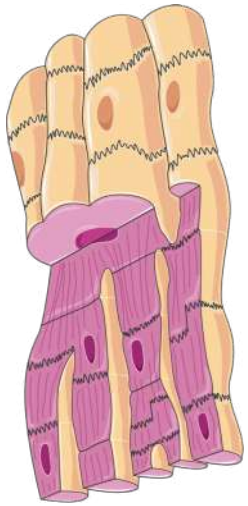
BB 101
Cells and Heredity

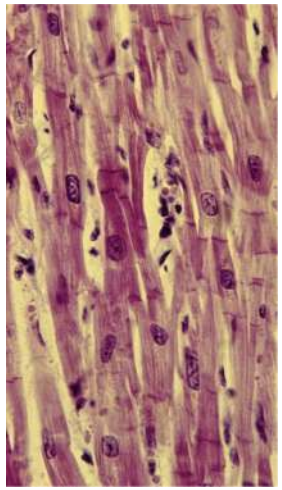
Tutorial 2
18.01.2024

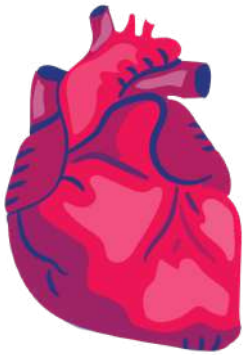
Cell

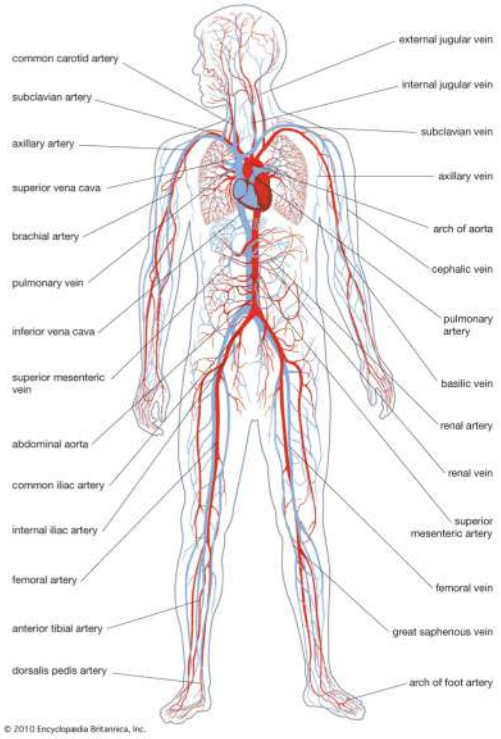
Building block, basic unit of life **Why?**

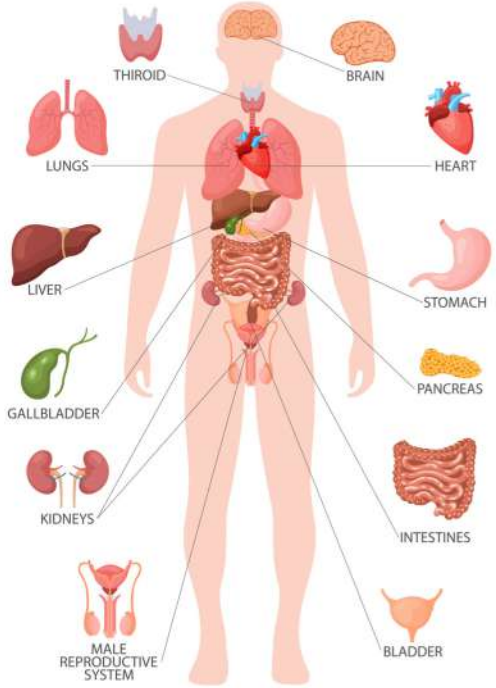
Cell **Tissue** **Organ** **Organ System** **Organism**







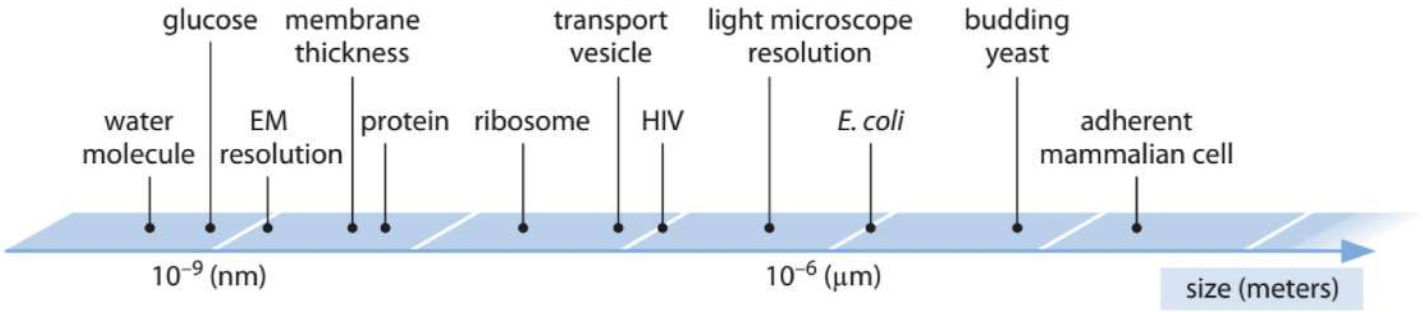




Which system does these form?

