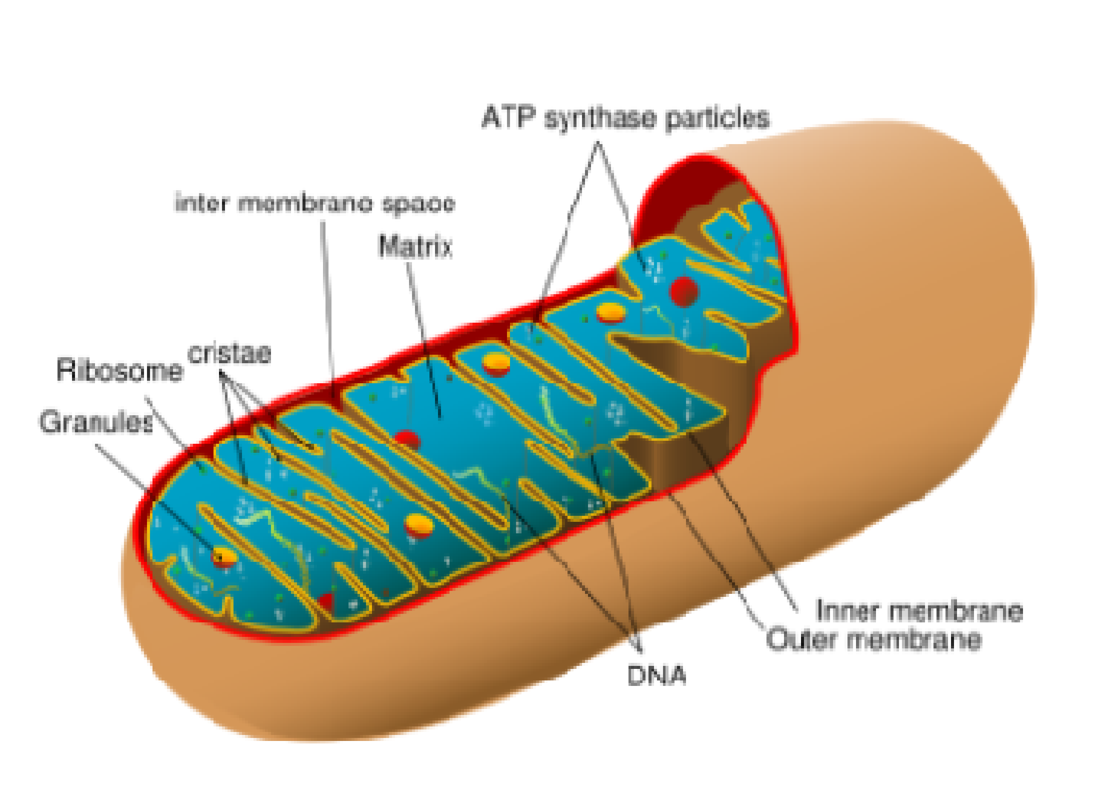
Mitochondrial Inner Membrane

The inner mitochondrial membrane is compartmentalized into numerous cristae, which expand the surface area of the inner mitochondrial membrane, enhancing its ability to generate ATP. In typical liver mitochondria, for example, the surface area, including cristae, is about five times that of the outer membrane. Mitochondria of cells which have greater demand for ATP, such as muscle cells, contain more cristae than typical liver mitochondria.



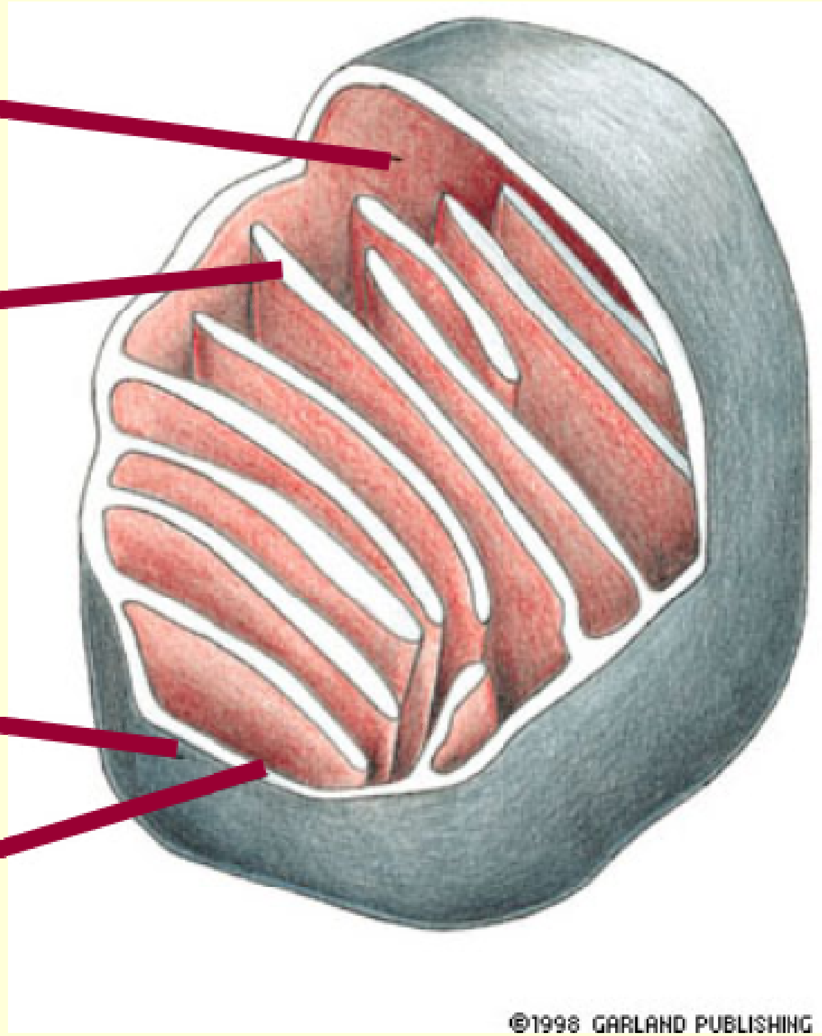
Mitochondrial Outer Membrane

The outer mitochondrial membrane, which encloses the entire organelle, has a protein-to-phospholipid ratio similar to the eukaryotic plasma membrane (about 1:1 by weight). It contains numerous integral proteins called porins, which contain a relatively large internal channel (about 2-3 nm) that is permeable to all molecules of 5000 daltons or less. Larger molecules, for example most proteins, can only traverse the outer membrane by active transport.



Mitochondria

- Double membrane creates 2 spaces
  - Matrix – large internal space
  - Intermembrane space – between the membranes



- Outer membrane
- Inner membrane

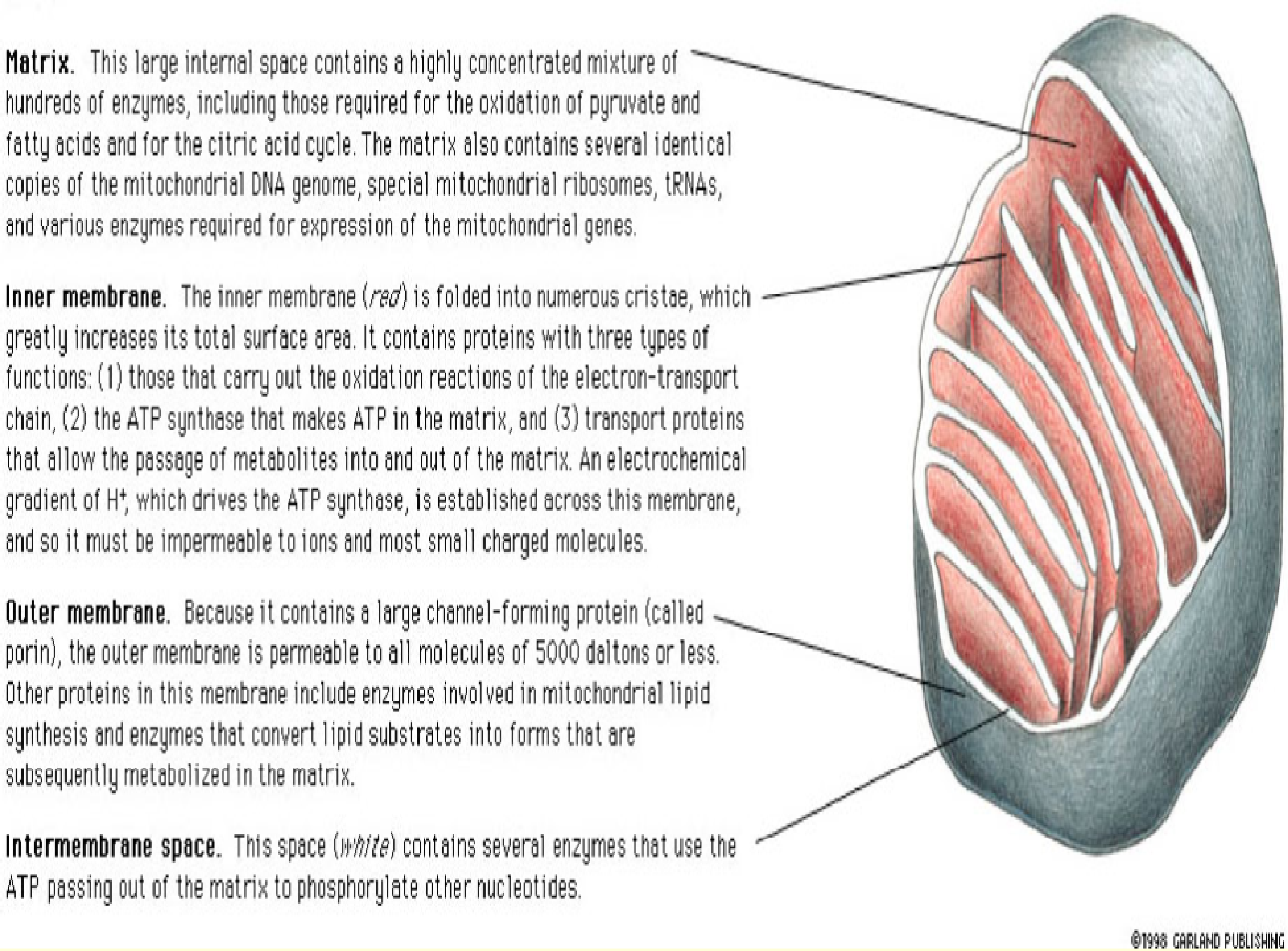


Fig. Str. Of Mitochondria

Chemical Composition

- Mitochondria consists of protein-70 percent & lipids -25 -30percent.
- Mitochondria contain 0.5percent of RNA & traces of DNA .
- Mitochondrial DNA comprises about 1 percent of total cell DNA
- Mitochondria contain enzymes for oxidation phosphorylation & electron transfer.

Mitochondria

- Produce most of a cells ATP – acetyl groups in the Kreb's cycle producing CO_2 and NADH.
- NADH donates the e^- to the electron transport chain and becomes oxidized to NAD^+
- e^- transfer promotes proton pump and ATP synthesis in process called oxidative phosphorylation
- Cells that require large amounts of energy such as the heart have large numbers of mitochondria

Mitochondria

- Contain their own copies of DNA and RNA along with transcription and translation system (ribosomes)
- Are able to regenerate themselves without the whole cell undergoing division
- Shape and size dependent on what the cell's function is

Thank You

PLANT GENETIC ENGINEERING

PROF. SHELKE P. D.

S.Y. B. Sc

Department of Botany

INTRODUCTION

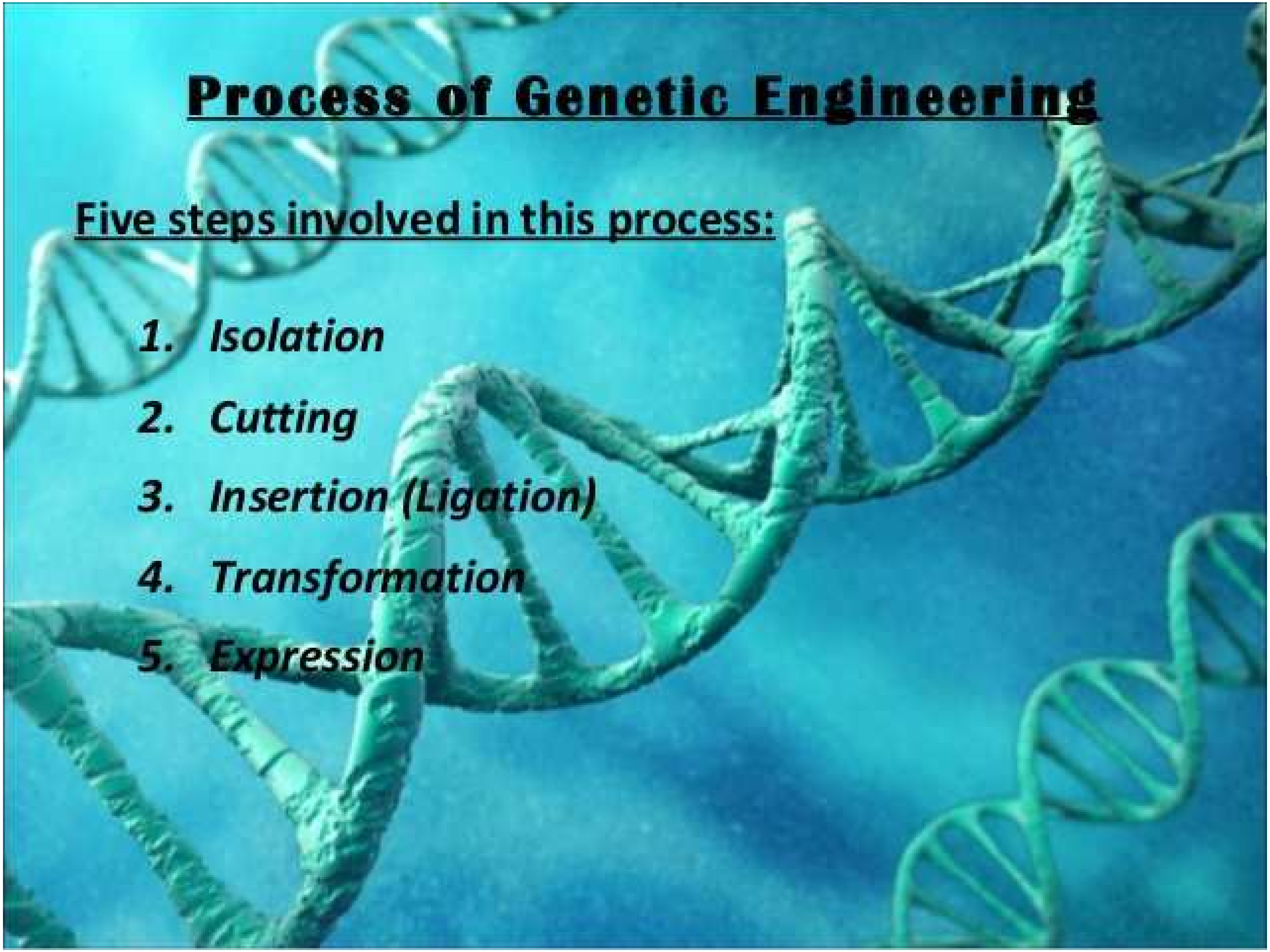
- Genetic engineering is also known as **recombinant DNA technology,** is the set of techniques that enables to DNA from different sources to be identified, isolated and recombine.
- Genetic engineering aims to rearrange he sequence of DNA in gene using artificial method.
- For e.g. genes and segments of DNA from one species is taken, recombined and put into another species.
- One of the main technique of genetic engineering is DNA cloning because it produces unlimited no of copies of a particular DNA segment.

DEFINATION

- "It is directed and artificial alteration of genetic makeup of cells or organisms either through modification of specific genes or by implantations of new gene into chromosome."

OR

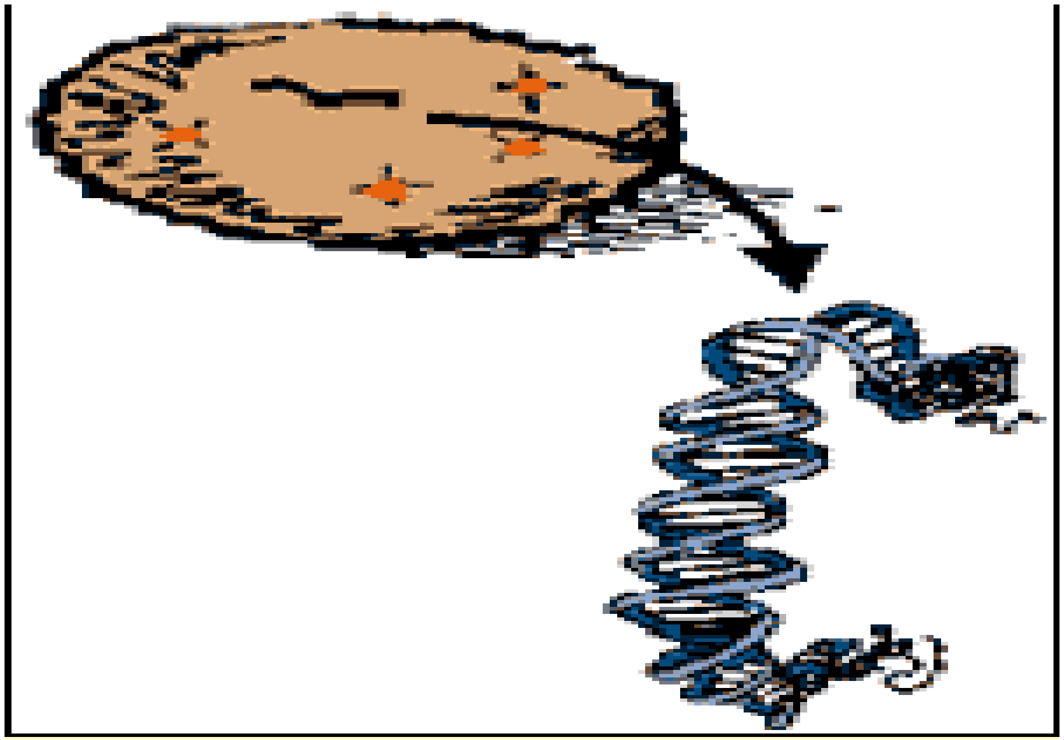
- Recombinant DNA is a DNA molecule formed by joining DNA segments from two or more sources.


Process of Genetic Engineering
Five steps involved in this process:
1. Isolation
2. Cutting
3. Insertion (Ligation)
4. Transformation
5. Expression

Basic steps for genetic engineering

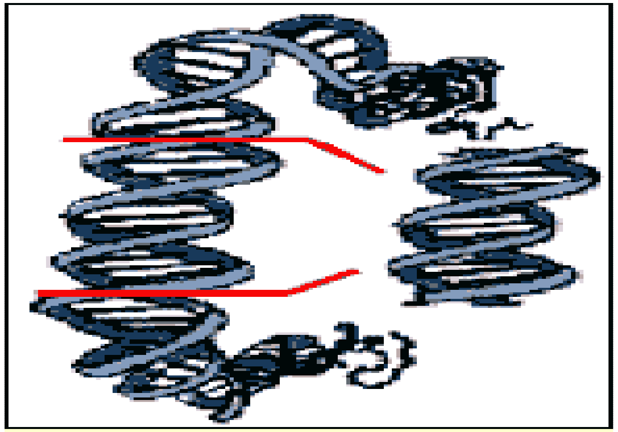
- Step 1: DNA Extraction
  The process of genetic engineering requires the successful completion of a series of five steps.

- DNA extraction is the first step in the genetic engineering process. In order to work with DNA, scientists must extract it from the desired organism.
- A sample of an organism containing the gene of interest is taken through a series of steps to remove the DNA



Extracting DNA from and organism.

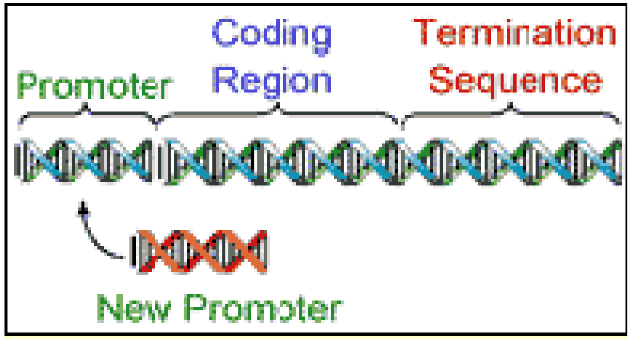
Step 2 : Gene Cloning



Selecting a gene for cloning

- The second step of the genetic engineering process is gene cloning.
- During DNA extraction, all of the DNA from the organism is extracted at once.
- Scientists use gene cloning to separate the single gene of interest from the rest of the genes extracted and make thousands of copies of it.

Step 3 : Gene Design

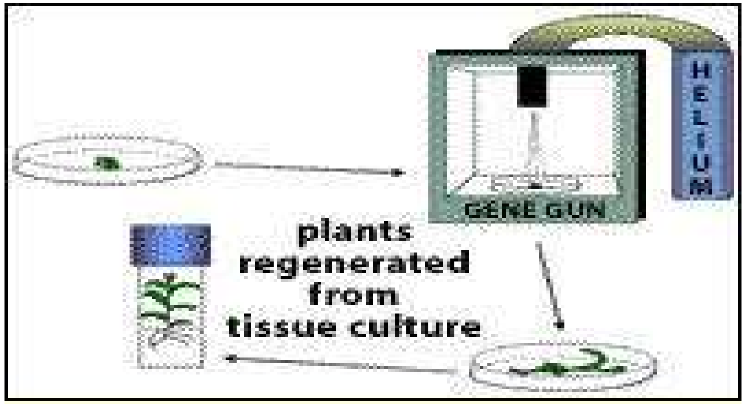


Replacing an existing promoter with a new promoter.

•Once a gene has been cloned, genetic engineers begin the third step, designing the gene to work once inside a different organism.

• This is done in a test tube by cutting the gene apart with enzymes and replacing gene regions that have been separated.

Step 4 : Transformation



Using the gene gun method to transform plant cells.

•The modified gene is now ready for the fourth step in the process, transformation or gene insertion.

•The new gene is inserted into some of the cells using various techniques.

•Some of the more common methods include the gene gun, microfibers, and electroporation.

•The new gene is inserted into some of the cells using various techniques.
•Some of the more common methods include the gene gun, microfibers, and electroporation.
• The main goal of each of these methods is to transport the new gene(s) and deliver them into the nucleus of a cell without killing it.
•Transformed plant cells are then regenerated into transgenic plants. The transgenic plants are grown to maturity in greenhouses and the seed they produce, which has inherited the transgenic, is collected.
The genetic engineer's job is now complete

Step 5 : Backcross Breeding / Expression

•Transgenic plants are crossed with elite breeding lines using traditional plant breeding methods to combine the desired traits of elite parents and the transgene into a single line.

•The offspring are repeatedly crossed back to the elite line to obtain a high yielding transgenic line.

•The result will be a plant with a yield potential close to current hybrids that expresses the trait encoded by the new transgene.

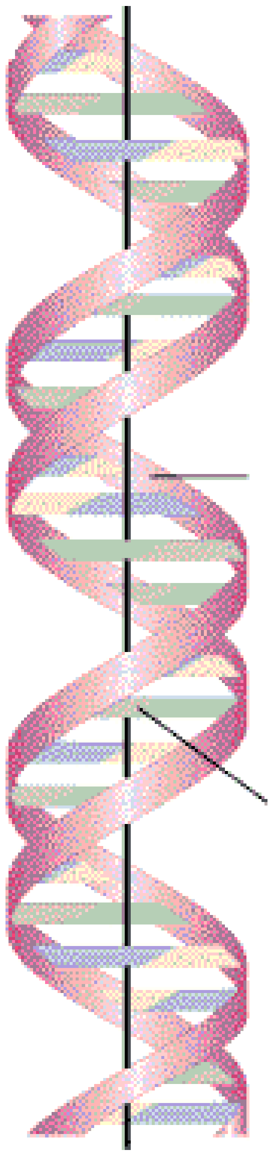
STRUCTURE OF DNA

- **DNA structure**. **DNA** is made up of molecules called nucleotides. Each nucleotide contains a phosphate group, a sugar group and a nitrogen base. The four types of nitrogen bases are adenine (A), thymine (T), guanine (G) and cytosine (C).

•**Deoxyribonucleic Acid** (**DNA**) is a **double-stranded, helical molecule**.

•It consists of two **sugar-phosphate backbones** on the outside, held together by **hydrogen bonds** between pairs of **nitrogenous bases** on the inside.

• The bases are of four types (**A**, **C**, **G**, & **T**): pairing always occurs between **A** & **T**, and **C** & **G.**


Sugar-Phosphate backbone
(two; outside)
Nitrogenous base-pairs
(inside)
A + T
G + C
Held together by hydrogen bonds
(H-bonds)

•.D.Watson and F.H.C. Crick (1953) combined the physical and chemical data, and proposed a double helix model for DNA molecule.

• This model is widely accepted. According to this model, the DNA molecule consists of two strands which are connected together by hydrogen bonds and helically twisted.

•Each step on one strand consists of a nucleotide of purine base which alternates with that of pyrimidine base.

•Thus, a strand of DNA molecule is a polymer of four nucleotides i.e. A, G, T, C.

•The two strands of double helix ran in antiparallel direction i.e. they have opposite polarity.
•The left hand strand has 5′ → 3′ polarity, whereas the right hand has 3′ → 5′ polarity as compared to the first one.
•The polarity is due to the direction of phosphodiester linkage.
•The hydrogen bonds between the two strands are such that they maintain a distance of 20 A.
•The double helix coils in right hand direction i.e. clockwise direction and completes a turn at every 34 A distance.

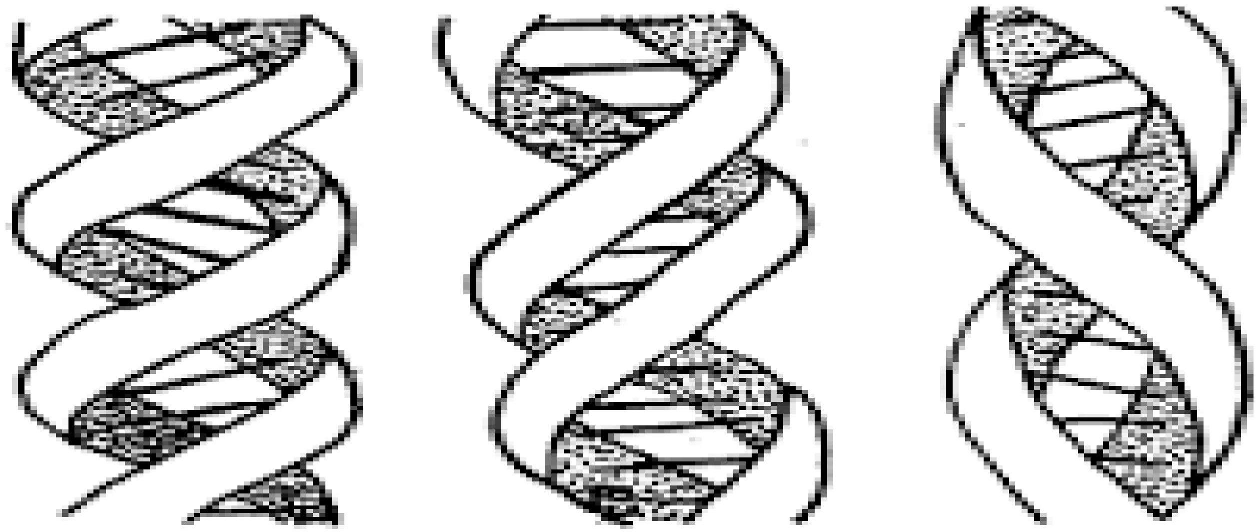
•The distance between two strands forms a minor groove. One turn of double helix at every 34Å distance includes 10 nucleotides **i.e. each nucleotide is situated at a distance of 3.4Å. Sugar-phosphate (nucleoside) makes the backbone of double helix of DNA molecule**

•The two strands join together to form a double helix. Bases of two nucleotides form hydrogen bonds i.e. A combines with T by two hydrogen bonds (A = T) and G combines with C by three hydrogen bonds (G = C)

•The turning of double helix results in the appearance of a deep and wide groove called major groove. The major groove is the site of bonding of specific protein.

FORMS OF DNA

•Three major forms of DNA are double stranded and connected by interactions between complementary base pairs. These are terms A-form, B-form ,and Z-form DNA.

