NUCLEUS
nucleus
GENERAL CHARACTERISTICS

- centre of cell activity
- DNA and chromosomes
- place of RNA synthesis
Structure of the nucleus

The cell's brain, the nucleus, is contained by a pore-packed membrane through which the nucleus communicates with the surrounding cytoplasm. The nucleus is of which there may be enormous interest, but it may be the vital source of nuclear protein. The chromatin material contains all the hereditary information needed for the reproduction of new cells.
1. shape
- spherical
- elongated
- lobular
- flattened

2. Number - usually 1
- 2 and more
- symplast

3. size - 4-40 \( \mu m \)
- nucleus-cytoplasm index
  - 1:3, 1:4

4. Location
- In the centre of the cell
- excentric
- In the base
- Under the plasmalema
Chromosomes

DNA packed in a linear structure – chromosome
DNA
DEOXYRIBONUCLEIC ACID

THYMINE

CYTOSINE

ADENINE

GUANINE
Nobel prize winners 2006

Dr. Andrew Fire

Craig Mello
Cells can inhibit the expression of individual genes (stop proteins from being made) by interfering with a mRNA being transcribed. This is done via a small double-stranded RNA. An enzyme named DICER snips short interfering RNAs (siRNA) from longer double-stranded RNAs made by (A) self-copying gene sequences, (B) by replicating viruses, or (C) regulatory RNA sequences known as microRNAs. All the RNAs (A, B, & C) are cleaved by DICER enzyme into short siRNA pieces that can suppress gene expression.
HOW RNAi SUPPRESSES GENES

RNA Induced Silencing Complex (RISC)

- Single strand siRNA or microRNA
- Unwound RNA
- Mismatched RNA
- cleaved mRNA

if 2 RNA strands are highly complimentary - RNA is cleaved
NO PROTEIN is MADE

if 2 RNA strands are partly mismatched - RISC sticks to mRNA

DNA
mRNA
protein
ribosome

RNA SILENCING

(A) dsRNA
(B) dsRNA of virus
(C) microRNA

Dicer cleaves RNA

siRNA or microRNA

artificial siRNAs via liposomes

NORMAL
Chromosomes

22 autosomes

sex chromosomes (X or Y).

(XX or XY).
CHROMATIN

Complex of DNA, proteins (histon (80%) and non-histon (20%), RNA

1. Histon proteins (80%), link with DNA in the nucleus
   a. 5 types: H1, H2A, H2B, H3 и H4.
   б. Rich in lisin and arginin ,
      (+) charged, linked with PO$_4^-$ of DNA

2. non-histon proteins(20%)
DNA - 1.5 m
PACKED WITH HISTON PROTEINS

a. NUCLEOSOMES.

1. 8 HISTON PROTEINS
2. DNA round them

2. Link DNA.

CHROMATIN - ORGANIZATION
Organization of the chromatin
Types of chromatin

In interphase nucleus:

a. Heterochromatin – condensed, inactive - 90%.

1. Stained intensively with basic dyes
2. Demonstrated with Foilgen’s reaction for DNA

Location: inner membrane, nucleolus, inside in carioplasm
Types of chromatin

- b. Euchromatin
  - dispersed,
  - active,
  - place of RNA
Types of chromatin
Structure of nucleus
Nucleus membrane
Nucleus membrane consists of two elementary membranes

- Border between nucleus and cytoplasm

A. Outer membrane - in connection with rER,
   - covered with ribosomes

B. Inner membrane – covered with nucleus lamina

C. Perinuclear space – between both membranes.

In connection with the space of the cyarernae of rER
Structure of nuclear membrane
Nuclear pores

Communication between nucleoplasm and cytoplasm.

A. Structure. Cylindrical shape, D= 120nm, D of the inner channel=9nm

1. Nuclear pore complex - octagonal structure.
2. 100 globular proteins , weight 125 x 10^6 D.

2. 3 000 - 4 000 pores in the nuclear membrane.

The number increases with transcription.
Nuclear pore
Nucleolus
Place of transcription of rRNA

A. Morphology. Non-membrane structure, stained with basic dyes

1. Only in nucleus in interphase.
2. During mitosis disappears
   a. 1-3 nuleolus in one nucleus.
   b. 1-3 mcm. More in protein-synthetising cells
   c. Nucleolononema – coiled fiber, seen after impregnation
   d. Nucleolar organizors – in chromosomes (13, 14, 15, 21, 22)

2. EM - pars granulosa, pars fibrosa, pars amorpha
Nucleolus

A. No membrane

B. Structure:
1. Pars granulosa - nucleonema (0.5 μm)
2. Pars fibrosa

C. Function – synthesis of rRNA and ribosomes
Pars granulosa и pars fibrosa
Cell cycle

(\text{Go})

Presynthetic period (G1)
- DNA polymerase
- Synthesis of iRNA and tRNA

Synthetic period (S)
- DNA replication
- Postsynthetic period (G2)
- Spiralization of DNA
- Synthesis of rRNA

M itosis (M)
46 chromosomes
92 chromatids

92 chromosomes (4N amount of DNA)
divided equally between two daughter cells

46 chromosomes
92 chromatids
(4N amount of DNA)

46 chromosomes
(2N amount of DNA)

6-12 hr
duplication of
chromosomal DNA

G2
4 hr

G1
10-11 hr

M
1 hr

G0
Mitosis

**Prophase (spirem)**
1. Chromosome appears, nucleolus and nuclear membrane disappear, mitotic spindle is formed.

**Metaphase (monaster)**
   a) Chromosomes are in the centre.

**Anaphase (diaster)**
   a) 2x centrioles
   b) At both poles.

**Telophase (dispirem)**
   a) Despiralization of the chromosomes
   b) Appearance of nucleolus and nuclear membrane
   c) Division of cytoplasm in both daughter cells.