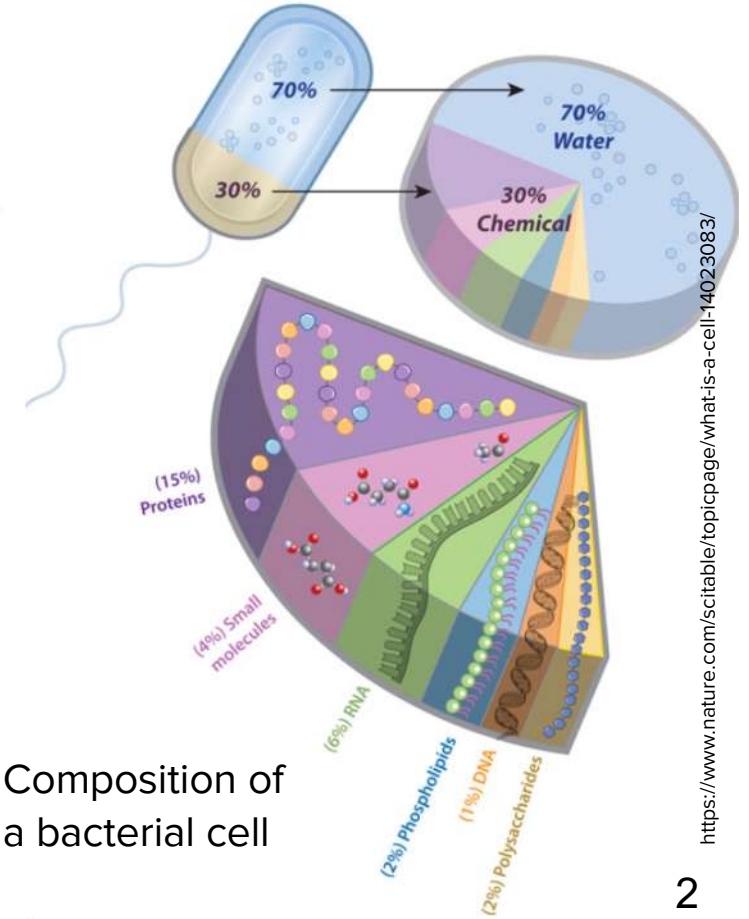
Cardiovascular System

Cell size and composition



https://www.youtube.com/watch?v=fox09v-9gXc

Ovum is the largest cell in humans



https://www.nature.com/scitable/topicpage/what-is-a-cell-14023083/

Composition of a bacterial cell

Organelles: Compartmentalization of cell

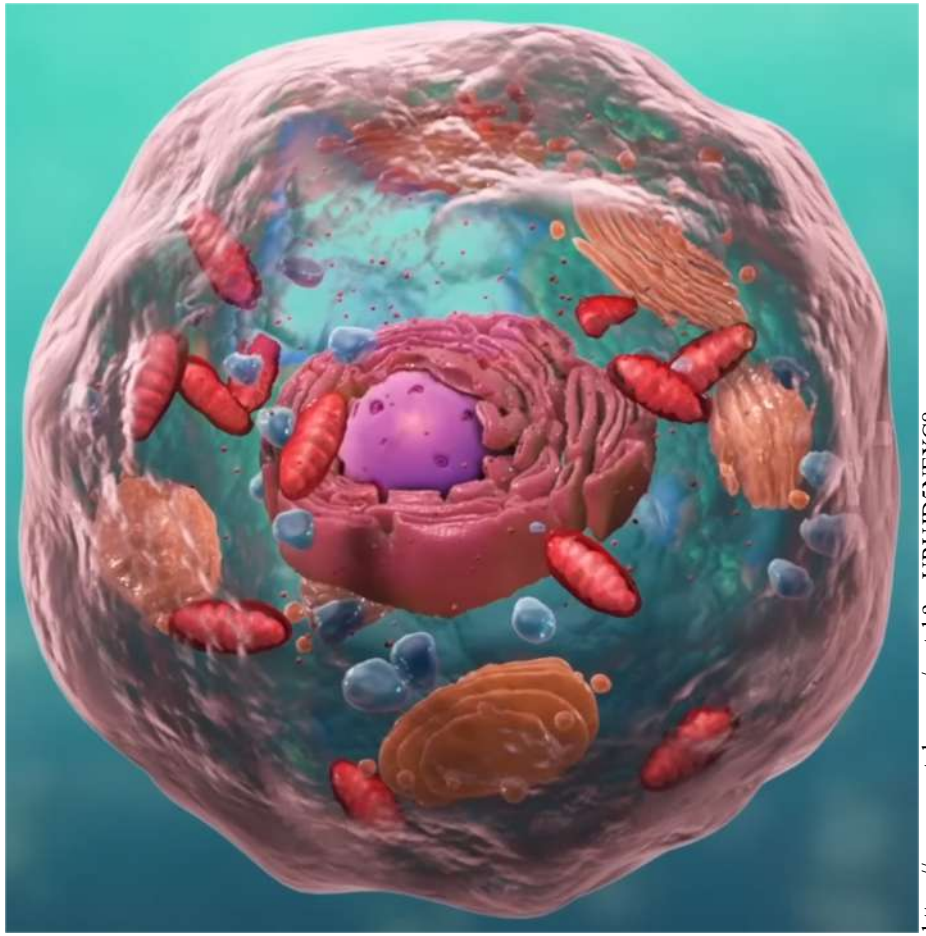
https://education.nationalgeographic.org/resource/organelles/