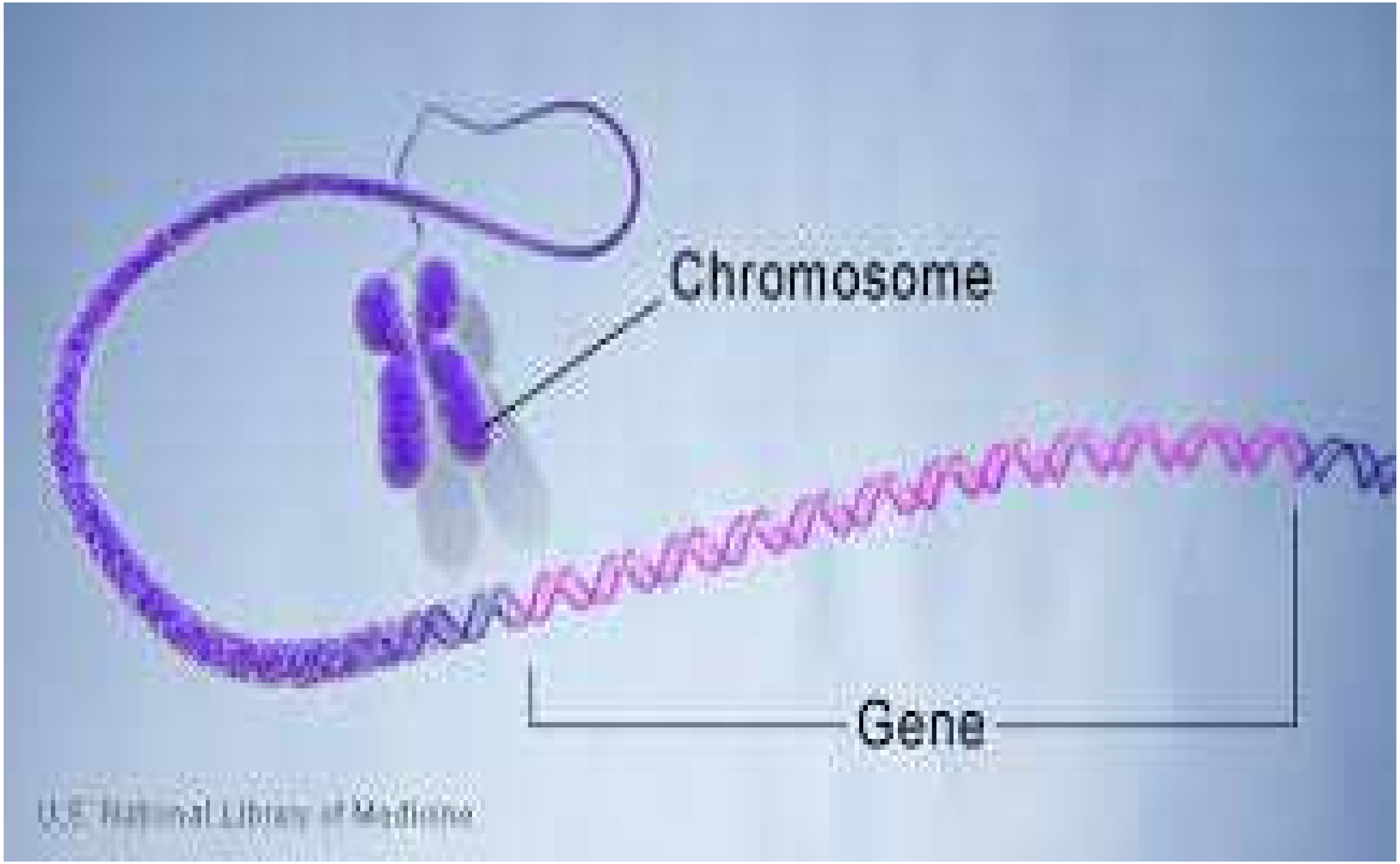


Form	A	B	Z
helical twist	right	right	left
base pairs per turn	11	10	12
occurrence	RNA, DNA	DNA	DNA

Feature	B-DNA	A-DNA	Z-DNA
Type of helix	Right-handed	Right-handed	Left-handed
Helical diameter (nm)	2.37	2.55	1.84
Rise per base pair (nm)	0.34	0.29	0.37
Distance per complete turn (pitch) (nm)	3.4	3.2	4.5
Number of base pairs per complete turn	10	11	12
Topology of major groove	Wide, deep	Narrow, deep	Flat
Topology of minor groove	Narrow, shallow	Broad, shallow	Narrow, deep

Structure of gene in prokaryotes and eukaryotes

- A gene is the basic physical and functional unit of heredity. Genes are made up of DNA. Some genes act as instructions to make molecules called proteins.
- However, many genes do not code for proteins. In humans, genes vary in size from a few hundred DNA bases to more than 2 million bases.


Chromosome
Gene
U.S. National Library of Medicine

UNITES OF GENE

1) Cistron:

- It is the largest element in a gene which encodes a polypeptide during protein synthesis. The term “cistron” refers to a test called cis-trans test, which is similar to a complementation test. The term “cistron” is a unit of function.

2) Recon:

•They are locations within a gene which participate in recombination. There is a minimum distance between recons within a gene. The term “recon” is a unit of recombination.

3) Muton:

•They are elements within a gene that can undergo a mutation and lead to the production of mutant phenotype.

•The term “muton” is a unit of mutation. Each recon may have several mutons within them, and many mutons within a recon may stay linked because of recombination.

•Thus, a gene may have one more than one cistrons, a cistron may have several recons, and a recon may have several mutons.

4) COMPLAN :

It is unit of complementation . It has been used to replace cistron.

5) Operon :

It is combination of operator gene and a sequence genes which act together as a unit .

6) Replicon : It is unit of replication.

Gene expression

- **Gene expression** is the process by which information from a gene is used in the synthesis of a functional gene product. These products are often proteins, but in non-protein coding genes such as transfer RNA (tRNA) or small nuclear RNA (snRNA) genes, the product is a functional RNA.

- **Gene Expression is the process of synthesis of protein from DNA via RNA as an intermediate. The functioning of cells are dependant on the activity of many proteins.**

- Gene expression is highly regulated. All these genes present in the cell are not active and different types of cells express different genes.

- The expression of gene is regulated by certain segments of DNA upstream of **coding sequences .** (Portion of genes DNA composed of exon that codes for protein)

Organization of gene in prokaryotes (Bacteria)

- Almost all the genes are present in bacteria occur on the bacterial chromosome.
- E.g. E.coli.
- It has about 4300 genes carried by the chromosomal DNA molecule. Some genes are arranged as families , called as **operons.**
- Bacterial genes are organized as operons. An operon is a unit of prokaryotic gene expression. **they are regulated by follwing method,**

- **Structural Gene:**

Any genes that code for protein or RNA product is called as **structural gene.**

- **Regulator gene:**

The genes that codes for a protein in regulating the expression of the genes is called **regulator gene.** That encodes a protein product that controls the **transcription** of DNA.

- **Promoter :**

It is the site at which transcription of gene is initiated.

- **Terminator :**

It is the site at which transcription is terminated (stopped).

This promoter and terminator sequences are called as **trans** acting element.

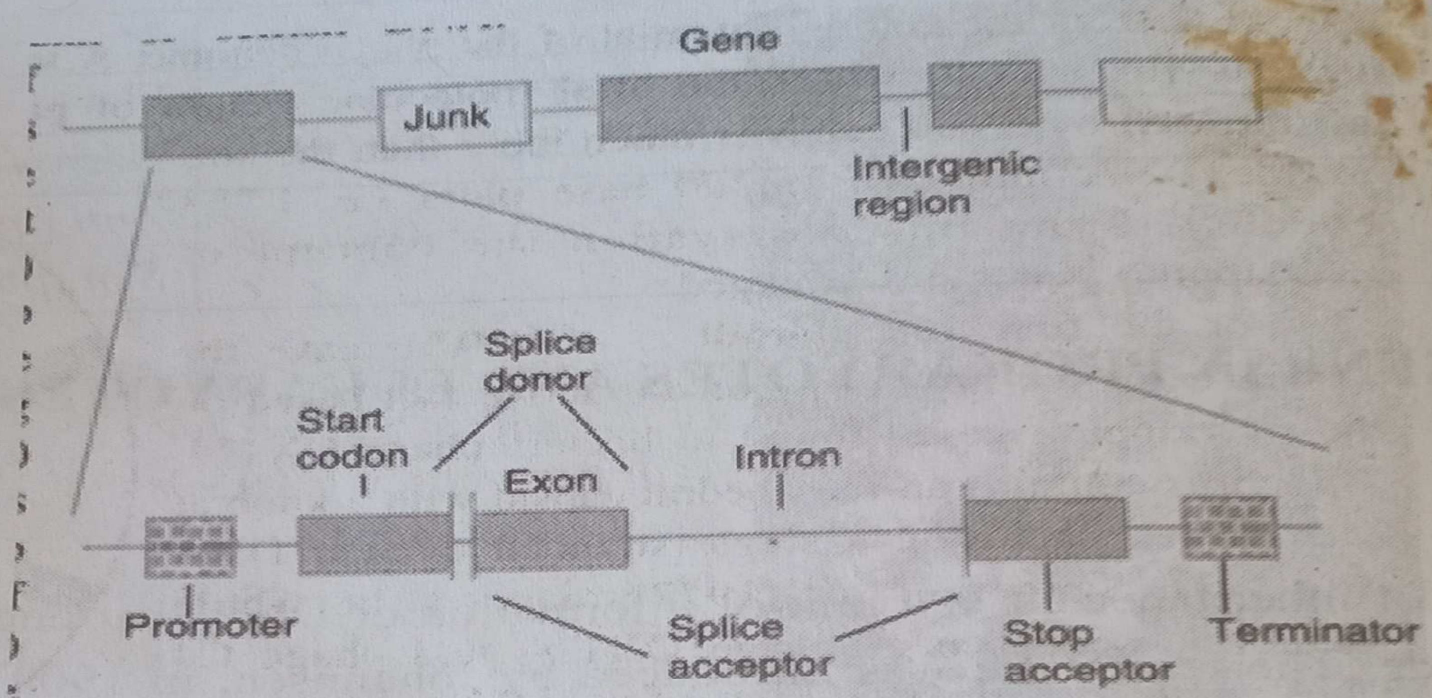


Fig 6.3: Structure of Gene showing Terminators, Promoter, Exons and Introns

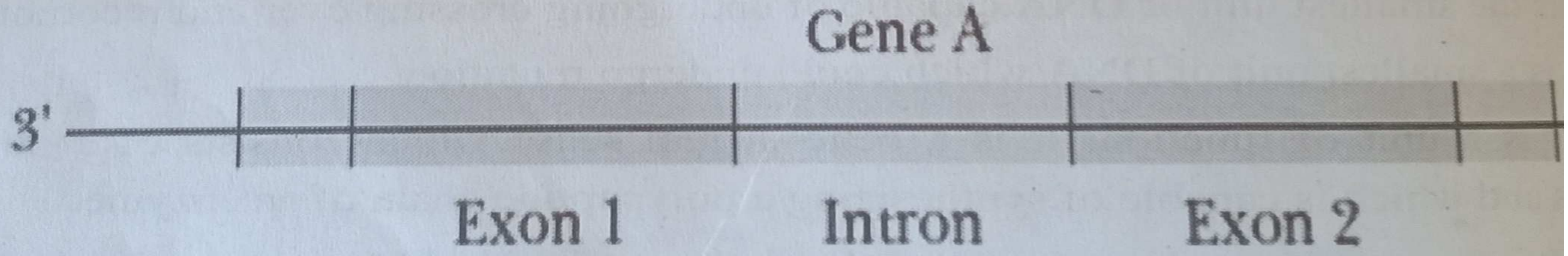


Figure 6.4: Eukaryotic genes

Introns :

Any nucleotide sequence within gene that is removed by RNA splicing during maturation of the final product.

Exon :

Exon is a any part of gene that will encode a part of the final mature RNA produced by that gene after **introns** have been removed by RNA splicing.

Eukaryotic system :

In eukaryotes , the efficiency of gene expression is increased by another sequence called as **Enhancer.**

- Enhancer has ability to function even they are separated by long distances from transcription initiation site.

- Many eukaryotic genes are regulated by **cis** acting element called as **silencers.** These are the sequences those decrease the transcription of the regulated genes.

- Eukaryotic gene include additional sequences that lie within the coding region.

•Exons are the coding sequence while Introns are the non coding sequence.

•The entire genes are transcribed to yield a long RNA molecule then introns are removed by splicing. The exons are joined to form intact molecule.

•Thus only exons are included in the mature RNA.

• Exon sequences are conserved but introns are varies because introns are larger than exon.

THANK YOU

Welcome

Protiens

Prof. Shelke Pratibha D.
Department of Botany

PROTIENS

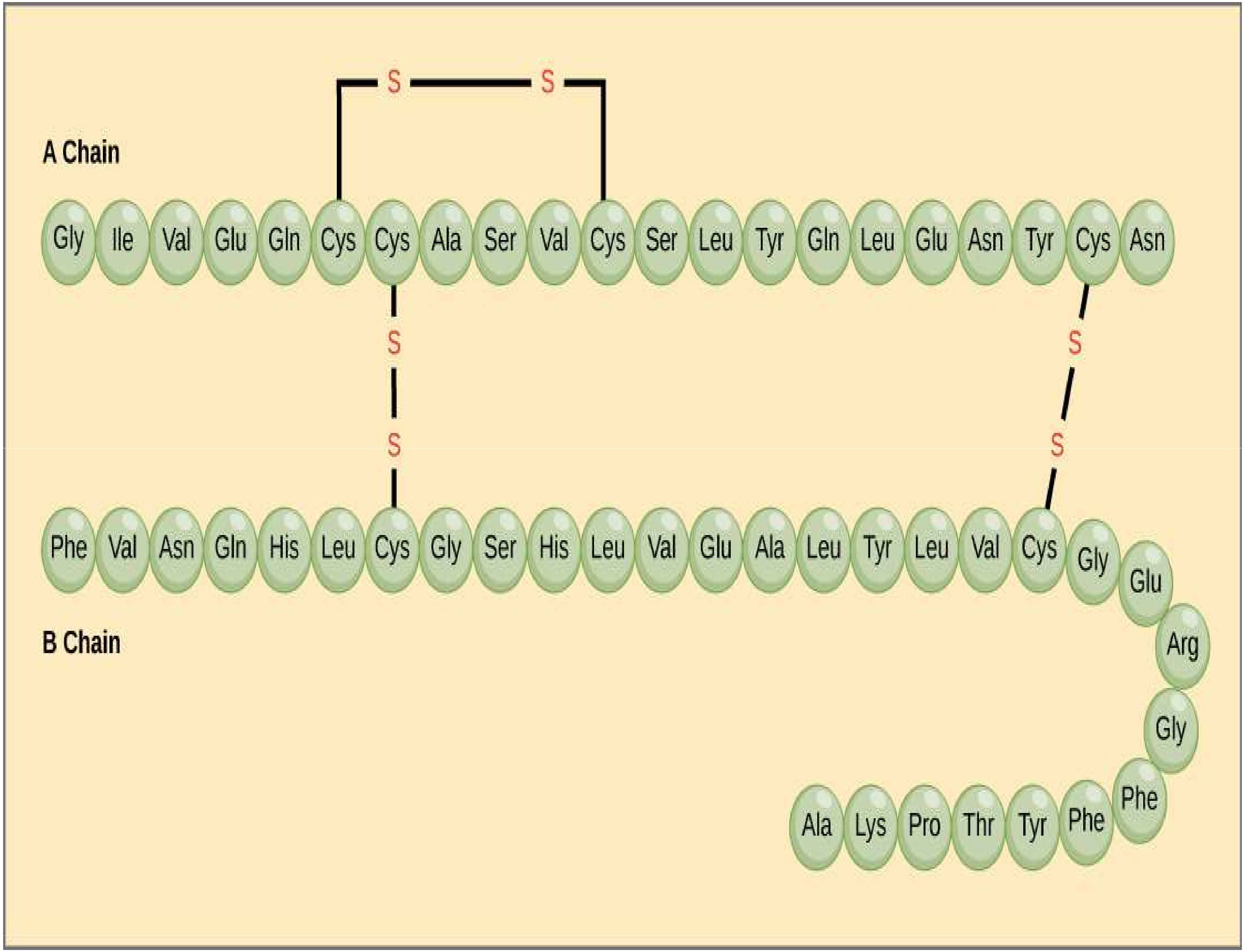
- Proteins are one of the four different types of macromolecules, in addition to carbohydrates, lipids, or fats, and nucleic acids, such as DNA and RNA.
- **Macromolecules** are large molecules that perform specialized functions inside living organisms. The structural arrangement of a protein molecule will differ in accordance with its function.

❖ DEFINATION

- any of a large group of nitrogenous compounds of high molecular weight that are essentional constituents of all living organisms.They consists of one or more chains of amino acids linked by peptide bonds and are folded into a specific three-dimensional shape maintained by further chemical bonding.

CLASSIFICATION

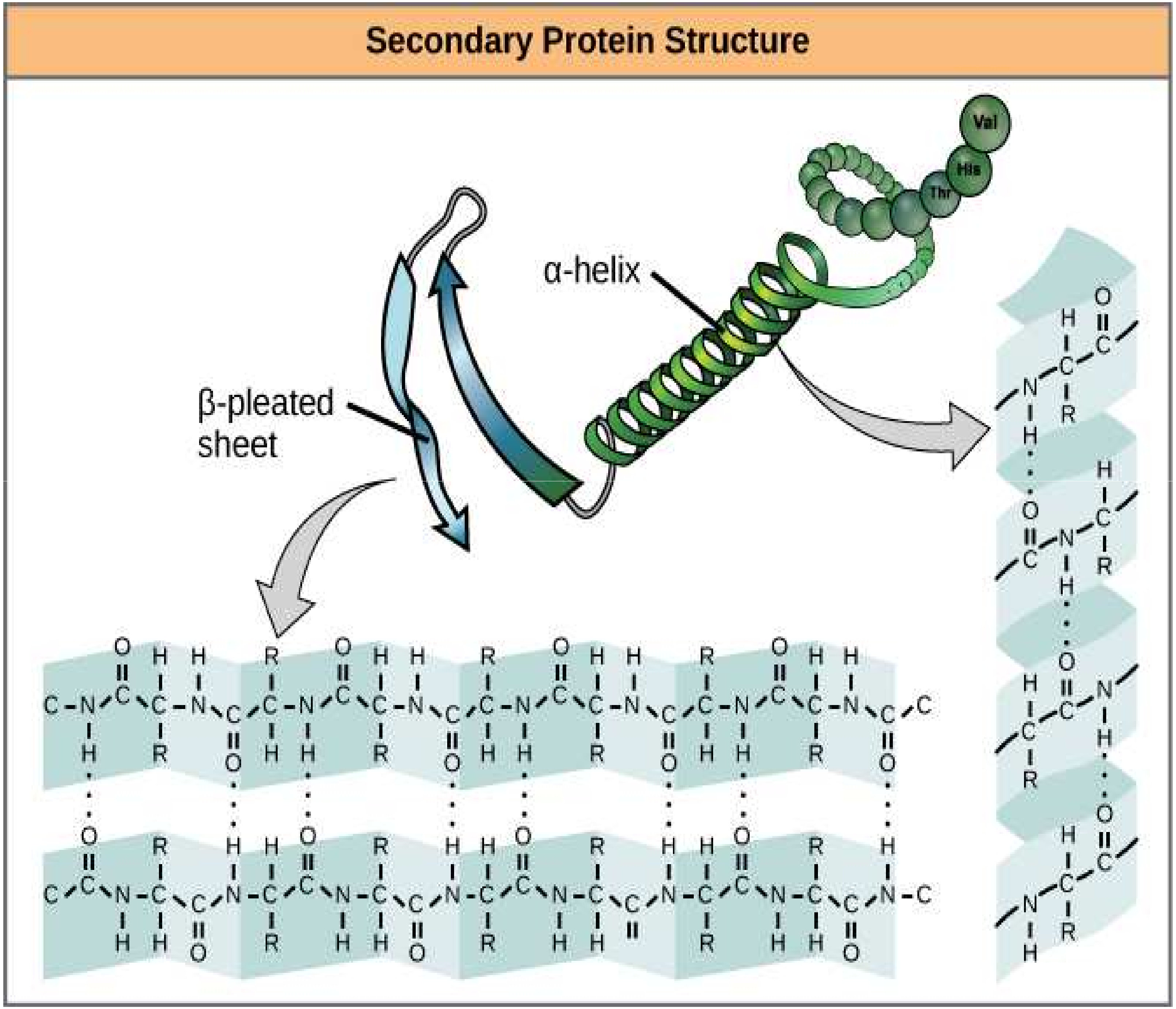
- **The four levels of protein structure: primary, secondary, tertiary, and quaternary.**
- **Primary structure**
- The simplest level of protein structure, **primary structure**, is simply the sequence of amino acids in a polypeptide chain.
- For example, the hormone insulin has two polypeptide chains, A and B, shown in diagram below. (The insulin molecule shown here is cow insulin, although its structure is similar to that of human insulin.)
- Each chain has its own set of amino acids, assembled in a particular order.



A Chain
Gly Ile Val Glu Gln Cys Cys Ala Ser Val Cys Ser Leu Tyr Gln Leu Glu Asn Tyr Cys Asn
S
S
S
S
S
S
B Chain
Phe Val Asn Gln His Leu Cys Gly Ser His Leu Val Glu Ala Leu Tyr Leu Val Cys Gly Glu Arg Gly Phe Phe Tyr Thr Pro Lys Ala

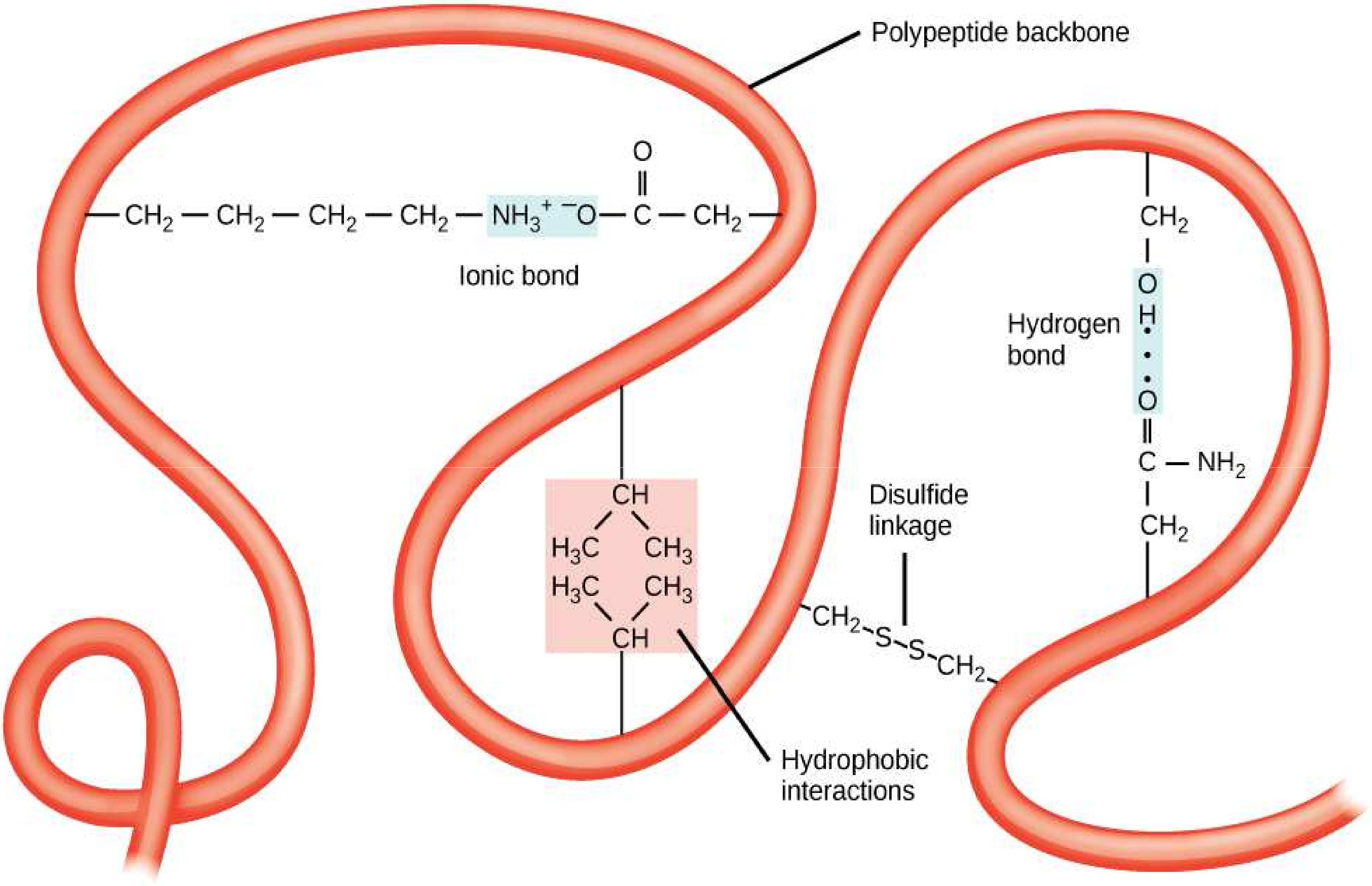
- **Secondary structure :**

- The next level of protein structure, **secondary structure**, refers to local folded structures that form within a polypeptide due to interactions between atoms of the backbone.
- The most common types of secondary structures are the α helix and the β pleated sheet. Both structures are held in shape by hydrogen bonds, which form between the carbonyl O of one amino acid and the amino H of another.


Secondary Protein Structure
Val
His
Thr
α-helix
β-pleated
sheet

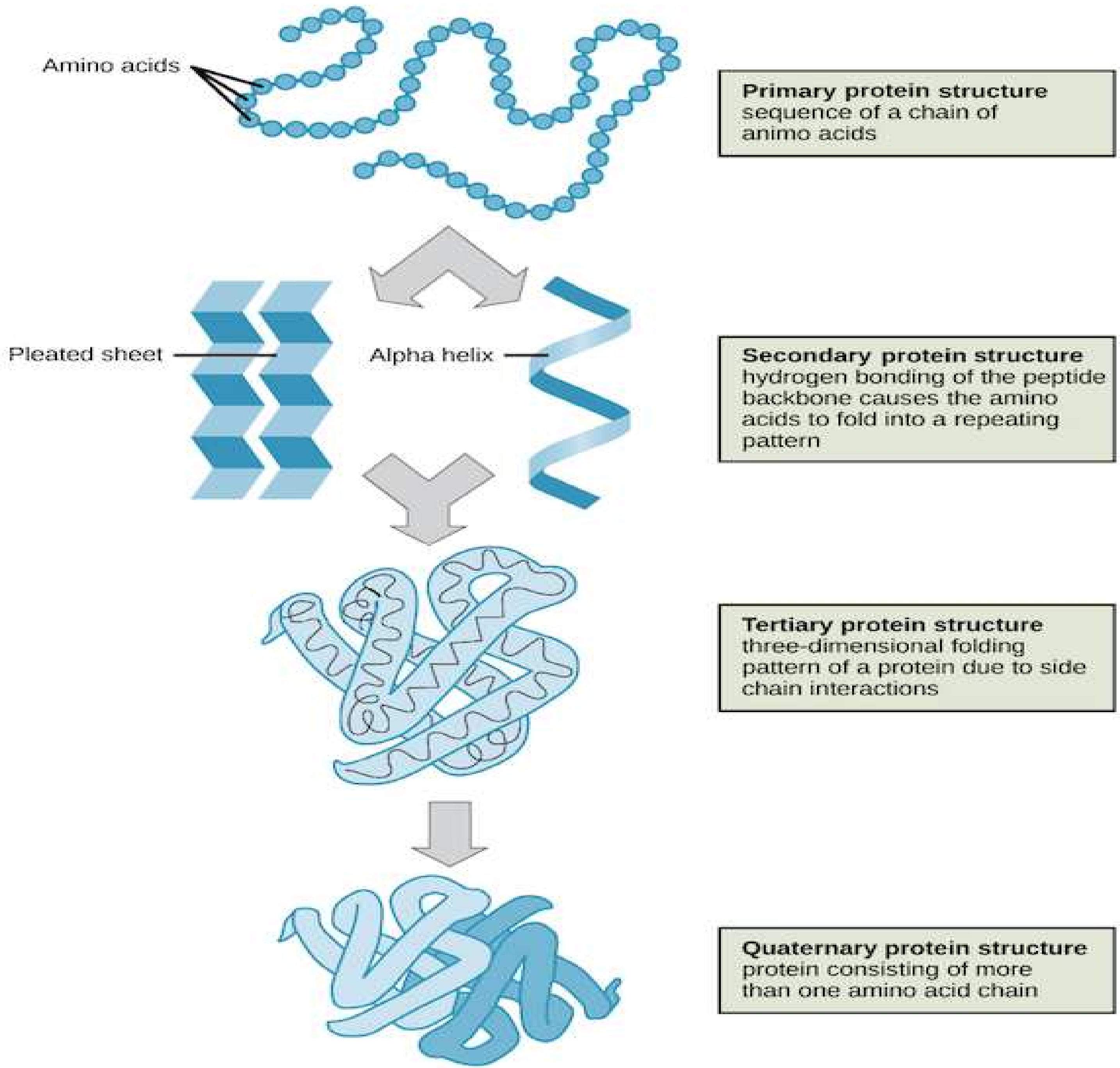
- **Tertiary structure :**

- The overall three-dimensional structure of a polypeptide is called its **tertiary structure**.
- The tertiary structure is primarily due to interactions between the R groups of the amino acids that make up the protein.


Polypeptide backbone
Ionic bond
Hydrogen bond
Disulfide linkage
Hydrophobic interactions

- **Quaternary structure :**

- Many proteins are made up of a single polypeptide chain and have only three levels of structure .
- However, some proteins are made up of multiple polypeptide chains, also known as subunits. When these subunits come together, they give the protein its **quaternary structure**.


Amino acids
Primary protein structure
sequence of a chain of
animo acids
Pleated sheet
Alpha helix
Secondary protein structure
hydrogen bonding of the peptide
backbone causes the amino
acids to fold into a repeating
pattern
Tertiary protein structure
three-dimensional folding
pattern of a protein due to side
chain interactions
Quaternary protein structure
protein consisting of more
than one amino acid chain

PHYSICAL PROPERTIES

- **Colour and Taste**
  Proteins are colourless and usually tasteless. These are homogeneous and crystalline.
- **Shape and Size**
  The proteins range in shape from simple crystalloid spherical structures to long fibrillar structures. Two distinct patterns of shape
  have been recognized :
  A. Globular proteins- These are spherical in shape and occur mainly in plants, esp., in seeds and in leaf cells. These are bundles formed by folding and crumpling of protein chains. e.g., pepsin, edestin, insulin, ribonuclease etc.

- **B. Fibrillar proteins-** These are thread-like or ellipsoidal in shape and occur generally in animal muscles. Most of the studies regarding protein structure have been conducted using these proteins. e.g., fibrinogen, myosin etc.
- **Molecular Weight**
  The proteins generally have large molecular weights ranging between 5 × 103 and 1 × 106. It might be noted that the values of molecular weights of many proteins lie close to or multiples of 35,000 and 70,000.
- **Colloidal Nature**
  Because of their giant size, the proteins exhibit many colloidal properties, such as; Their diffusion rates are extremely slow and they may produce considerable

- such as; Their diffusion rates are extremely slow and they may produce considerable light-scattering in solution, thus resulting in visible turbidity (Tyndall effect).
- **Denaturation**
  Denaturation refers to the changes in the properties of a protein. In other words, it is the loss of biologic activity.
- In many instances the process of denaturation is followed by coagulation— a process where denatured protein molecules tend to form large aggregates and to precipitate from solution.

