

Nucleus

Discovery

Robert Brown (1831) ^{e31} in root cells of Orchid.

Known as

master organelle, controller of cell.

non cytoplasmic or extra cytoplasmic organelle.

largest cell organelle in Animal cells.

Note:

Decreasing order of sizes-

① In Animal cells

nucleus > mitochondrion > > > ---- Ribosome

② In plant cells (mature)

Vacuole > nucleus > plastid > mitochondria

> > > ---- ribosome

Occurrence:

PK cells → -ve

EK cells → +ve

↳ exceptions: mature mammalian RBC, Sieve tube cell.
↓ exception
Camel, Lemna

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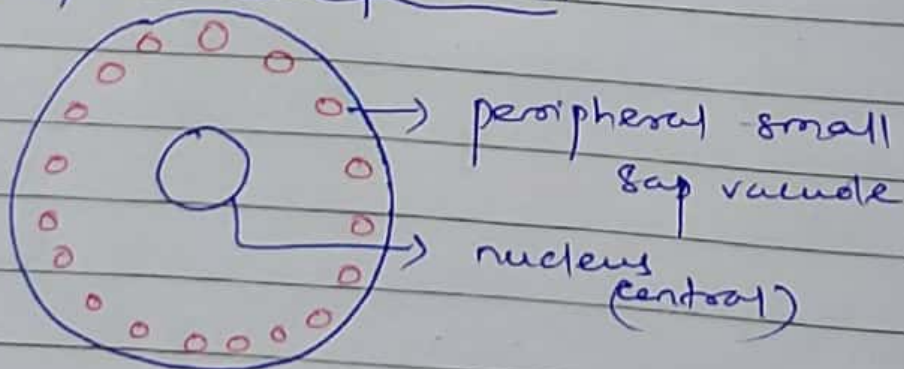
2k cells \rightarrow tree

↳ exceptions: mature mammalian RBC, Sieve tube cell.
↓ exception
Camel, Lemna

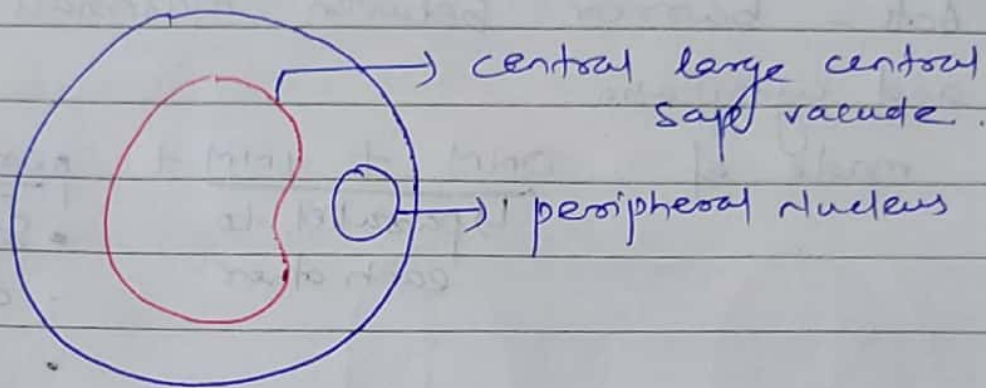
Position of nucleus in a cell

• Nucleus is present ~~at~~ at metabolically most active centre of cell.

① Animal cell / immature plant cell



⑬. mature plant cell



Number of nucleus per cell

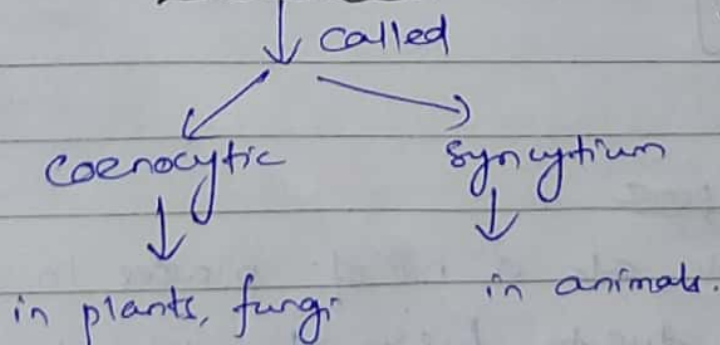
0 → enucleated cell → mature sieve tube cell
mature mammalian RBC.

