

BASICS OF NEUROBIOLOGY

CELL ORGANELLES I.

ZSOLT LIPOSITS

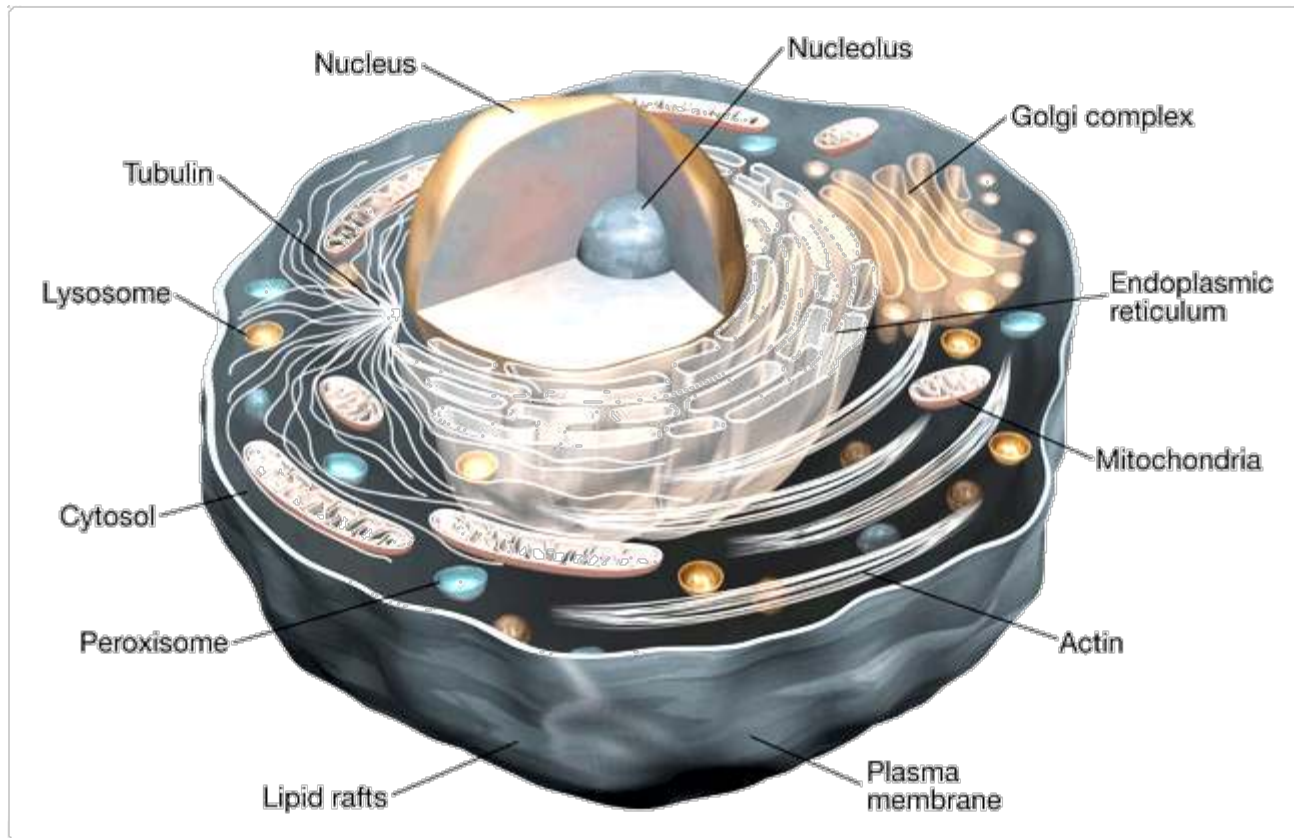
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PROKARYOTIC AND EUKARYOTIC CELLS

SUBCELLULAR STRUCTURES OF THE ANIMAL CELLS

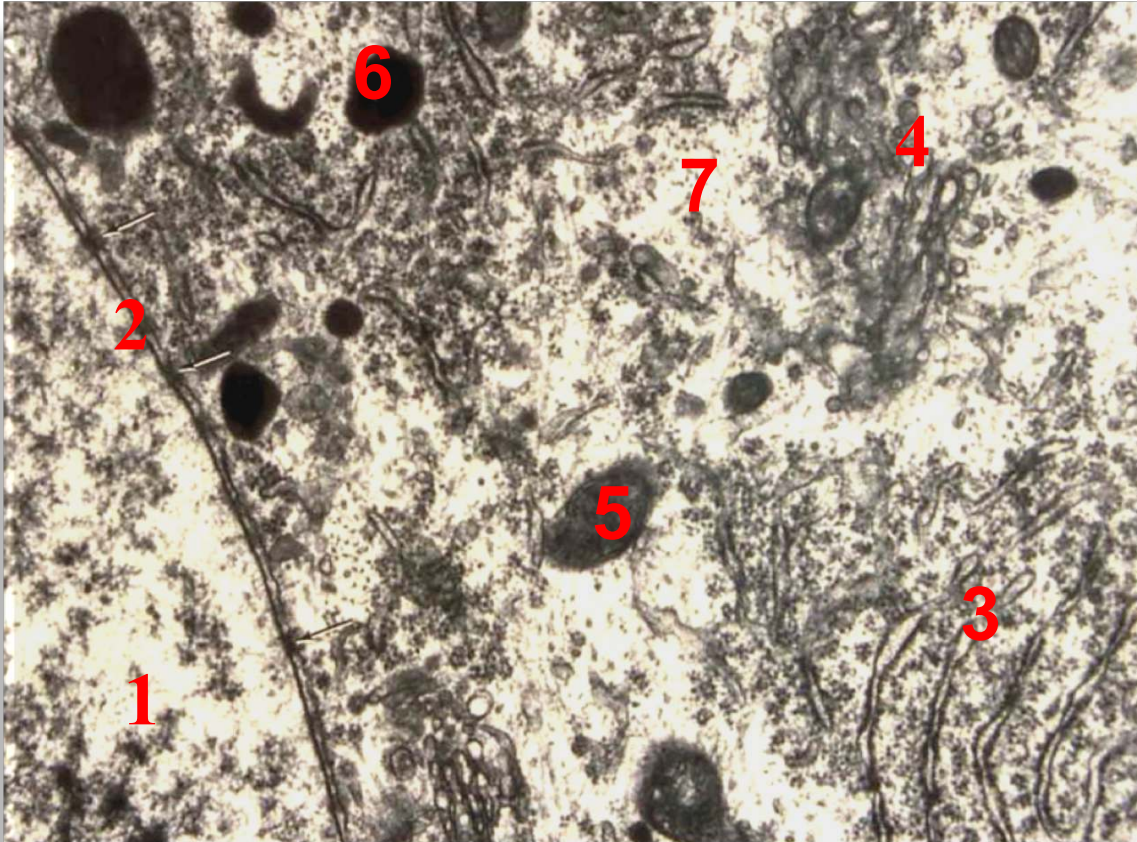
- CELL MEMBRANE
- CYTOPLASM
- CELL NUCLEUS
- NUCLEOLUS
- ROUGH ENDOPLASMIC RETICULUM
- SMOOTH ENDOPLASMIC RETICULUM
- GOLGI APPARATUS
- TRANSPORT VESICLES
- LYSOSOMES
- MITOCHONDRION
- CYTOSKELETON
- CILIUM
- CENTRIOLUM

