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## Objetivos del aprendizaje

- Entender la importancia del núcleo en la fisiología celular
- Analizar las diferentes estructuras presentes en el núcleo y sus propiedades
- Entender el mecanismo de transporte núcleo-citoplasma
- Interpretar la actividad metabólica del nucléolo
- Analizar el proceso de compactación de ADN

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### Temas relacionados:

- Estructura de la membrana biológica
- Proteínas de membrana
- Transporte entre compartimientos intracelulares
- Estructura del ADN
- Replicación del ADN
- Mutaciones. Reparación de ADN

### Núcleo

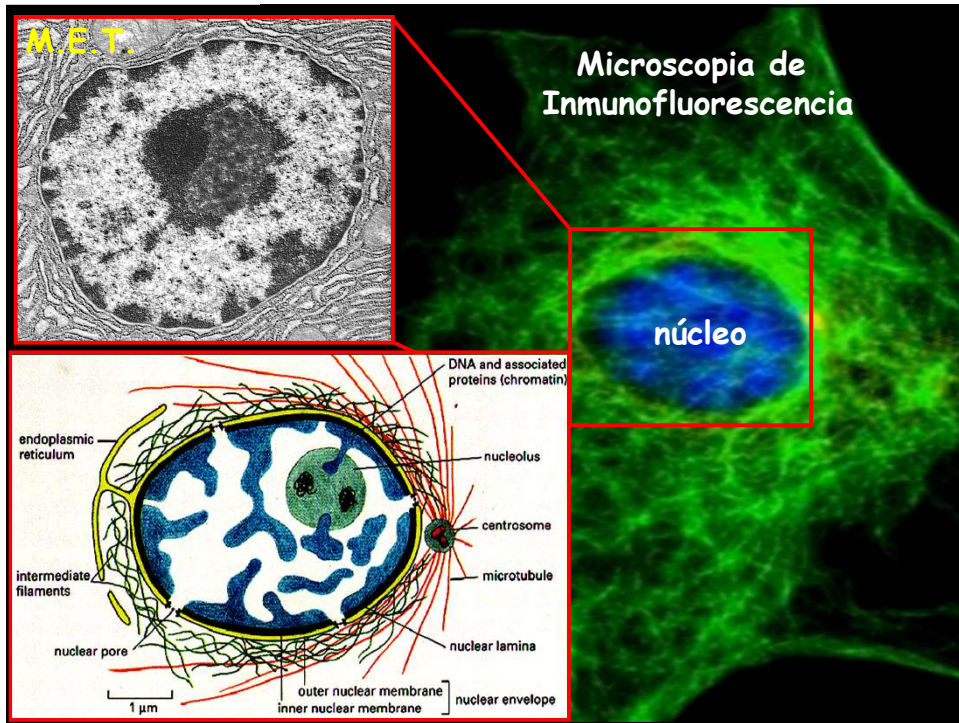
- Metodología del ADN recombinante
- Transcripción
- Traducción
- Ciclo celular. División celular
- Transducción de señales

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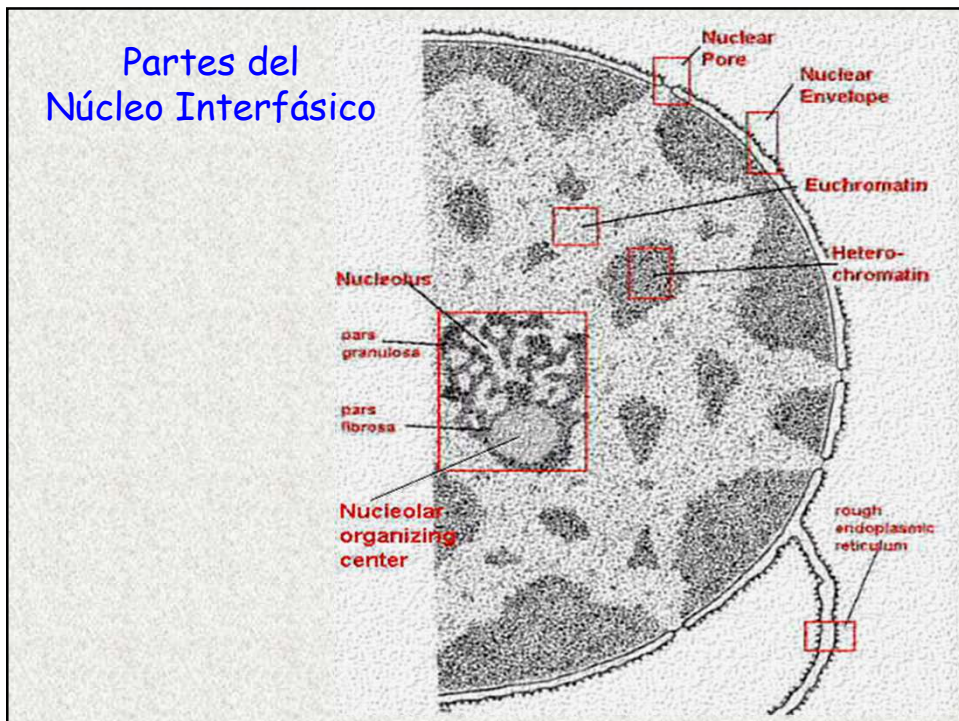
### Temario

- Estructura del núcleo celular
- Envoltura nuclear
- Poros nucleares. Complejo de poro
- Transporte núcleo-citoplasma
- Lámina nuclear
- Nucléolo: organizador nucleolar, unidad de transcripción nucleolar
- Compactación del ADN

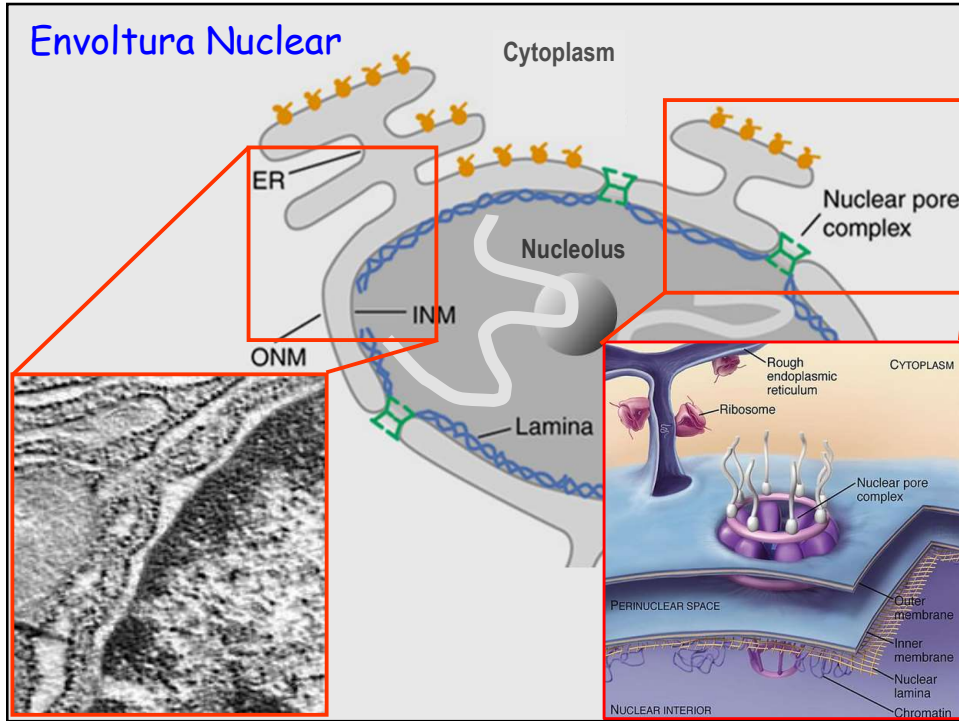
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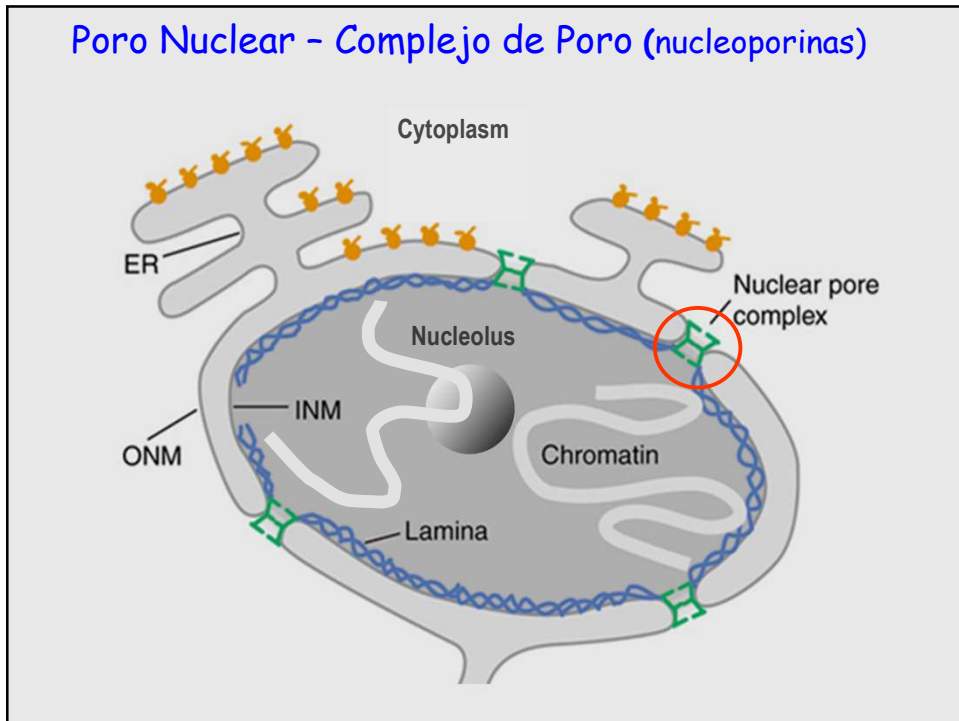
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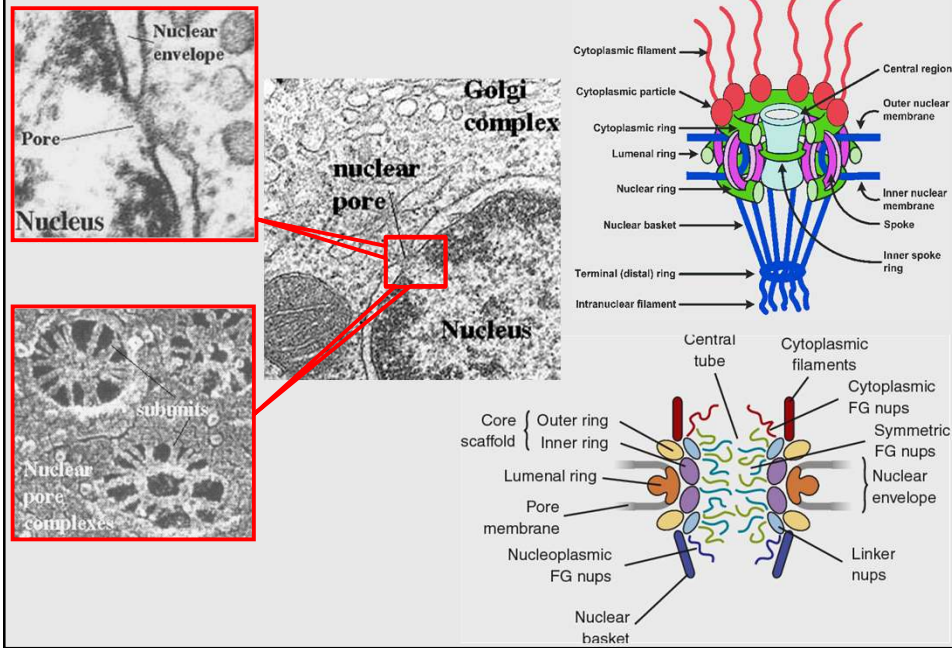