- Increased efficiency
  - Optimize conditions for various reactions to occur at faster rate.
- Enhanced control
  - Regulate interaction of molecule with each other.
- Specialized function
  - Each organelle carry out unique functions.

Origin?

Endosymbiotic theory

Organelles



https://www.youtube.com/watch?v=URUJD5NEXC8

Nucleus

Golgi

Vacuoles

Mitochondria

Endoplasmic reticulum

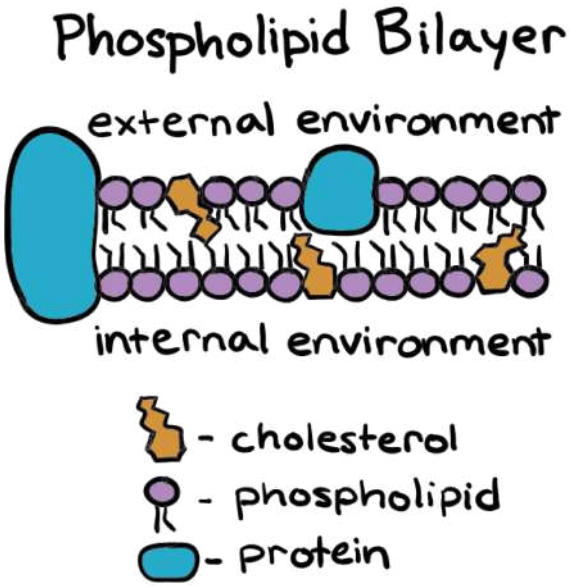
Cytoskeleton

Chloroplast

https://www.youtube.com/shorts/0M5-yCKhFhI

Organelles

Plasma membrane

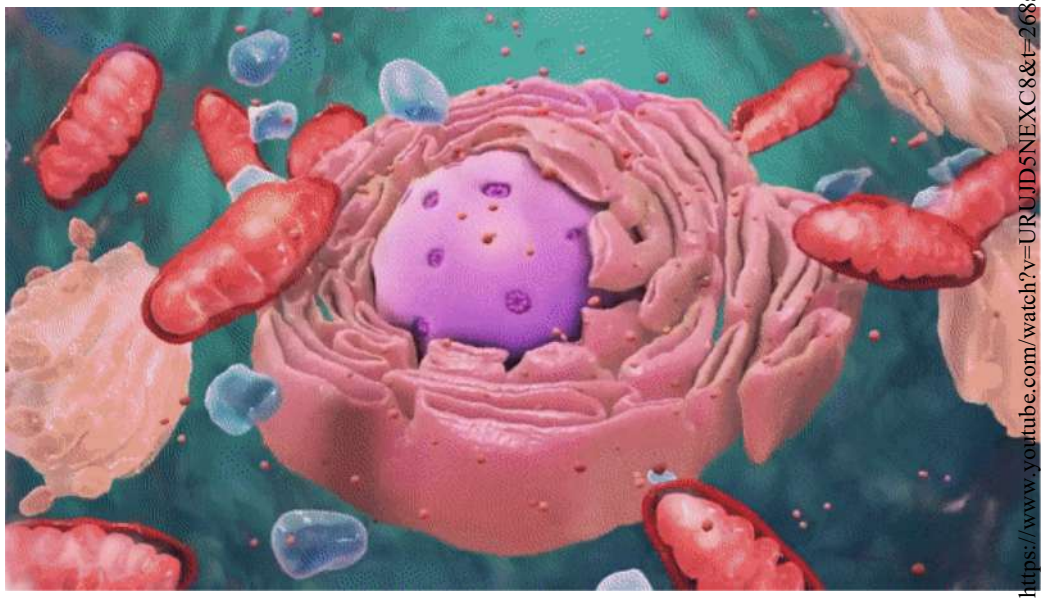


Fluid-mosaic model
Selectively-permeable

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.khanacademy.org%2Fscience%2Fap-biology%2Fcell-structure-and-function%2Fmembrane-permeability%2Fa%2Ffluid-mosaic-model-cell-membranes-article&psig=AOvVaw1IpqGxiCniKx9j86tttYs5&ust=1705042972650000&source=images&cd=vfe&opi=89978449&ved=0CBMQjRxqFwoTCIjV9pri1IMDFQAAAAAdAAAAABAD