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ULTRASTRUCTURAL DETAILS OF ORGANELLES



1. NUCLEUS
2. NUCLEAR MEMBRANE
3. ROUGH ER
4. GOLGI-APPARATUS
5. MITOCHONDRION
6. LYSOSOME
7. CYTOPLASM

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THE CELL MEMBRANE

FLUID MOSAIC MODEL OF MEMBRANE STRUCTURE

STRUCTURE OF THE PHOSPHOLIPID MOLECULE, AMPHIPATHIC CHARACTER

THE PHOSPHOLIPID BILAYER

INNER MEMBRANE PROTEINS

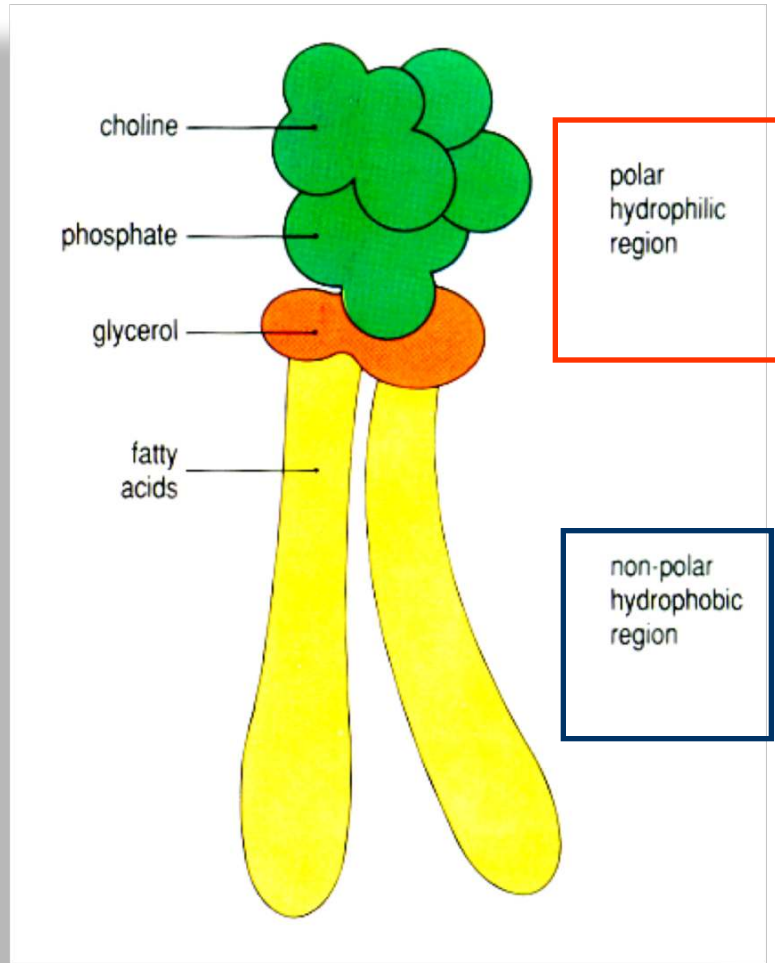
SURFACE PROTEINS

TRANSMEMBRANE PROTEIN

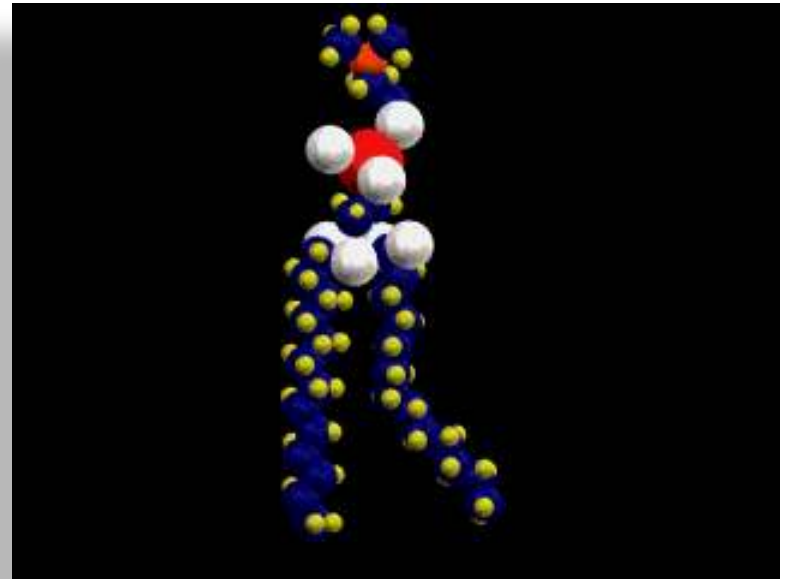
GLYCOPROTEINS AND GLYCOLIPIDS

FREEZE-FRACTURE IMAGE OF THE MEMBRANE, P AND E FACES

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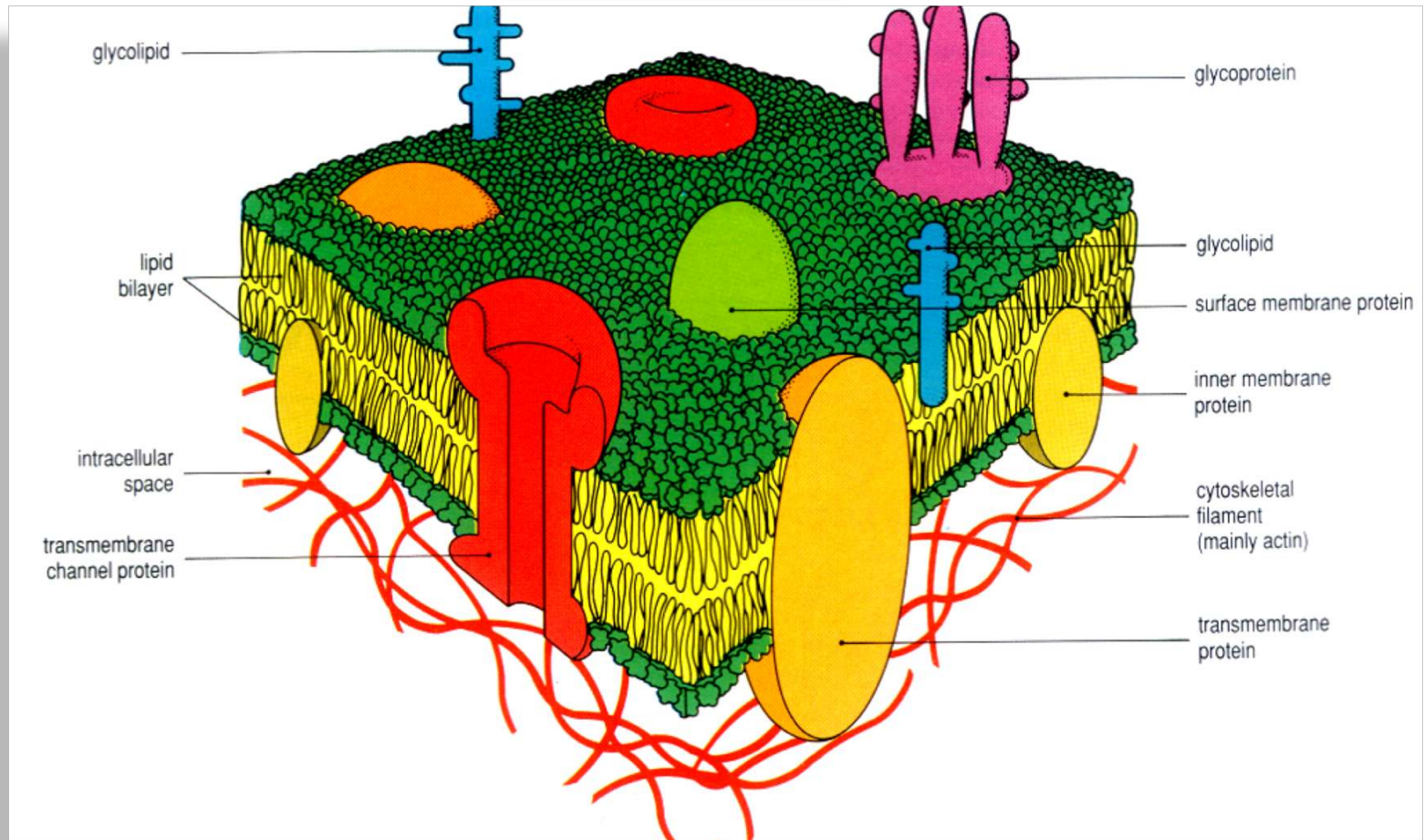