- **Amphoteric Nature**
  Like amino acids, the proteins are amphoteric, i.e., they act as acids and alkalies both. These migrate in an electric field and the direction of migration depends upon the net charge possessed by the molecule. The net charge is influenced by the pH value. Each protein has a fixed value of isoelectric point (pl) at which it will move in an electric field.
- **Ion Binding Capacity**
  The proteins can form salts with both cations and anions based on their net charge.

Chemical Properties of Proteins

- **Hydrolysis**
  Proteins are hydrolyzed by a variety of hydrolytic agents.
  A. By acidic agents: Proteins, upon hydrolysis with conc. HCl (6–12N) at 100–110°C for 6 to 20 hrs, yield amino acids in the form of their hydrochlorides.
  B. By alkaline agents: Proteins may also be hydrolyzed with 2N NaOH.
- **Reactions involving COOH Group**
  A. Reaction with alkalies (Salt formation)
  B. Reaction with alcohols (Esterification)
  C. Reaction with amines
- **Reactions involving NH2 Group**
  A. Reaction with mineral acidare treated with mineral acids like HCl, the acid salts are formeds (Salt formation): When either free amino acids or proteins.

functions

- **Repair and Maintenance**
- Protein is termed the building block of the body. It is called this because protein is vital in the maintenance of body tissue, including development and repair. Hair, skin, eyes, muscles and organs are all made from protein.
- **Energy**
- Protein is a major source of energy. If you consume more protein than you need for body tissue maintenance and other necessary functions, your body will use it for energy.

- **Hormones**
- Protein is involved in the creation of some hormones. These substances help control body functions that involve the interaction of several organs. Insulin, a small protein, is an example of a hormone that regulates blood sugar.
- **Enzymes**
- Enzymes are proteins that increase the rate of chemical reactions in the body. In fact, most of the necessary chemical reactions in the body would not efficiently proceed without enzymes.

- **Transportation and Storage of Molecules**
- Protein is a major element in transportation of certain molecules. For example, hemoglobin is a protein that transports oxygen throughout the body. Protein is also sometimes used to store certain molecules
- **Antibodies**
- Protein forms antibodies that help prevent infection, illness and disease. These proteins identify and assist in destroying antigens such as bacteria and viruses.

THANK YOU

WELCOME

Transcription

Prof. Shelke P. D.
T.Y.B.Sc
Department of Botany

Transcription

- What is the process of transcription?
- **Transcription** is the **process** by which the information in a strand of DNA is copied into a new molecule of messenger RNA (mRNA). DNA safely and stably stores genetic material in the nuclei of cells as a reference, or template

Basic Stages Of Transcription

- **Transcription occurs in the three steps—initiation, elongation, and termination—all shown here.**
- Step 1: Initiation. Initiation is the beginning of transcription. ...
- Step 2: Elongation. Elongation is the addition of nucleotides to the mRNA strand. ...
- Step 3: Termination.

Transcription in Prokaryotes:

- In prokaryotic organisms transcription occurs in three phases known as initiation, elongation and termination.
- RNA is synthesized by a single RNA polymerase enzyme which contains multiple polypeptide subunits.

- In E. coli, the RNA polymerase has five subunits: two α, one β, one β' and one σ subunit ($\alpha_2\beta\beta'\sigma$). This form is called the holoenzyme.

- The σ subunit may dissociate from the other subunits to leave a form known as the core enzyme.

(i) Initiation:

- Transcription cannot start randomly but must begin specifically at the start of a gene.
- Signals for the initiation of transcription occur in the promoter sequence which lies directly upstream of the transcribed sequence of the gene.

- The promoter contains specific DNA sequences that act as points of attachment for the RNA polymerase.

- In E. coli, two sequence elements recognized by the RNA polymerase known as the -10 sequence and the -35 sequence arc present. The exact sequences can vary between promoters but all conform to an overall pattern known as the consensus sequence.

- The σ subunit of the RNA polymerase is responsible for recognizing and binding the promoter, probably at the -35 Box.

- The σ subunit then dissociates from the open promoter complex leaving the core enzyme.

- At the same time the first two ribonucleotides bind to the DNA, the first phosphodiester bond is formed and transcription is initiate

(ii) Elongation:

- During elongation the RNA polymerase moves along the DNA molecule melting and unwinding the double helix as it progresses.

- The enzyme adds ribonucleotides to the 3′ end of the growing RNA molecule with the order of addition determined by the order of the bases on the template strand.

- The unwound area contains the newly synthesized RNA base-paired with the template DNA strand and extends over 12-17 bases.

- The unwound area needs to remain small because unwinding in one region necessitates over-winding in adjacent regions and this imposes strain on the DNA molecule.

- To overcome this problem, the RNA is released from the template DNA as it is synthesized allowing the DNA double helix to reform

(iii) Termination:

- The termination of transcription occurs non-randomly and takes place at specific points after the end of the coding sequence.

- In E. coli, termination occurs at sequences known as palindromes.

- These are symmetrical about their middle such that the first half of the sequence is followed by its exact complement in the second half.

- binding of a protein called Rho (ρ) which disrupts base-pairing between the template and the transcript when the polymerase pauses after the stem-loop.

- The termination of transcription involves the release of the transcript and the core enzyme which may then re-associate with the σ subunit and go on to another round of transcription

Welcome

Algae

Prof. Thube T. B.
Department of Botany

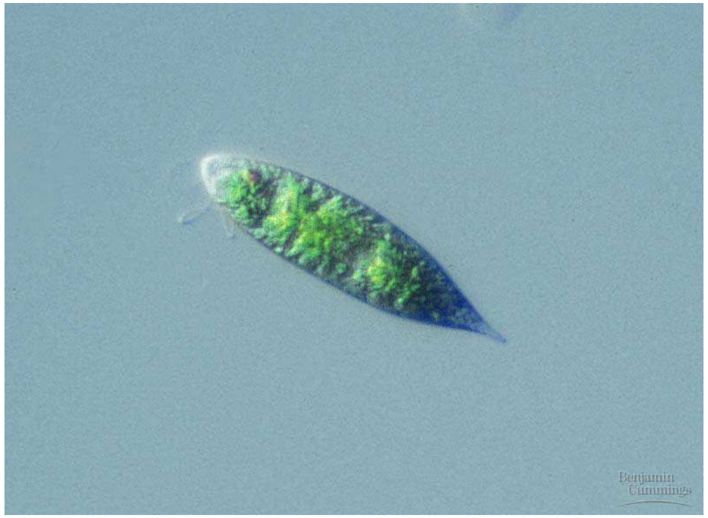
Characteristics

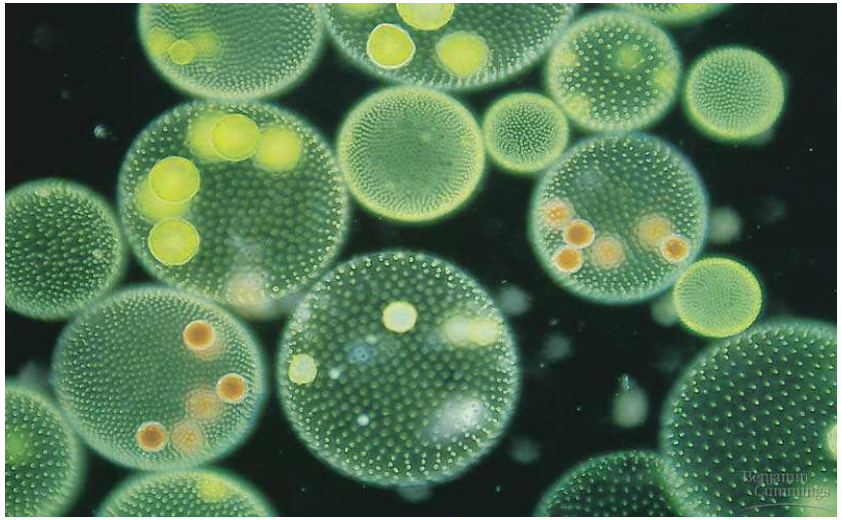
- Range in size from microscopic to single celled organisms to large seaweed
- Autotrophic
- Form the reproductive structures – gametangia or gamete chambers
- Aquatic and have flagella at some point in life
- Often contain **pyrenoids,** organelles that synthesis and store starch

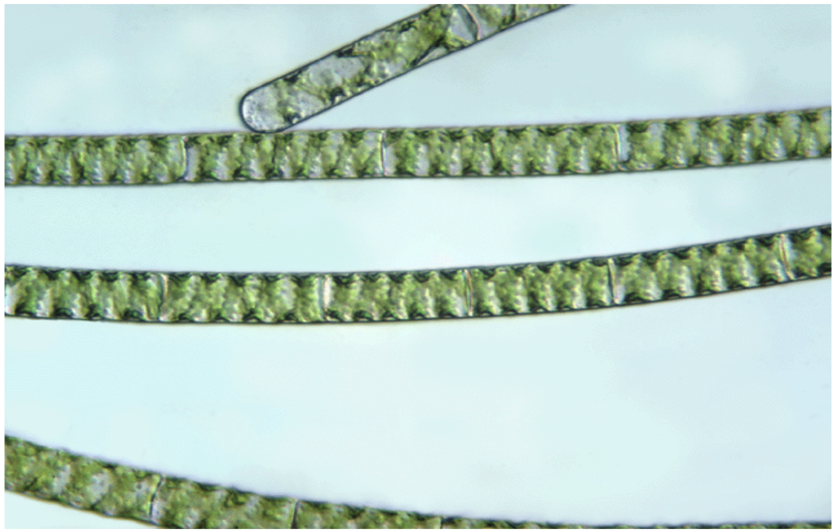
STRUCTURE

- Thallus (haploid)
- Four types of algae
  - Unicellular
  - Colonial
  - Filamentous
  - multicellular

IDENTIFY THE TYPE OF ALGAE







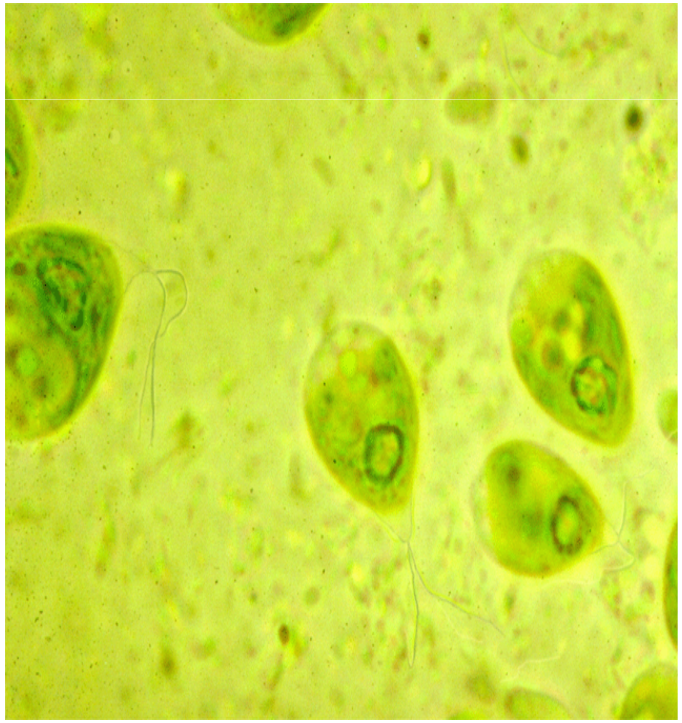
CLASSIFICATION OF ALGAE

- SEVEN PHYLUM BASED ON
  - COLOR
  - TYPE OF CHLOROPHYLL
  - FOOD-STORAGE SUBSTANCE
  - CELL WALL COMPOSITION

REPRODUCTION

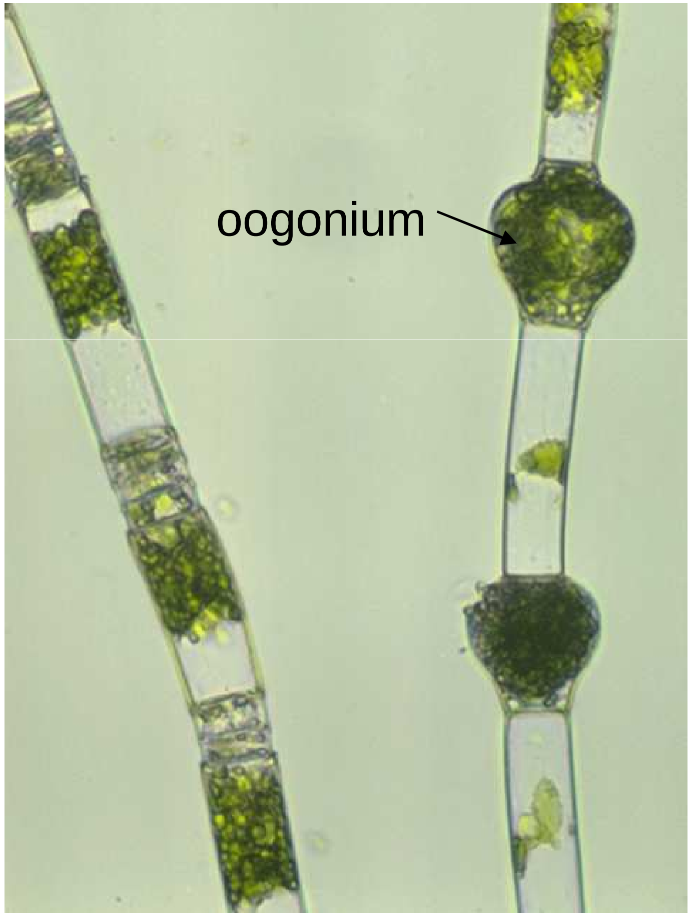
MOST REPRODUCE BOTH SEXUALLY AND ASEXUALLY

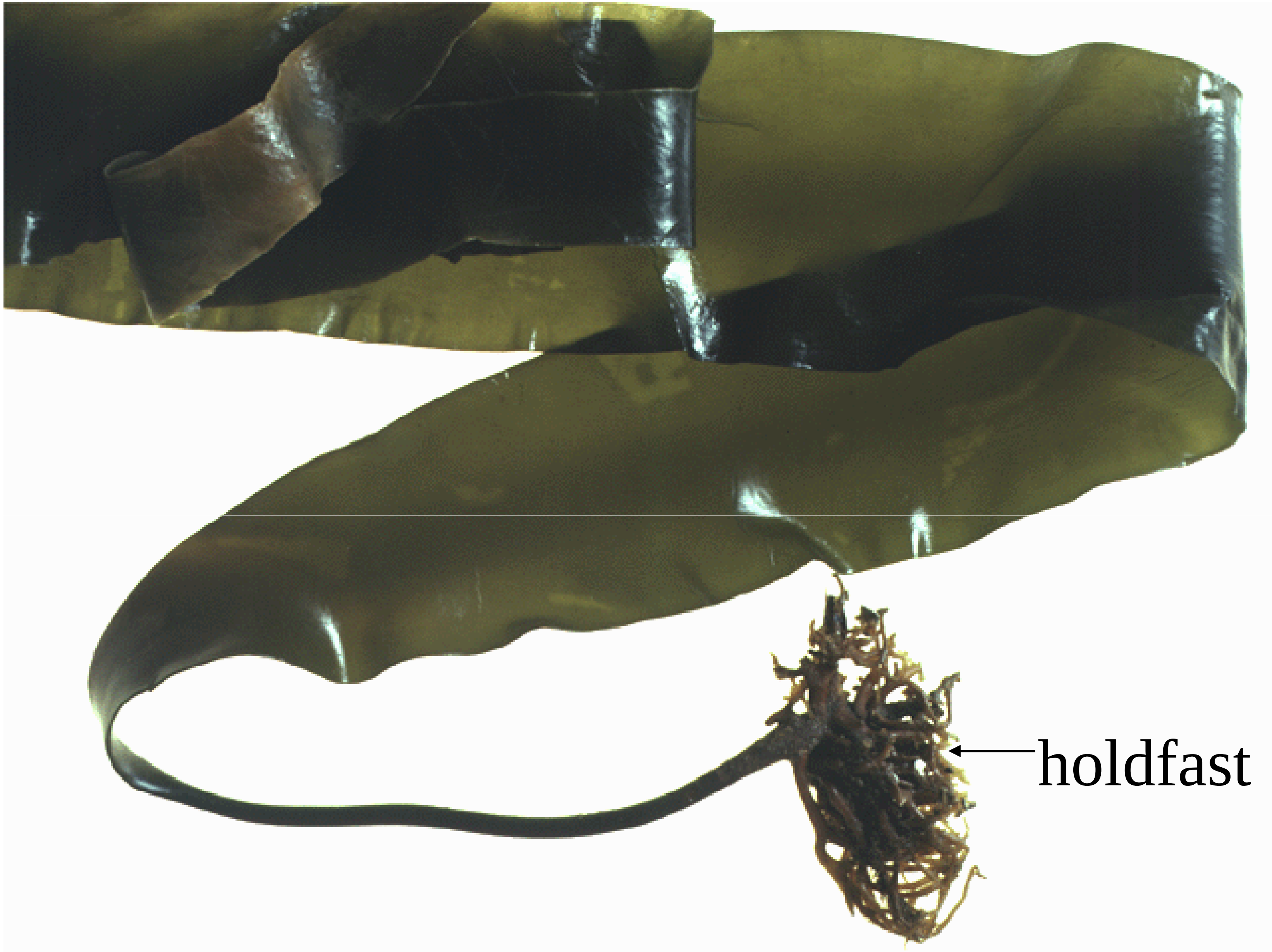
- Most sexual reproduction is triggered by environmental stress
- Asexual Reproduction
  - Mitosis
- Sexual Reproduction
  - Meiosis
  - Zoospores
  - Plus and minus gametes
  - Zygospore



Reproduction in Multicellular Algae

- Oedogonium reproduction
  - Antheridium-release flagellated sperm that swim to the oogonium
  - Oogonium-houses the zygote which is a diploid spore
    - The spore undergoes meiosis and produces 4 haploid zoospores. One of the four cells becomes a rootlike holdfast the others divide and become a new filament.




holdfast

Spirogyra reproduce sexually by conjugation

Ulva Reproduces by Alternation of Generations

- Two distinct multicellular phases-one is haploid and the other is diploid
  - Gametophyte is haploid
  - Sporophyte is diploid

Phylum Chlorophyta

- **Green algae**
- 7000 diverse species
- Biologist reason that green algae give rise to land plants.
- Both green algae and land plants have chlorophyll a and B as well as carotenoids and store food as starch
- Both have walls made of cellulose

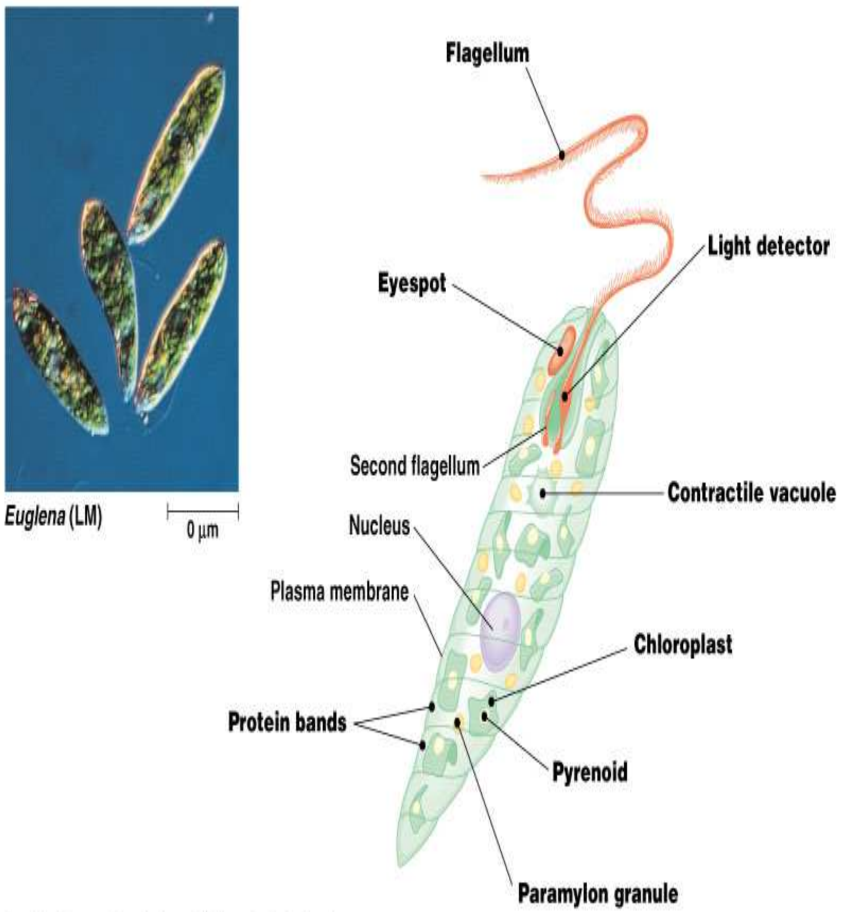
Phylum Phaeophyta

- 1500 species of **Brown algae**
- Mostly marine and include seaweed and kelp
- All are multicellular and large (often reaching lengths of 147 feet)
- Individual alga may grow to a length of 100m with a holdfast, stipe and blade
- Used in cosmetics and most ice creams

Phylum Rhodophyta

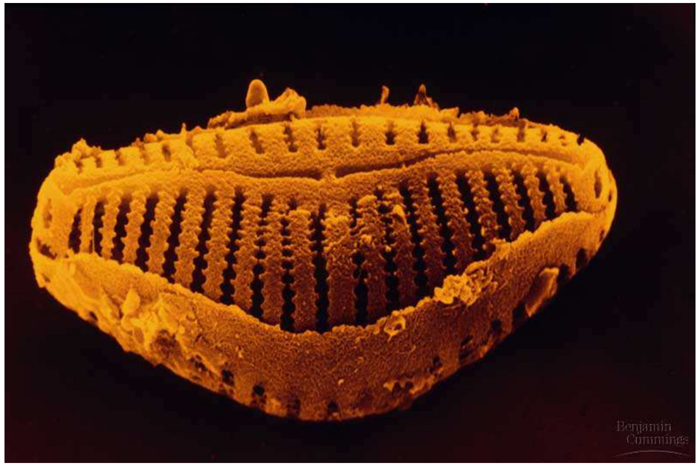
- 4000 species of **RED Algae**
- Most are marine
- Smaller than brown algae and are often found at a depth of 200 meters.
- Contain chlorophyll a and C as well as phycobilins which are important in absorbing light that can penetrate deep into the water
- Have cells coated in carageenan which is used in cosmetics, gelatin capsules and some cheeses

Phylum Euglenophyta



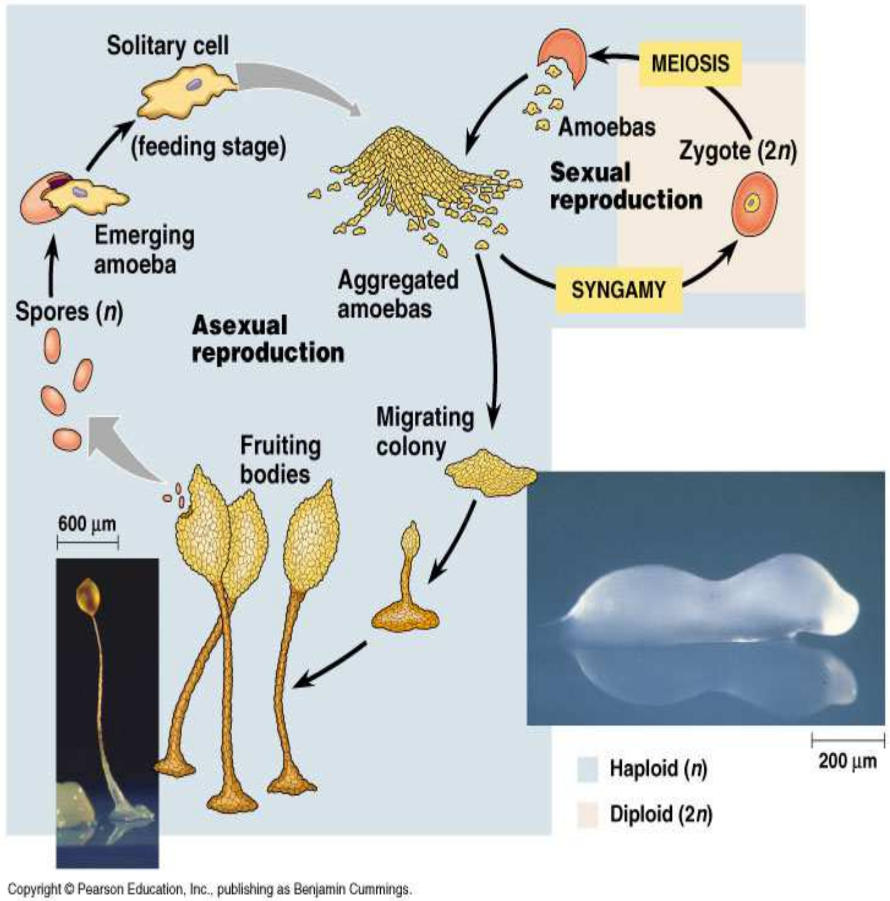
- 1000 species of Euglenoids
- Have both plantlike and animal-like characteristics
- Fresh water

Other Phylum Representatives



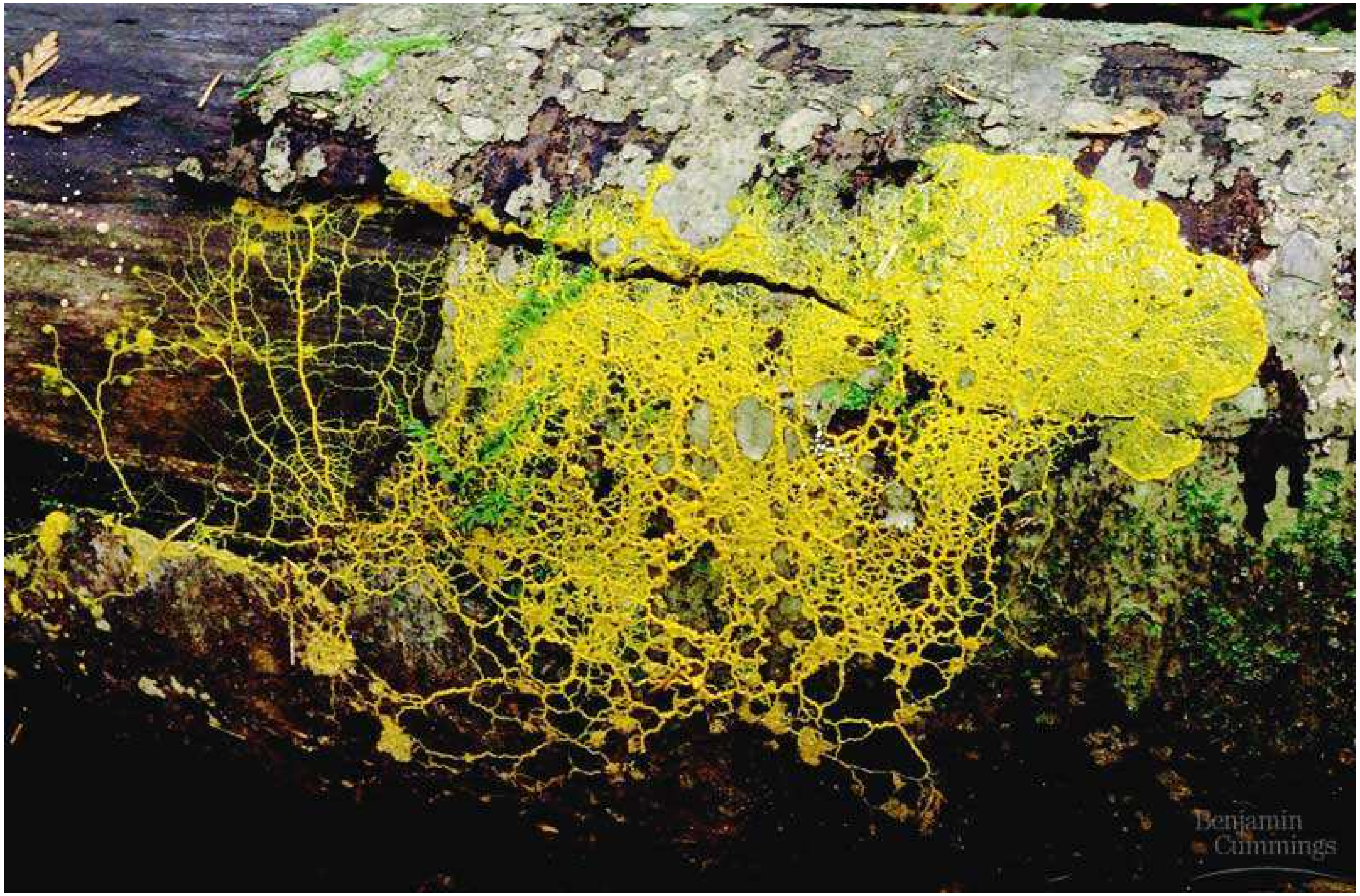
Important in the formation of petroleum products

Funguslike Protist

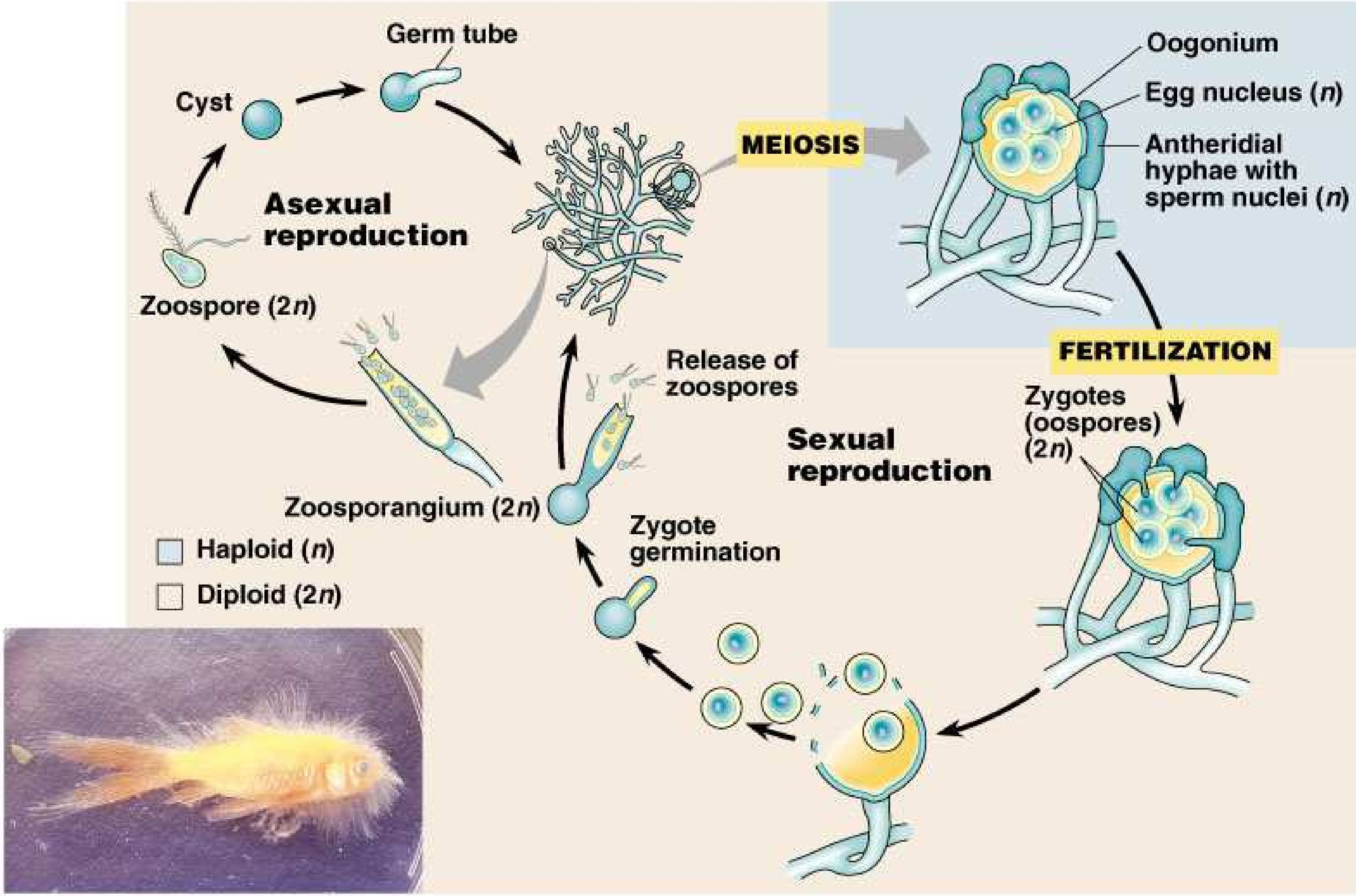


Cellular Slime molds

Plasmodial Slime Molds



Water Molds



Germ tube
Cyst
Asexual reproduction
Zoospore (2n)
MEIOSIS
Oogonium
Egg nucleus (n)
Antheridial hyphae with sperm nuclei (n)
FERTILIZATION
Release of zoospores
Zygotes (oospores) (2n)
Sexual reproduction
Zoosporangium (2n)
Zygote germination
Haploid (n)
Diploid (2n)

Thank You

Welcome

Angiosperms

Prof. Thube T.B.
Department of Botany

Angiosperm

- A plant that produces seeds that are enclosed in fruit
- Greek word that means seed in a vessel

EQ: How do I name the types of angiosperms and list the characteristics they share?

