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# Nucleus

**Exam — Cell Organelles**

Pre-Med practice questions about the nucleus, chromatin, and nuclear components

**8 items — Printable Exam**

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**1** **What is the primary function of the nucleolus in a eukaryotic cell?**

A Replication of chromosomal DNA before mitosis.

B Synthesis and processing of ribosomal RNA and assembly of ribosomal subunits.

C Storage of mRNA molecules before translation.

D Degradation of misfolded nuclear proteins.

E Attachment of chromosomes to the nuclear envelope.

**2** **Which statement about the nuclear envelope of a typical eukaryotic cell is correct?**

A It consists of a single phospholipid monolayer surrounding the nucleus.

B Its outer membrane is continuous with the rough endoplasmic reticulum.

C Nuclear pore complexes permit only RNA, but not proteins, to pass.

D The nuclear lamina is composed of microtubules attached to the inner membrane.

E It remains completely intact and unchanged throughout mitosis in all eukaryotic cells.

**3** **Which of the following molecules requires active, signal-mediated transport through a nuclear pore complex to enter the nucleus from the cytosol?**

A Carbon dioxide.

B A 10-kDa ion such as $Na^+$.

C A 70-kDa transcription factor containing a nuclear localization signal.

D Water.

E Ribose and deoxyribose sugars.

**4** **In a non-dividing cell that is actively transcribing genes, nuclear DNA is predominantly found as:**

A Highly condensed metaphase chromosomes aligned on the spindle.

B Circular DNA molecules attached to the plasma membrane.

C Heterochromatin tightly packed and transcriptionally silent throughout the nucleus.

D Euchromatin that is relatively decondensed and accessible to transcription machinery.

E Single-stranded DNA molecules to allow rapid transcription.

**5** **Which feature distinguishes eukaryotic nuclear DNA from prokaryotic chromosomal DNA?**

A Eukaryotic nuclear DNA is always circular, whereas prokaryotic DNA is linear.

B Eukaryotic nuclear DNA is associated with histone proteins to form nucleosomes.

C Prokaryotic chromosomal DNA is enclosed by a nuclear envelope.

D Prokaryotic DNA is found exclusively in multiple chromosomes.

E Only prokaryotic DNA contains genes for ribosomal RNA.

**6** **A small molecule strongly activates histone acetyltransferases (HATs) in a population of eukaryotic cells. Which of the following is the most direct effect on chromatin and transcription?**

A Increased positive charge on histone tails, tighter DNA binding, and global transcriptional repression.

B Decreased acetylation of histones, leading to conversion of euchromatin into heterochromatin.

C Neutralization of positive charges on histone tails, loosening nucleosome–DNA interactions, and increased transcription of many genes.

D Degradation of histones in lysosomes, leaving naked DNA that cannot be transcribed.

E Conversion of nuclear DNA to circular form, enhancing transcription efficiency.

**7 A transcription factor contains a functional DNA-binding domain but acquires a point mutation that destroys its nuclear localization signal (NLS). The mutant protein is expressed at normal levels. Which outcome is most likely?**

A It accumulates in the cytosol and fails to activate transcription of its target genes.

B It accumulates in the nucleus because nuclear pores import all proteins by passive diffusion.

C It enters mitochondria instead, where it binds mitochondrial DNA.

D It is degraded immediately by lysosomes because it lacks an NLS.

E It still shuttles normally between cytosol and nucleus because exportins recognize any protein above a size threshold.

**8 In eukaryotic cells, the directionality of nuclear import and export cycles through nuclear pore complexes depends critically on:**

A The orientation of phospholipids in the nuclear envelope.

B A gradient of Ran-GTP and Ran-GDP across the nuclear envelope.

C Higher calcium concentration in the nucleus than in the cytosol.

D Continuous ATP generation by mitochondrial ATP synthase located in the nuclear envelope.

E Proteolytic cleavage of importins after each transport cycle.

# Answer Key

| # | Ans | Answer Text |
|---|---|---|
| 1 | B | Synthesis and processing of ribosomal RNA and assembly of ribosomal subu... |
| 2 | B | Its outer membrane is continuous with the rough endoplasmic reticulum. |
| 3 | C | A 70-kDa transcription factor containing a nuclear localization signal. |
| 4 | D | Euchromatin that is relatively decondensed and accessible to transcripti... |
| 5 | B | Eukaryotic nuclear DNA is associated with histone proteins to form nucle... |
| 6 | C | Neutralization of positive charges on histone tails, loosening nucleosom... |
| 7 | A | It accumulates in the cytosol and fails to activate transcription of its... |
| 8 | B | A gradient of Ran-GTP and Ran-GDP across the nuclear envelope. |