Phospholipid molecule

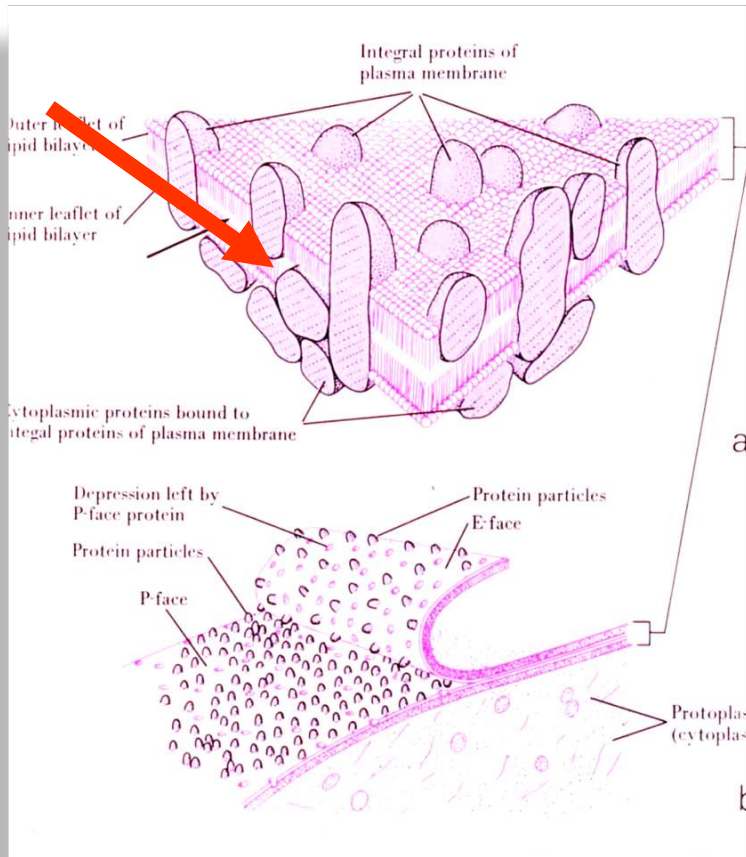


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Cell membrane



Freeze fracture



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CYTOPLASM

CELL MEMBRANE-ENCLOSED PART OF THE CELL HOSTING THE CELL ORGANELLES

IT IS A GEL THAT MAKES UP 70% OF THE WHOLE CELL VOLUME

CONTAINS WATER, INORGANIC SALTS AND ORGANIC MOLECULES

THE CYTOSKELETON IS EMBEDDED, THE ORGANELLES ARE SUSPENDED IN IT

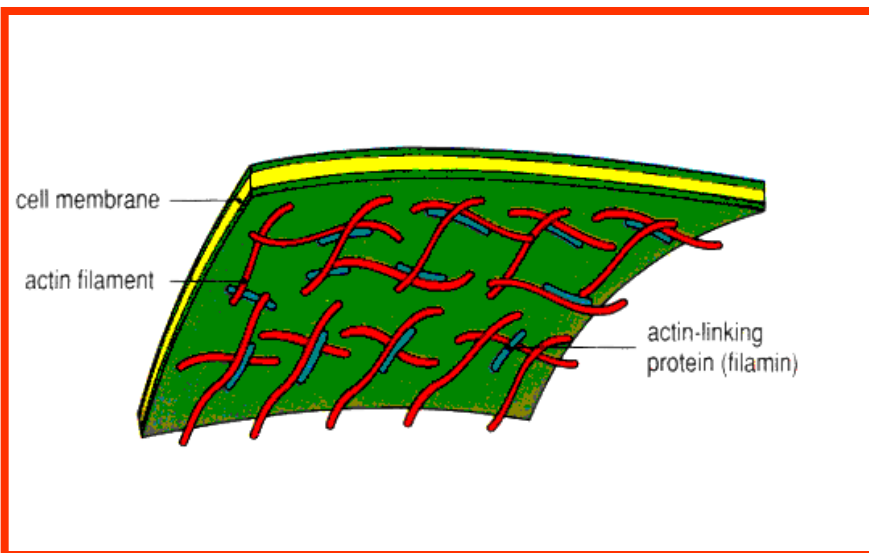
SITE OF METABOLIC ACTIONS, SIGNAL TRANSDUCTION AND CELL DIVISION

GIVES A PLASTIC CHARACTER TO THE CELL

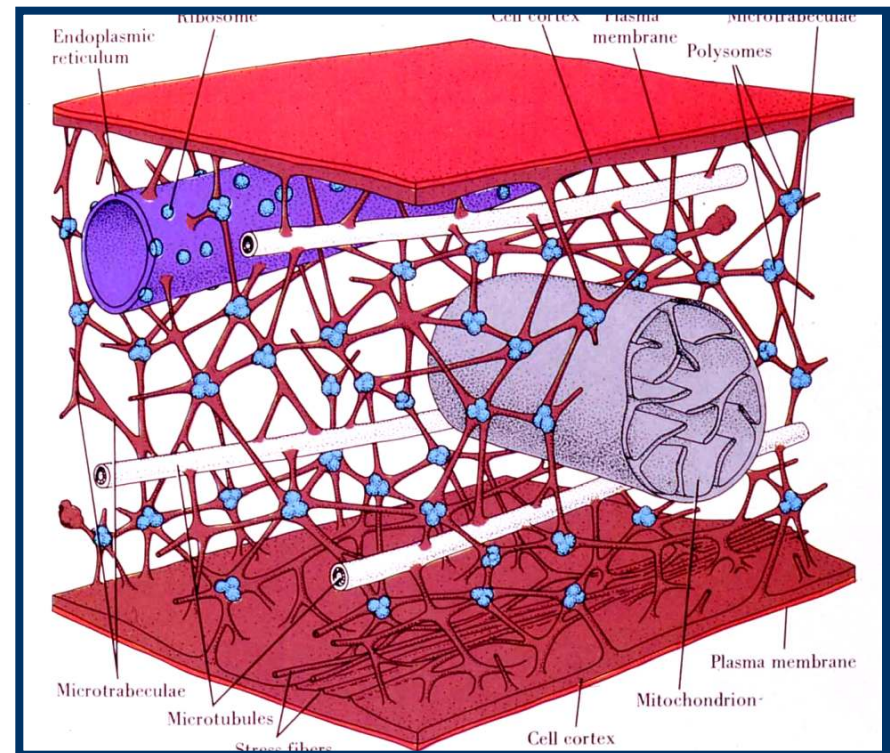
IN CONVENTIONAL HISTOLOGICAL PREPARATIONS IT SHOWS EOSINOPHYLIA