Two characteristics of an angiosperm:

- Flower
- Fruit

Flower Vocabulary

- Petals – colorful structure when flower opens
- Sepals – leaf like structures that enclose a bud

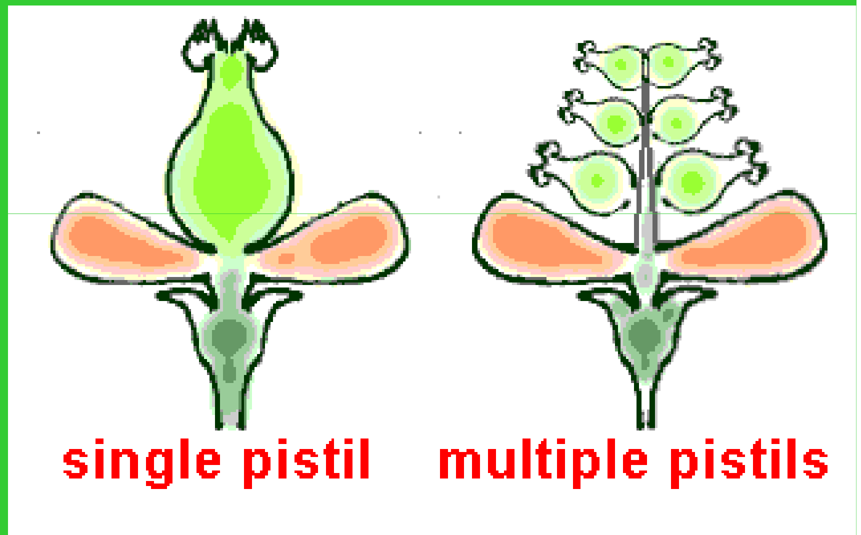
EQ: How do I name the types of angiosperms and list the characteristics they share?

Flower Vocabulary

- Stamens – male reproductive parts
  - Filament – thin stalk
  - Anther – produces pollen – knob at top of filament

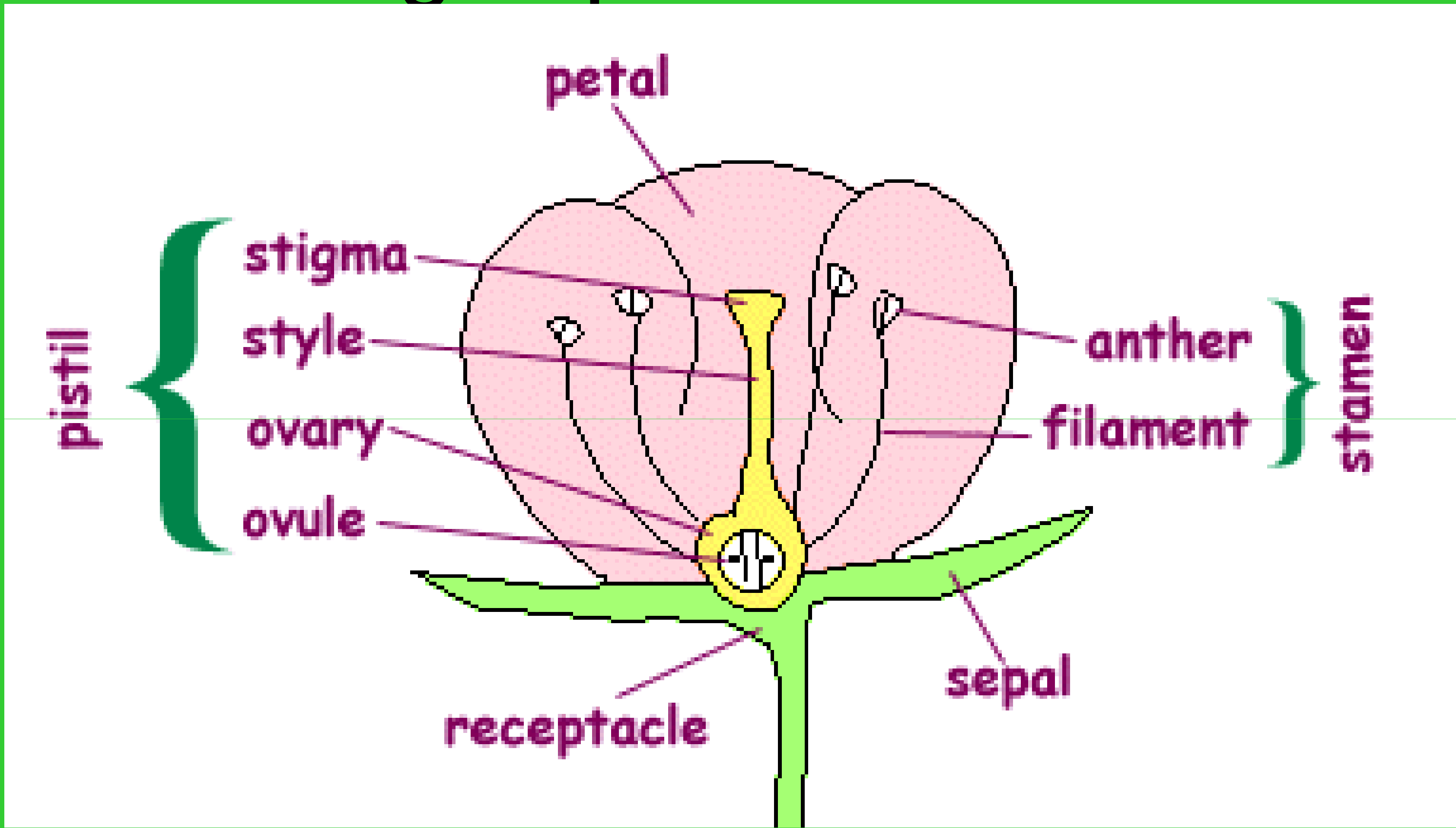
Flower Vocabulary

- Pistils – found in center of flower
  - Stigma – sticky tip of pistil
  - Style – slender tube that connects the stigma to the ovary (hollow base of the flower where ovules are



EQ: How do I name the types of angiosperms and list the characteristics they share?

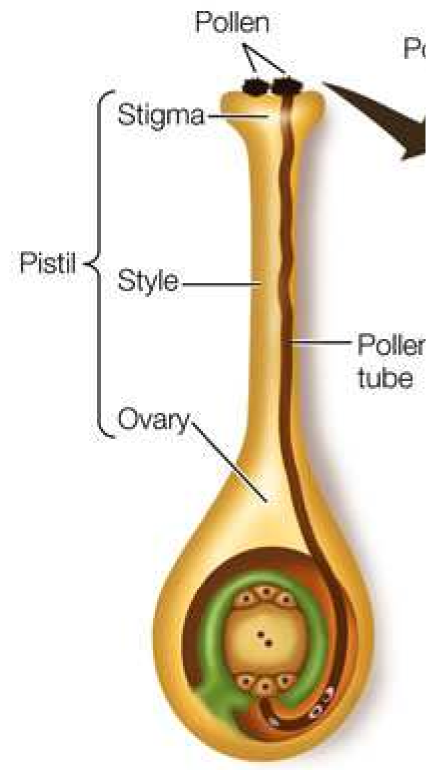
Angiosperm Flower



EQ: How do I name the types of angiosperms and list the characteristics they share?

Reproduction of an Angiosperm

1. Pollen falls on stigma
2. Sperm and egg cell join together in flower's ovule
3. Zygote develops into the embryo part of the seed



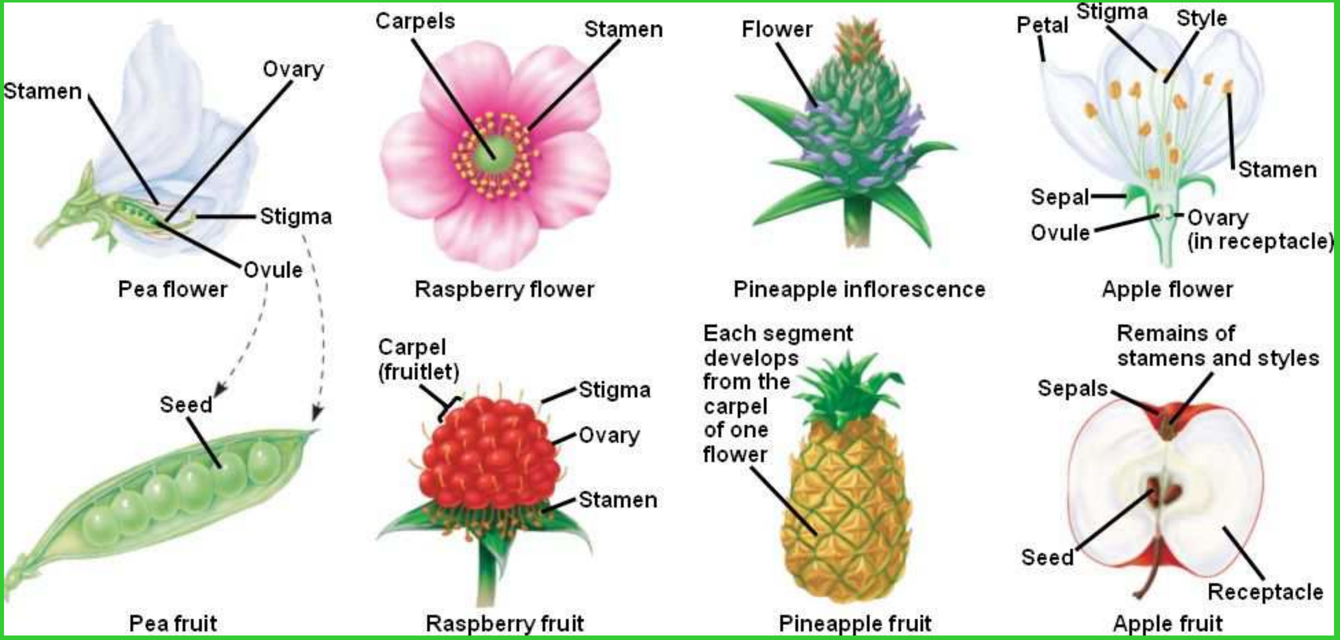
LIFE 8e, **Figure 38.3**

EQ: How do I name the types of angiosperms and list the characteristics they share?

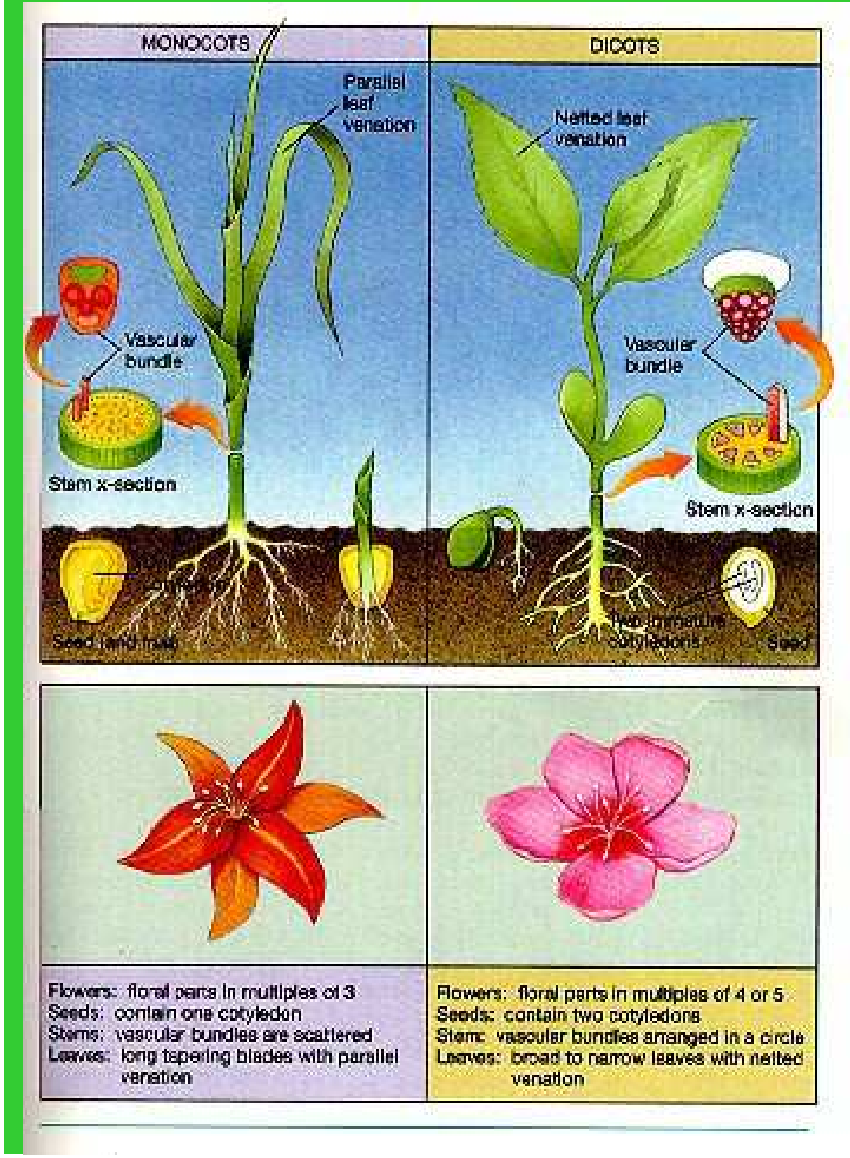
EQ: How do I name the types of angiosperms and list the characteristics they share?

Seed Dispersal

- As seed develops, the ovary changes into a fruit
  - a ripened ovary and other structures that enclose one or more seeds



Types of Angiosperms

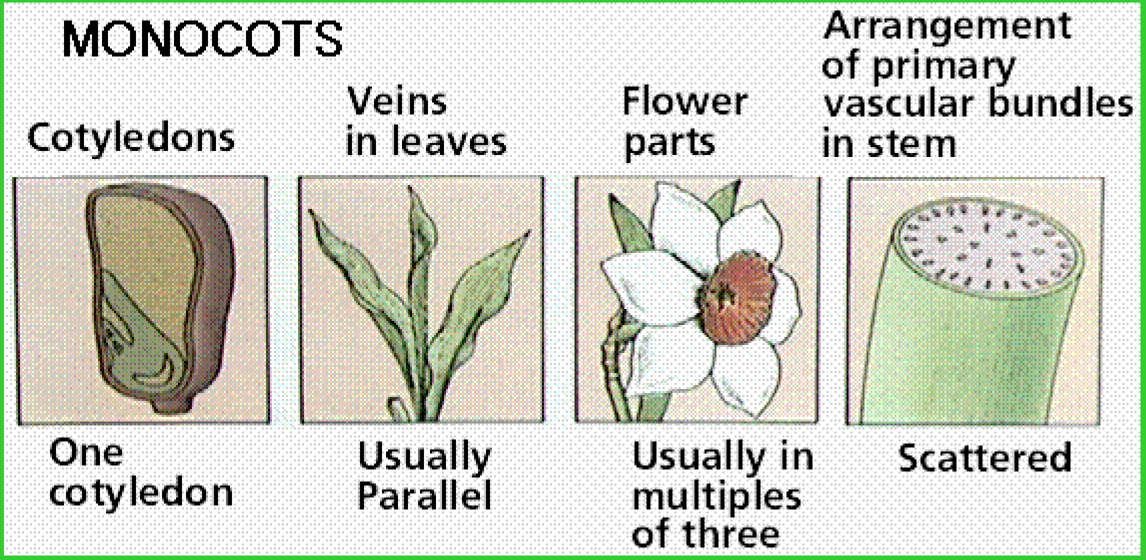


- Divided into 2 major groups
  - Monocots
  - Dicots

EQ: How do I name the types of angiosperms and list the characteristics they share?

Monocot

- Have one seed leaf
- Flowers usually have either three petals or a multiple of three petals
- Long slender leaves with veins that run parallel to each other
- Bundles of vascular tissue is scattered throughout stem

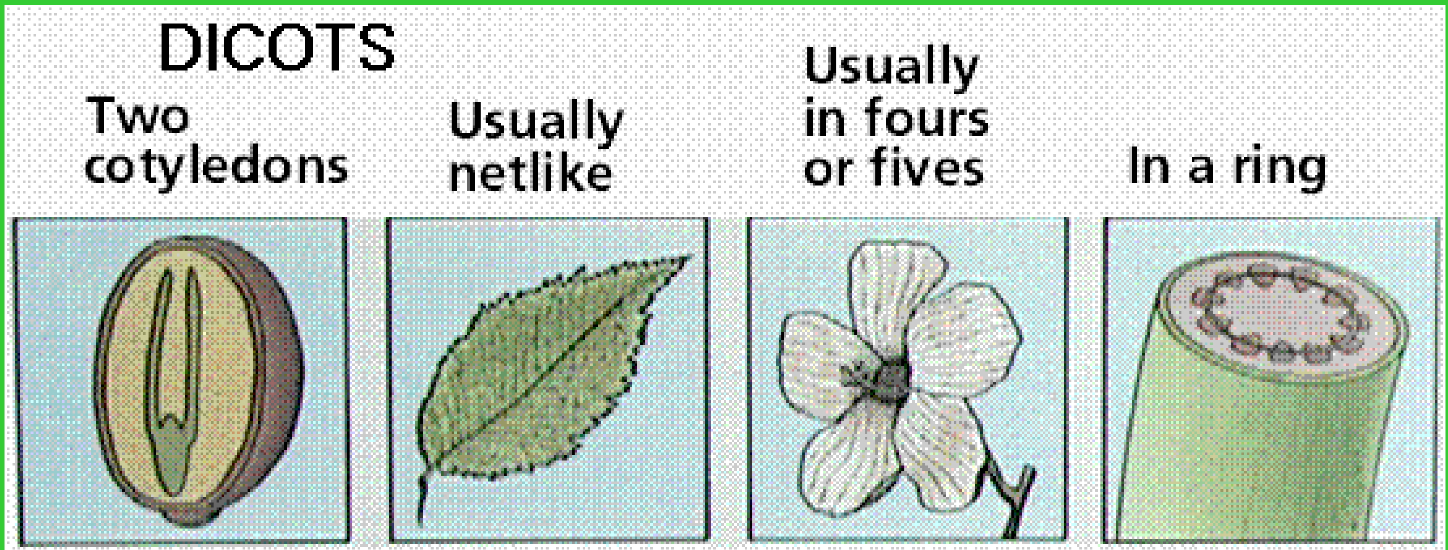


EQ: How do I name the types of angiosperms and list the characteristics they share?

Dicots

- Produce seeds with two leaves
- Flowers have 4 or 5 leaves or multiples of these
- Leaves are wide with veins that branch off from one another
- Bundles of vascular tissue bundled together

EQ: How do I name the types of angiosperms and list the characteristics they share?



Thank You

Bryophytes

Prof. Thube T. B.
Department of Botany

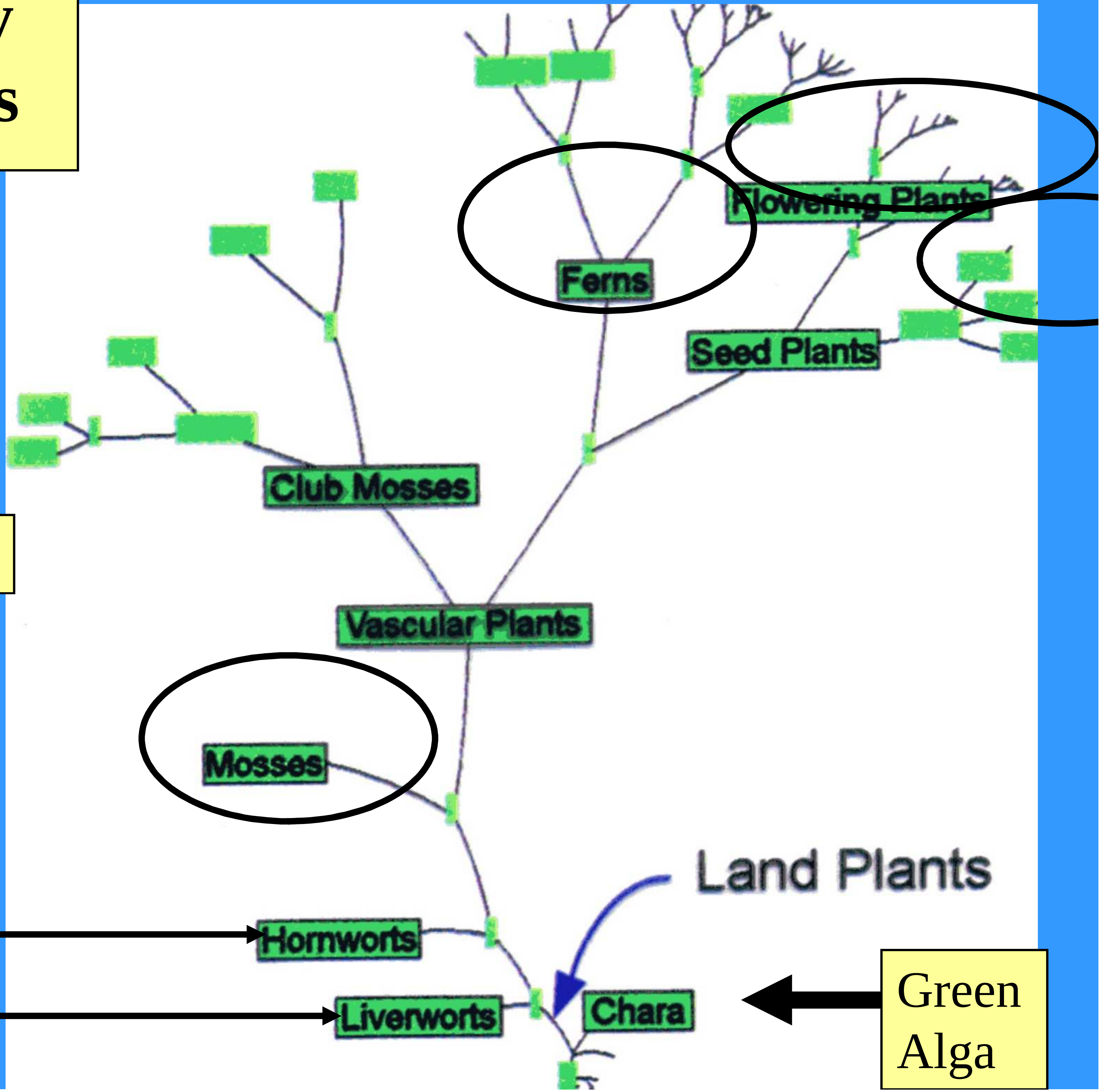
Scope of Bryophytes

**Bryophytes are a polyphyletic group, somewhat artificial.
We will look at only one group, as a representative. Other groups (hornworts, liverworts) are quite different.

**They share in common lacking well developed vascular tissues, but some vascular-less extant organisms have evolved from vascular ancestors.

**The distinguishing characteristic is the presence of only one sporangium on an unbranched sporophyte.

Evolutionary Relationships



Other Bryophytes

Green Alga

Bryophytes vs. Algae

Characteristic	Algae	Bryophytes
habitat	mostly aquatic or marine	mostly terrestrial
food conduction	specialized cells generally absent; a few have sieve-like cells (browns)	mostly conduction through relatively unspecialized cells
water conduction	specialized cells absent	simple cells may be present
anchorage	specialized region generally absent (but recall *Fucus* morphology)	rhizoids for anchorage and nutrient absorption often present
morphology	generally unicellular or filamentous; a few with parenchymatous or coenocytic morphology	generally parenchymatous
life history	alternation of generations in some forms—sporophytes and gametophytes independent	alternation of generations in all forms—sporophyte dependent on gametophyte at least for a period
gametangia	single cells or groups of single cells not accompanied by a jacket of sterile cells	complex reproductive structures

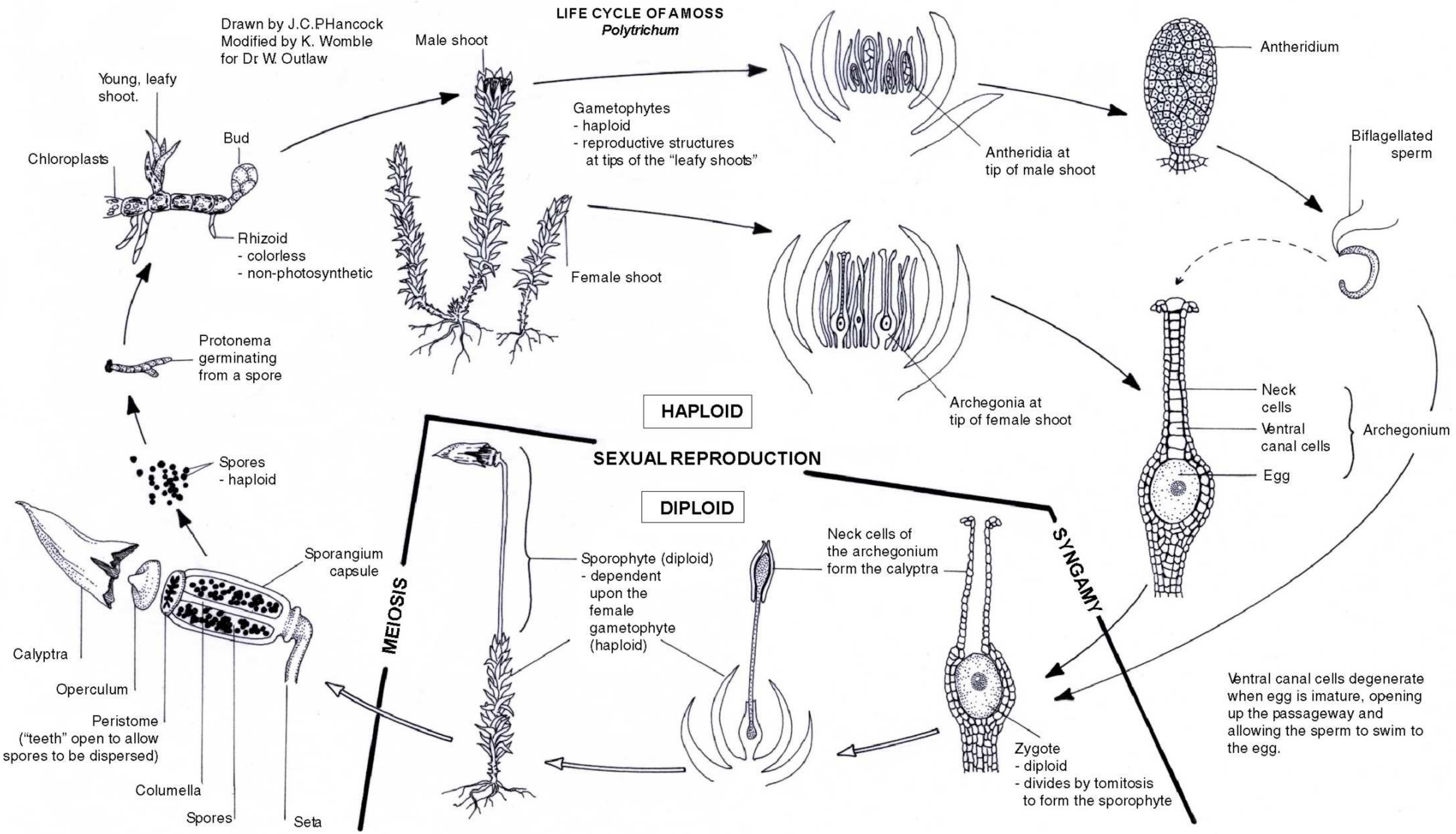
Bryophytes vs. Other Plants

Characteristic	Bryophytes	Other plants
Sporophyte dominance	no	yes
Sporophyte dependence	"yes"	"no"
Vascular tissue	absent, simple	complex
Sporangia/sporophyte	1	many
Lignin (support compound)	"no" ("proto-lignin")	yes
Size	small	may be large
True roots, leaves	no	yes (most groups)
Water, mineral absorption	general	mostly through roots
Protective layers (cuticle)	poorly developed	exquisitely developed
Sporophyte	annual, ephemeral, unbranched	often perennial, many branches
Gametophyte	free-living	free-living ("all" seedless plants) —OR— enclosed in sporophyte (female of all seed plants)

Moss Gametophyte

Moss Sporophyte

Moss Life Cycle



Thank You

Drying Flowers

Dried Flowers

- often sold to customers desiring a permanent arrangement

Methods

- several have been developed
- almost any flower can be preserved
- wide variety of materials available

Dried Flowers

- few florists elect to preserve their own materials
- widely available from commercial sources

Hanging Method

- flowers should be picked for drying just before they reach their prime
- overly mature flowers do not dry well

Hanging Method

- strip off all leaves and tie flowers in small bunches
- suspend flowers upside down in a warm dry place without light

Hanging Method

- darkness preserves the color
- drying time varies according to the type of flower and the conditions of the drying location

Hanging Method

- most flowers dry in one to three weeks
- leave bunches hanging until they are needed for arrangements

Desiccant Drying

- consists of burying flowers in a substance that will extract moisture from the flowers by absorption

Desiccant Drying

- most flowers can be dried without a loss of color or shape when the petals are supported by the drying agent

Desiccant Drying

- support medium should provide even drying throughout the flower and keep petals from curling

Desiccant Drying

- all spaces between petals should be completely filled
- remove stems from the flowers about one half inch below the calyx

Desiccant Drying

- place one to two inches of the drying agent in the bottom of a container
- place the flowers face up on the bed of desiccant

Desiccant Drying

- cover the flowers completely with more of the desiccant

Desiccant Drying

- gently support the petals while working the substance into and between the folds or the flowers

Desiccant Drying

- seal container to prevent the drying agent from absorbing moisture from the air

Desiccant Drying

- cardboard boxes work well
- holes can be punched in the bottom to remove the desiccant without damaging the flowers

Desiccant Drying

- length of drying time varies from two to four weeks
- when flowers have dried completely, gently remove them from the desiccant

Desiccant Drying

- brush remaining agent off of flowers.