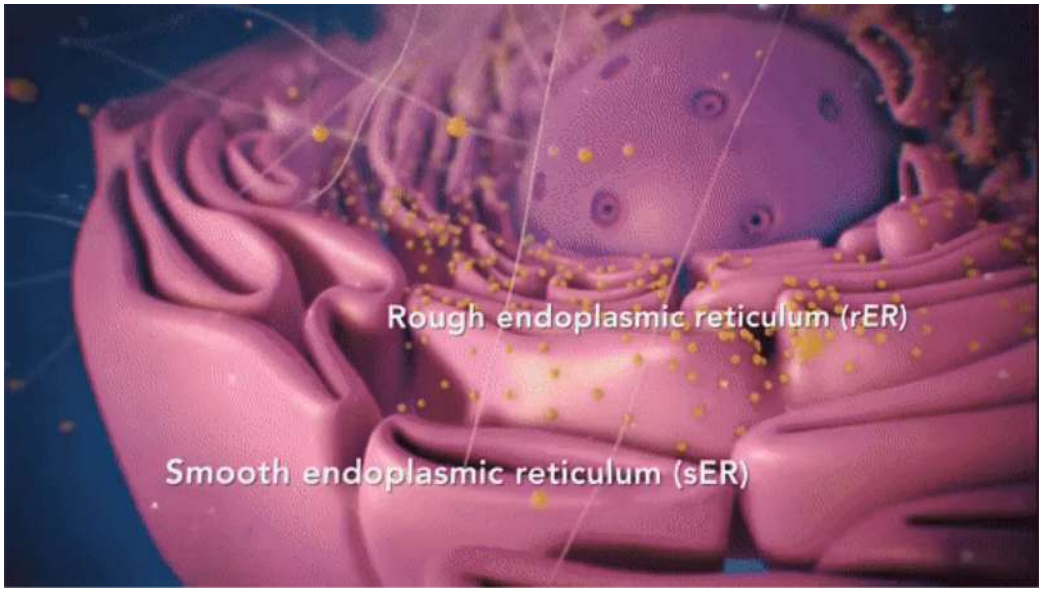
Organelles

Nucleus: Control center of cell



Contains DNA – Genetic material
Regulation of cellular functions
Response to external stimuli
Nucleolus

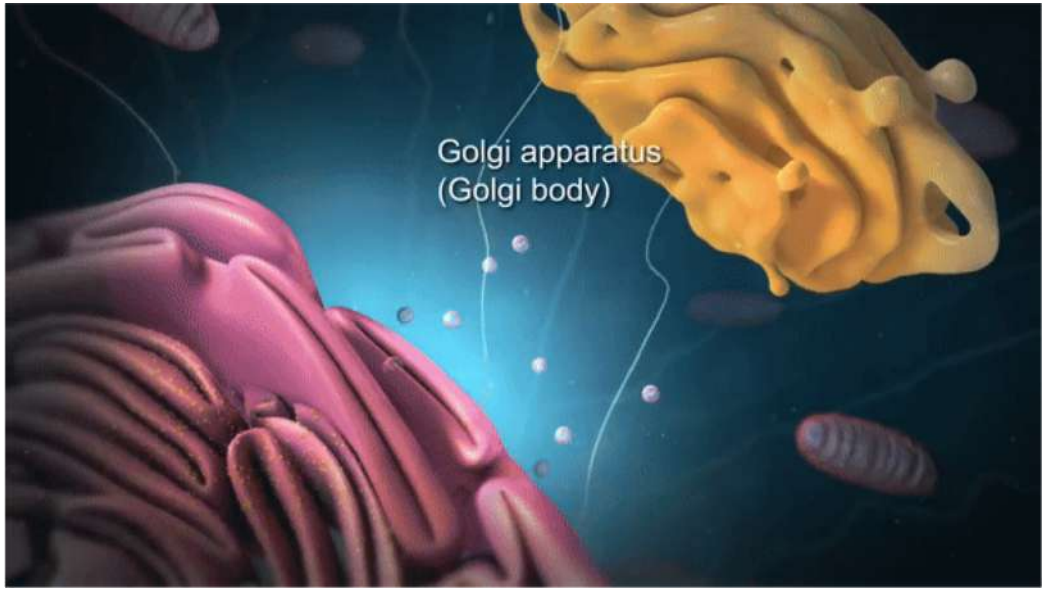
Endoplasmic reticulum: The transporter



Smooth and Rough endoplasmic reticulum
Protein folding and modification
Transport proteins synthesized in the cytoplasm