IN SLICE PREPARATION ITS HARVESTING IS POSSIBLE FOR MOLECULAR ANALYSIS

Cell cortex



Cytoskeleton



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TRANSPORT ACROSS PLASMA MEMBRANES

PASSIVE DIFFUSION

CONCENTRATION GRADIENT DEPENDENT, ALCOHOL, GASES

FACILITATED DIFFUSION

PASSIVE, REQUIRES TRANSPORTERS, GLUCOSE, AMINO ACIDS

ACTIVE TRANSPORT

REQUIRES ENERGY (ATP), OPERATES AGAINST CONCENTRATION GRADIENTS

UTILIZES TRANSMEMBRANE CHANNELS, SODIUM/POTASSIUM PUMP

BULK TRANSPORT

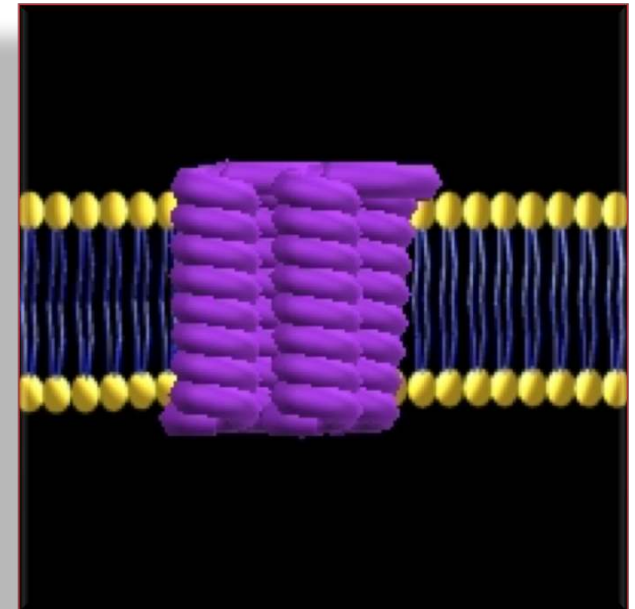
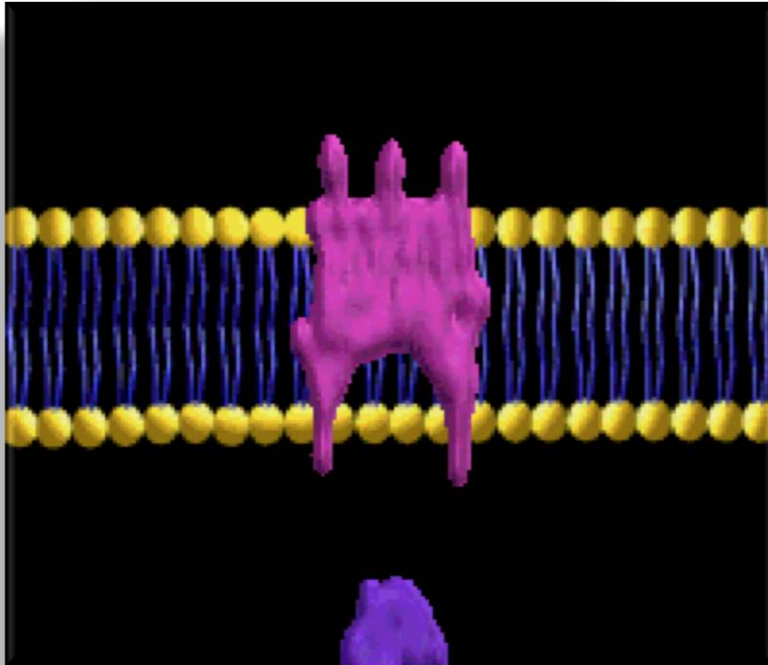
ENDOCYTOSIS, EXOCYTOSIS

PHAGOCYTOSIS

PINOCYTOSIS

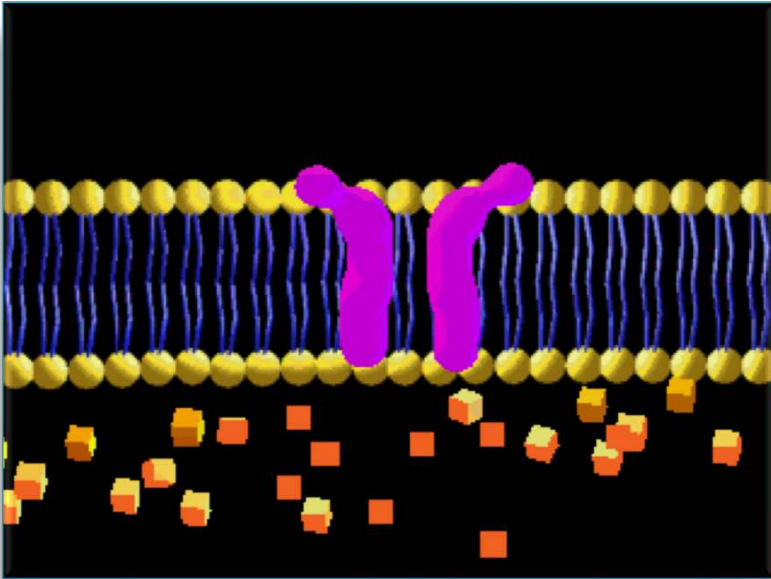
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RECEPTOR PROTEIN