Desiccant Drying

- use a small paintbrush
- flowers dries with a desiccant are extremely fragile

Desiccant Drying

- spray flowers with a dried flower preservative to protect and strengthen them

Desiccant Drying

- attach floral wires to the flowers for stems
- original stems may be dried and reattached with hot glue

Desiccant Drying

- if wires are attached, use floral tape to secure the flower to the wire and to give the stem a more natural look.

Sand and Borax

- fine washed beach sand is best
- sand should be sifted before use

Sand and Borax

- damp sand can be oven dried in a shallow pan at 250 degrees for thirty minutes
- mix two parts sand with one part borax

Sand and Borax

- borax can be purchased in the laundry section of any grocery store
- drying time is one to two weeks

Cornmeal & Borax

- white cornmeal and borax mixture is light and works well with delicate flowers
- mix ten parts white cornmeal with three parts borax

Cornmeal & Borax

- sift to mix thoroughly
- borax is used to protect the petals from mold and weevils during drying

Cornmeal & Borax

- this method takes three to seven days

Kitty Litter

- is made of ground clay
- can be used over and over
- sift of screen litter to discard larger pieces

Kitty Litter

- select a brand that has small particles
- coarse particles are not suitable for drying flowers

Silica Gel

- industrial compound that can be purchased for drying
- more expensive than other drying agents

Silica Gel

- can be reused almost indefinitely
- best drying agent for preserving flowers

Silica Gel

- dries quickly and flowers retain more of their natural colors
- may be purchased at a hobby or discount store that carries crafts

Silica Gel

- Tell-Tale, the most common brand name for drying flowers
- has blue crystals

Silica Gel

- the blue color is an indicator
- when flowers are dry the color changes to pink

Silica Gel

- after drying, sift silica gel to remove flower debris
- dry in an oven at 250 degrees for 30 minutes

Silica Gel

- the Tell-Tale crystals will return to their blue color when dry

Microwave drying

- quick method
- superior quality
- colors are brighter

Microwave

- flowers are not as dry and perishable as conventionally dried flowers
- trim stems half to 3/4 inch in length

Microwave

- spread silica gel one to two inches deep in small glass or paper bowl
- prepare one container for each flower

Microwave

- arrange one flower blossom face up in each bowl of silica gel

Microwave

- sprinkle additional silica gel between petals until the flowers are completely covered
- use a toothpick or small brush to separate petals

Microwave

- place one or two flowers in the microwave oven at a time
- place a cup of water in the corner of the microwave to provide moisture

Microwave

- this will prevent the flower from completely drying up
- microwave for one to four minutes according to the drying guide in the text

Microwave

- after drying, leave flowers in the silica gel for 1 to 24 hours
- remove flowers carefully from the bowl

Microwave

- shake gently to remove silica gel
- use a small paintbrush to remove any remaining gel

Microwave

- spray with preservative spray and attach a 16 or 18 gauge wire to the stem with floral tape

Glycerin

- colorless liquid made from fats and oils which can be used to preserve foliage

Glycerin

- preserves foliage in a pliable, more natural state
- frequently used for eucalyptus, magnolia dna maple leaves

Glycerin

- also used for drying baby's breath
- can be purchased at any drug store
- mix one part glycerin with two parts water

Glycerin

- pour mixture into a container at the depth of 4 to 5 inches
- stems of fresh foliage should be given a fresh slanting cut at the base

Glycerin

- place stems of foliages in the glycerin solution for four days to two weeks
- replenish solution as needed during preservation process

Glycerin

- foliage will darken to an olive or bronze color as the leaves absorb the solution

Glycerin

- to prevent darkening of leaves, add absorption dye to the solution
- dye will be absorbed into the stem and deposited in the foliage

Glycerin

- when the process is complete, hang foliages upside down to dry
- individual leaves are best preserved by submerging them in the solution

Glycerin

- place weights on the leaves to keep them below the surface
- ivy leaves and stems may be preserved by this method

Glycerin

- leave ivy submerged for four days
- rinse glycerin off with cool water when foliage is removed from the solution

Bleaching &Drying

- items to be bleached must first be dried
- place dried plant material in a solution of one cup bleach and two gallons water

Bleaching &Drying

- use plastic, glass or enamel containers
- do not use metal

Bleaching &Drying

- weight materials down so that it will be submerged at all times
- leave material in solution for 5-6 days, longer if necessary

Bleaching &Drying

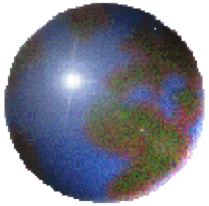
- remove after bleaching has occurred and rinse thoroughly
- leave material in a water bath for a day or two

Bleaching &Drying

- hang outside to dry and whiten
- to dye bleached materials, dip for 5 minutes ina boiling Rit solution

Bleaching &Drying

- mix dye according to package directions



Ecosystem

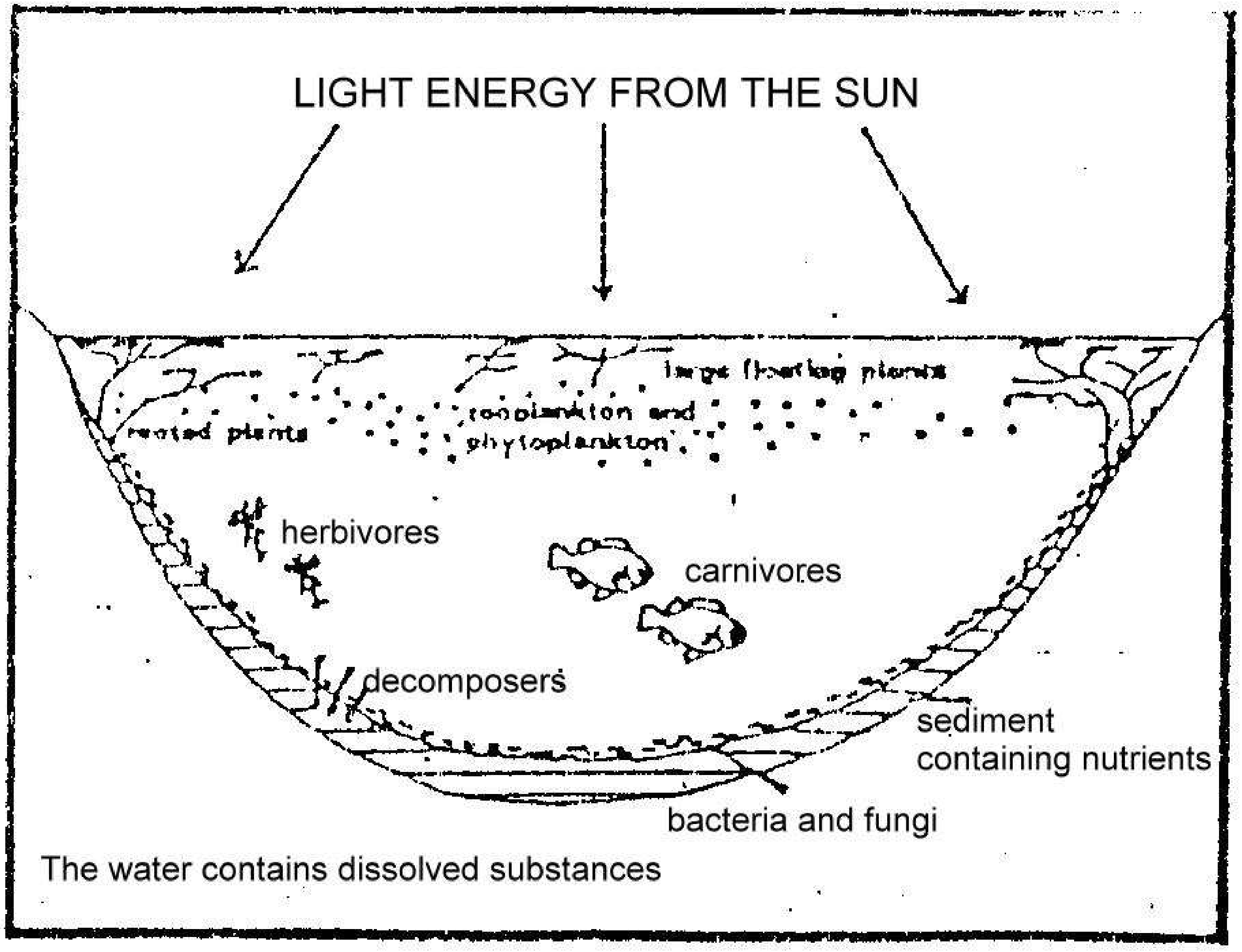
Prof. Thube A. A.
Department of Botany

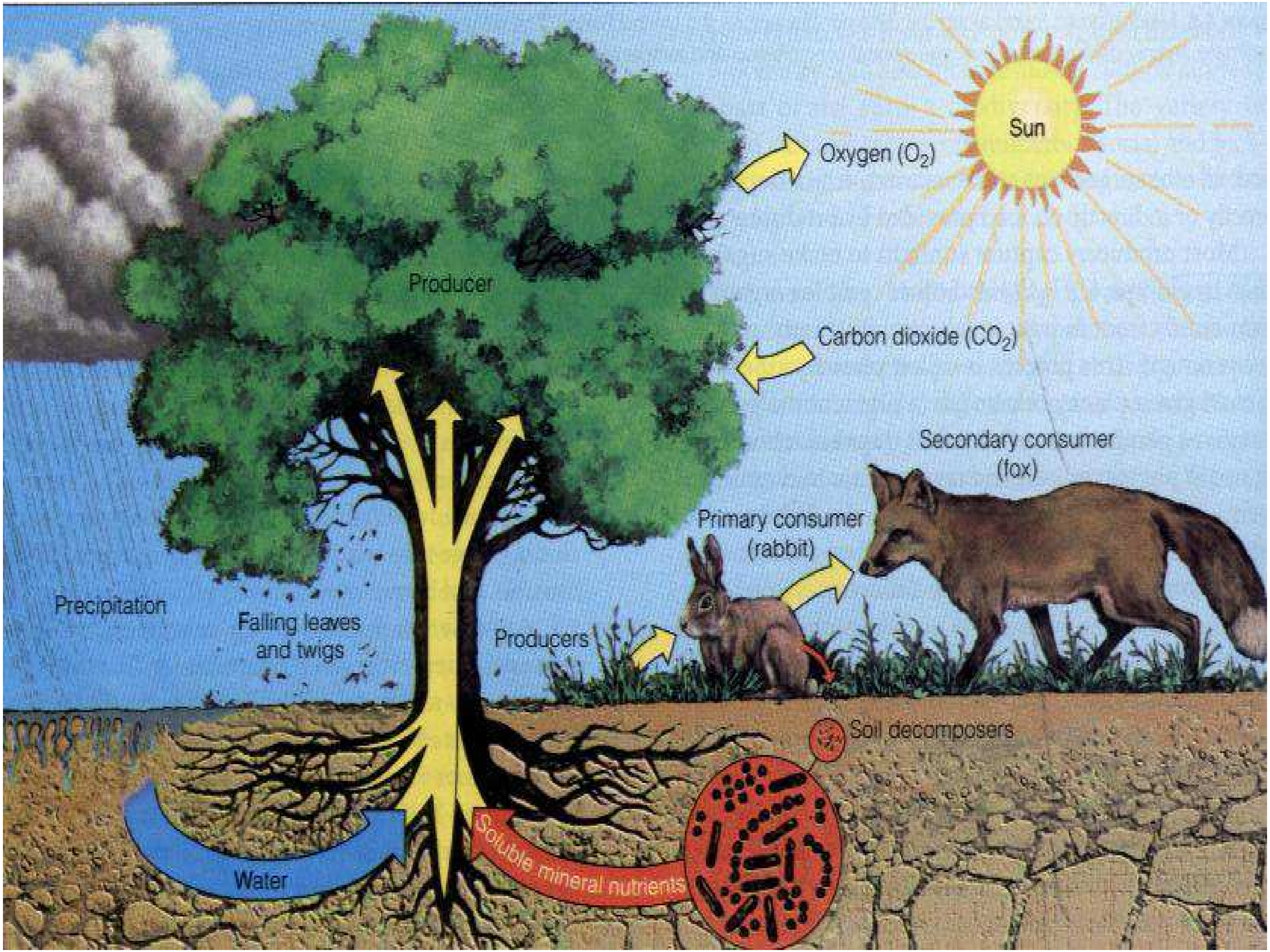
Contents

- What is an ecosystem
- Three major principles of ecosystem
- Components of an ecosystem
  - Abiotic components
  - Biotic components
- Movement of energy and nutrients
  - Food chain
  - Food webs
  - Trophic levels, biomass and biome
- Linkages and interactions in an ecosystem
  - Carbon cycle and oxygen cycle
  - Model of nutrient cycle
- Environmental Limitation in ecosystem development.

What is an ecosystem

- An ecosystem is a grouping of organisms that interact with each other and their environment in such a way as to preserve the grouping.
- There is a great variety of ecosystems in existence, all of them are characterized by general structural and functional attributes.

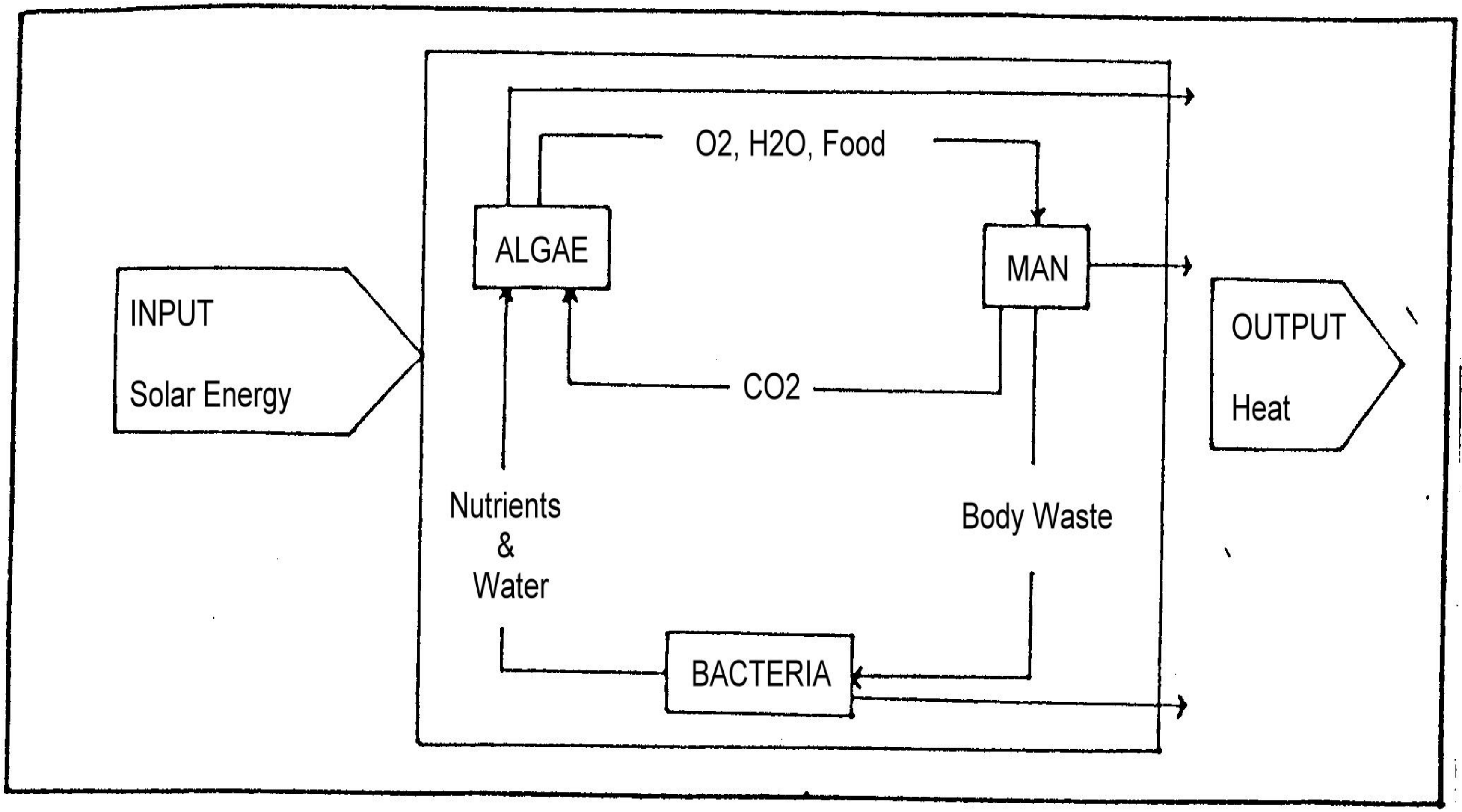

LIGHT ENERGY FROM THE SUN
large floating plants
zooplankton and
phytoplankton
rooted plants
herbivores
carnivores
decomposers
sediment
containing nutrients
bacteria and fungi
The water contains dissolved substances


Sun
Oxygen (O_2)
Producer
Carbon dioxide (CO_2)
Secondary consumer
(fox)
Primary consumer
(rabbit)
Precipitation
Falling leaves
and twigs
Producers
Soil decomposers
Water
Soluble mineral nutrients

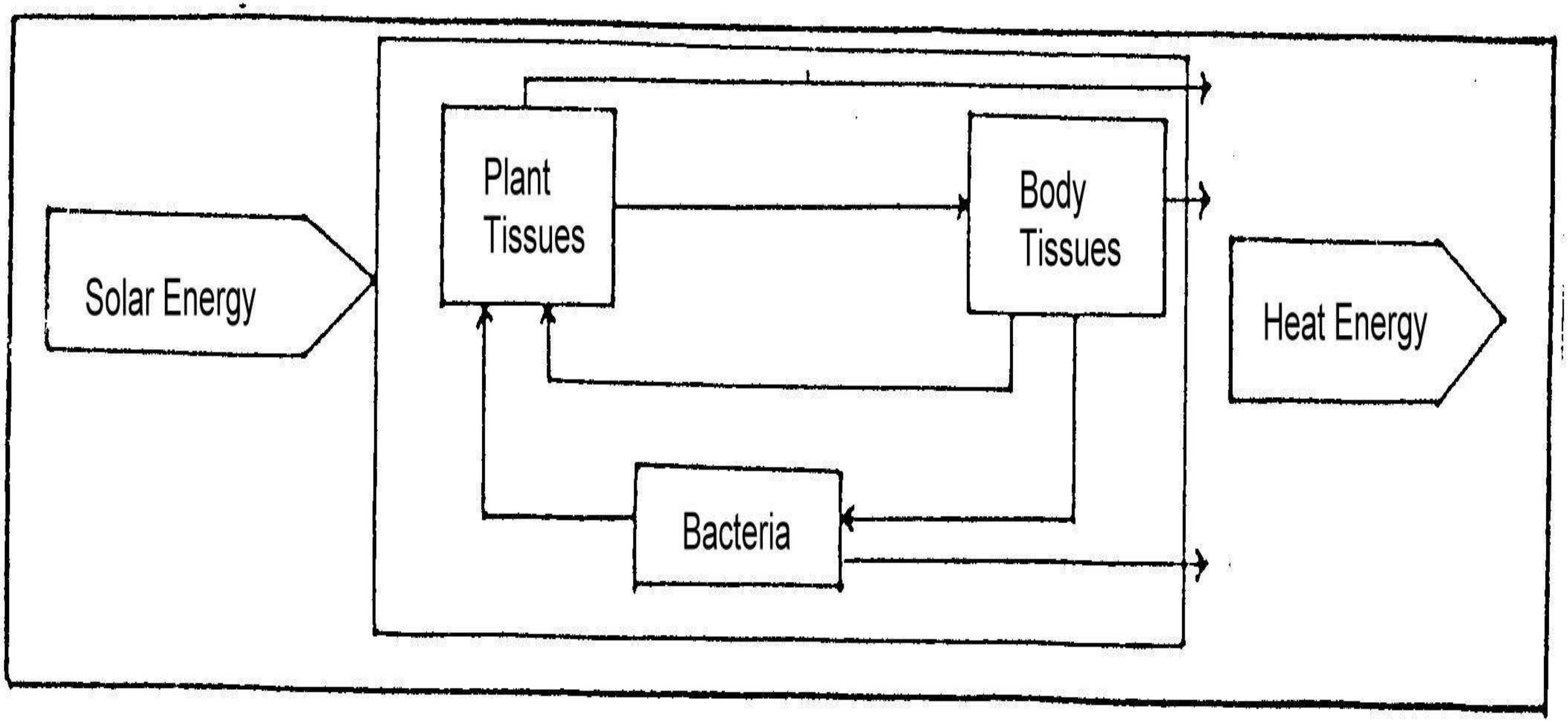
Three major principles of ecosystem

- Nutrient cycling:
  - Movement of chemical elements from the environment into living organisms and from them back into the environment through organisms live, grow, die and decompose.
- Energy flow:
  - Energy is required to transform inorganic nutrients into organic tissues of an organism.
  - Energy is the driving force to the work of ecosystem.
- Structure
  - It refers to the particular pattern of inter-relationships that exists between organisms in an ecosystem.

Nutrient cycling

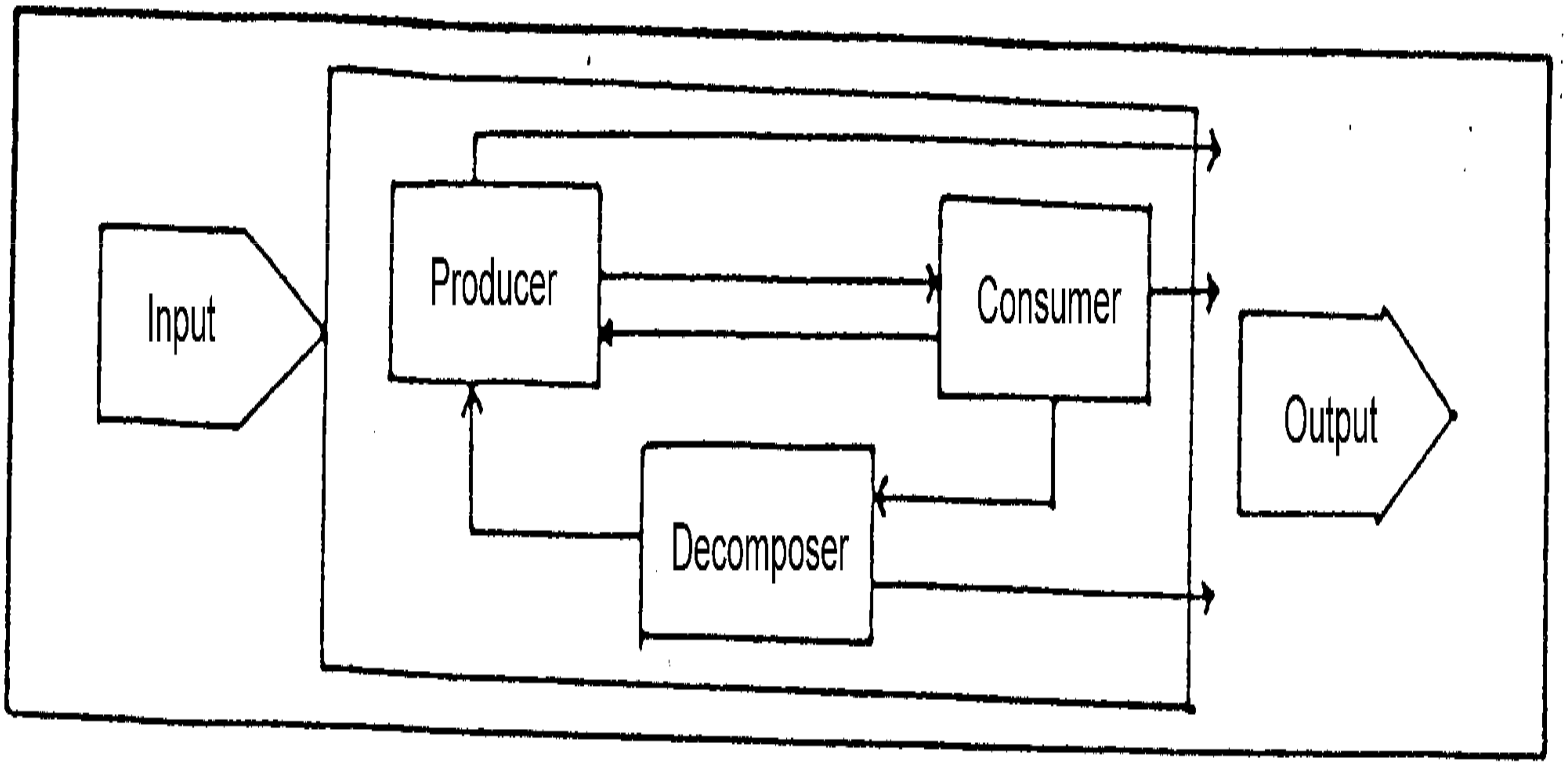


Energy flow



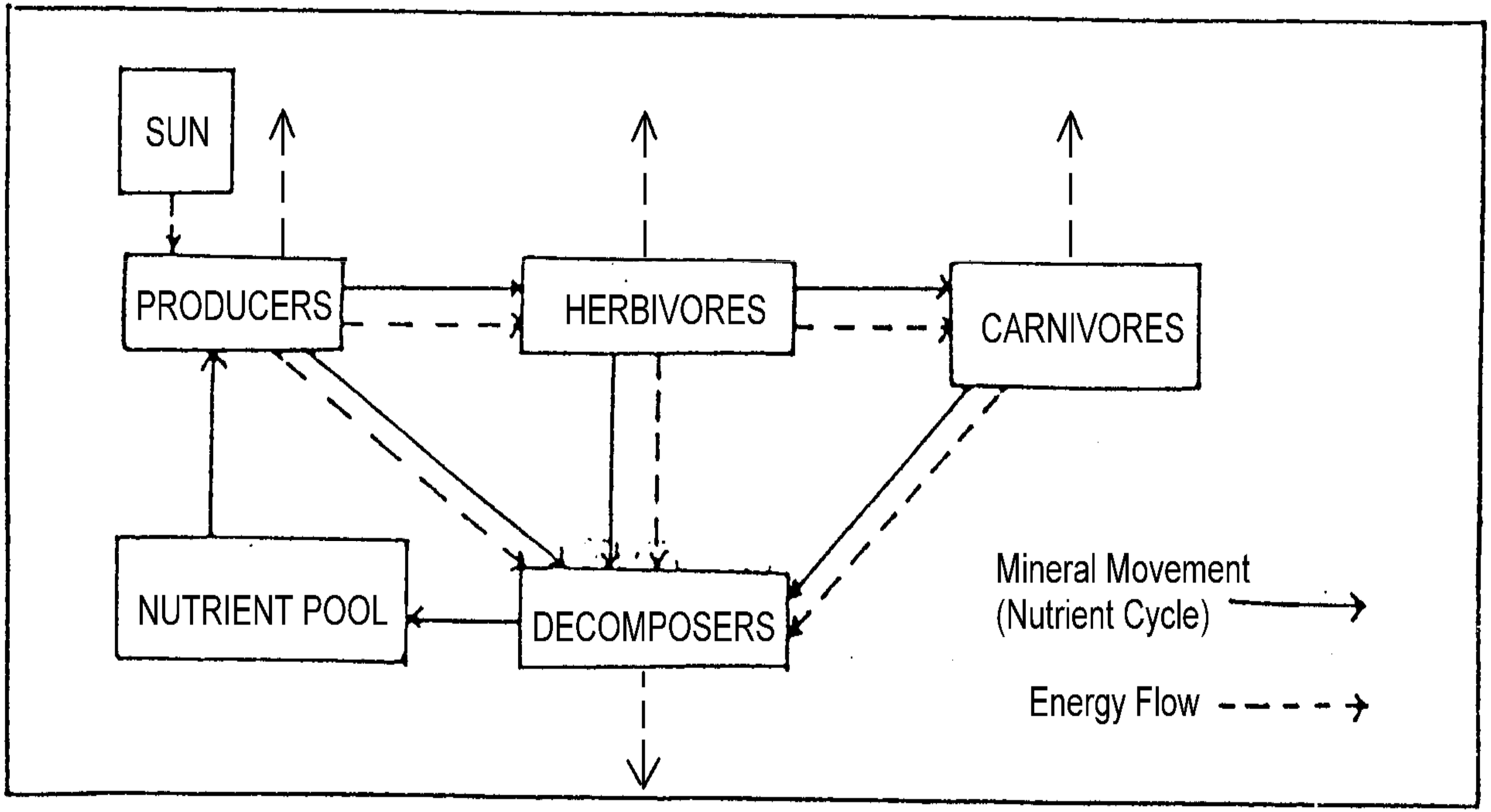
Solar Energy
Plant
Tissues
Body
Tissues
Heat Energy
Bacteria