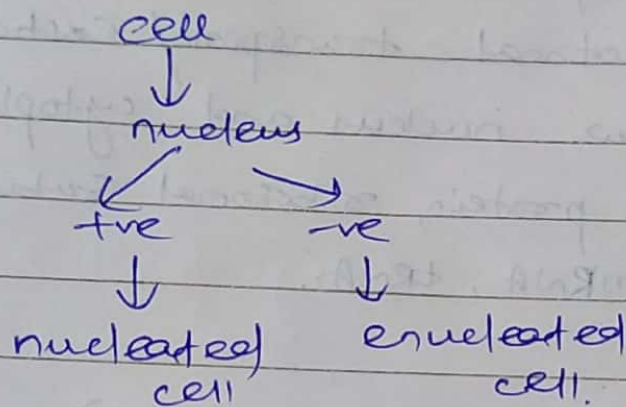
1 → uninucleated cell (common)

2 → binucleated cell → *Paramecium caudatum*

3 → trinucleated cell → *Paramecium aurelia*

>3 / many → multinucleated cell. → tapetal cell.





Ultrastructure of interphasic nucleus

Interphasic nucleus consists of

- nuclear envelope
- nucleoplasm
- chromatin
- nucleolus.

① Nuclear envelope

- Acts a barrier between materials of nucleus and cytoplasm.
- made of ONM + INM + perinuclear space.
 - ↳ parallel to each other.
 - Space b/w INM and ONM.
 - 10-50nm (diameters)

ONM

- often associated with 80S ribosome.
- rough
- normally bound to RER.

INM

- Never associated with ribosome.
- smooth
- never bound to RER.

Nuclear pore

- present at a no. of places in nuclear envelope.
- formed due to fusion of ONM and INM.
- Allows bidirectional transport/exchange of materials b/w nucleus and cytoplasm.
 - ↳ RNA, protein, ribosomal subunit
 - ↳ mRNA, tRNA.

(for fig: please check class note)

② Nucleoplasm

- Also known as nuclear matrix.
- Semifluid, transparent, colloidal substance inner to INM.
- contains enzymes, minerals, nucleoside, nucleotides, chromatin, nucleolus.
 - mainly triphosphates. ←