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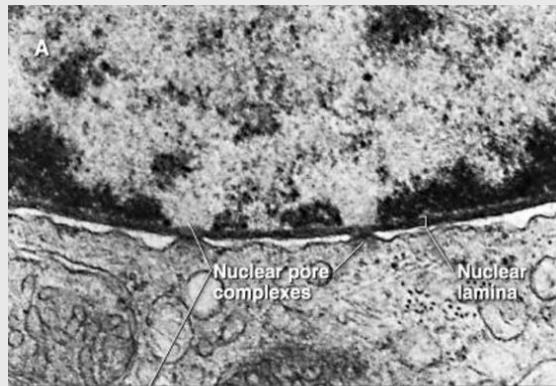
### Poros-Complejo de Poro: nucleoporinas (nups)



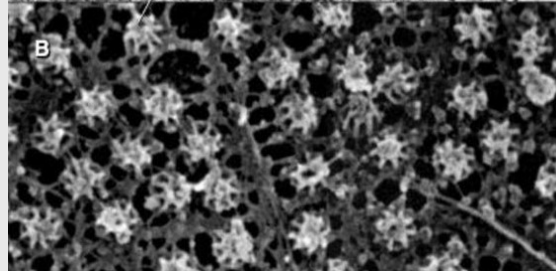
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### Micrografías electrónicas de la Envoltura Nuclear

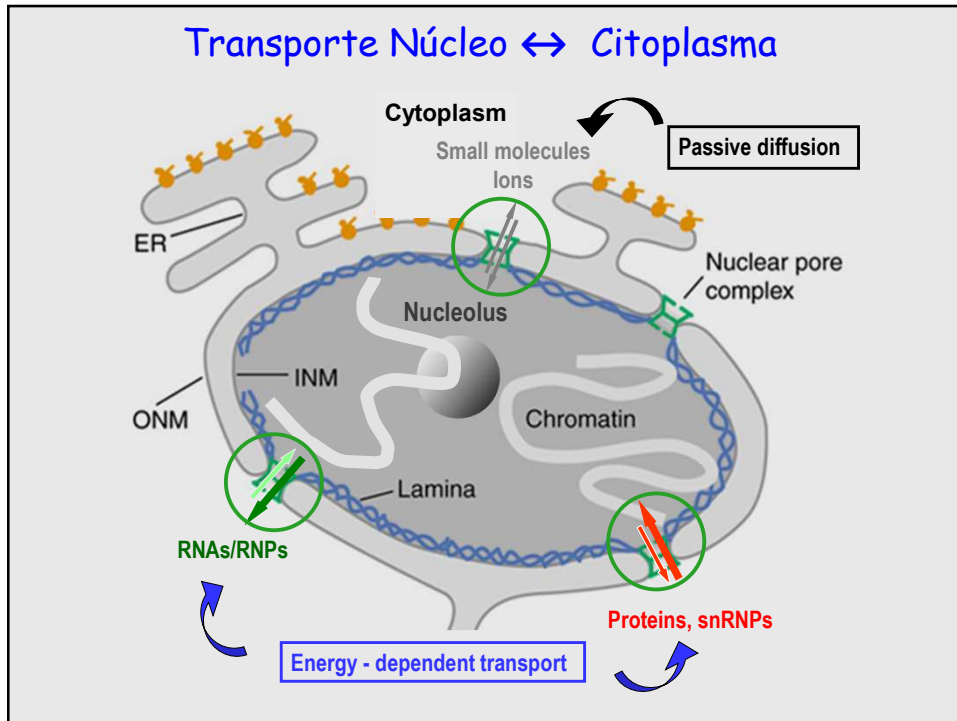
Microscopía electrónica en una sección fina



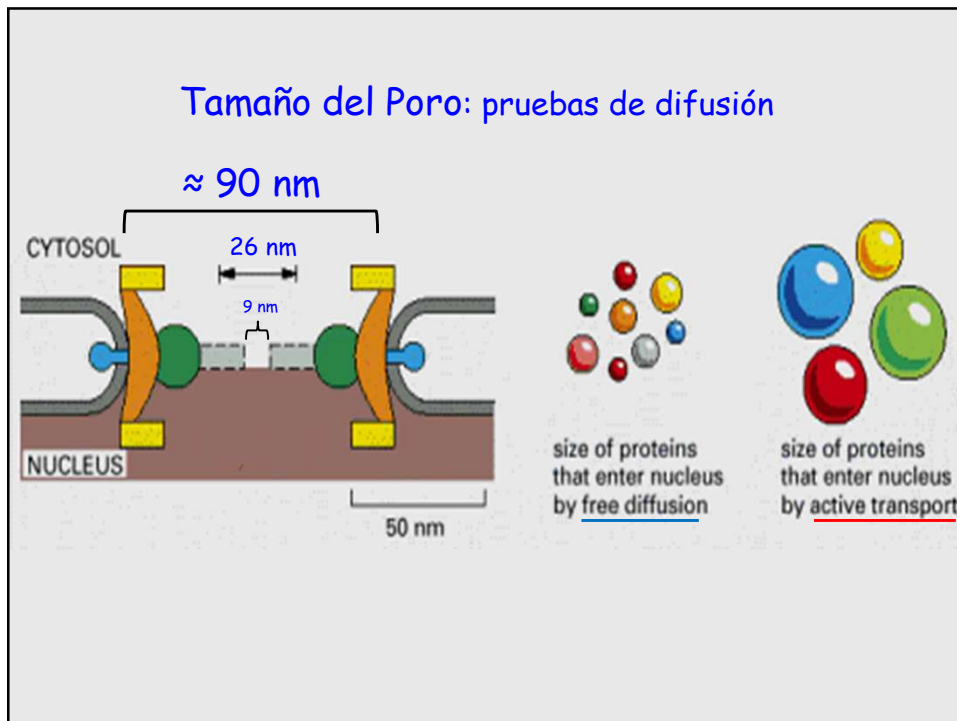
Microscopía de barrido



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## Tráfico Nuclear: Componentes

- Adaptadores (Adapters)
  - Reconocen las secuencias direccionales
    - NLS
    - NES
  - Ejemplos
    - Importin alfa – reconoce NLS
    - hnRNP A1 – para mRNAs
- Receptores
  - Reconoce los adaptadores y una vez unidos a estos se une a los filamentos nucleares del poro nuclear.
  - Interaccionan con GTPasa llamada Ran.
  - “Karyopherins” –familia de Importin  $\beta$
- Direccionalidad
- -Ran GTPasa informa a los receptores su la localizacion (nucleo o citoplasma)
- RanGTP es modificado dependiendo de que lado esta

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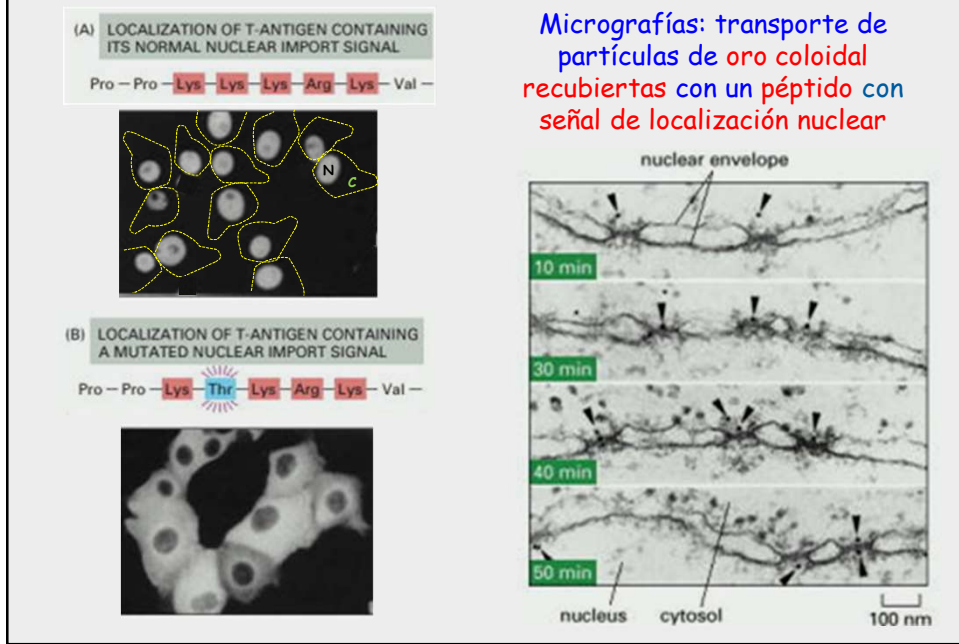
## Secuencias Señales en el transporte núcleo-citoplasma

FUNCTION OF SIGNAL SEQUENCE	EXAMPLE OF SIGNAL SEQUENCE
Import into nucleus	-Pro-Pro-Lys-Lys-Lys-Arg-Lys-Val- <span style="color: red;">KRPAATKKAGQA</span> <span style="color: red;">KKKK</span>
Export from nucleus	<span style="color: yellow;">-Leu-Ala-Leu-Lys-Leu-Ala-Gly-Leu-Asp-Ile-</span> <span style="color: yellow;">LQLPPLERLTL</span>
Import into mitochondria	<sup>+</sup> H <sub>3</sub> N-Met-Leu-Ser-Leu-Arg-Gln-Ser-Ile-Arg-Phe-Phe-Lys-Pro-Ala-Thr-Arg-Thr-Leu-Cys-Ser-Ser-Arg-Tyr-Leu-Leu-
Import into plastid	<sup>+</sup> H <sub>3</sub> N-Met-Val-Ala-Met-Ala-Met-Ala-Ser-Leu-Gln-Ser-Ser-Met-Ser-Ser-Leu-Ser-Leu-Ser-Ser-Asn-Ser-Phe-Leu-Gly-Gln-Pro-Leu-Ser-Pro-Ile-Thr-Leu-Ser-Pro-Phe-Leu-Gln-Gly-
Import into peroxisomes	<span style="color: blue;">-Ser-Lys-Leu-COO<sup>-</sup></span>
Import into ER	<sup>+</sup> H <sub>3</sub> N-Met-Met-Ser-Phe-Val-Ser-Leu-Leu-Leu-Val-Gly-Ile-Leu-Phe-Trp-Ala-Thr-Glu-Ala-Glu-Gln-Leu-Thr-Lys-Cys-Glu-Val-Phe-Gln-
Return to ER	<span style="color: red;">-Lys-Asp-Glu-Leu-COO<sup>-</sup></span>

Some characteristic features of the different classes of signal sequences are highlighted in color. Where they are known to be important for the function of the signal sequence, positively charged amino acids are shown in red and negatively charged amino acids are shown in green. Similarly, important hydrophobic amino acids are shown in yellow and hydroxylated amino acids are shown in blue. <sup>+</sup>H<sub>3</sub>N indicates the N-terminus of a protein; COO<sup>-</sup> indicates the C-terminus.