Structure

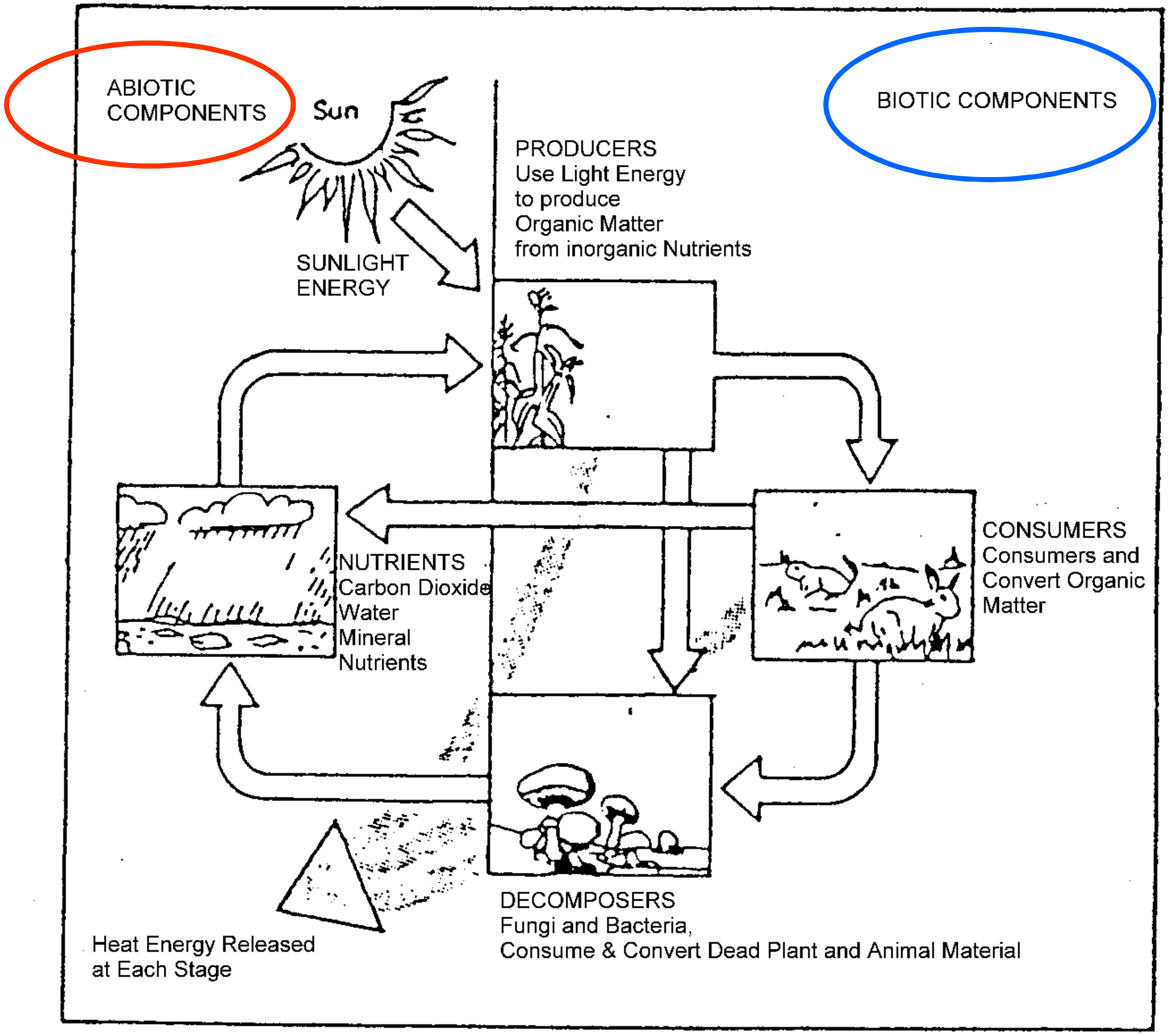


Ecosystem:

Nutrient cycling, energy flow and structure



Components of an ecosystem



Abiotic components

- They form the environment and determine the type / structure of ecosystem.
  - Sunlight (temperature)
  - Nutrients
    - Rainfall, minerals, carbon, nitrogen,…..
- Type of ecosystems:
  - Tropical rainforest, Desert, Tundra, Grassland,…..

Distribution of vegetation / ecosystem

			TEMPERATURE
COOL DESERT	G	SPRUCE-FIR FOREST	COOL
	R		
	A		---
	S		
TEMPERATE DESERT	S	DECIDUOUS FOREST	TEMPERATE
	L		
	A		---
	N		
HOT DESERT	D	TROPICAL FOREST	HOT

<---------- <250 mm >750 mm ------------>

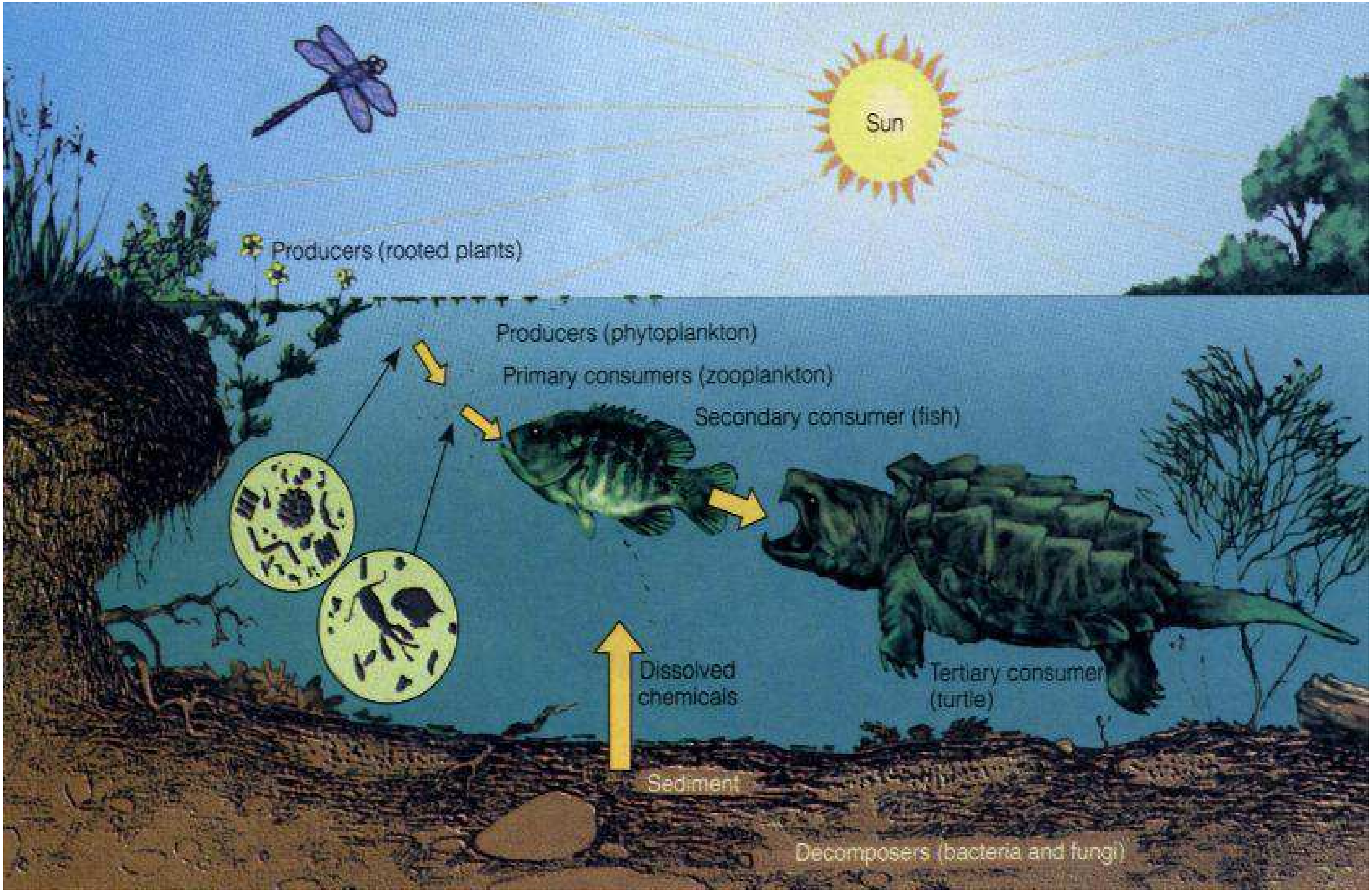
RAINFALL

Biotic components

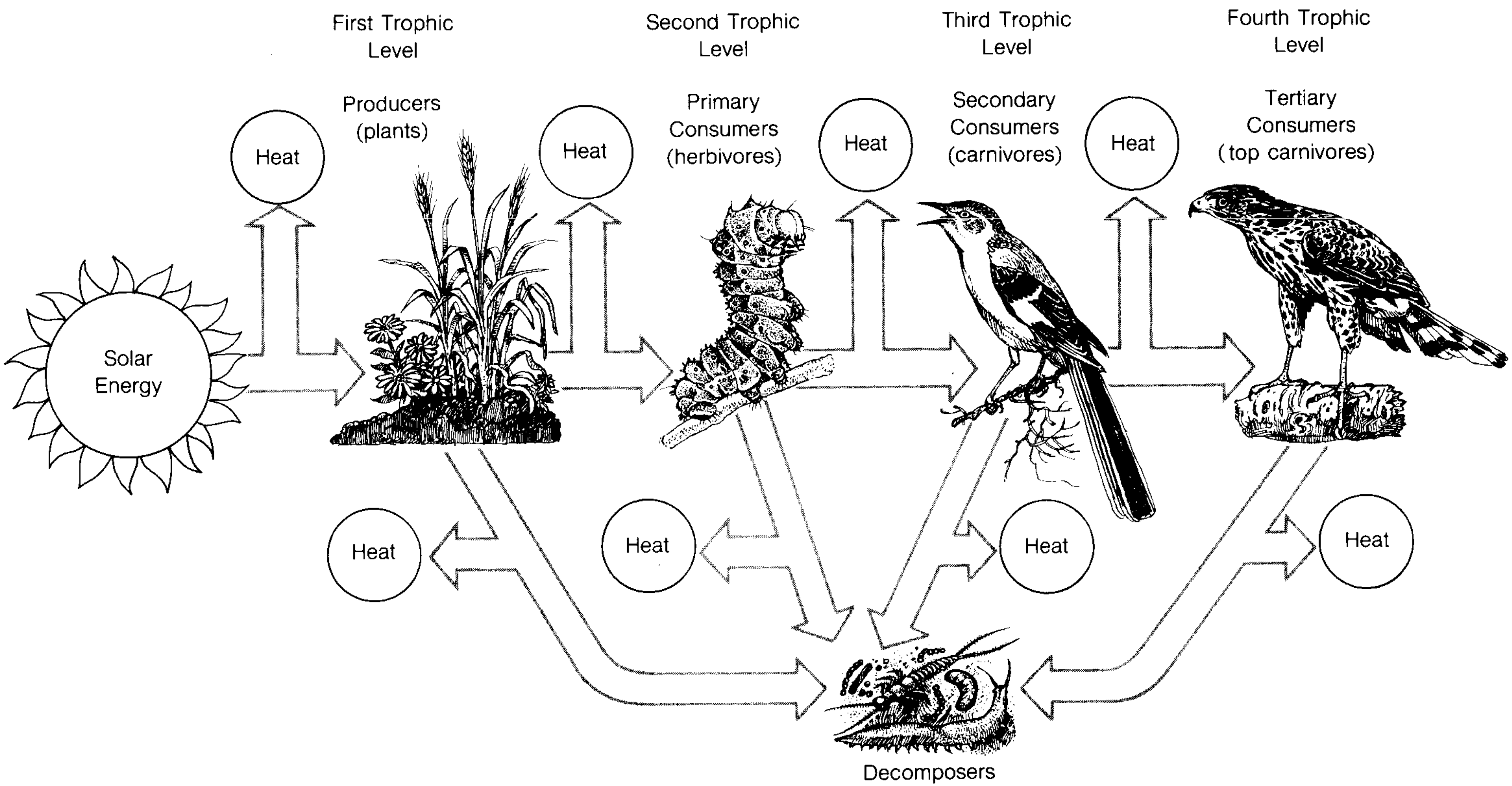
- Producers (Autotrophs):
  - All green plants. They use solar energy, chlorophyll, inorganic nutrients and water to produce their own food. (Photosynthesis)
- Consumers:
  - They consume the organic compounds in plant and animal tissues by eating.
    - Herbivores (plant feeders) Primary consumers
    - Carnivores (meat eaters) Secondary consumers
    - Omnivores (general feeders)

Biotic components

- Decomposers
  - They are tiny organisms includes bacteria and fungi, which turn organic compounds in dead plants and animals into inorganic materials.
  - They cause the continual recirculation of chemicals within ecosystem (nutrient cycle)


Sun
Producers (rooted plants)
Producers (phytoplankton)
Primary consumers (zooplankton)
Secondary consumer (fish)
Tertiary consumer
(turtle)
Dissolved
chemicals
Sediment
Decomposers (bacteria and fungi)

Biotic components and food chain

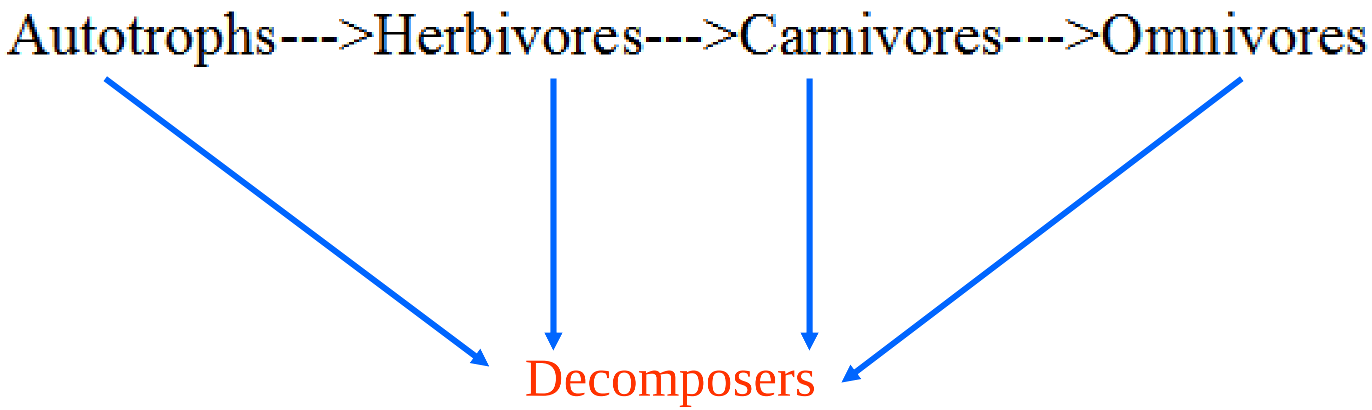


Movement of energy and nutrients

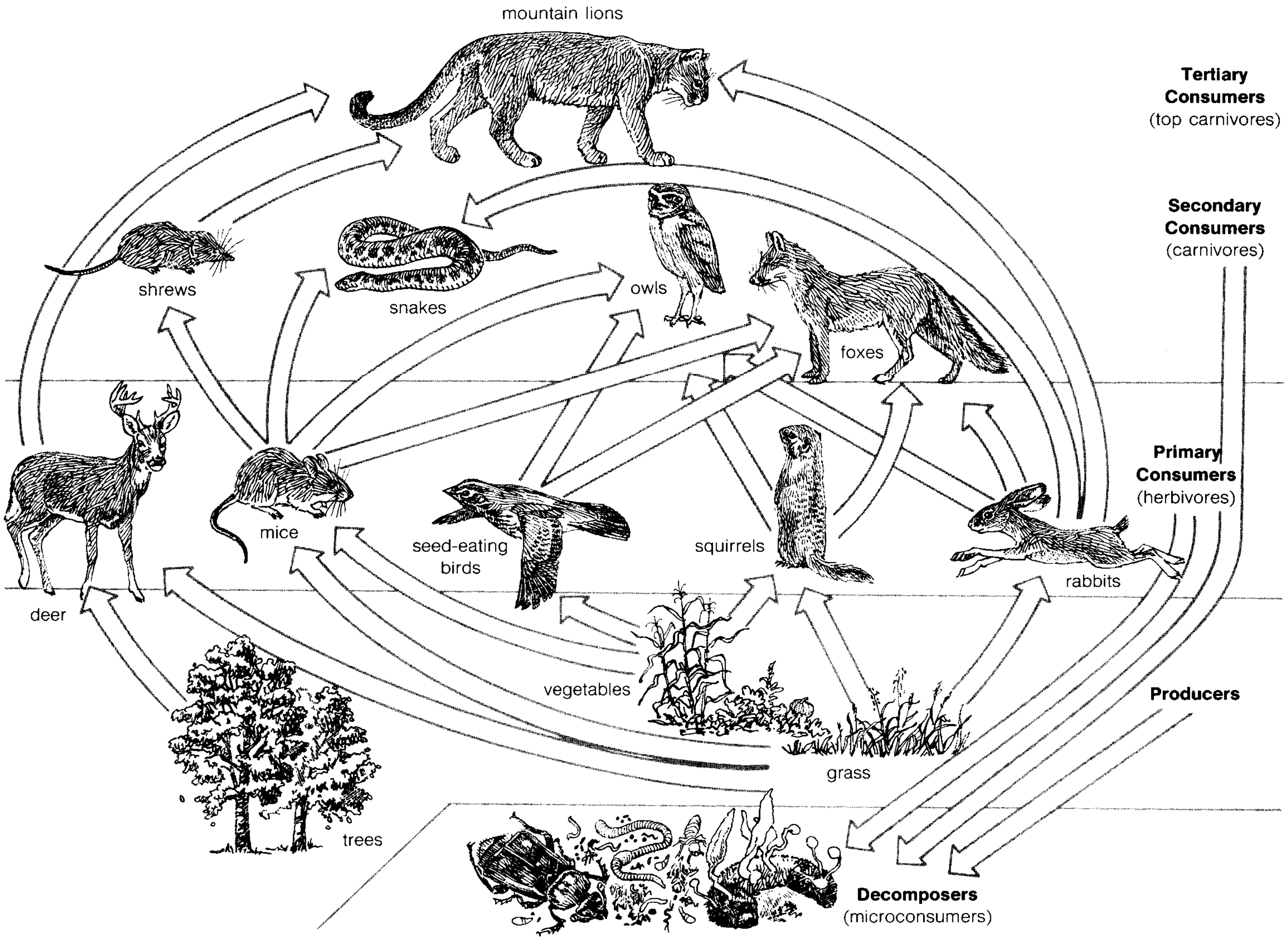
- Food chain
- Food webs
- Trophic levsel, biomass and biome

Food Chain

- The particular pathway of nutrient and energy movement depends on which organism feeds on anther.



Food Webs


mountain lions
Tertiary
Consumers
(top carnivores)
Secondary
Consumers
(carnivores)
shrews
snakes
owls
foxes
Primary
Consumers
(herbivores)
deer
mice
seed-eating
birds
squirrels
rabbits
vegetables
Producers
grass
trees
Decomposers
(microconsumers)

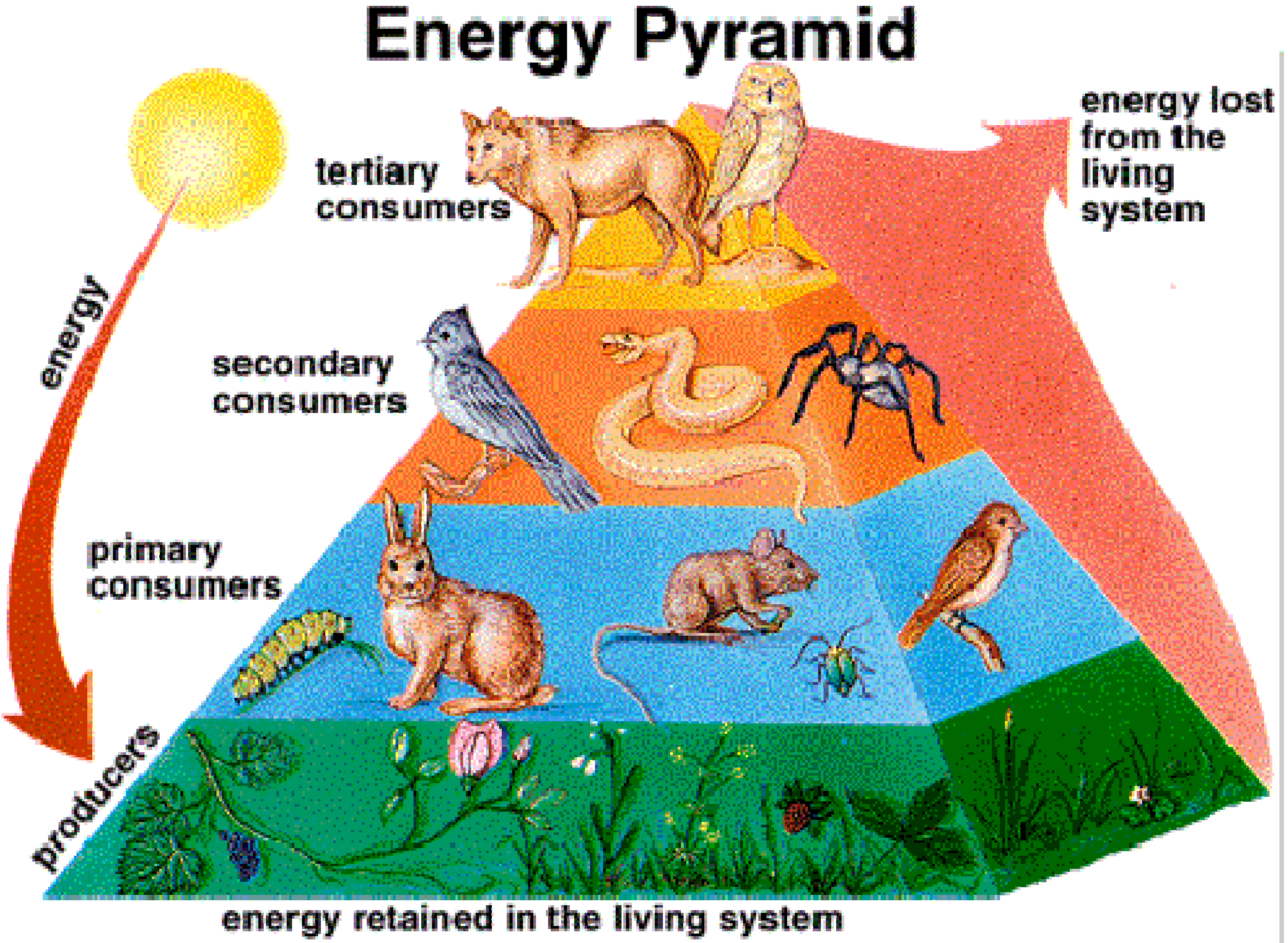
Trophic Levels

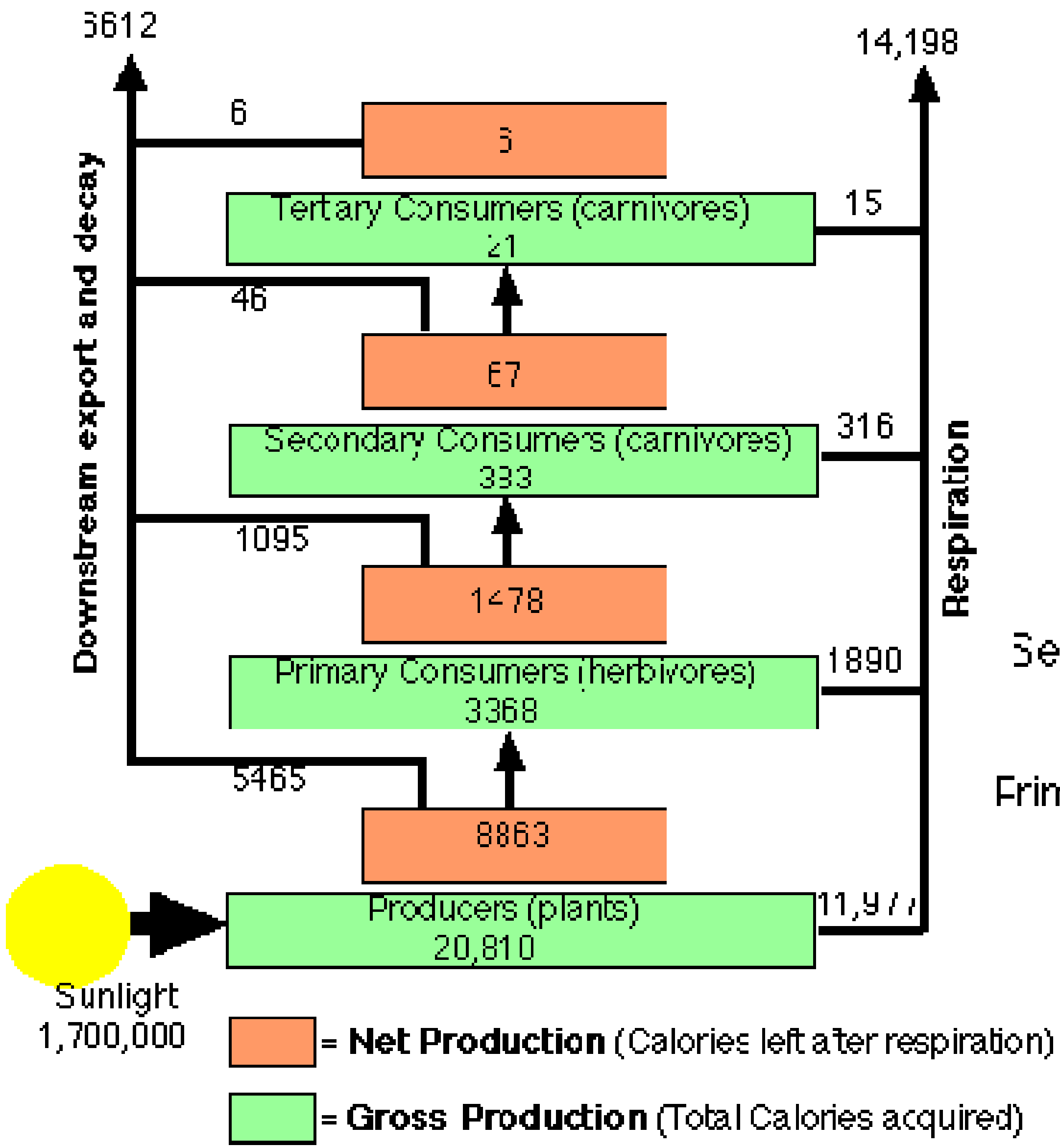
- A trophic level means a feeding level.
  - First level – all producers
  - Second level – all herbivores
  - Third level – first level carnivores
  - Fourth level – second level carnivores
  - So on……..

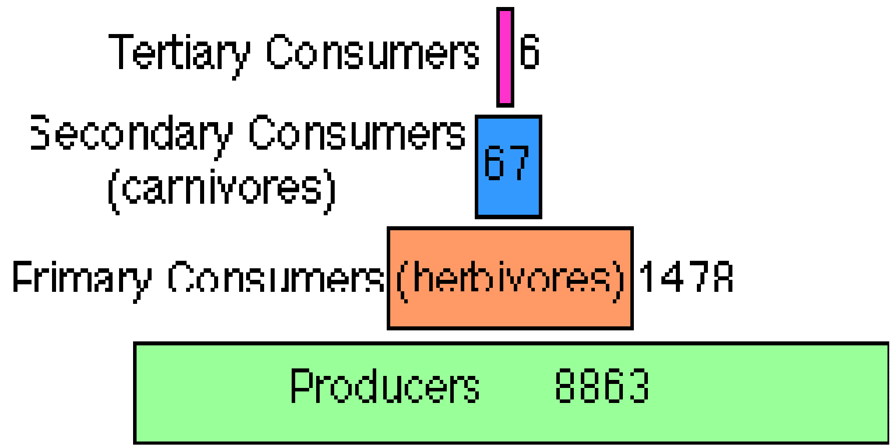
Trophic levels

- Energy and Nutrients passed through the ecosystem by food chains and webs from lower trophic level to the higher trophic level.
- However, only 5% to 20% energy and nutrients are transferred into higher trophic level successfully.
- For this reason, first trophic level has the largest number of organisms, and second trophic level is less than first one; the third level is less than second level, and so on.