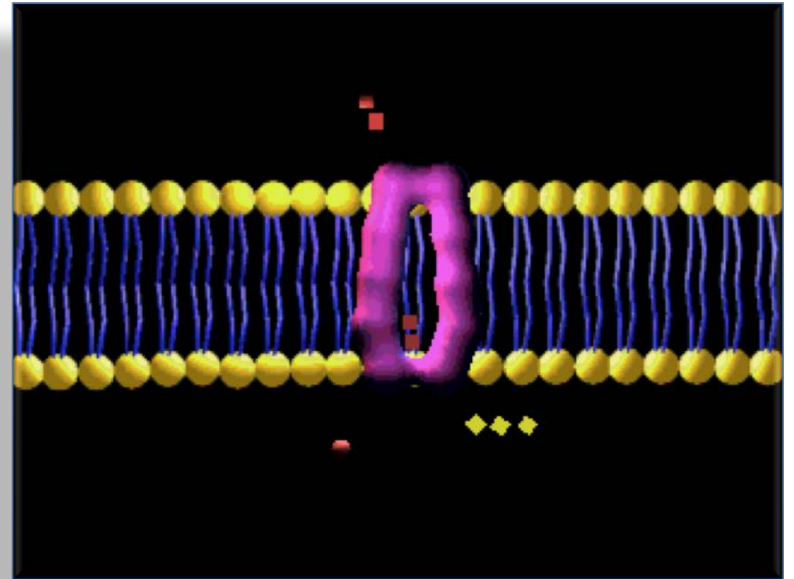


MARKER PROTEIN

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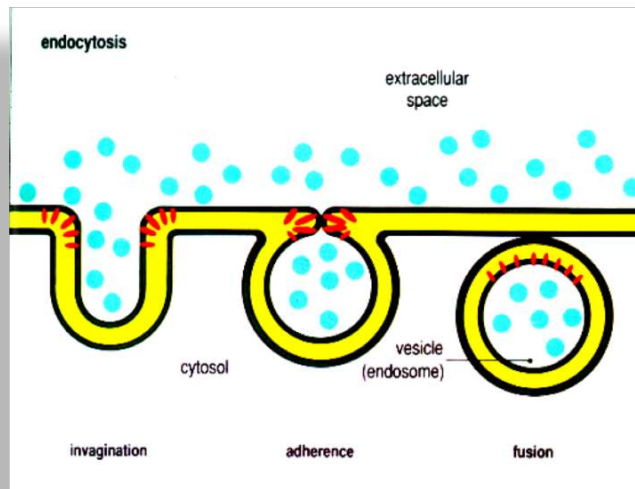


DIFFUSION

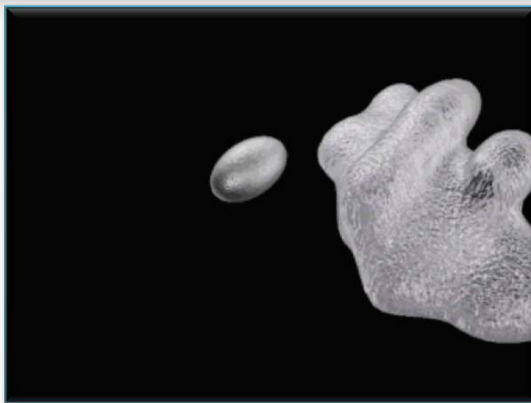
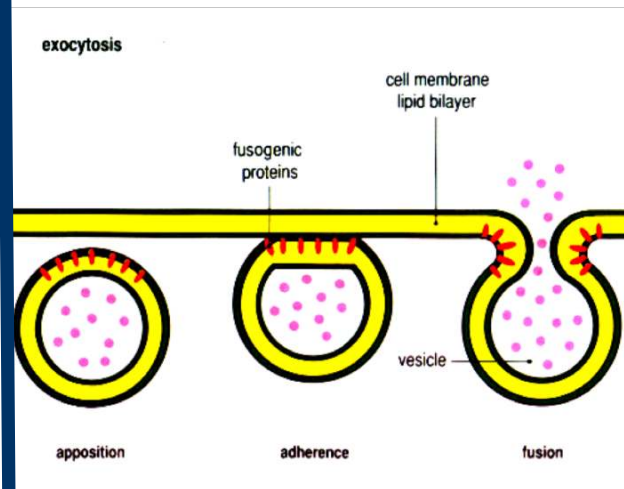