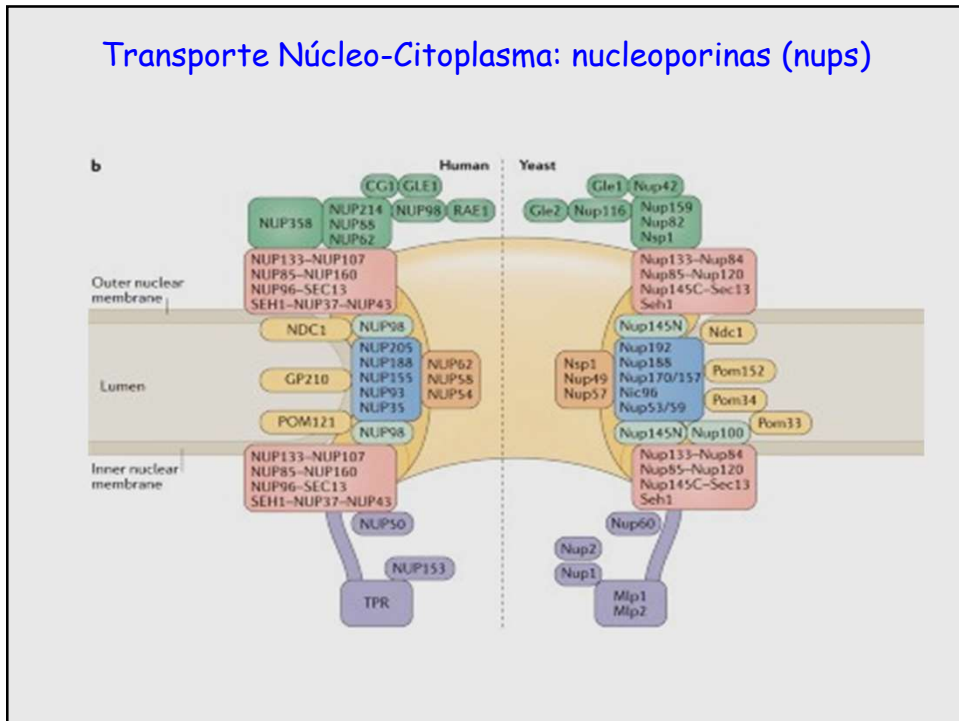
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### Localización del antígeno-T del virus SV40



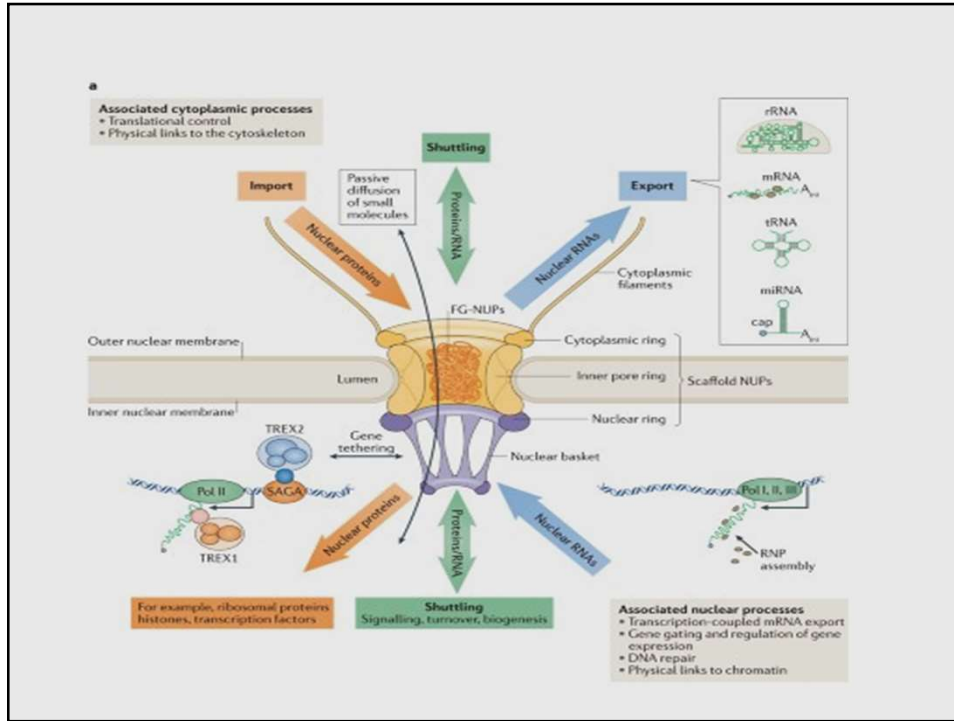
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### Transporte Núcleo-Citoplasma: nucleoporinas (nups)

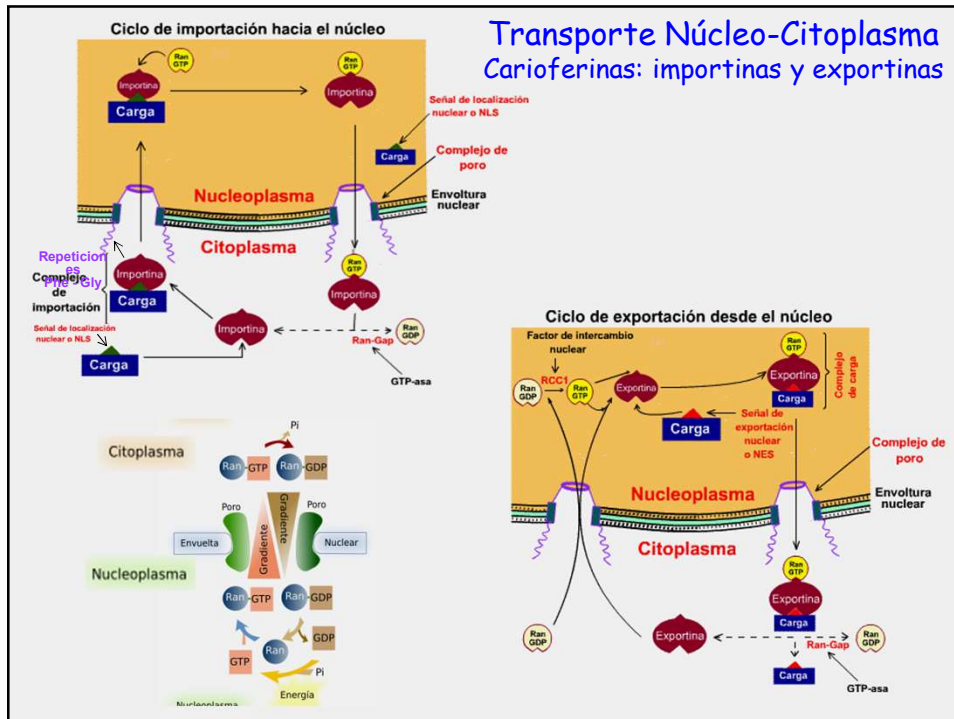


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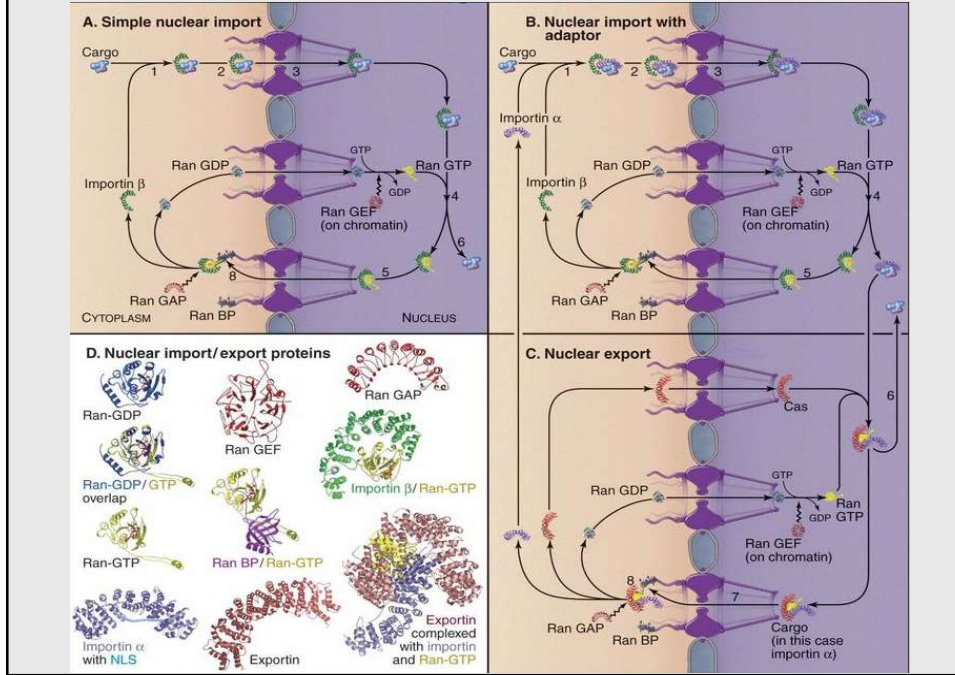


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Transporte Núcleo-Citoplasma. Carioferinas importinas y exportinas



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Importe nuclear via importina B sin adaptador

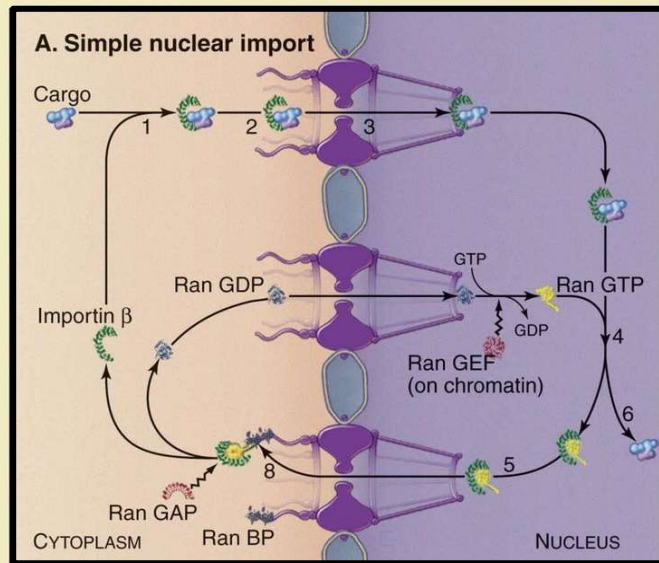
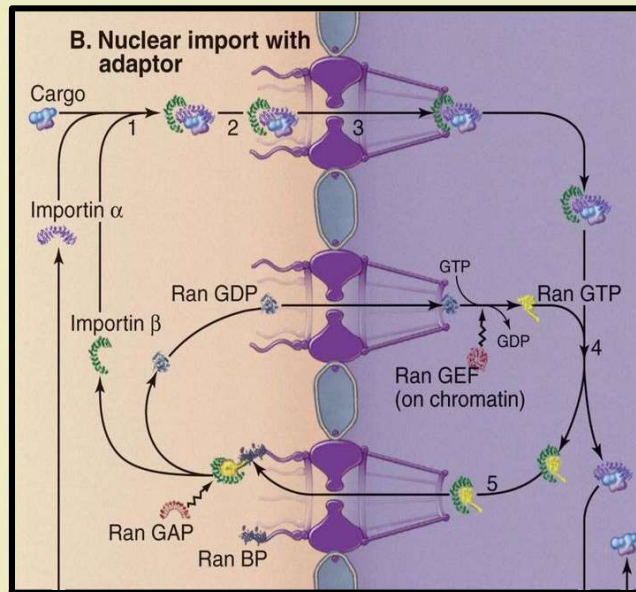