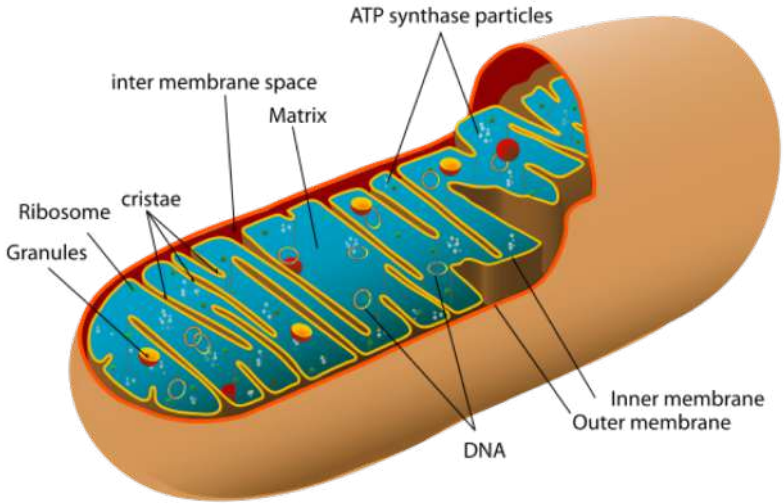
Organelles

Golgi: Post office of the cell



Protein sorting for delivery to various destinations

Mitochondria: Powerhouse



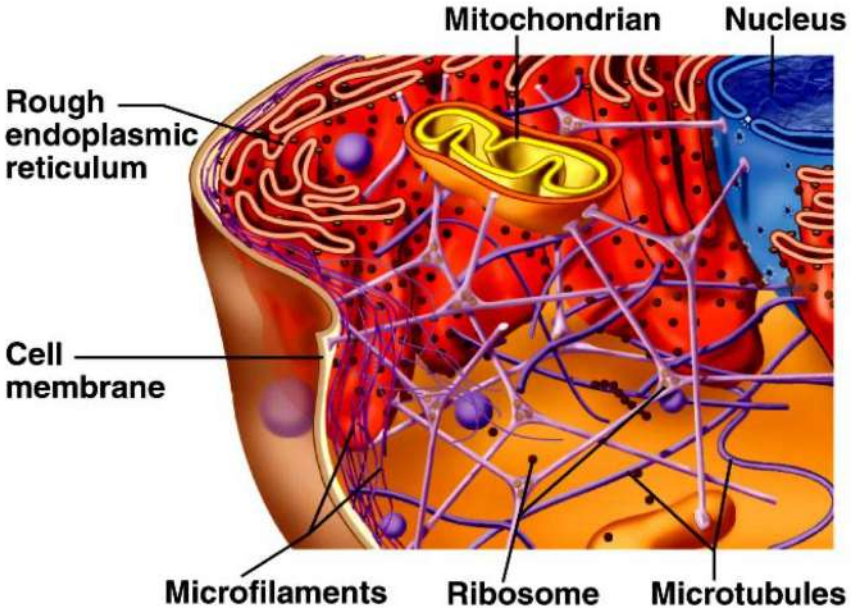
Production of ATP

ATP: Energy currency of the cell

Animation link https://www.youtube.com/watch?v=39HTpUG1MwQ

Cytoskeleton

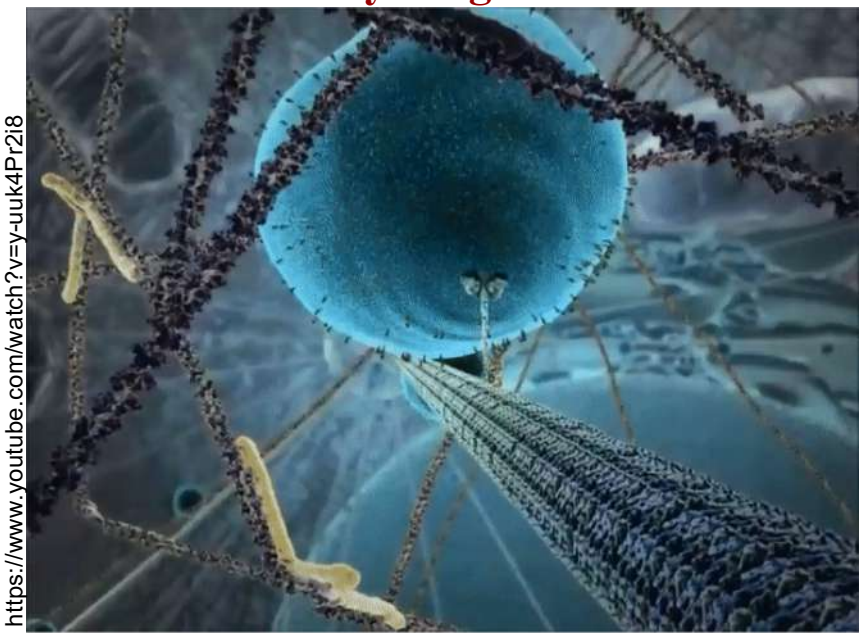
Cytoskeleton: structural support for the cell and provides tracks for movement