Na⁺/K⁺/ATPase PUMP

Endocytosis

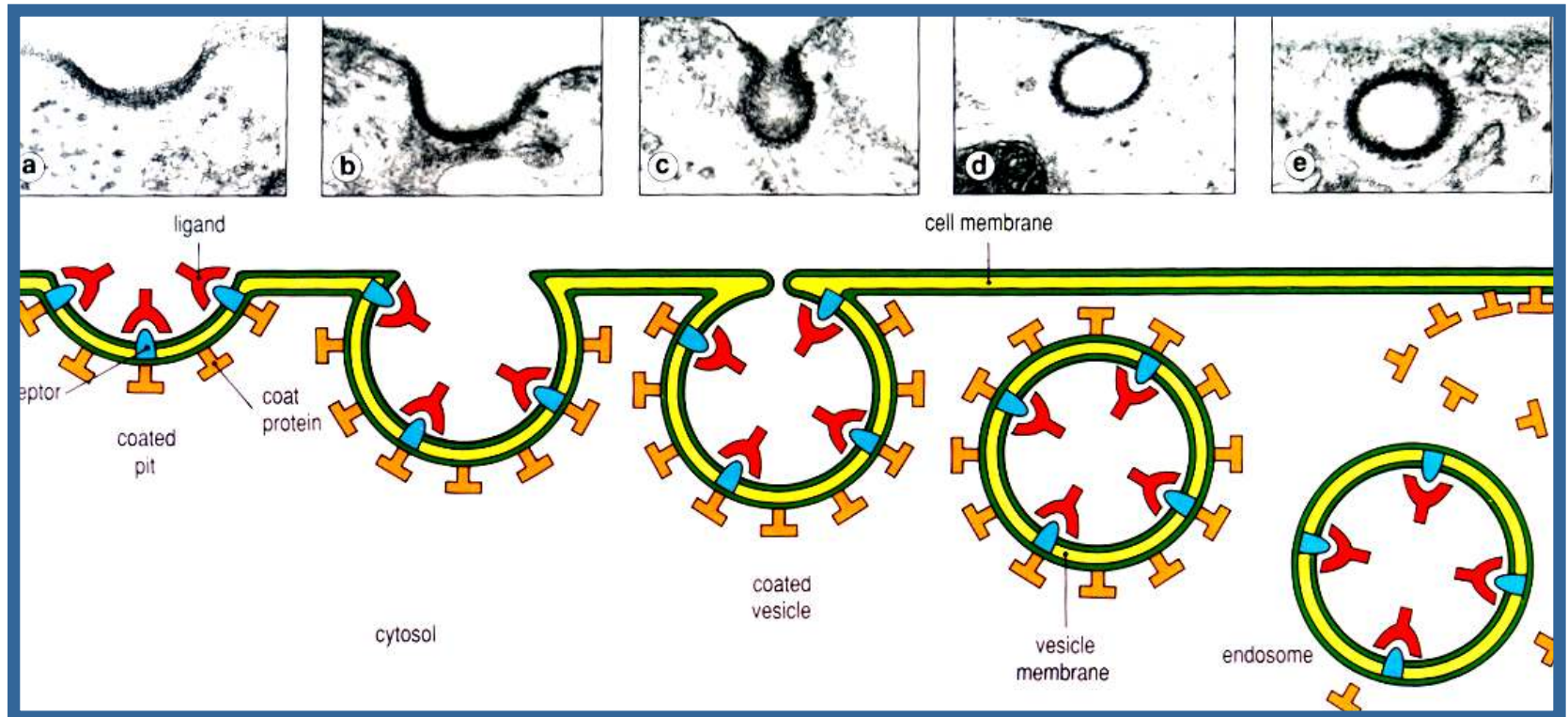


Exocytosis

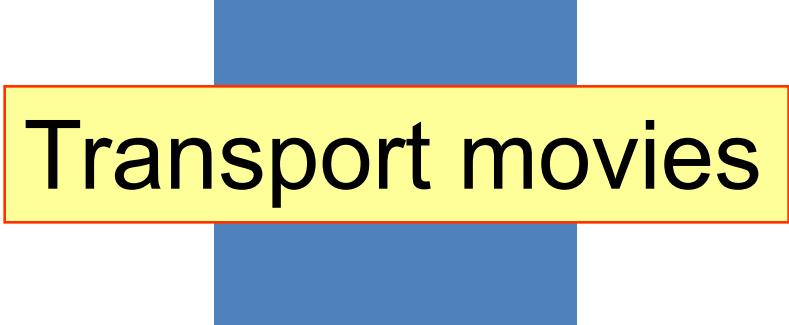


PHAGOCYTOSIS

PINOCYTOSIS



Clathrin coat



Transport movies

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CELL NUCLEUS

NUCLEAR ENVELOPE

DOUBLE MEMBRANE LAYER, CONTINUOUS WITH ROUGH ENDOPLASMIC RETICULUM

NUCLEAR PORES

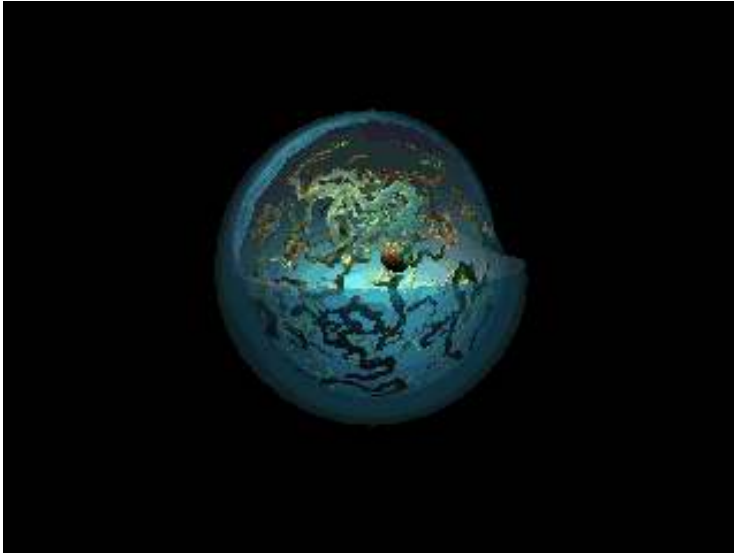
HOLES IN THE DOUBLE MEMBRANE, NUCLEAR PORE COMPLEX, REGULATES TRAFFICKING BETWEEN THE NUCLEUS AND CYTOPLASM (MACROMOLECULES, RNA)

NUCLEAR MATRIX

DNA (DEOXYRIBONUCLEIC ACID), GENETIC CODE, EU- AND HETEROCHROMATIN
RIBONUCLEIC ACID (RNA), TRANSFER, MESSENGER AND RIBOSOMAL
NUCLEOPROTEINS, HISTONE- AND NON-HISTONE TYPES, REGULATE TRANSCRIPTION,
BARR BODY, FEMALE SEX-CHROMOSOME

STORAGE OF GENETIC INFORMATION, THE HUMAN GENOME, TRANSCRIPTION

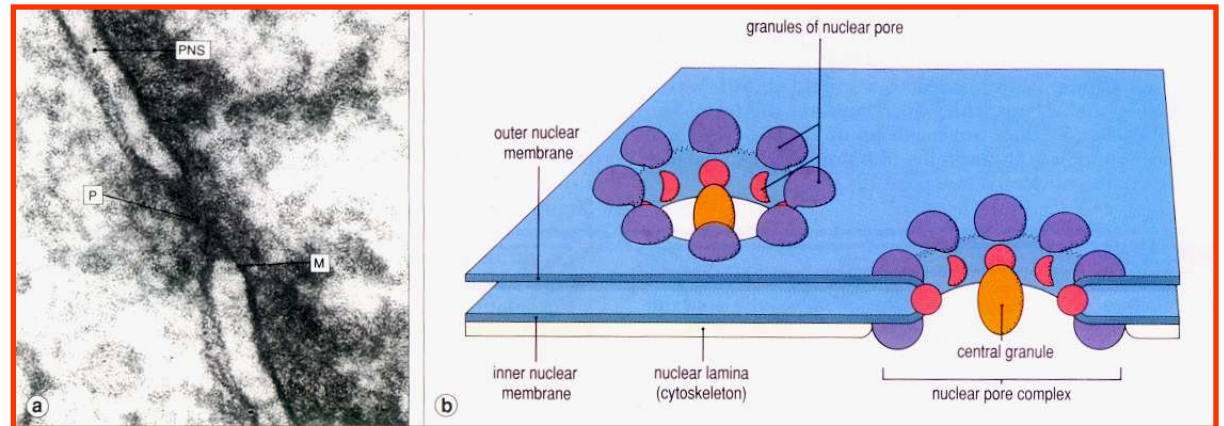
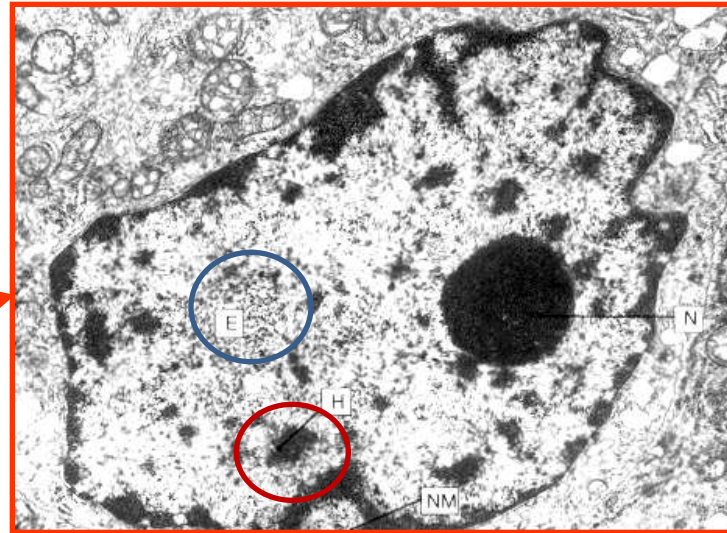
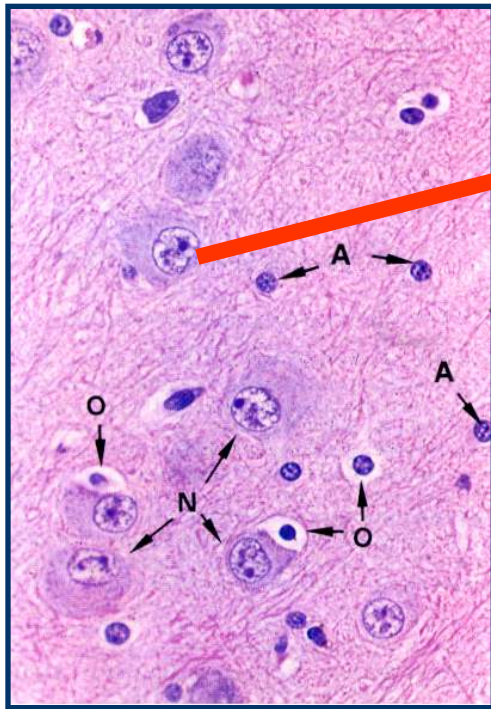
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Processing of genetic information



