CONCEPT: mRNA EXPORT AND THE NUCLEUS

Nuclear Structures

● The nucleus consists many _____ with different functions

□ The **nuclear envelop** is formed by two lipid bilayers

- Outer membrane is continuous with the ER

- The perinuclear space (space between two membranes) is the same as the ER lumen

□ **Nuclear pore complexes** reside in the nuclear envelop and _____ the nucleoplasm and cytosol

- Cylindrical channel built from ~30 nucleoporin proteins

- Around 3000-4000 pores per cell

- Transfers proteins greater than 30,000 Daltons (smaller molecules just diffuse)

□ The **nuclear lamina** is a matrix of proteins that provides shape and support to the nucleus

- **Lamins** are proteins that line the inner surface of the nuclear membrane (10-40nm thick)

□ The **nucleoulus** is the location where ribosomes are _____

- Contains the **nuclear organizer region** (NOR) = stretch of DNA that contains multiple rRNA gene copies

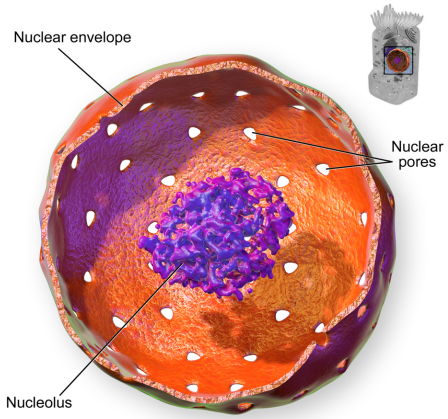
- Proteins important for ribosomal synthesis also accumulate here

□ Other less known structures include *cajal bodies, GEMs,* and *speckles*

□ Chromatin (DNA and protein) is located within specific regions of the nucleus

- Heterochromatin (condensed chromatin) binds to specific regions of the nuclear envelop

EXAMPLE: Nucleus Structure



Nucleus

mRNA export

● After transcription pre-mRNAs must be _____ from the nucleus because translation occurs in the cytosol

□ A pre-mRNA must bind to the *mRNP exporter* before it will be exported

- A **nuclear export signal** is recognized by the exporter protein

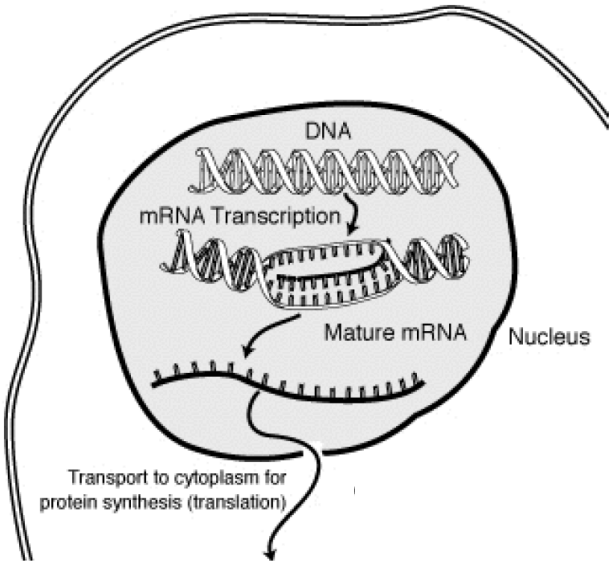
□ pre-mRNA is exported through nuclear pore complexes

- Only correctly processed mRNA can be exported from the nucleus

- Travels 5' through the pore

□ An **exosome** _____ any improperly processed RNA and introns left in the nucleus

EXAMPLE: pre-mRNA exported from the nucleus into the cytosol



Nuclear Import

● **Nuclear localization signals (NLS)** are required for proteins needing to get into the nucleus

□ Contain large stretches of lysine and arginine

- Import is regulated by proteins binding to and block recognition of the NLS

□ The **importin** protein recognizes the _____ in the cytosol

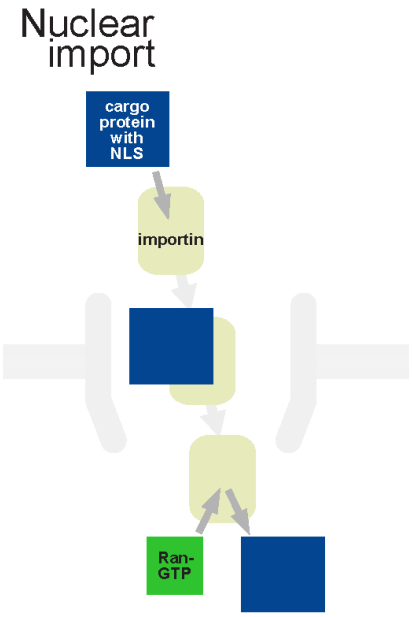
- This protein is transported to the nucleus via the nuclear pore

□ A **RAN-GTP** protein then binds to importin and releases the NLS containing protein into the nucleus

- Then the Ran-GTP – importin complex travels back through the nuclear pore

□ The **RAN-GTP** hydrolyzes to GDP and release importin – which is free to repeat the cycle

EXAMPLE: Process of nuclear import



PRACTICE:

1. Match the following nuclear locations to its function
   i. Nuclear pore complexes _____
   ii. Nuclear lamina _____
   iii. Nucleolus _____
   iv. Nuclear Envelope _____

A. Matrix of proteins that provide nuclear shape and structure
B. Processing of ribosomes
C. Separate the nucleus from the cytoplasm
D. Allow for transport between the nucleus and cytoplasm

2. Ribosomes are synthesized in which of the following locations?
    a. Nuclear Pore Complex
    b. Nuclear Lamina
    c. Nucleolus
    d. Cytoplasm

3. Import of molecules into the nucleus requires the use of importin and RAN-GTP. When RAN-GTP binds to importin, what happens to the molecule?
    a. The molecule is released into the cytoplasm
    b. The molecule is released into the nucleus
    c. The molecule is bound in the cytoplasm
    d. The molecule is bound in the nucleus

4. True or False: Unprocessed mRNA is exported from the nucleus to be processed before translation.
    a. True
    b. False