Types

- Actin (Microfilament)
- Microtubules
- Intermediate filaments

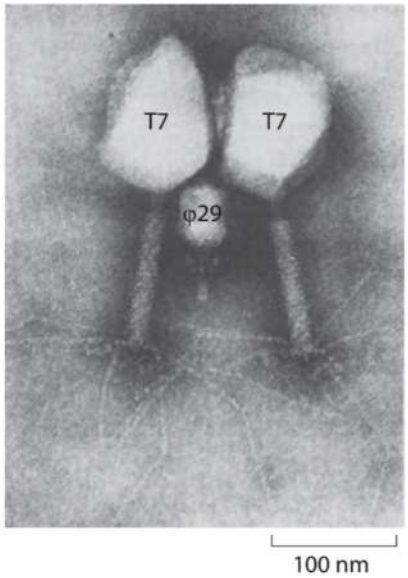
Molecular motors carry cargo on the microtubule tracks

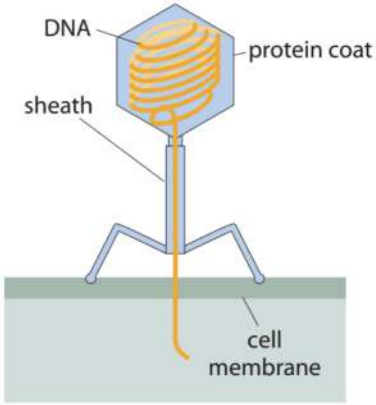


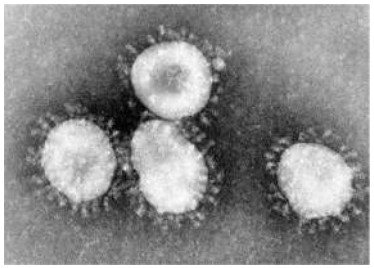
https://www.youtube.com/watch?v=y-uuk4Pr2i8

One end of the protein binds to vesicles and carry them to their destinations.

Viruses







SARS-COV2

Viruses cannot survive without a host cell to infect.

Living?

https://www.youtube.com/shorts/MAqPS9tFEAo

Attachment

Injection of Genetic material

Replication

New viruses

Cell lysis and transmission

BB 101
Heredity

Outline

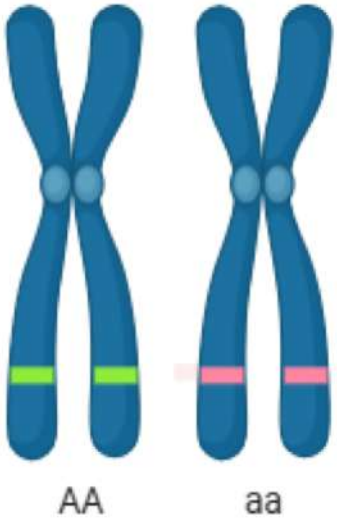
1. Basic Concepts and terminologies of Inheritance

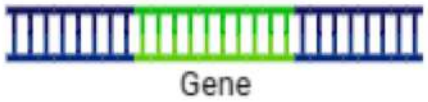
2. Practice of mendelian genetics problems

3. Concept of ABO Blood Groups and Practice Problems

Genes vs Alleles

- **Gene** – A region of specific DNA sequence which is responsible for a particular trait
- **Alleles** – Different forms of genes inherited from the parents (alternative variation of the genes)



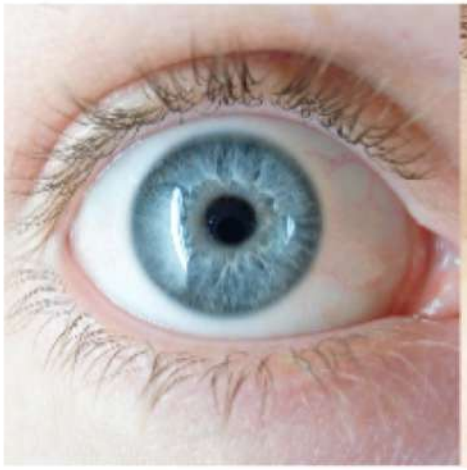


- **Dominant alleles have an effect over the recessive alleles**

What are Genotypes and Phenotypes

- Phenotypes – Actual observed properties
- Genotypes – Full hereditary information