Trophic levels



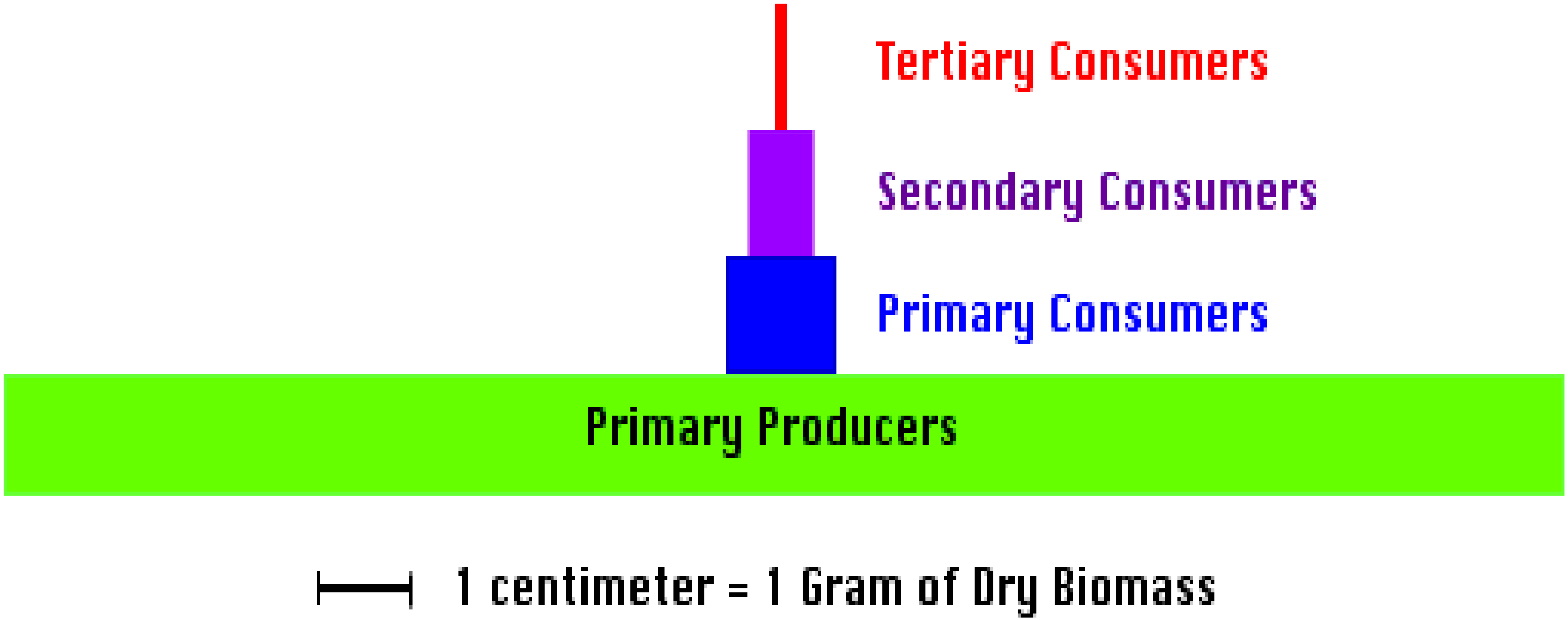

3612
14,198
Downstream export and decay
Respiration
6
6
Tertiary Consumers (carnivores)
21
15
46
67
Secondary Consumers (carnivores)
333
316
1095
1478
Primary Consumers (herbivores)
3368
1890
5465
8863
Producers (plants)
20,810
11,977
Sunlight
1,700,000
= **Net Production** (Calories left after respiration)
= **Gross Production** (Total Calories acquired)


Tertiary Consumers 6
Secondary Consumers (carnivores) 67
Primary Consumers (herbivores) 1478
Producers 8863

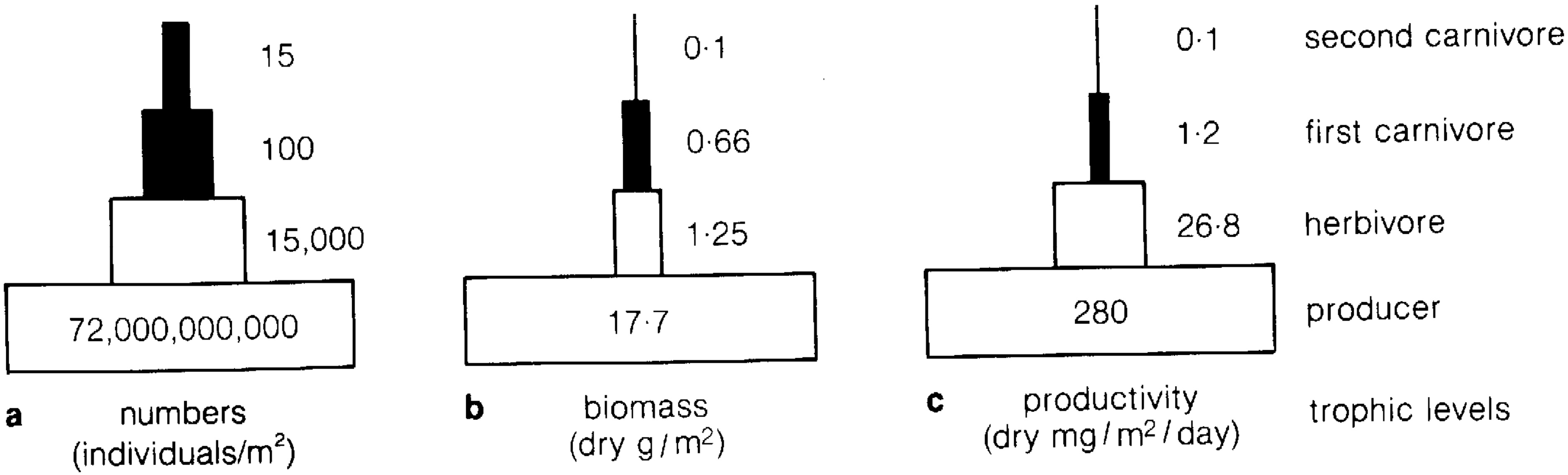
Biomass

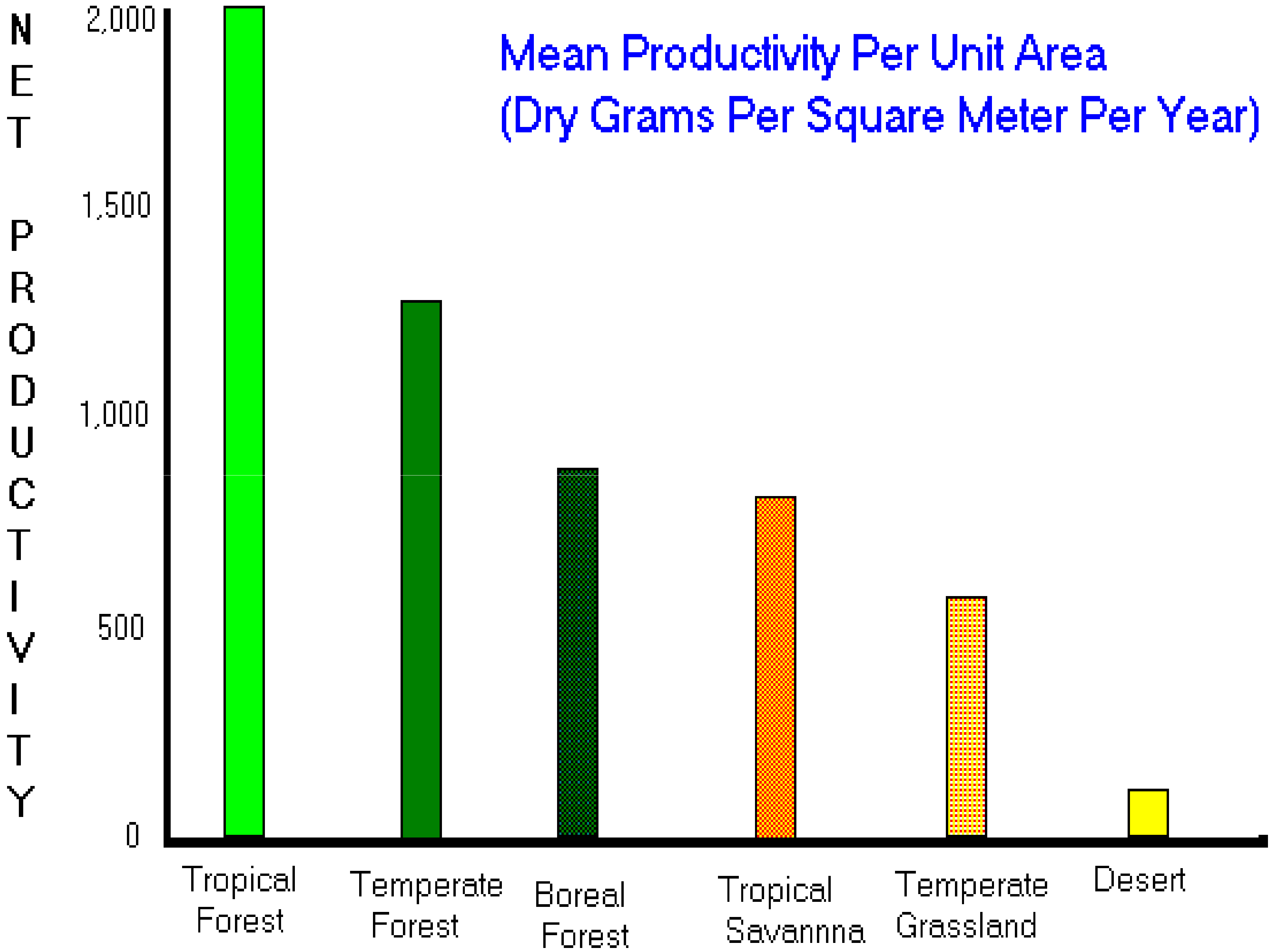
- Biomass means the total combined weight of any specified group of organisms.
- The biomass of the first trophic level is the total weight of all the producers in a given area.
- Biomass decreases at higher trophic levels.

Biomass


Tertiary Consumers
Secondary Consumers
Primary Consumers
Primary Producers
1 centimeter = 1 Gram of Dry Biomass

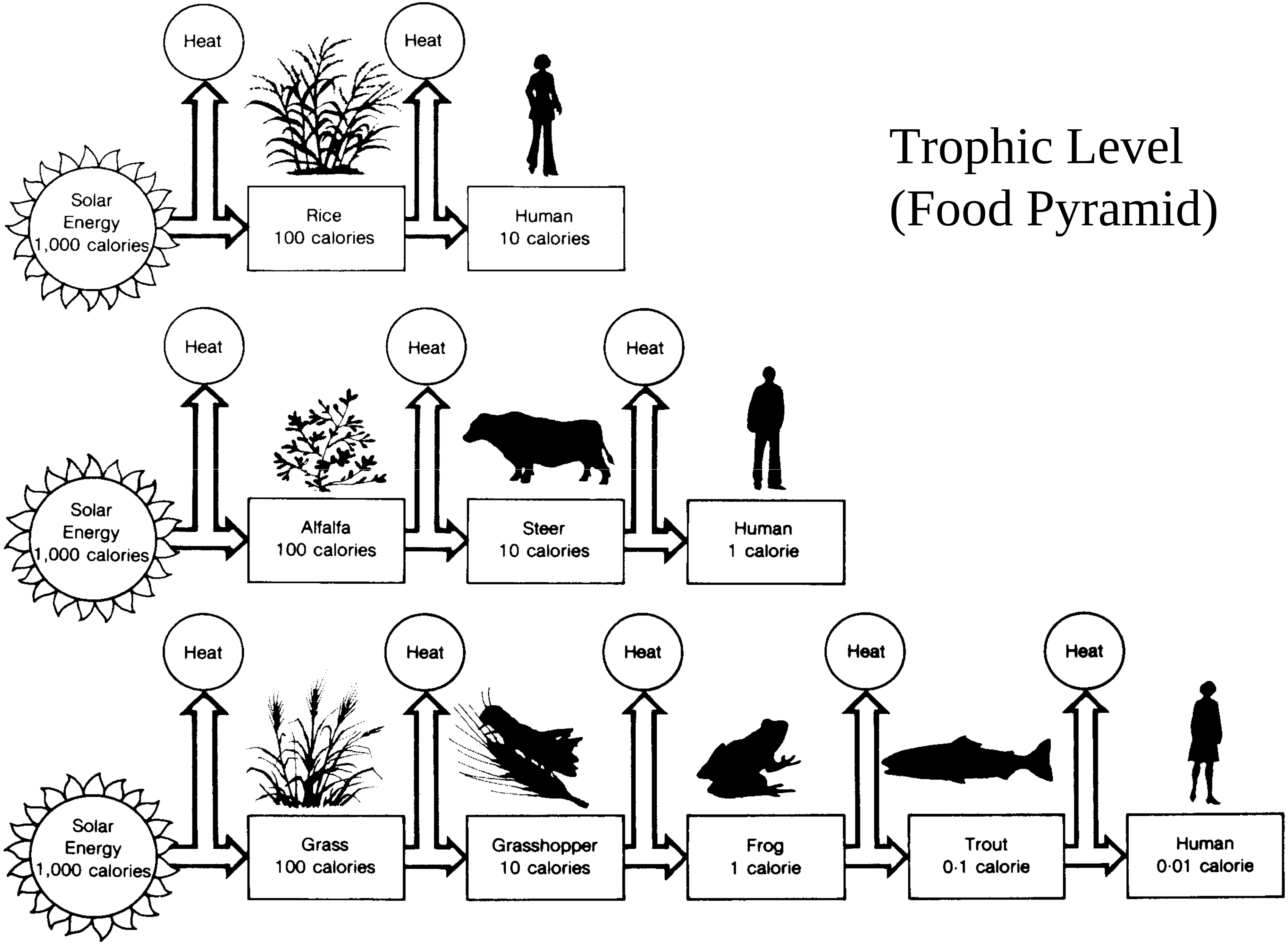
Biomass and productivity





Mean Productivity Per Unit Area
(Dry Grams Per Square Meter Per Year)
NET PRODUCTIVITY
2,000
1,500
1,000
500
0
Tropical Forest
Temperate Forest
Boreal Forest
Tropical Savannna
Temperate Grassland
Desert

Trophic Level (Food Pyramid)



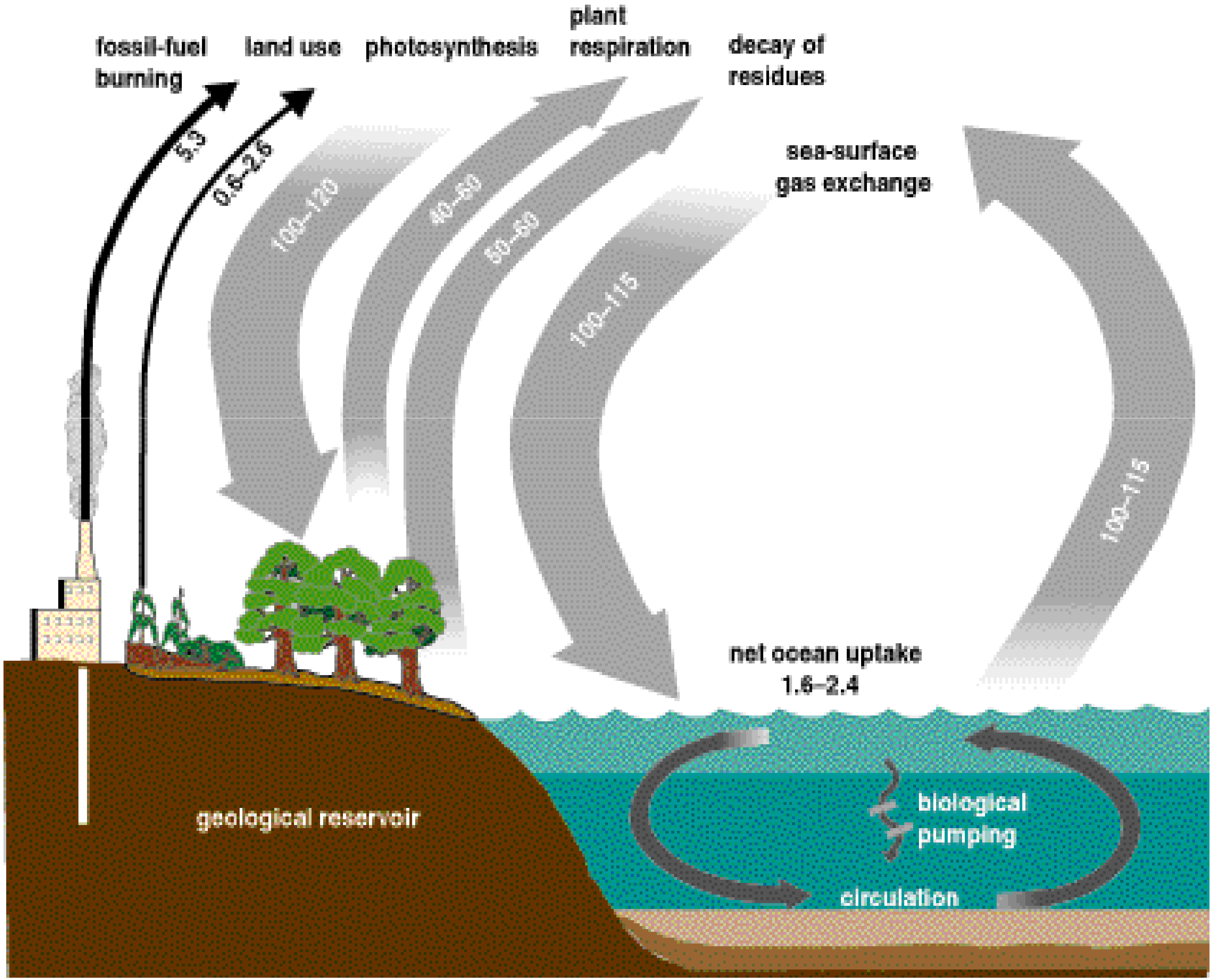
Biome

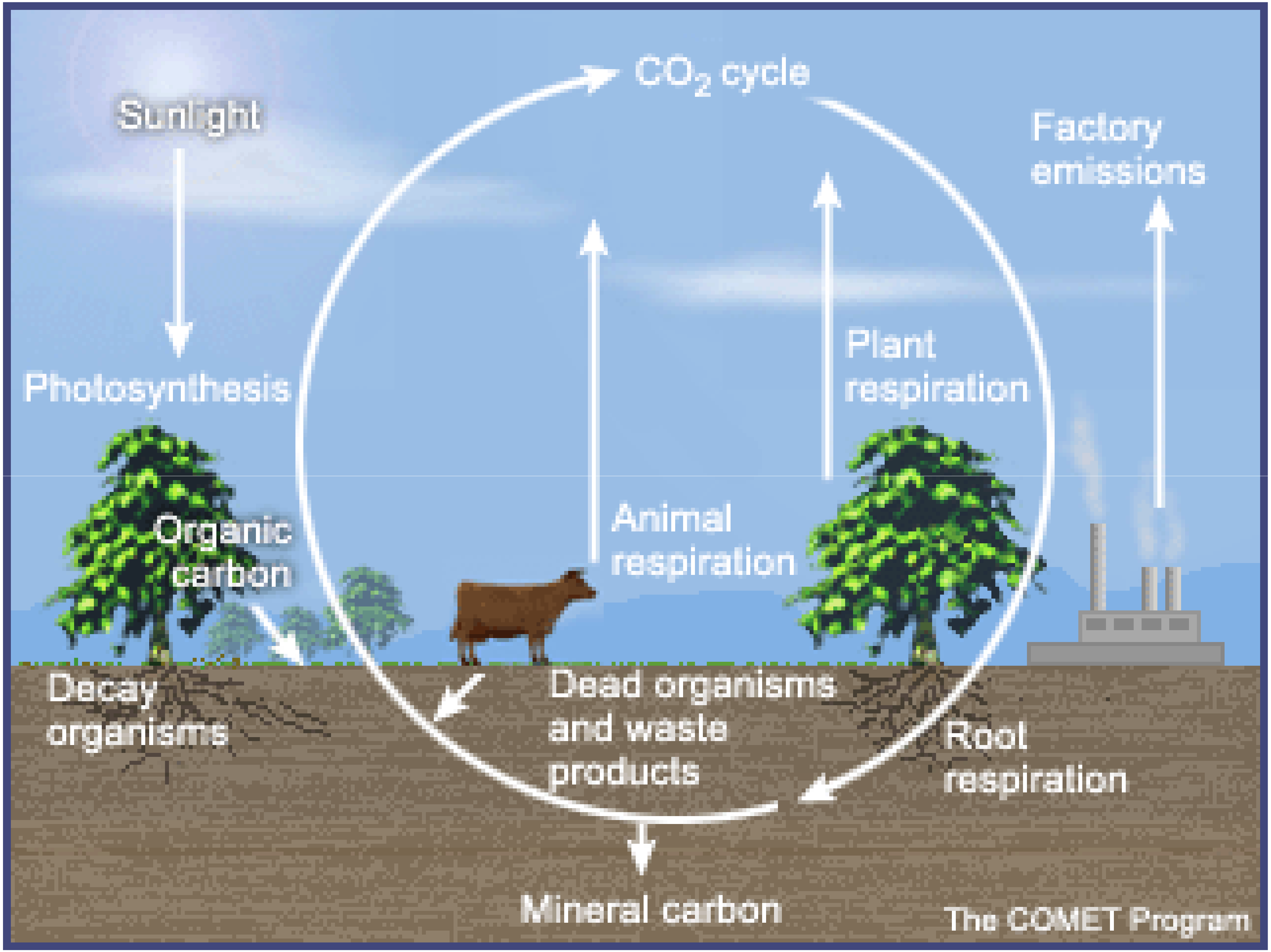
- This is a total different concept apart from Biomass.
- Biome are defined as
  - "the world's major communities, classified according to the predominant vegetation and characterized by adaptations of organism to that particular environment.

Linkages and Interactions in an ecosystem

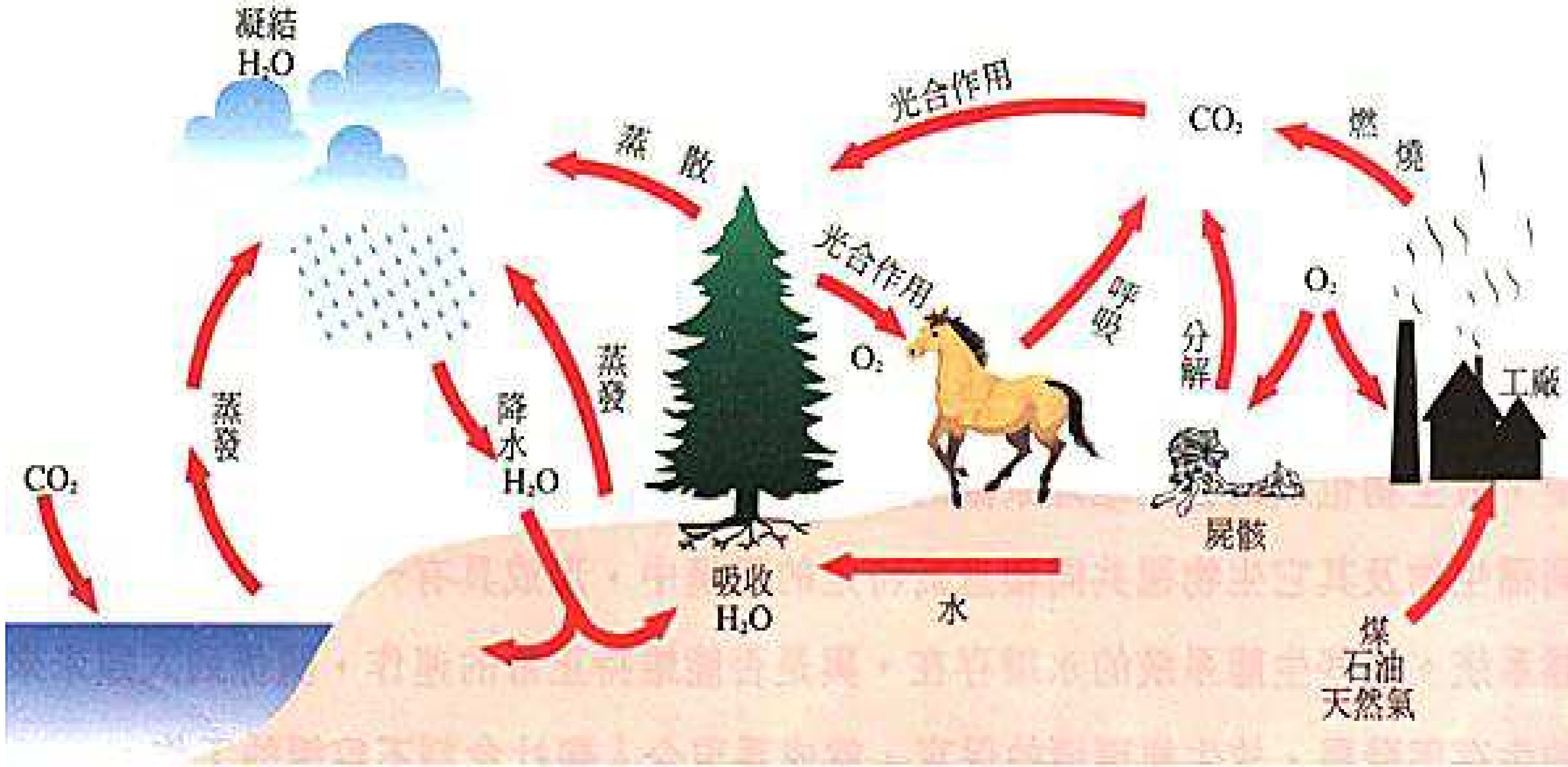
- Carbon and Oxygen cycle
- Nitrogen cycle
- A model of nutrient cycle

Carbon Cycle and Oxygen Cycle

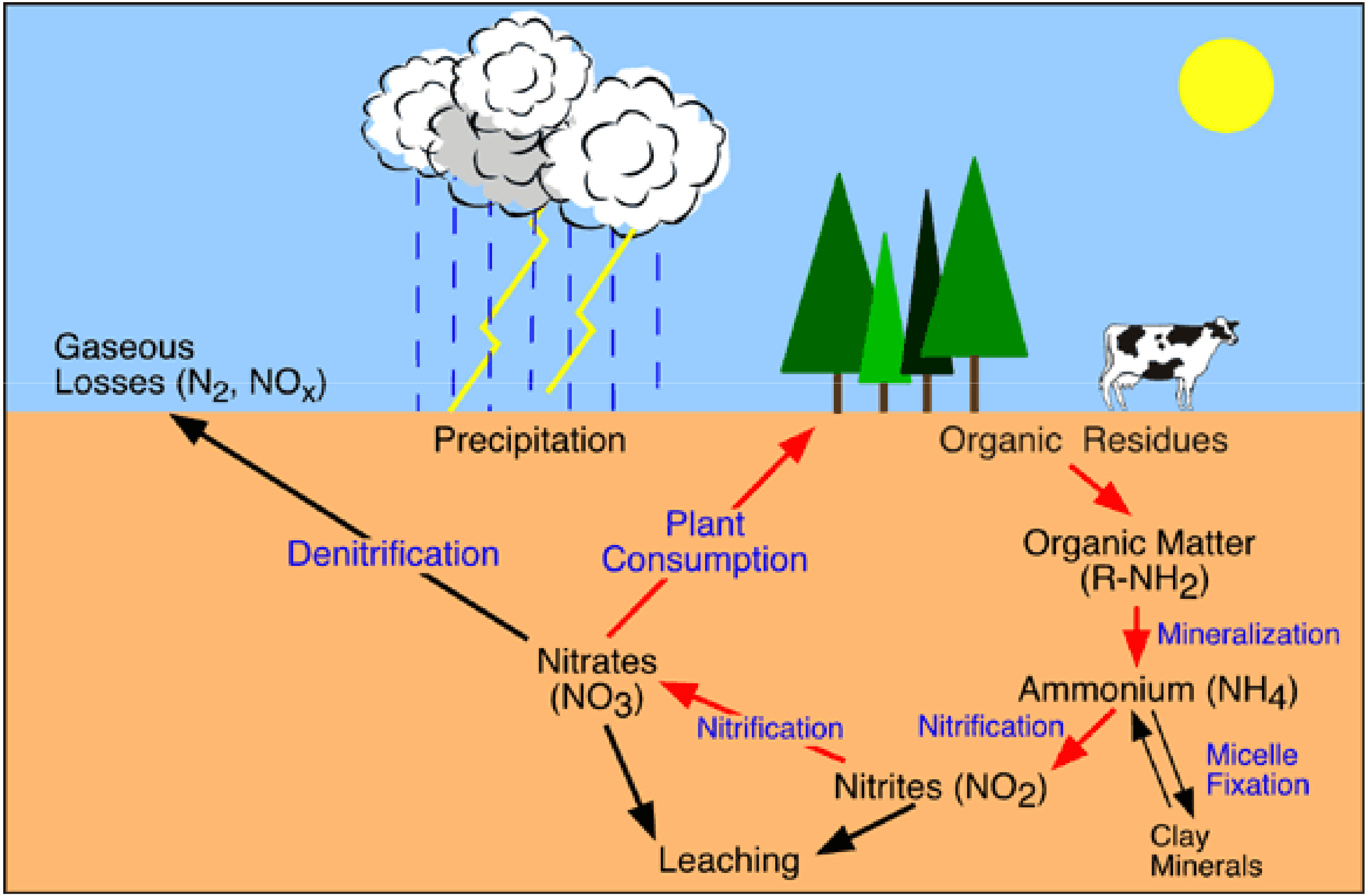



CO2 cycle
Sunlight
Factory emissions
Photosynthesis
Plant respiration
Organic carbon
Animal respiration
Decay organisms
Dead organisms and waste products
Root respiration
Mineral carbon
The COMET Program