NUCLEUS



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NUCLEOLI

ONE OR TWO SPHERICAL STRUCTURES LOCATED IN THE NUCLEUS

NO MEMBRANE COVER

PROMINENT IN CELLS UNDER INTENSE PROTEIN SYNTHESIS

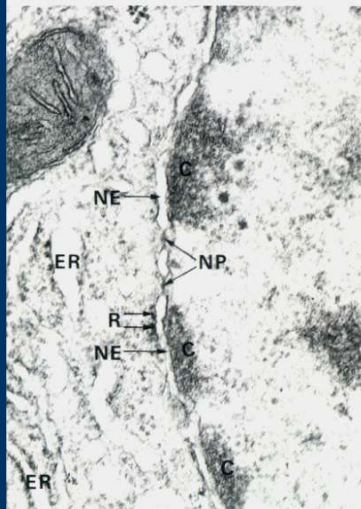
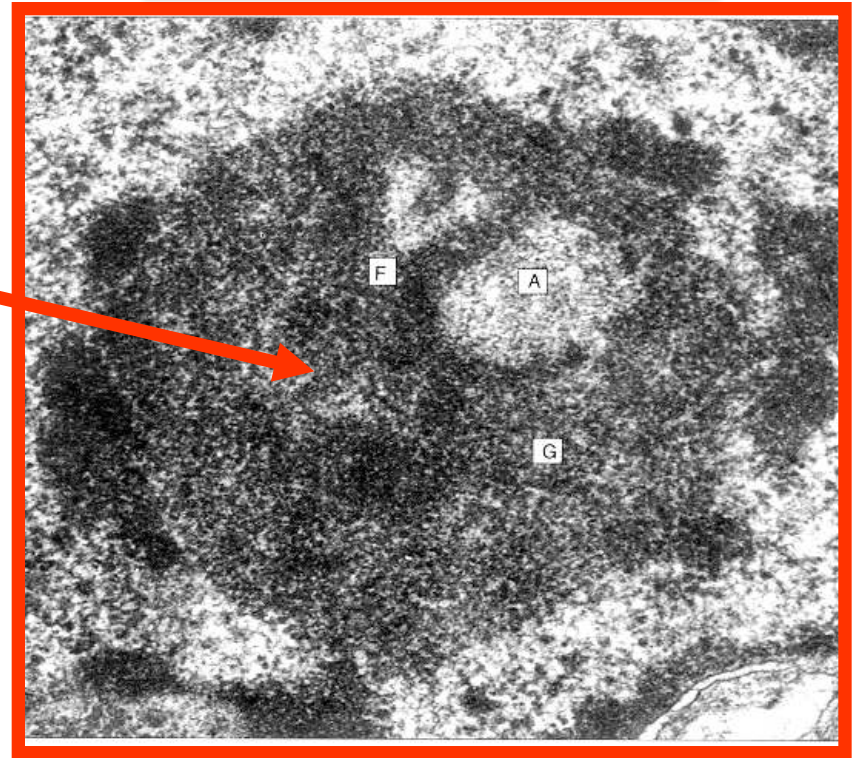
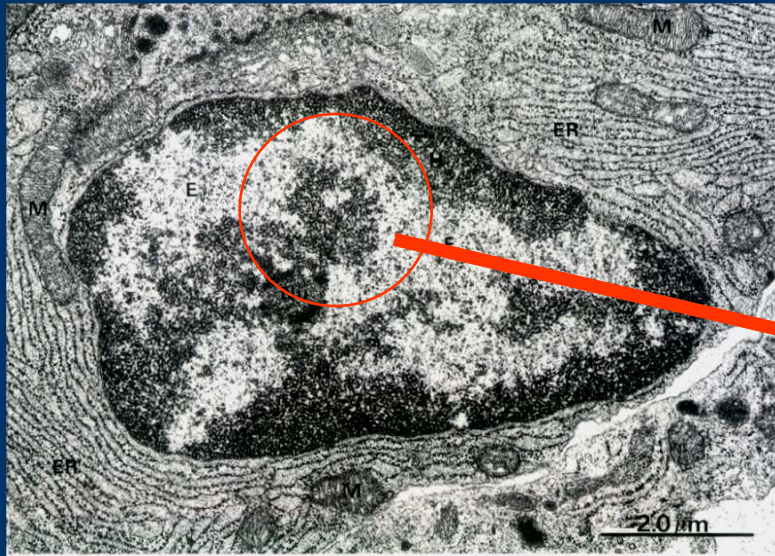
DEVELOPS AT NUCLEOLAR ORGANIZING REGIONS (ribosomal RNA genes)

STRUCTURALLY ORGANIZED IN AMORPH (A), FIBRILLAR (F) AND GRANULAR (G) COMPONENTS

PRODUCE RIBOSOMAL RNAs THAT ARE CONJUGATED WITH RIBOPROTEINS IN ORDER TO MAKE RIBOSOMAL SUBUNITS

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NUCLEOLUS



A: amorph
F: fibrillary
G: globular

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ROUGH ENDOPLASMIC RETICULUM (RER)