Phenotype= Blue Eyes



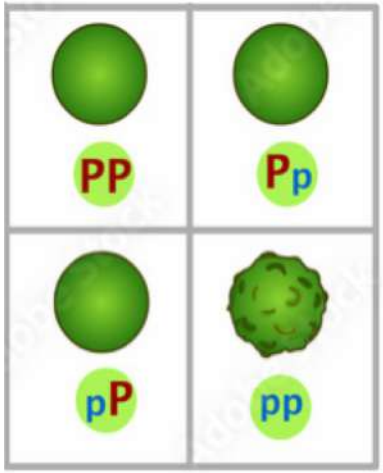
Genotype=bb

Recessive=b

Phenotype=Brown Eyes

Genotype = Bb or BB

Dominant =B

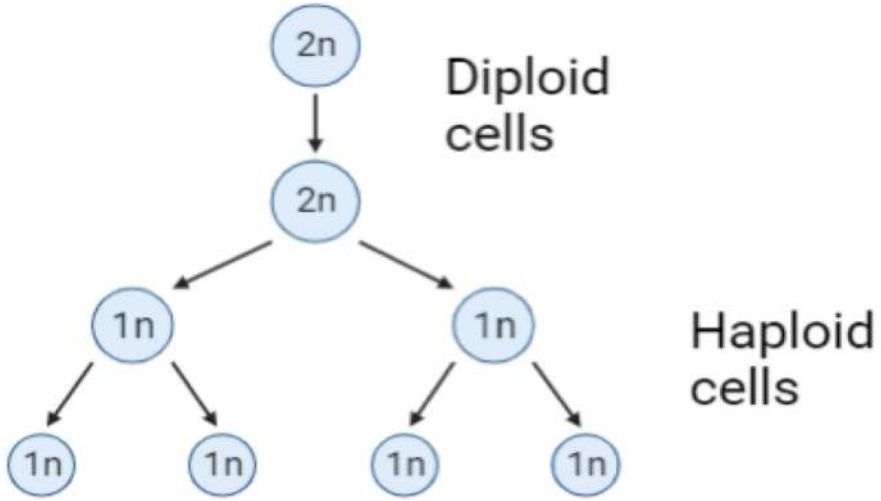


P – round seed

p – wrinkled seed

Haploid and diploid cells

- **Diploid -** A eukaryotic cell with two sets of chromosomes
- **Haploid -** A cell with individual set of chromosomes

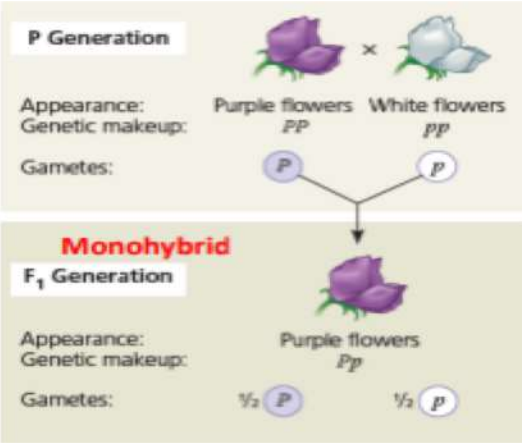


Monohybrid cross and Dihybrid Cross

Law of segregation – Two alleles for a heritable trait separate from each other during gamete formation.

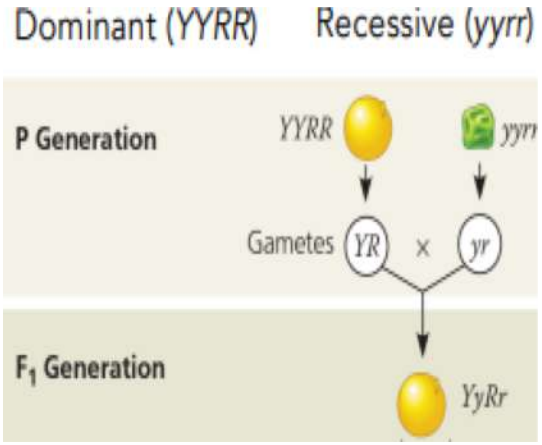
Law of Independent Assortment – Alleles of two (or more) different genes get sorted into two gametes independently of one another.

Monohybrid cross



Phenotypic Ratio – 3:1
Genotypic Ratio – 1:2:1

Dihybrid



Phenotypic Ratio – 9:3:3:1
Genotypic Ratio – 1:2:1:2:4:2:1:2:1

Problems

1. The following two genotypes are crossed: Aa Bb Cc dd Ee *Aa bb Cc Dd Ee. What will the proportion of the following genotypes be among the progeny of this cross?

a. Aa Bb Cc Dd Ee

b. Aa bb Cc dd ee

Ans: a. 1/32

b. 1/64

Problems

Two organisms, with genotypes BbDD and BBDd, are mated. Assuming independent assortment of the B/b and D/d genes, write the genotypes of all possible offspring from this cross and use the rules of probability to calculate the chance of each genotype occurring.