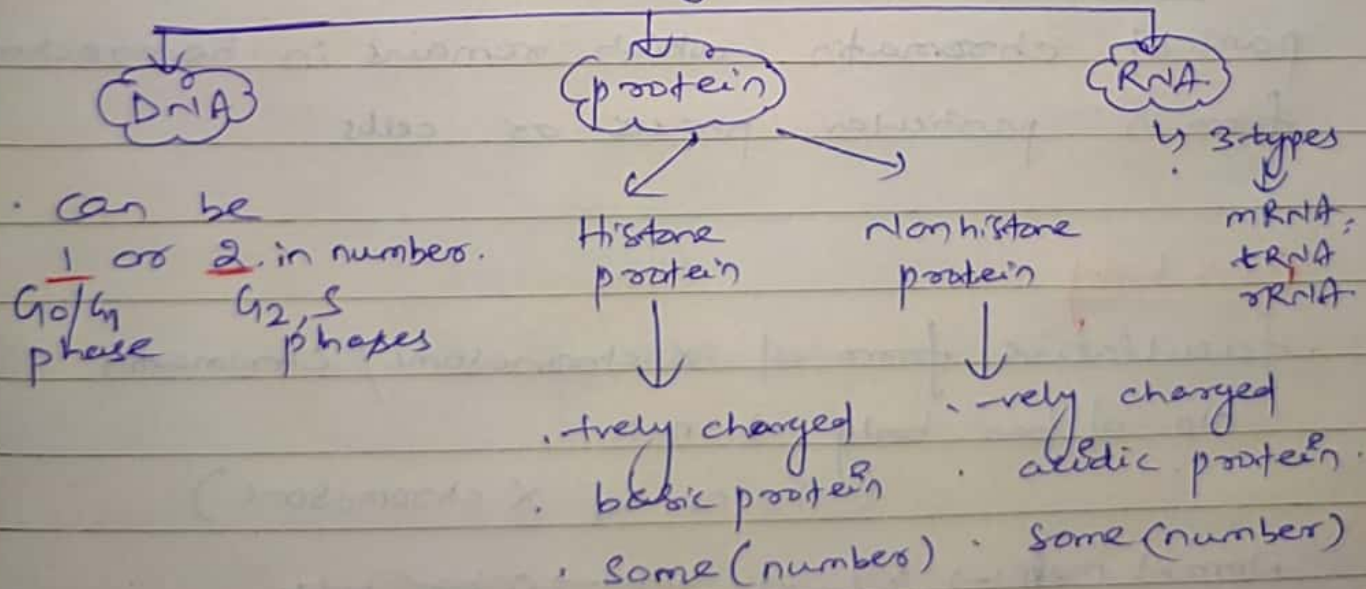
© chromatin

Term → coined by Flemming (1879)
derived from Greek word chroma
↳ color.

chromatin is stained by basic dye

- +vely charged dye.
- ex - Acetocarmine.

Chemical composition of chromatin



Types of chromatin

features

staining

euchromatin

lightly stained

heterochromatin

darkly stained

histone content

less

more

transcriptionally
(genetically)

active

inactive

Replication

packing

early S phase

loosely
packed

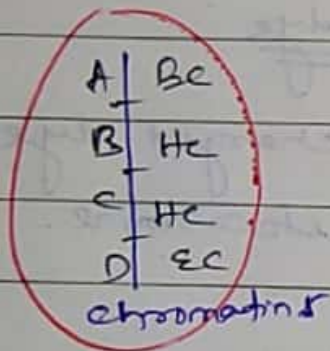
late S phase

tightly packed

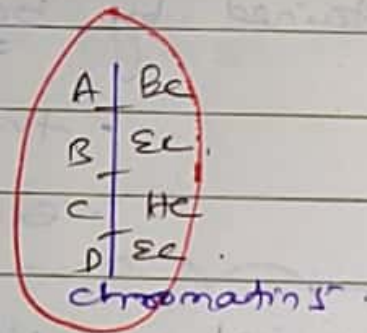
Types of heterochromatin (Hc)

① Constitutive heterochromatin

part of chromatin which remains in heterochromatin form in all phases, ~~and~~ ~~all~~ all cells.



cell A / stage A
(phase)



cell B / stage B
(phase)

Here

B \rightarrow facultative Hc

C \rightarrow constitutive Hc.

② Facultative heterochromatin

part of chromatin which remains in heterochromatin form in particular phases or cells.

Bar body

• facultative form of X chromosome / chromatin.

No. of bar body $\rightarrow n-1$

($n \rightarrow$ no. of X chromosome)

Normal male $\rightarrow XY \rightarrow 1-1 \rightarrow 0$ bar body

Normal female $\rightarrow XX \rightarrow 2-1 \rightarrow 1$ bar body.

Drum Stick

Special type of bar body found in blood cells.

①. Nucleolus

Discovery : Pontana

Term : Bowman,

- nonmembrane bound \rightarrow its materials (content) are in direct contact with nucleoplasm.
- round and densely stained
 \hookrightarrow by acidic dye.

Bound to chromatin at NOR (nucleolar organising region)

Number of nucleolus per nucleus

- 1 or >1
- depends on the amount of protein synthesized by cell.
- more in those cells that are actively involved in protein synthesis.

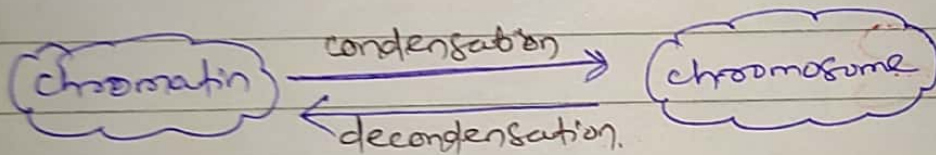
Functions of nucleolus

Site of rRNA and
↓
except
5S rRNA.

ribosomal subunit formation
↓
∴ nucleolus
↓ called
ribosome factory

Chromosome

- observed in dividing cells only.



- long, thin
- indistinct

observed → • in nondividing cells.

- in interphase and late telophase

- short, thick
- distinct

• in dividing cells.

- observed in M phase
prophase, metaphase,
Anaphase, early
telophase.