Fig. 14-17

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Importe nuclear via importina B con adaptador

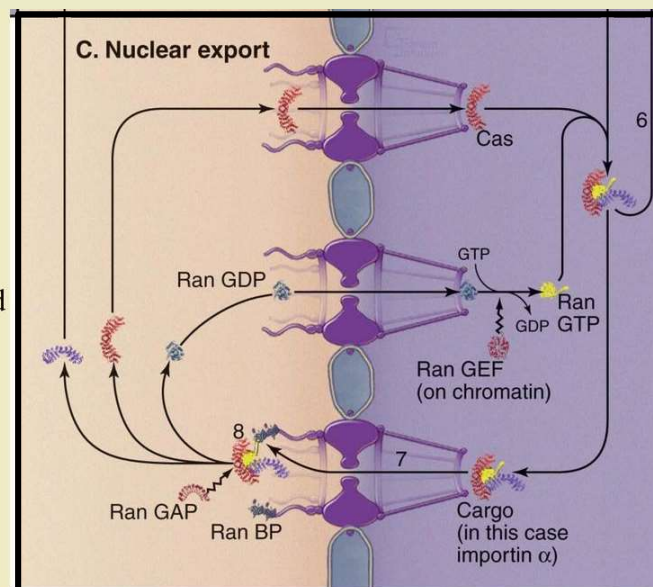


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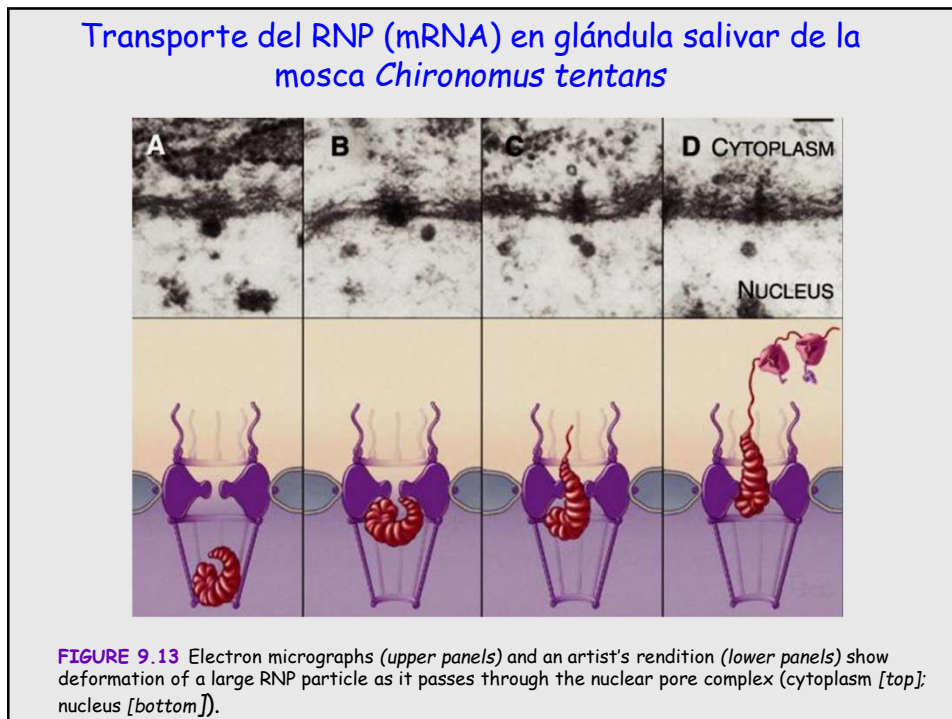
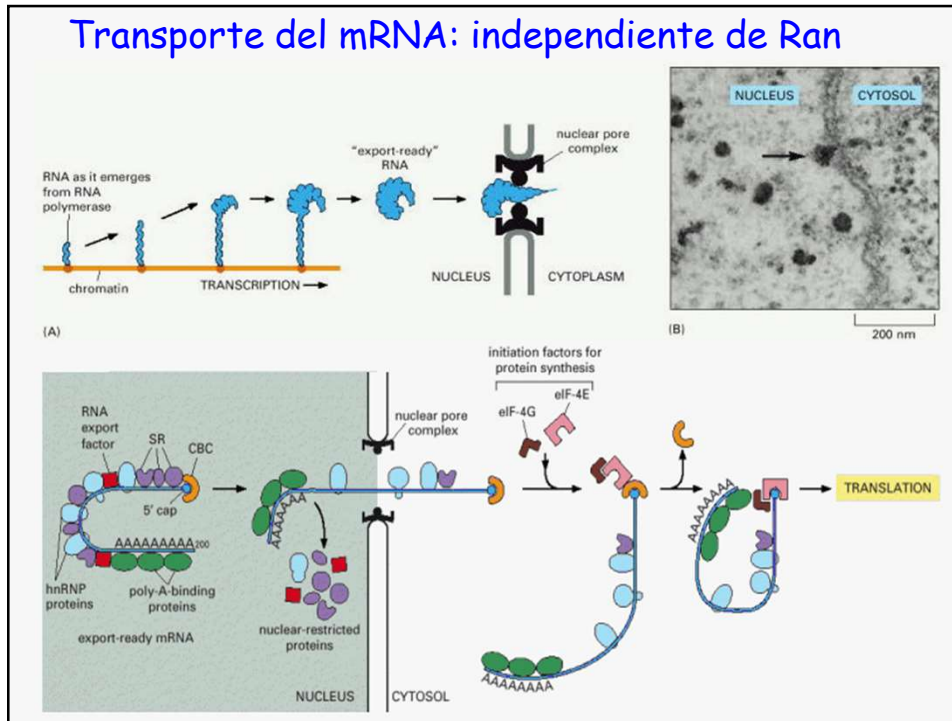
Exporte nuclear con receptor Cas transportando a Importina alfa

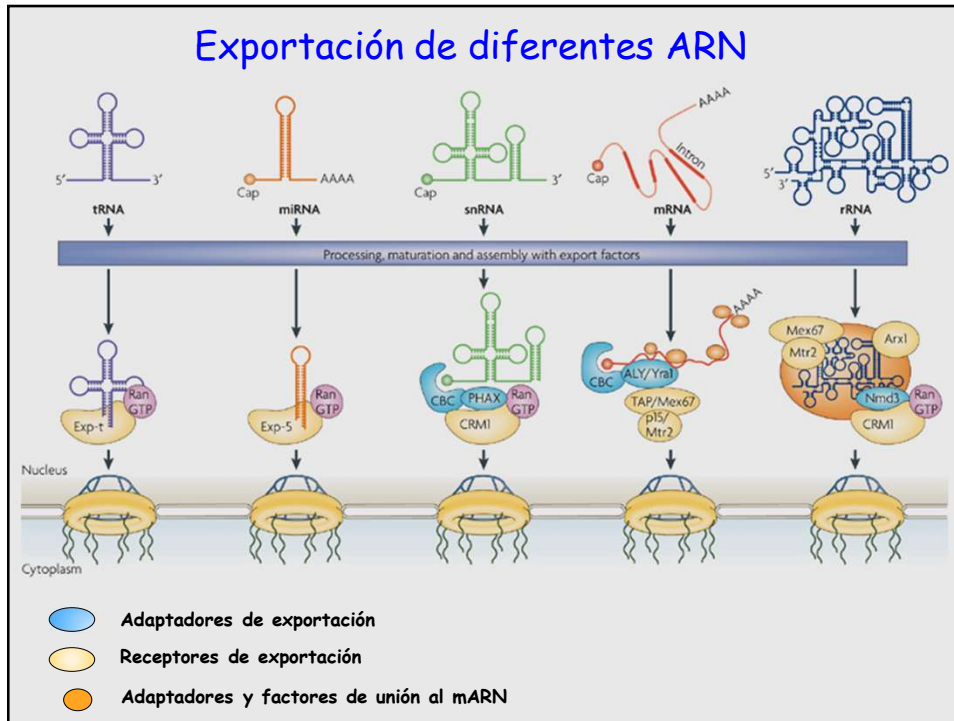
- Ran presente para direccionalidad
- Ran GDP vs
- Ran GTP



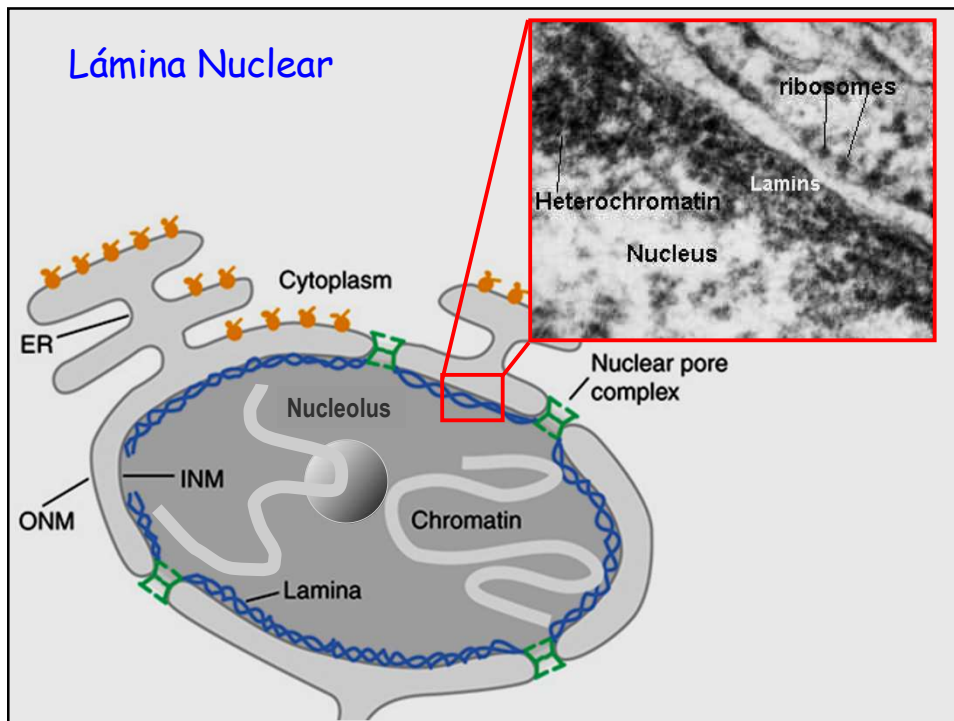
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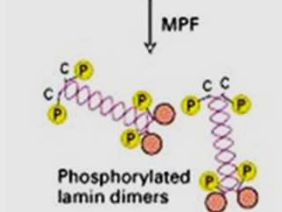
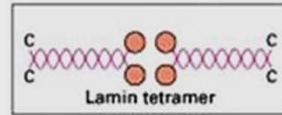
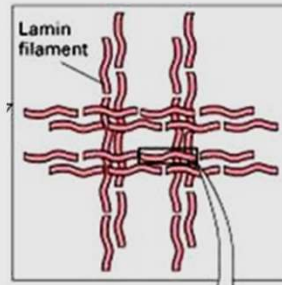
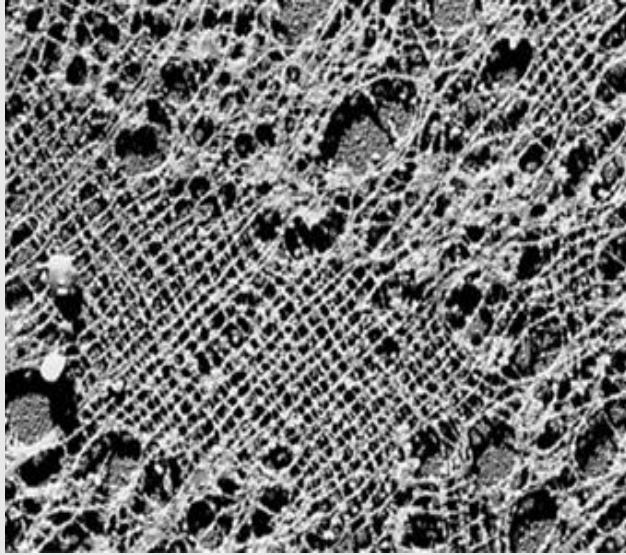