Ans - ¼ BBDD; ¼ BbDD; ¼ BBDd; ¼ BbDd

Number of Genotypic Classes Expected and Number of Phenotypic Classes from Self-Crosses

Number of Segregating Gene Pairs	Number of Phenotypic Classes	Number of Genotypic Classes
1[a]	2	3
2	4	9

Q. What will be the number of phenotypic and genotypic classes if the number of segregating gene pairs is n?

Ans– 2^n, 3^n

Q. If there are 81 genotypic classes, how many segregating gene pairs will there be?

Q. If there are 5 segregating gene pairs, what will be the number of phenotypic classes?

Ans - 4

Ans - 32

Pedigree : Concepts

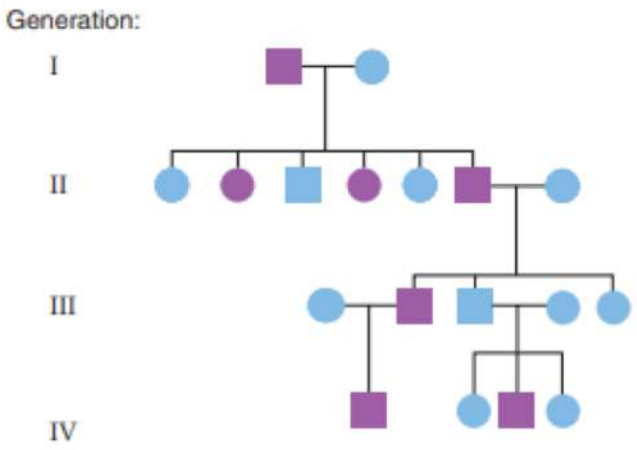
Female

Male

Affected Individuals

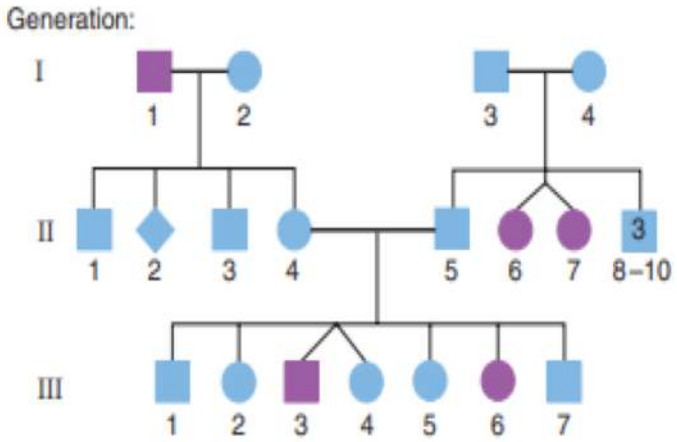
General characteristics of **dominant inheritance** for a trait :

- Every affected person in the pedigree must have at least one affected parent
- The trait usually does not skip generations.



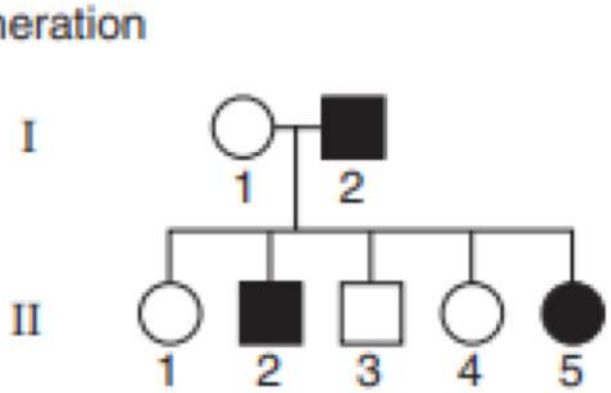
General characteristics of **recessive inheritance** for a trait

- Most affected individuals have two normal parents, both of whom are heterozygous. The trait appears in the F1
- Recessive traits often skip generations.



Problems

Consider the following pedigree, in which the allele responsible for the trait (a) is recessive to the normal allele (A):



a. What is the genotype of the mother? - Aa

b. What is the genotype of the father? - aa

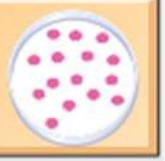
c. What are the genotypes of the children? - aa(II-2, II-V) ; Aa (II-1, II-3, II-4)

Extensions and Deviations of Mendelian Genetics

Genotype	I^AI^A or I^Ai	I^BI^B or I^Bi	I^AI^B	ii
Red blood cell appearance				
Phenotype (blood group)	A	B	AB	O

Phenotype (Blood Group)	Genotype
O	i/i
A	I^A/I^A or I^A/i
B	I^B/I^B or I^B/i
AB	I^A/I^B

ABO blood group

Serum from blood type	Antibodies present in serum	Cells from blood type: O	A	B	AB
O	Anti-A Anti-B				
A	Anti-B				
B	Anti-A				
AB	—				

What transfusions are safe between people with different blood groups in the ABO system?

Problems

A woman of blood group AB marries a man of blood group A whose father was of group O. What is the probability that

a. their two children will both be of group A?

- ¼

a. one child will be of group B, the other of group O?

- 0

c. the first child will be a son of group AB and the second child a son of group B

- 1/64

Thank You