G₀/G₁ phase



1x chromatin
1x ds DNA

S/G₂ phase



cohesin protein

1x chromatin
2x ds DNA

prophase/ metaphase



(T → telomere)

1x chromosome
2x chromatids
2x ds DNA
1x centromere
4x telomeres

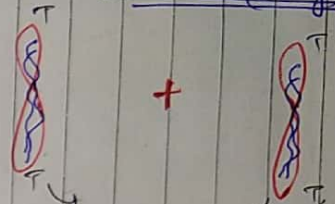


chromosome



chromosome

Anaphase/ telophase (early)



1x chromosome
1x chromatid
1x ds DNA
1x centromere
2x telomeres

Chromatids

A, B → sister chromatids

C, D → " "

A, C → non-sister chromatids

A, D → " "

B, C → " "

B, D → " "

Same chromosome k chromatids ko sister chromatids

kehte hai.

Do alag alag chromosomes k chromatids ko non-sister chromatids

kehte hai.

kehte hai.

Various components of chromosome.

(A) pellicle

- covering of chromosome.
- proteinaceous.

(B) Matrix

- semifluid inside pellicle.
- contains ions, enzymes, minerals, etc.

(C) centromere

- Known as 1^o constriction.
- position is variable.
- responsible for providing definite shape of chromosome.
- every chromosome essentially has 1^o constriction.

↓ meaning

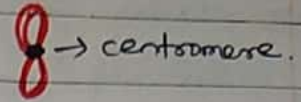
every chromosome has 1^o constriction
(matlab har chromosome mein 1^o constriction)
hota hai

- not stained.
- bears Kinetochores on its either side.
 - ↳ small
 - ↳ disc shaped.
 - ↳ proteinaceous
 - ↳ site of attachment of spindle fibre.
- helps in chromosome separation.

Types of chromosome on the basis of position of centromere

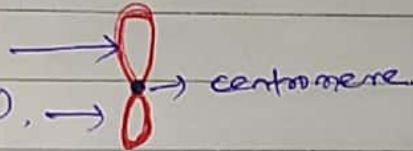
① Metacentric

- also called median / isobrachial chromosome.
- centromere → at middle of chromosome.
- with 2 equal ~~arms~~ arms.
- V shape in anaphase



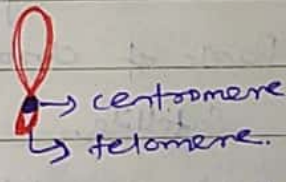
② Submetacentric

- also called heterobrachial / submedian chromosome.
- centromere → near middle of chromosome.
- 2 arms → unequal
 - ↳ long arm (q) →
 - ↳ short arm (p) →
- L shape in anaphase.



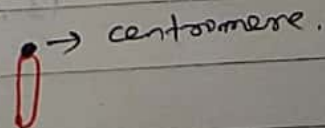
③ Acrocentric

- centromere → near telomere
- 2 arms → unequal
 - ↳ 1x very long arm →
 - ↳ 1x very short arm →
- I shape in anaphase.



④ Telocentric

- centromere → at telomere → terminal part of chromosome.
- appears to consist of 1 arm.
- I shape in anaphase.



① Secondary constriction

- Present in some (few) chromosomes
- Present at (specific) constant location of chromosome.
- Part of chromosome beyond 2nd constriction is called Satellite.
- DNA in satellite is called Satellite DNA.
- Chromosome with satellite is called SAT chromosome.

(Sine Acid
Thymonucleinico)

in human

5 pairs



Chromosome 13, 14, 15, 21, 22,
13, 14, 15, 21, 22.

⑤ Chromatid

1x chromatid \rightarrow 1x ds DNA

1 chromosome \rightarrow $\begin{cases} \rightarrow$ 1x chromatid \rightarrow Anaphase, telophase (early) \\ \rightarrow 2x chromatids \rightarrow prophase, metaphase. \end{cases}

- 2 chromatids of a chromosome are held by cohesin protein at centromere.
 \downarrow its per niece centromere.

⑥ Telomere

- Terminal part of chromosome/chromatid.
 \hookrightarrow linear chromosome

Note

- Circular chromosome K koi end nahi hota islie koi telomere nahi hoga.

- Seals and protects the ends of chromosome.

- Its DNA is called telomeric DNA

\hookrightarrow 4 stranded, G-rich.

\hookrightarrow formed by telomerase.

- ribonucleoprotein in nature (RNA + protein)
- marker enzyme of cancerous cells.

(for diagram please follow class note)