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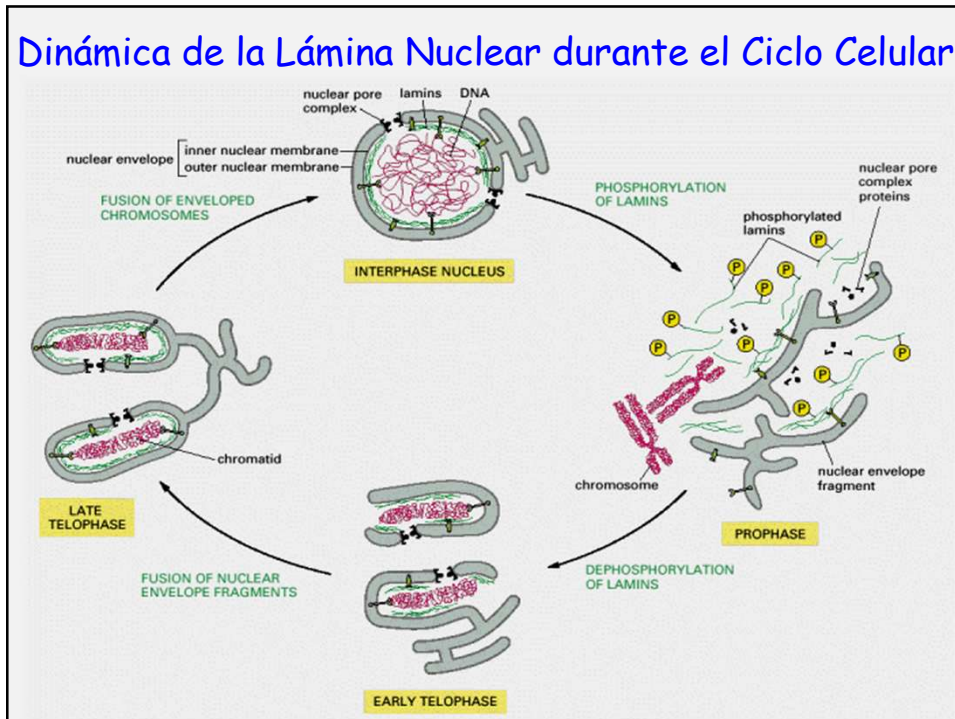
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## Estructura de la Lámina Nuclear

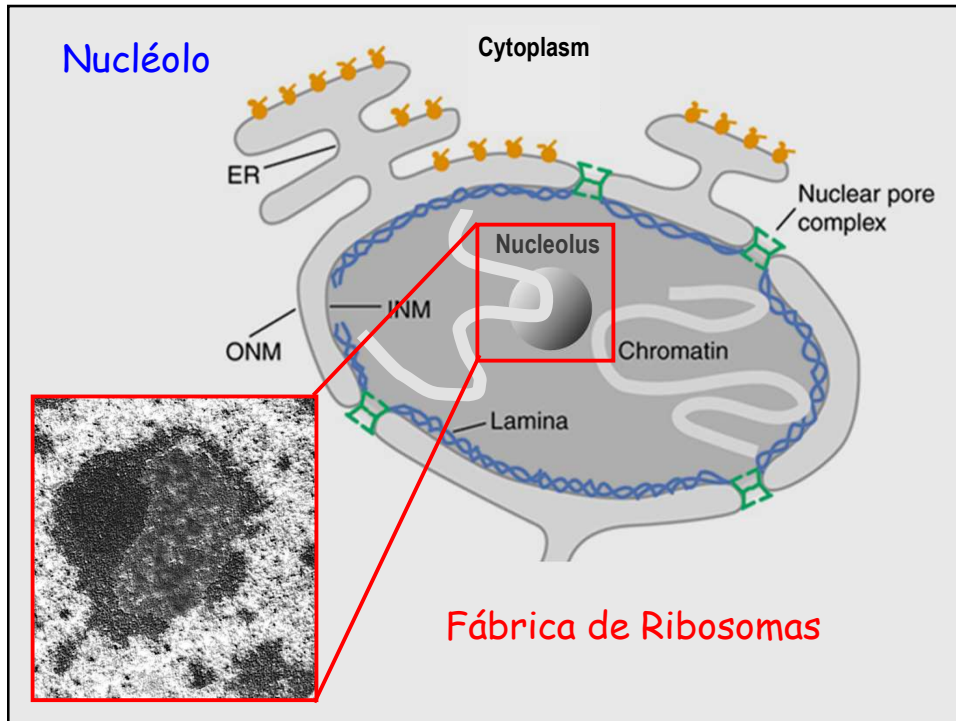


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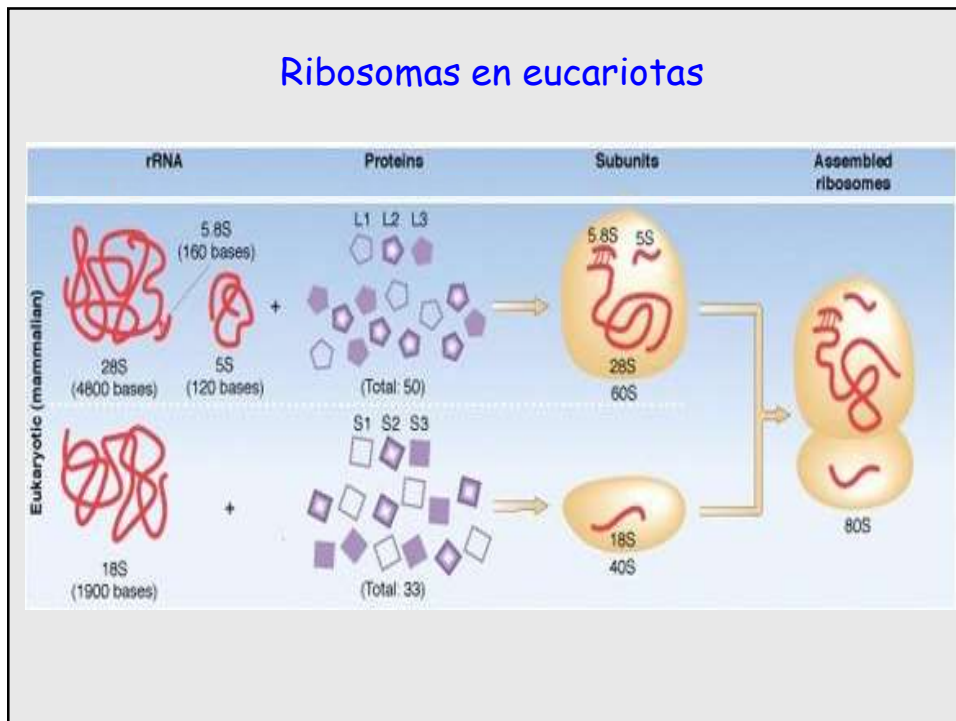
## Dinámica de la Lámina Nuclear durante el Ciclo Celular