A LABYRINTHINE COMPLEX MEMBRANE STRUCTURE COMPOSED BY TUBULES, VESICLES AND FLATTENED SACS

RIBOSOMES ARE ATTACHED TO THE OUTER SURFACE OF THE PARALLELLY ORIENTED SACS

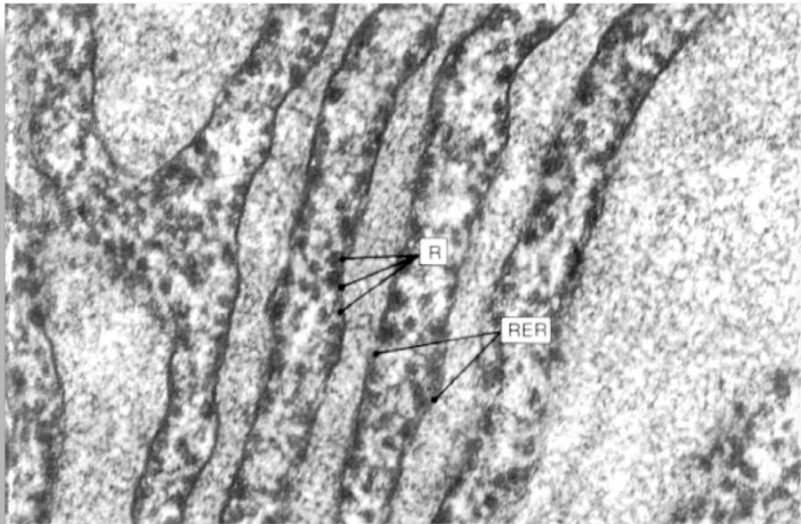
DUE TO ITS HIGH RIBONUCLEIC ACID CONTENT IT SHOWS AN INTENSE BASOPHYLIA
IN NEURONS, THE RER PATCHES ARE CALLED NISSL-BODIES

PROTEIN SYNTHESIS TAKES PLACES AT THE RIBOSOMES OF THE OUTER SURFACE

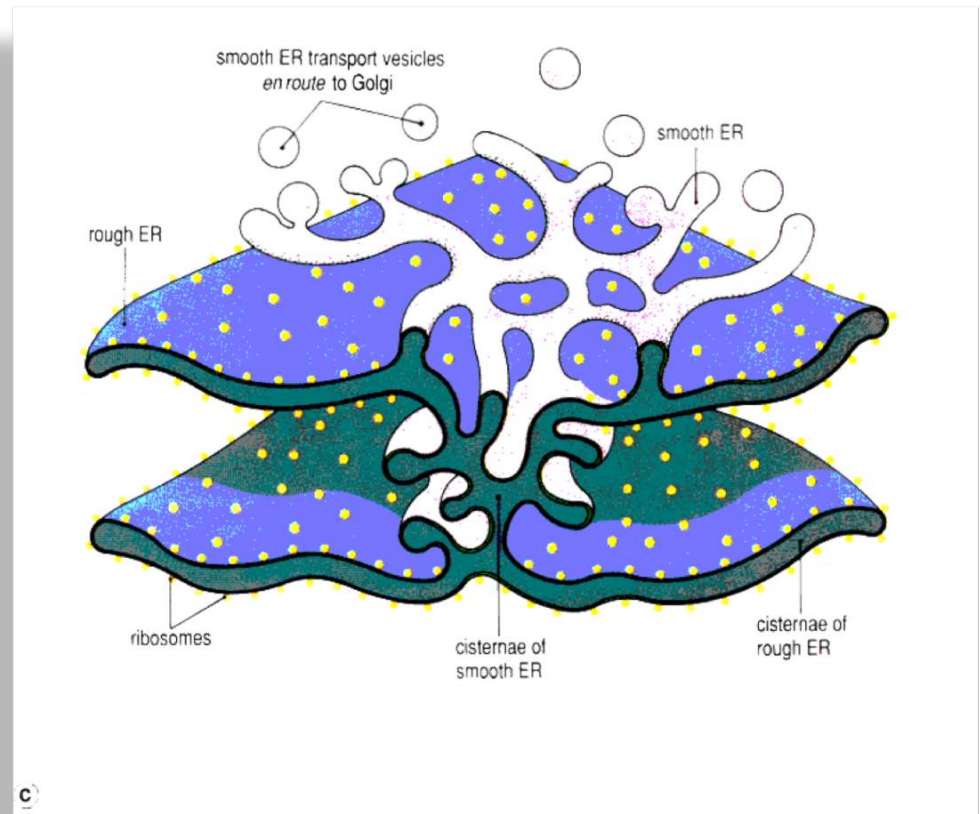
NEWLY SYNTHESIZED PROTEINS GET INTO THE LUMEN OF THE MEMBRANE SACKS

IN CELLULAR HYPERTROPHY, RER BECOMES DOMINANT IN THE CYTOPLASM

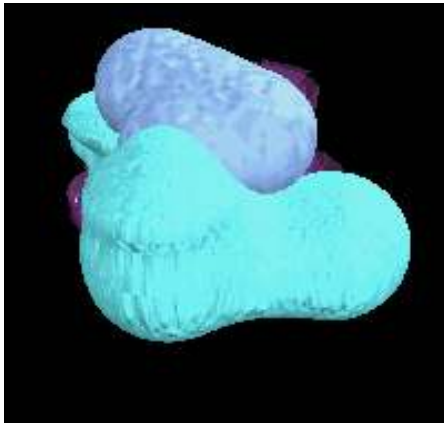
RER



SER



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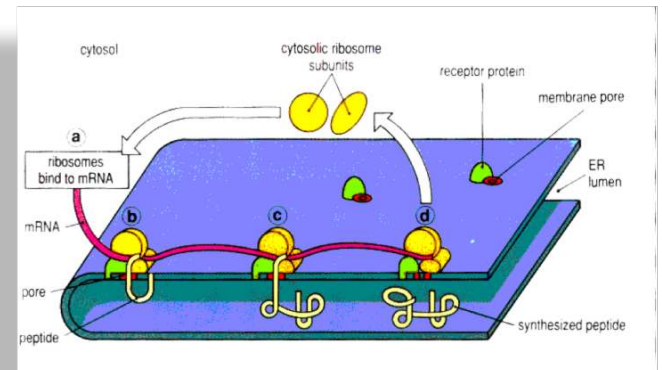
RIBOSOME

Ergastoplasm



Animation of protein synthesis

PROTEIN SYNTHESIS



5' cap AUGAGAUACCAAGAACCUACCAAGGUAGAGCUUUAGCCCG AAAAAAAAAAAAAA 3'

TRANSLATION

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SMOOTH ENDOPLASMIC RETICULUM (SER)

IRREGULAR NETWORK OF MEMBRANOUS TUBULES AND VESICLES

IN CONTRAST TO RER, IT DOES NOT CARRY RIBOSOMES

CONTINUOUS WITH THE RER SYSTEM AND LINKED TO THE GOLGI SYSTEM

SER TAKES PART IN LIPID SYNTHESIS, GLYCOGEN METABOLISM, BREAK DOWN OF METABOLITES AND DETOXIFICATION

STORES AND RELEASES CALCIUM IN EXCITABLE TISSUES (MUSCLE, NERVOUS TISSUE)

ABUNDANT IN LIVER CELLS AND STEROID-SYNTHESIZING ENDOCRINE CELLS