生物圈中水、氧氣和二氧化碳的循環



Nitrogen Cycle



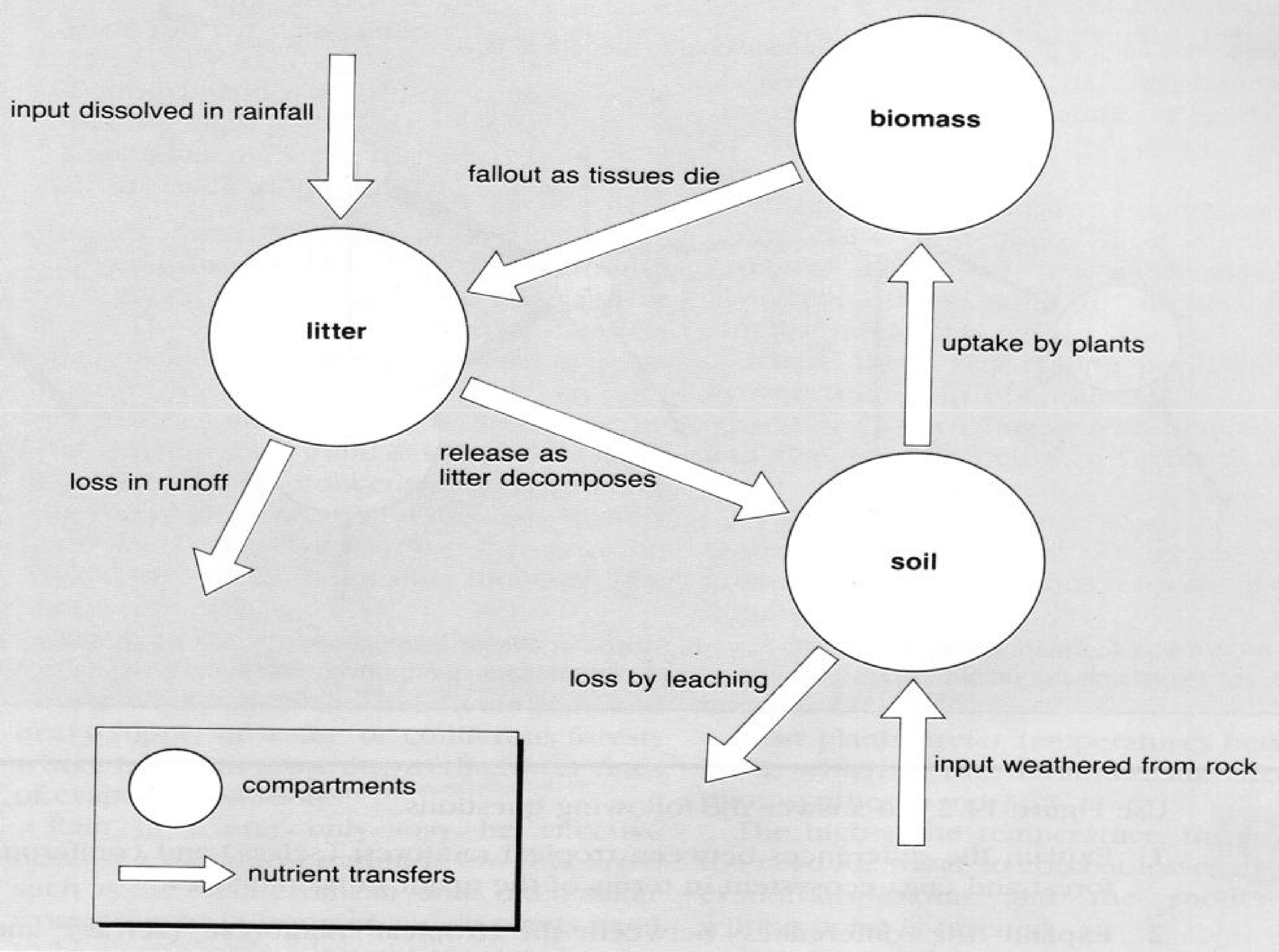
Nitrogen cycle

- Nitrogen cycle can be affected by man in five major ways:
  - Fertilizer production (mainly nitrates and ammonium salts) to grow more food by increasing yields, and replenishing lost nitrogen from the soil.
  - Burning of fossil fuels in cars, power plants, and heating which puts nitrogen dioxide into the atmosphere.
  - Increasing animals wastes (nitrates) from more people and from livestock and poultry grown in ranches.
  - Increased sewage flows from industry and urbanization.
  - Increased erosion of and runoff nearby streams, lakes and rivers from cultivation, irrigation, agricultural wastes, mining, urbanization and poor land use.

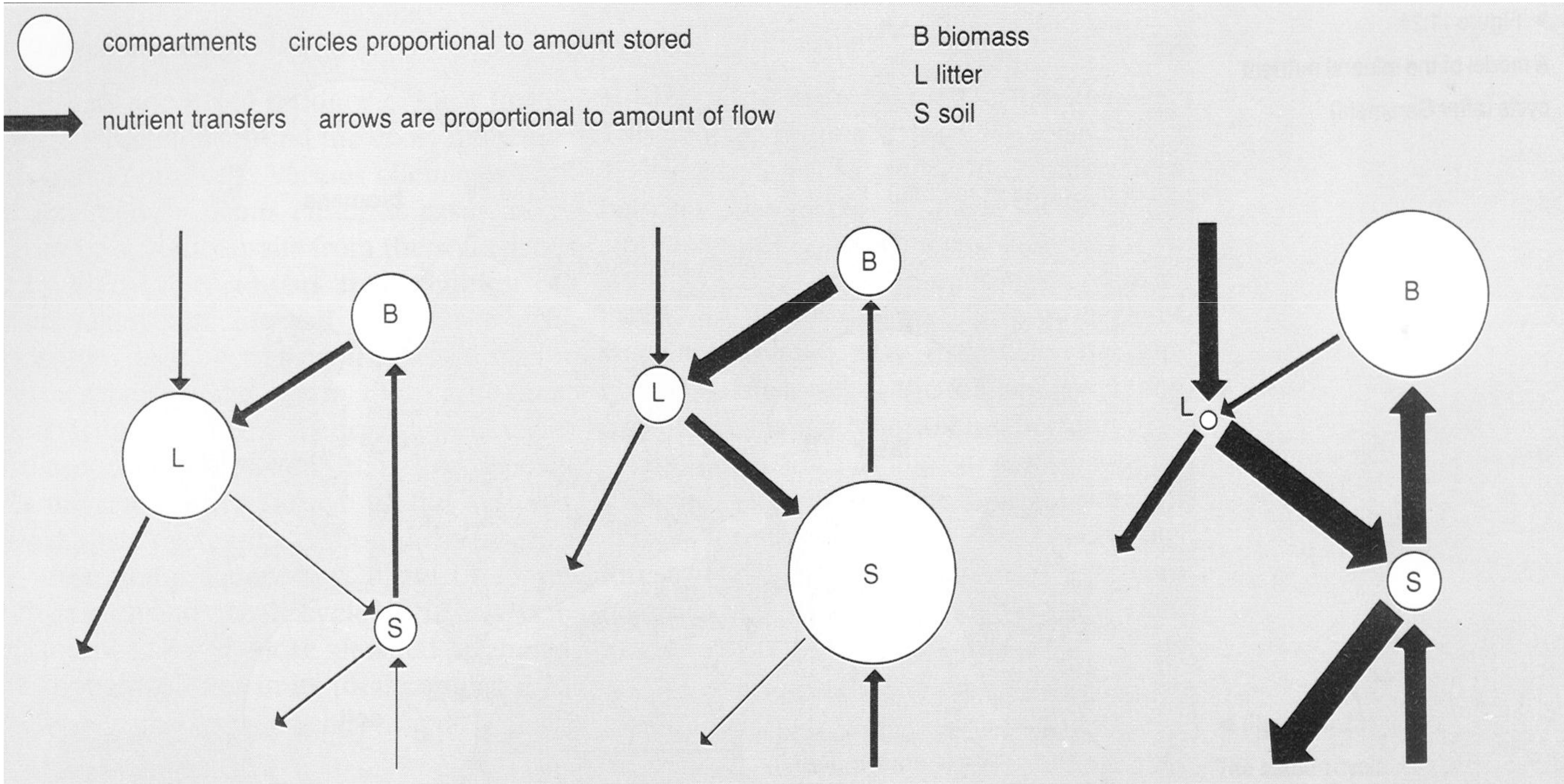
Model of Nutrient Cycle

- Nutrients (chemicals, minerals or elements) are circulated around the ecosystem and recycled continually.
- Gersmehl identified three storage compartments.
  - Litter: the surface layer of vegetation which may eventually become humus.
  - Biomass: the total mass of living organisms, per unit area.
  - Soil: the nutrients store in soil (weathered material) and semi-weathered material.

Model of Nutrient Cycle



3 Difference Nutrient Cycles



a Taiga (northern coniferous forest) environment

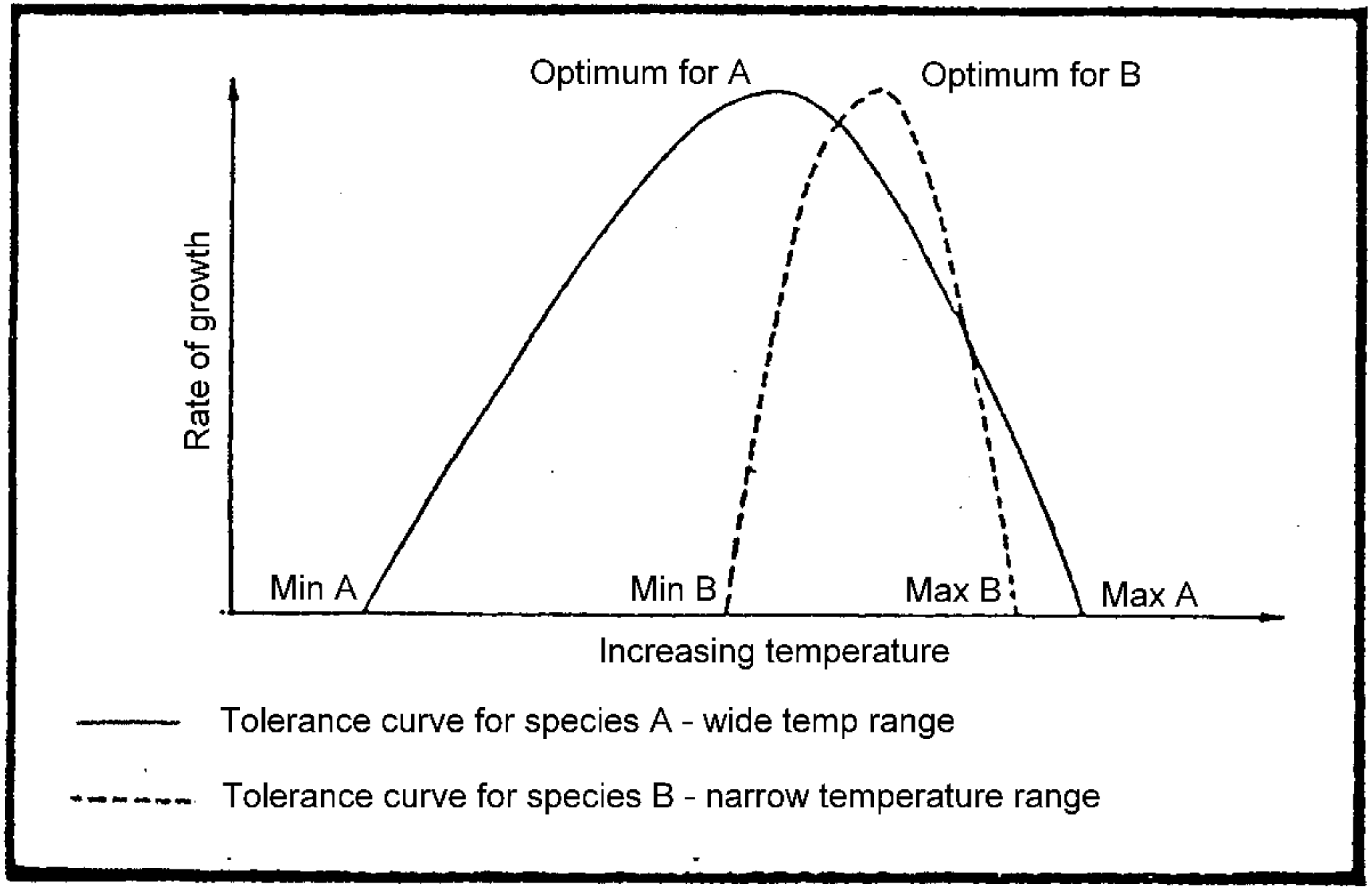
b Steppe or Prairie (mid-latitude continental grassland) environment

c Selvas (tropical rainforest) environment

Environmental Limitation in ecosystem development

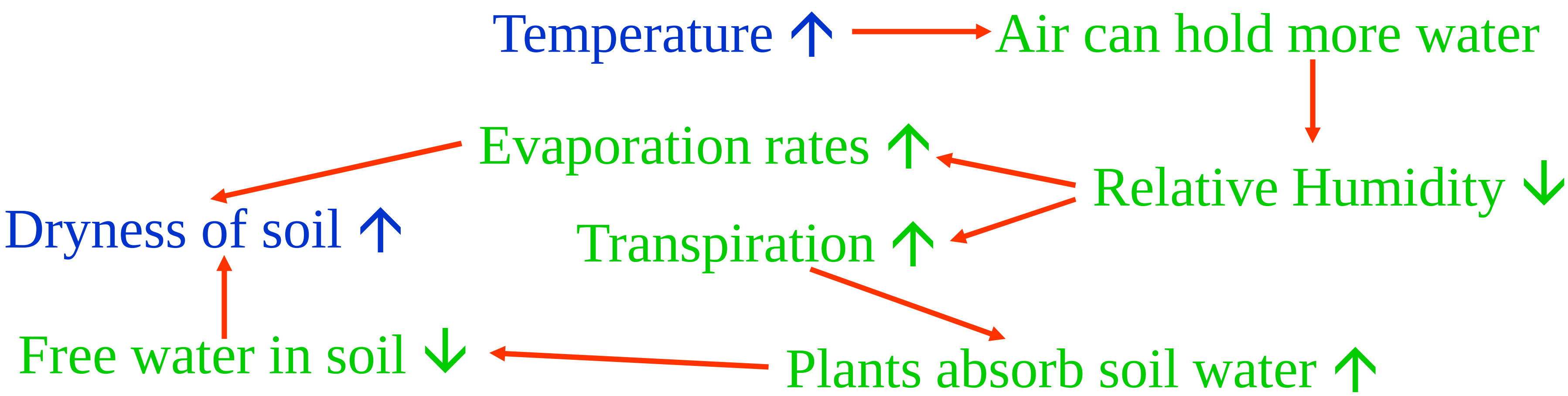
- Principles of limiting factors
  - Law of the maximum
  - Law of the minimum
- Principle of holocoenotic environment
- Limiting factors of an environment
  - Light
  - Temperature
  - Water
  - Wind
  - Topography
  - Soil
  - Biotic factors

Law of Maximum and Minimum



Principle of holocoenotic environment

- A German ecologist Karl Friederich (1927) suggested that 'community-environmental relationship are holocoenotic'. This means that there are no 'walls' or barriers between the factors of an environment and the organism or biotic community.
- If one factor is changed, almost all will change eventually.
- Example:



Limiting factors of an environment

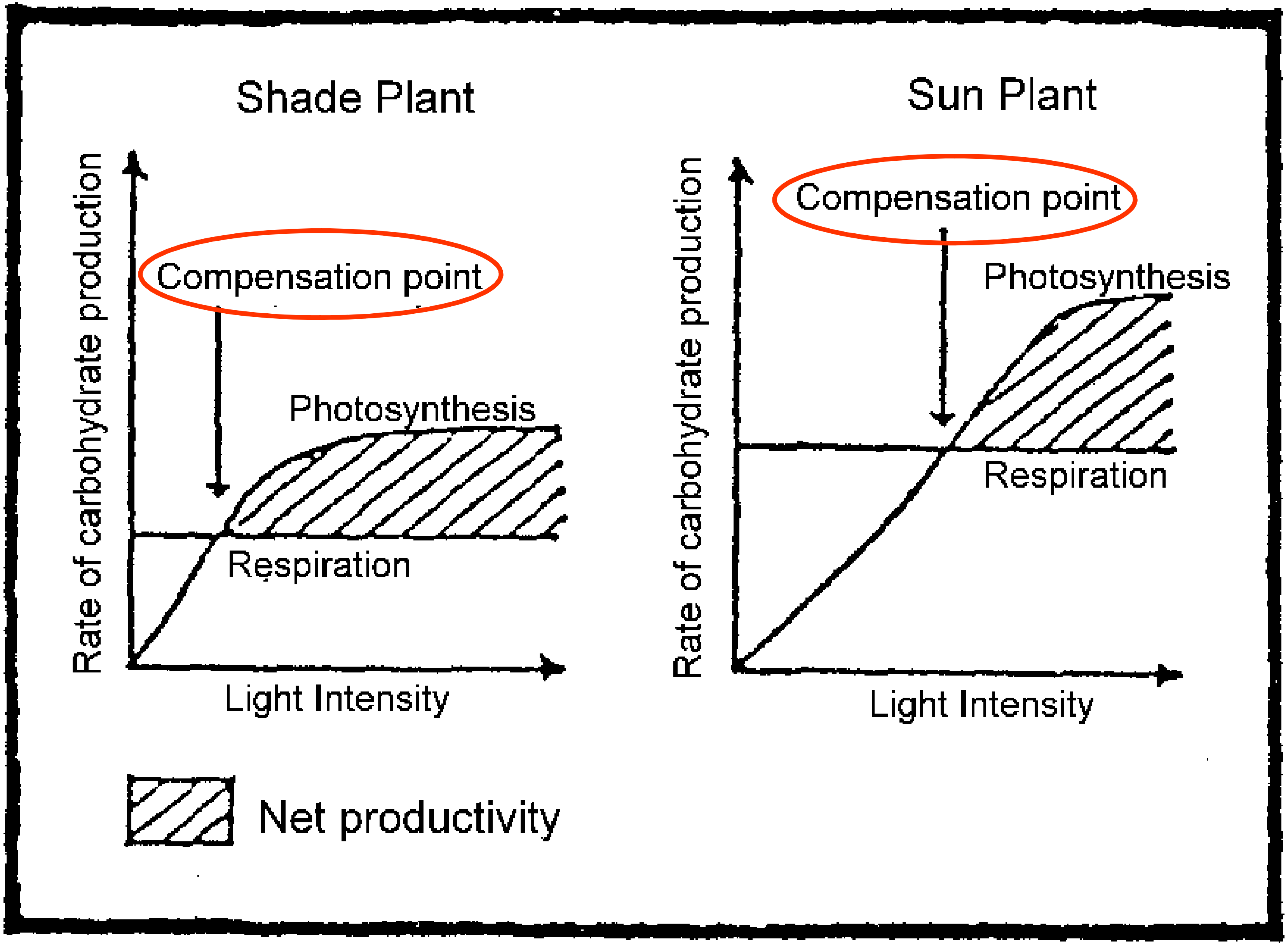
- Light
- Temperature
- Water
- Wind
- Topography
- Soil
- Biotic Factors

Light

- Light is an very important environment factor:
  - Source of energy for ecosystem
  - Control factor for reproduction and migration.

Light

- Quality of light:
  - Red and blue light: green plants (photosynthesis)
  - Green light: plants in woods or deep water
  - Ultraviolet light: retards plant growth
- Duration of light
  - Affect the behaviour of plants and animals (flowering, migration, mating….)
- Intensity of light:
  - Controlling factor for rate of photosynthesis
  - Net productivity is the function of photosynthesis and respiration.


Shade Plant
Compensation point
Photosynthesis
Respiration
Rate of carbohydrate production
Light Intensity
Net productivity
Sun Plant
Compensation point
Photosynthesis
Respiration
Rate of carbohydrate production
Light Intensity

Temperature

- Very important factor affecting
  - Directly effects on organisms
  - Indirectly effects in modifying other environmental factors such as relative humidity and water availability.
- Each species has its own minimum, maximum and optimum temperatures for life. (vary with age and water balances in the body)
  - Aquatic life has narrower tolerance ranges for temperature than those which live on land.
  - Tropical plants: > 15^{o}C,
  - Temperate cereals: >-2^{o}C,
  - Coniferous forests: withstand many degrees below freezing.

Water

- Water restrict ecosystem development because ,most organisms need large amounts of water to survive.
- Water requirement for plants will vary both with environmental conditions and among different species.
- Actual rate of transpiration is the function of
  - relative humidity
  - Air movement
  - Size of leaves
  - Size of stomata

Water

- Plants classification by water requirement.
  - Xerophytes: plants can survive in extremely arid areas.
  - Halophytes: plants can survive in saline conditions
  - Hydrophytes: plants live in water or in moist soil.

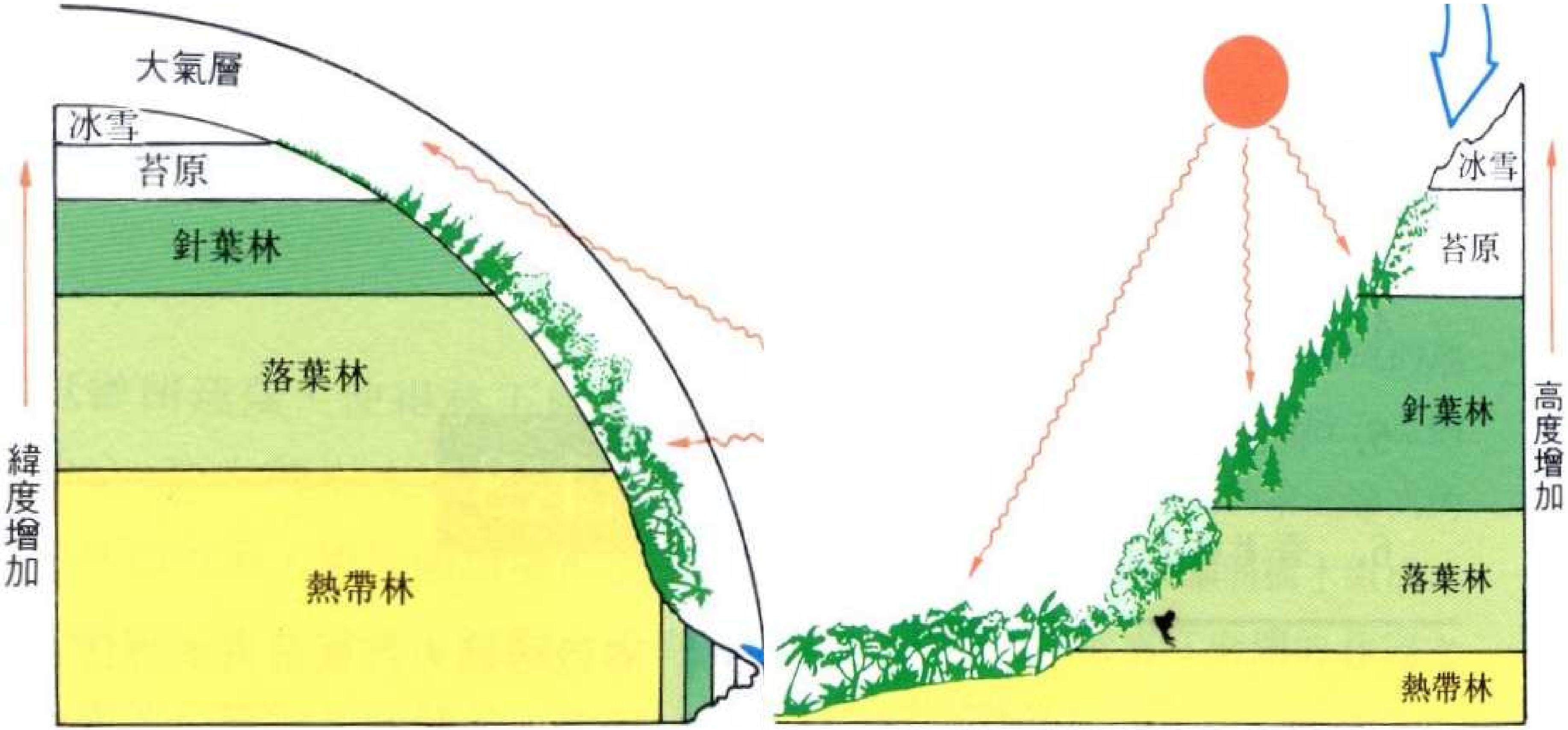
Wind

- Wind can act as an environmental factor
  - Directly by causing mechanical damage to plants
  - Indirectly affecting relative humidity and evaporation rates.
- High wind speed increases the rate of transpiration.
- Mountain summits, coasts and open plains vegetation may be dwarfed as a result of wind action.

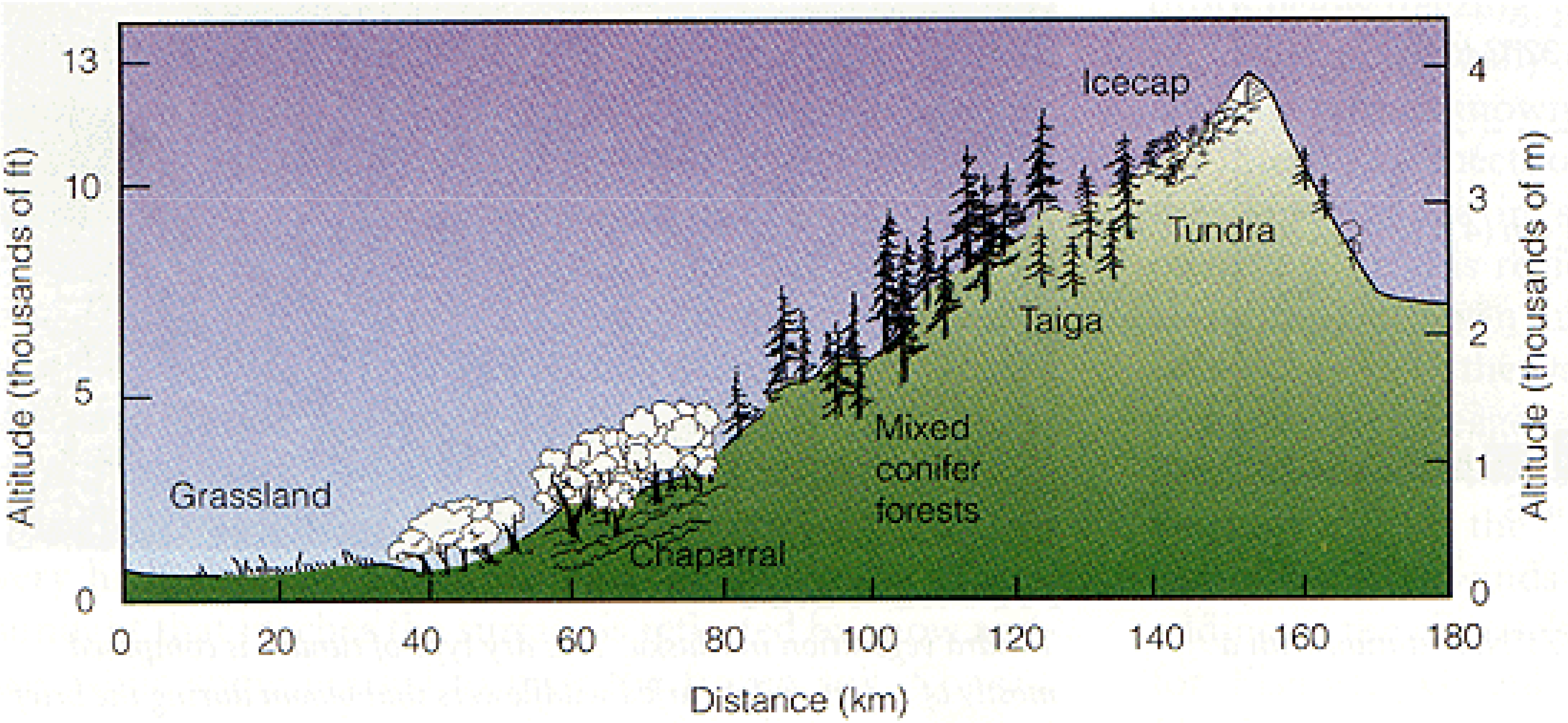
Topography

- Topography can influence ecosystem development in three major ways.
  - Direct effects of altitude on temperature
    - normal lapse rate (-6.5^{o}C/km)
  - The combination of changes in temperature and relative humidity
    - an altitudinal zonation of ecosystems.
  - Slope orientation and angle
    - South-facing slopes (in the northern hemisphere) are warmer and drier than north-facing slopes.
    - Angle of slope will be a critical factor in soil formation and drainage.

Topography



Topography



Icecap
Tundra
Taiga
Mixed conifer forests
Chaparral
Grassland
Altitude (thousands of ft)
13
10
5
0
Altitude (thousands of m)
4
3
2
1
0
0
20
40
60
80
100
120
140
160
180
Distance (km)

Soil

- Attributes of soils, such as texture, pH, soil climate and organic content operate in a closely inter-related fashion to exert control on
  - rates of decomposition
  - nutrient cycling,
  - plant distribution
  - productivity.

Biotic Factors

- Biotic factors are the interactions that occur between living things.
- Some species are beneficial or even essential for the existence of others, whereas some may be harmful.
  - The dominant plants will grow tallest and modify the light conditions for the rest of the community.
  - Plants struggle for light will influence root development and the competition for water and nutrients in the soil.
  - Many plants rely on animals for pollination and seed dispersal.
  - Many animals are directly dependent on plants for food.

Biotic Factors

- Man is by far the most important biotic factor.
- Man modifies of ecosystems by fire, hunting and agriculture,…...
- Industrialization and the intensification of agriculture, man has obliterated large areas of natural systems and caused pollution of both terrestrial and aquatic habitats.

Thank You