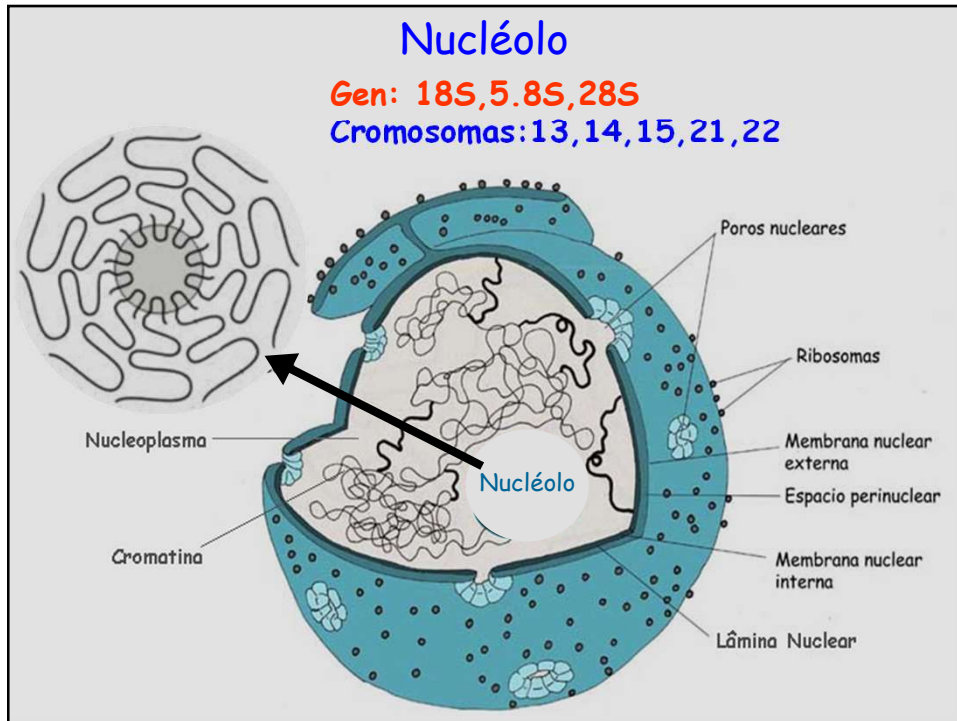
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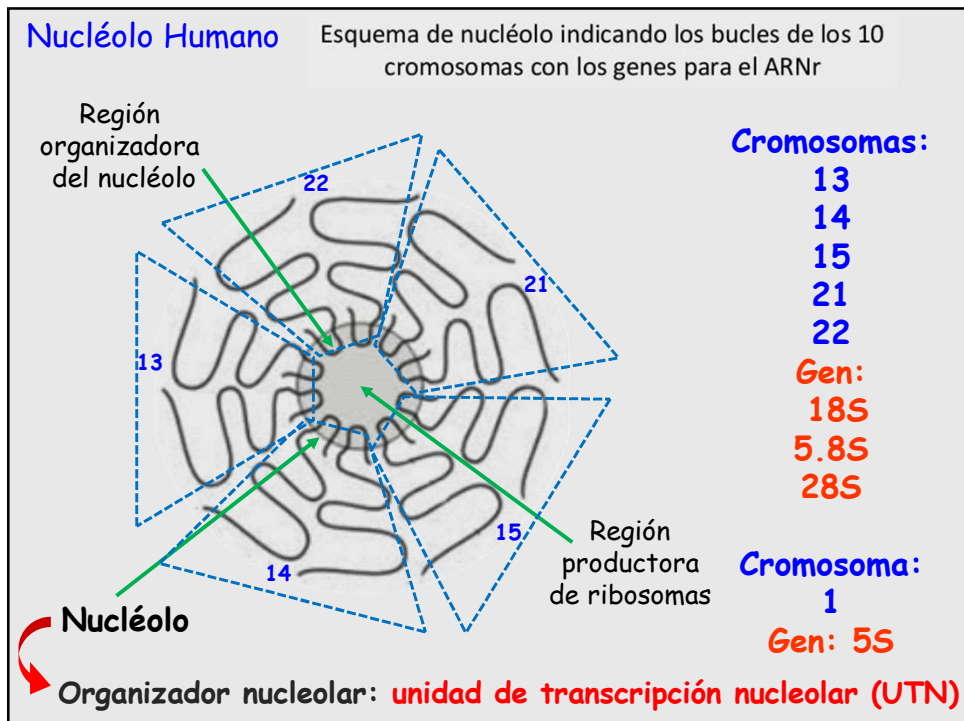
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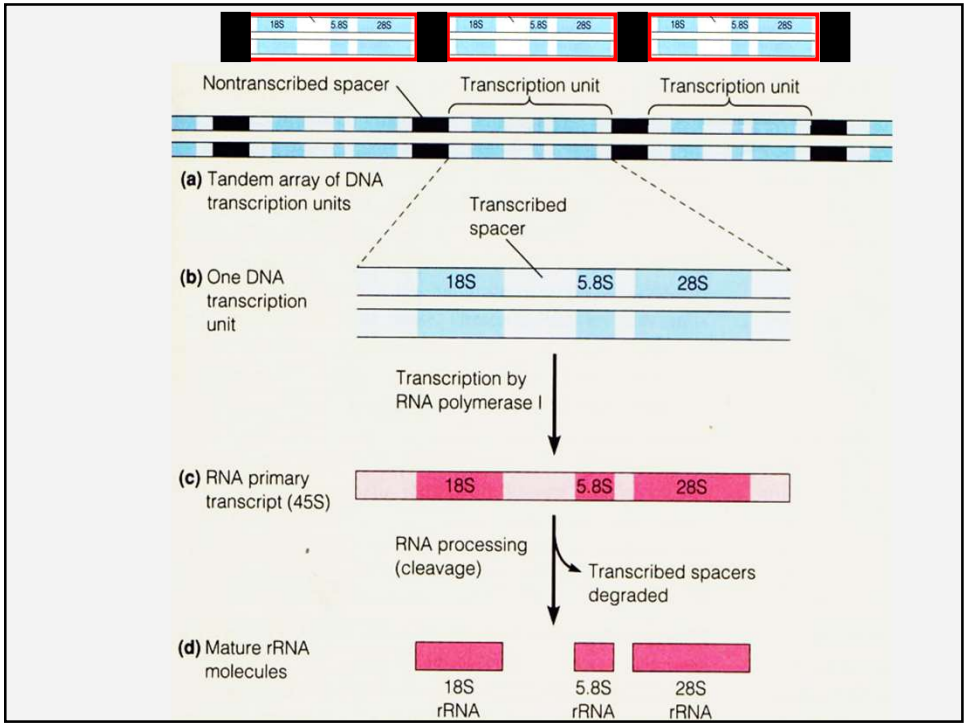
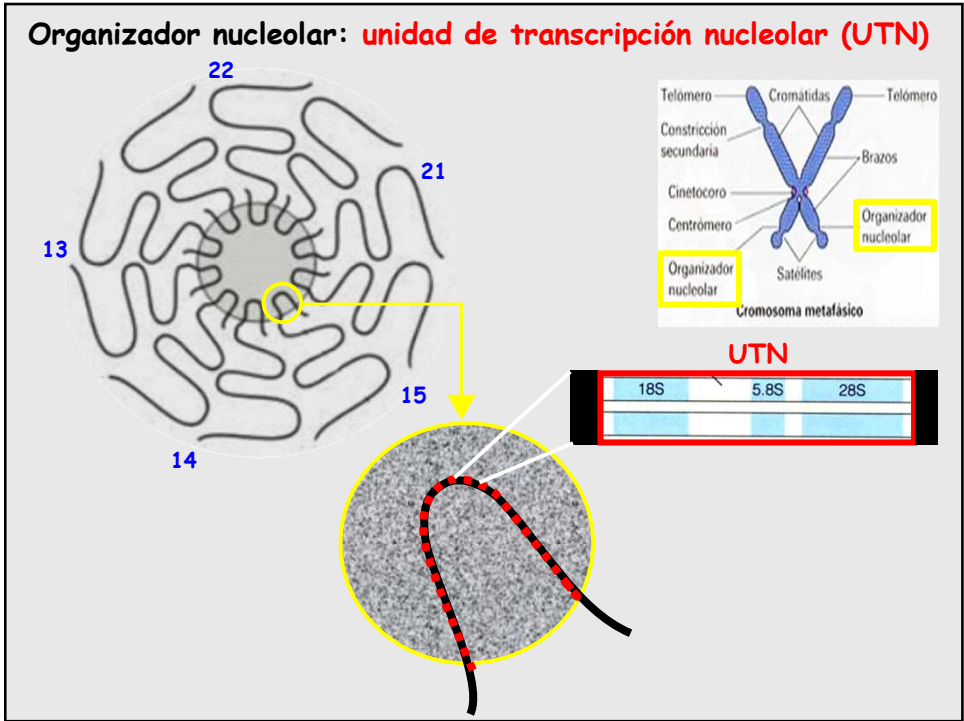


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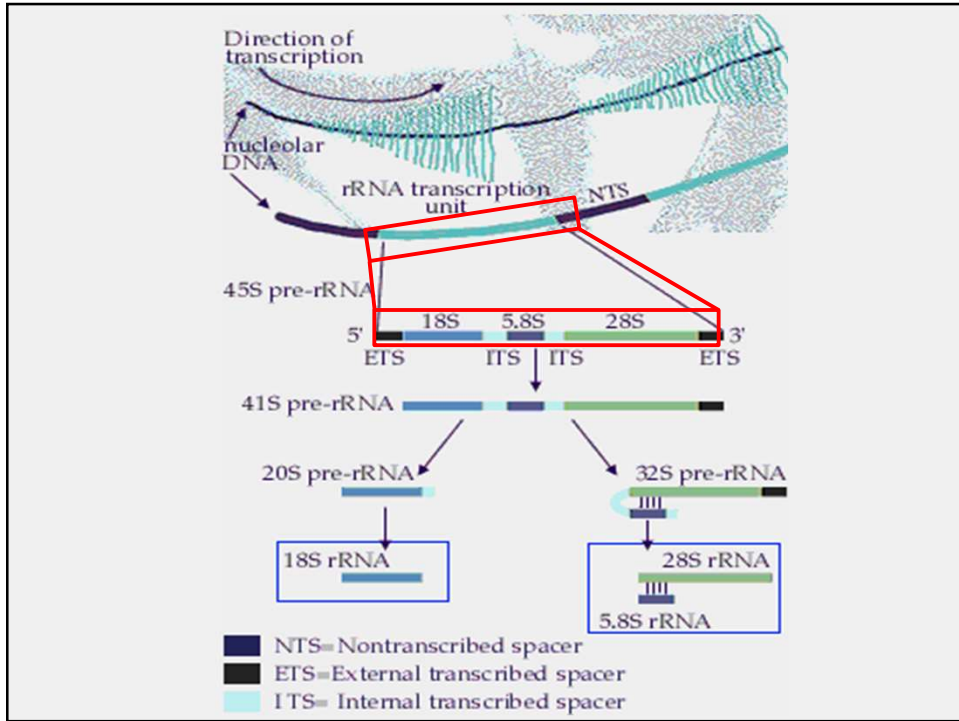


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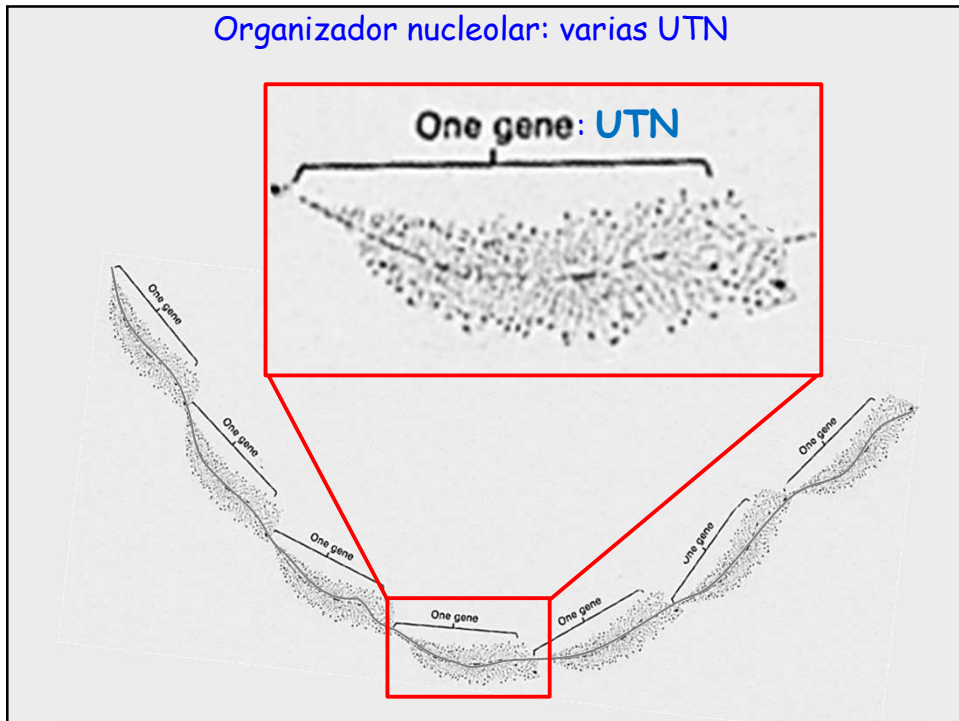




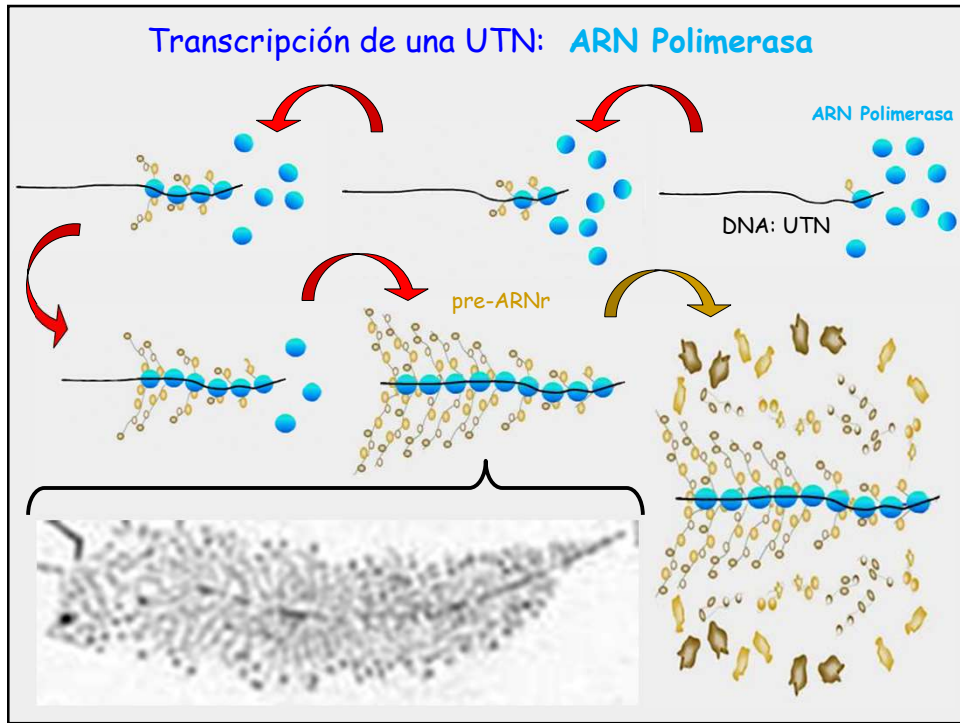




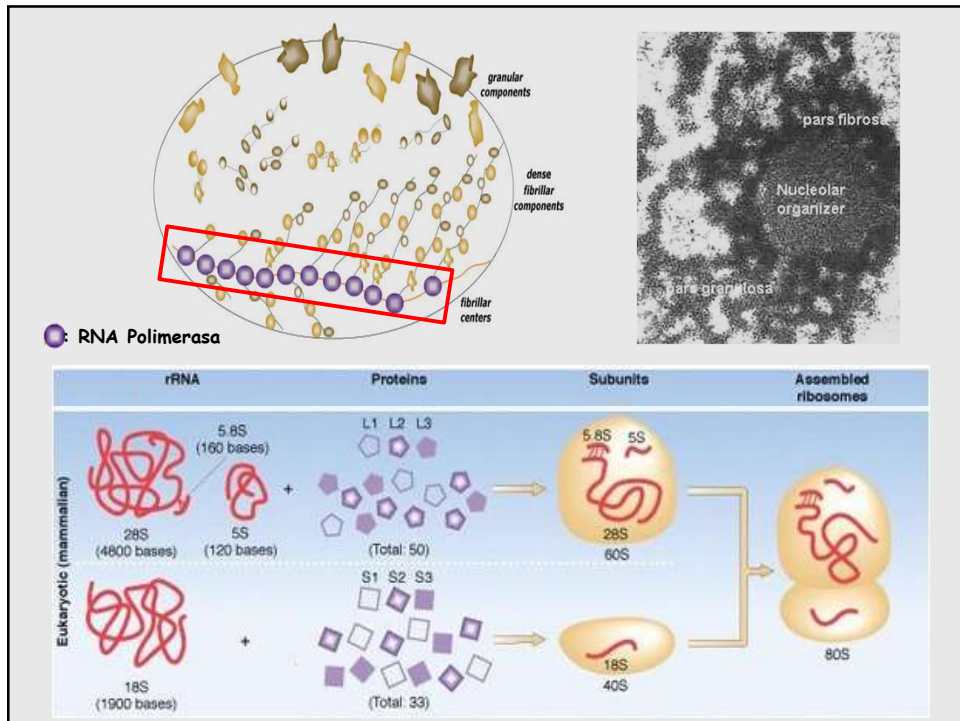
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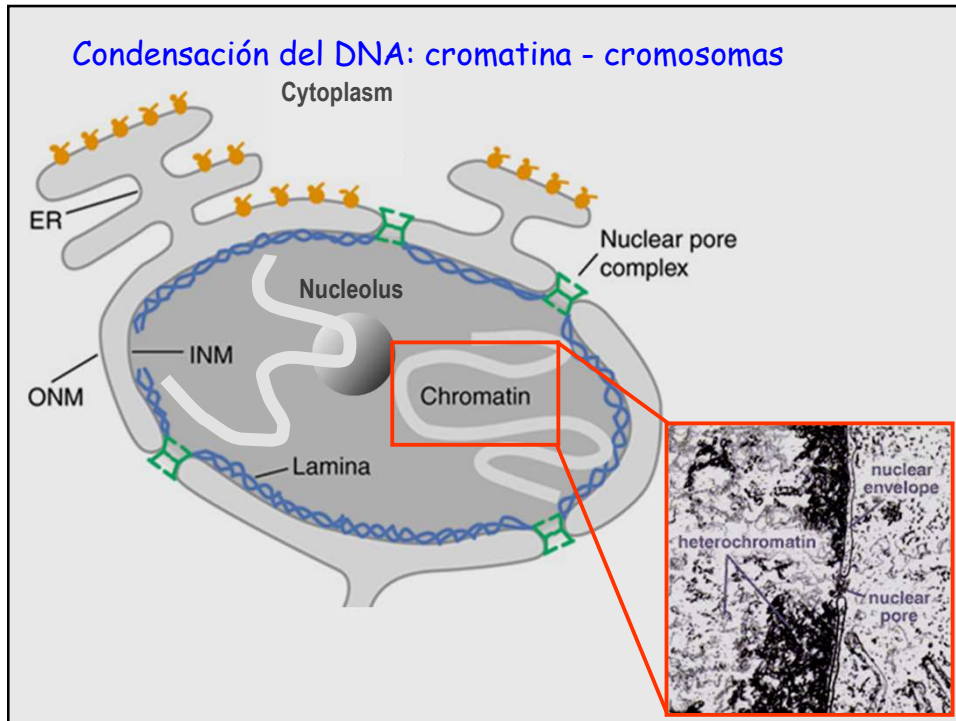
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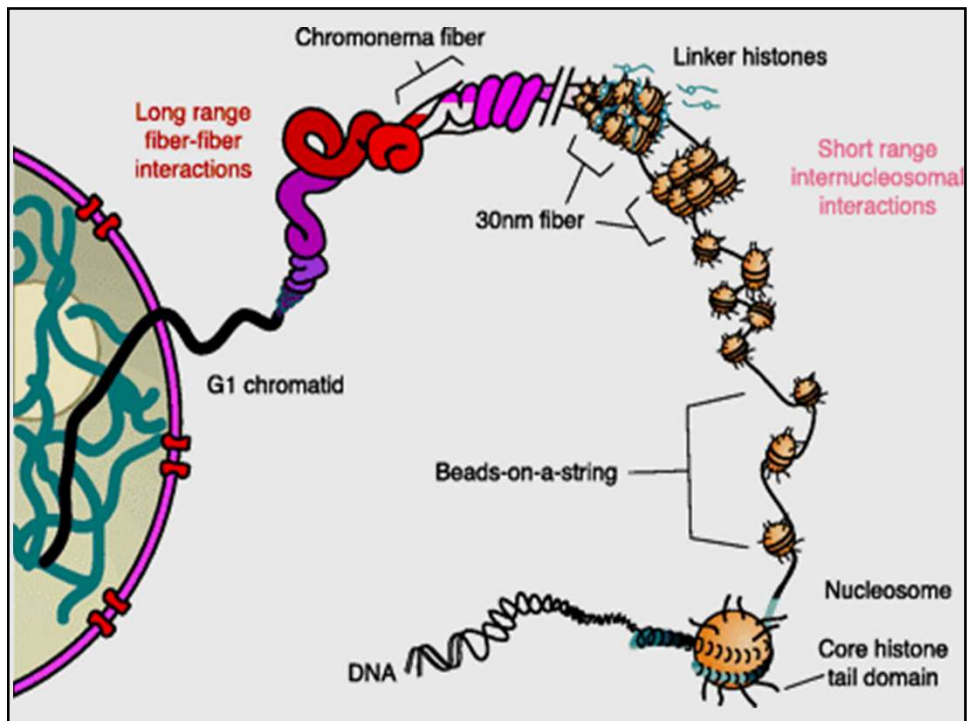
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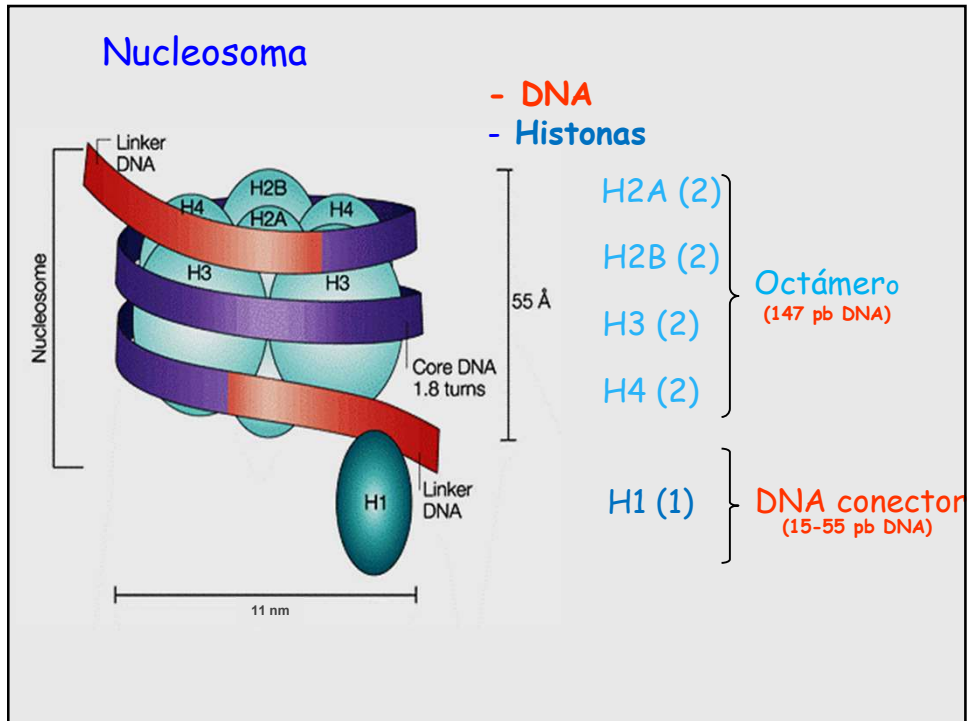
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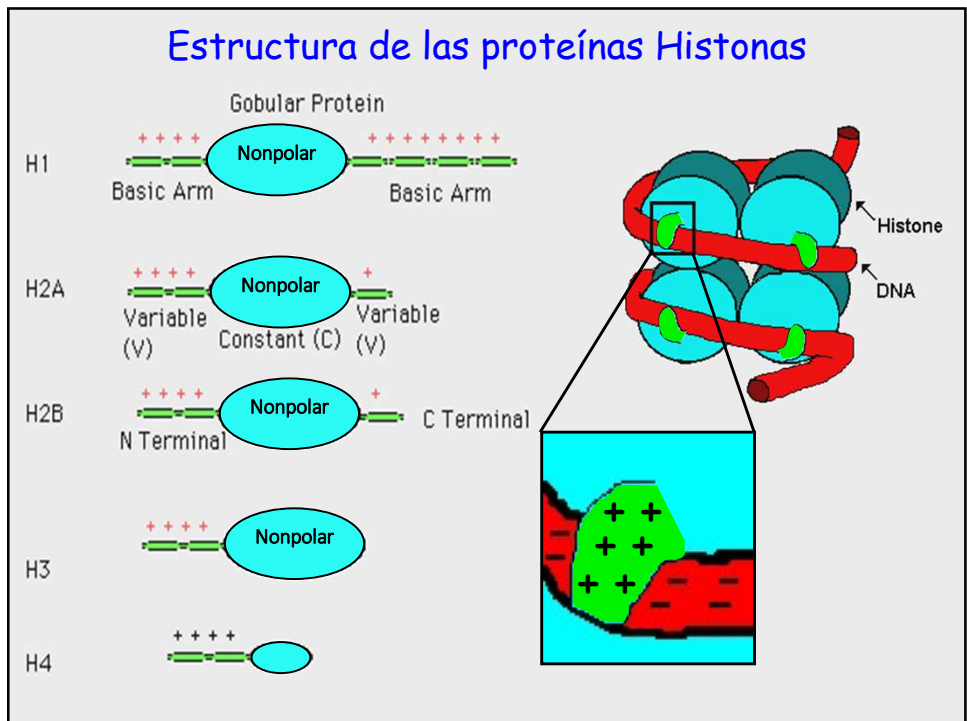
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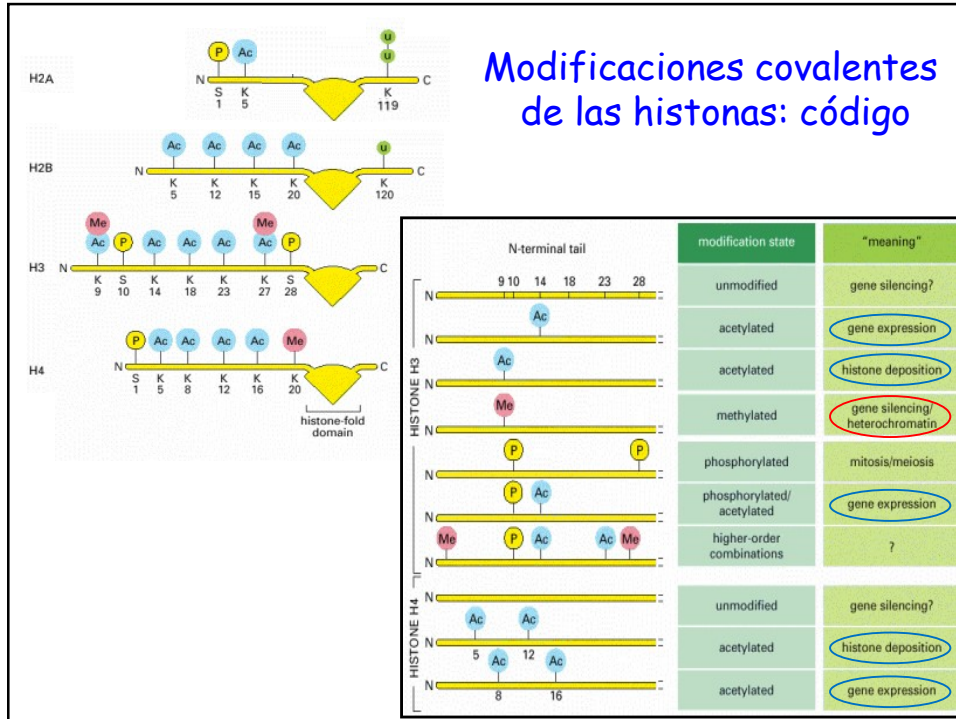
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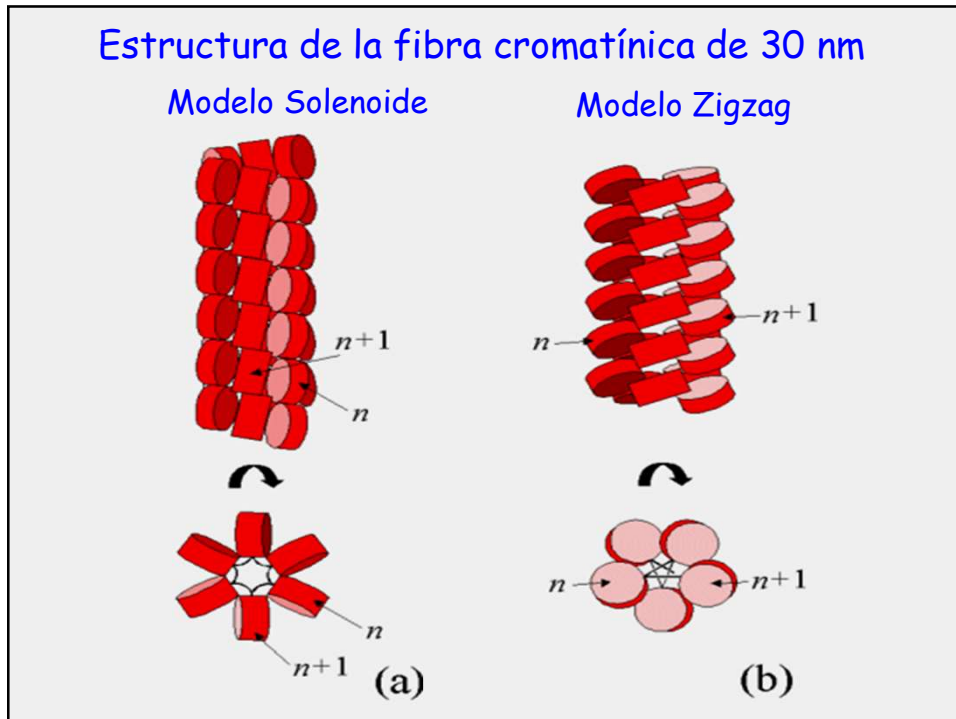
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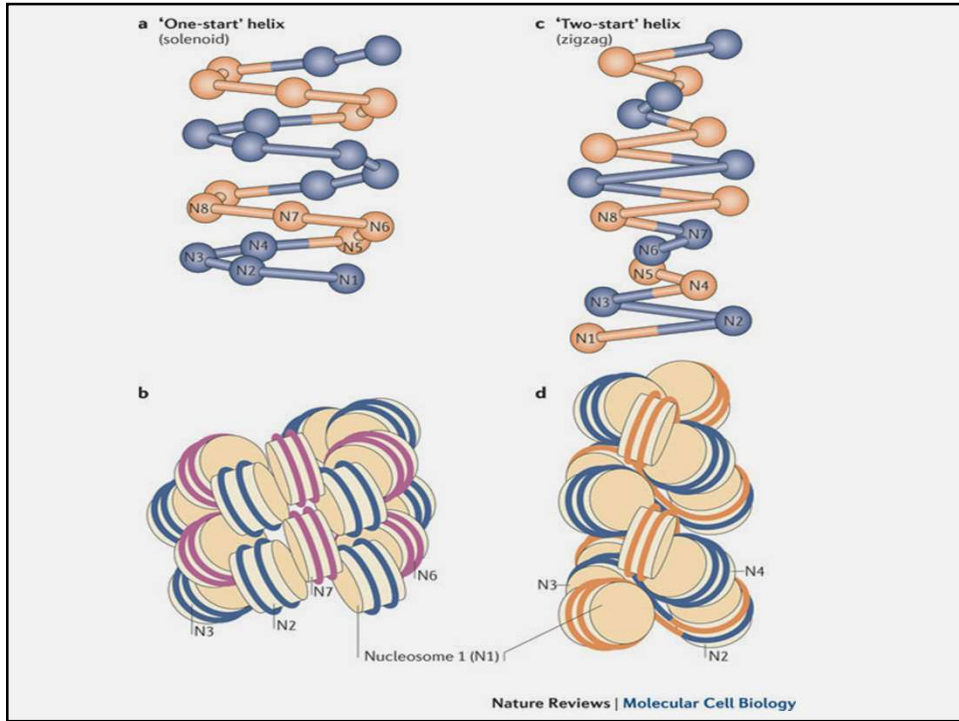
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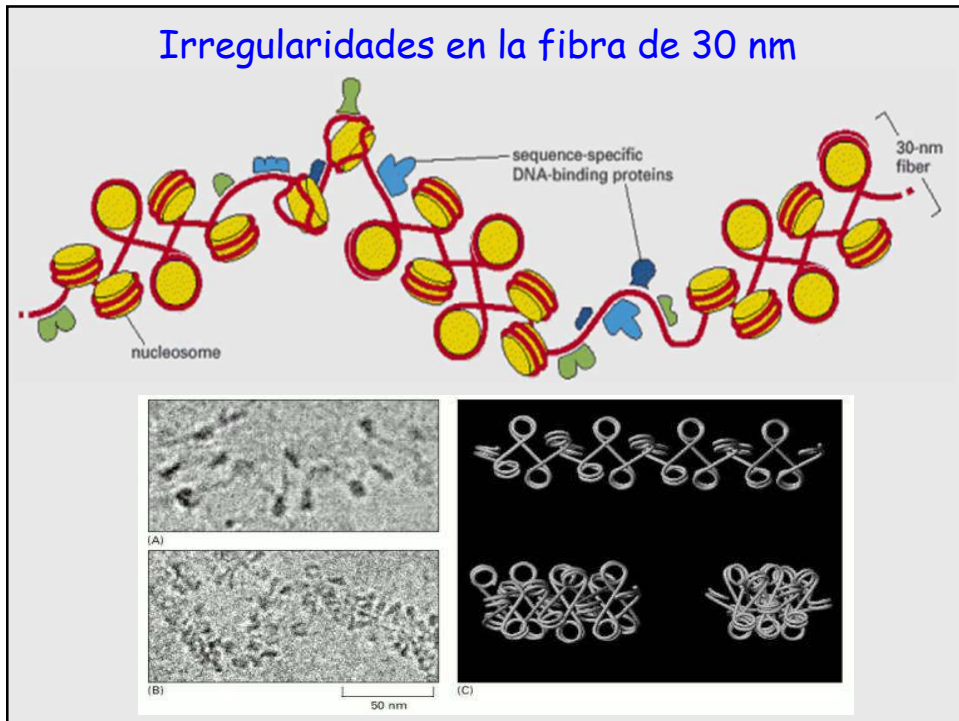
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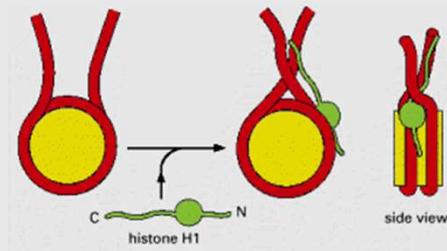
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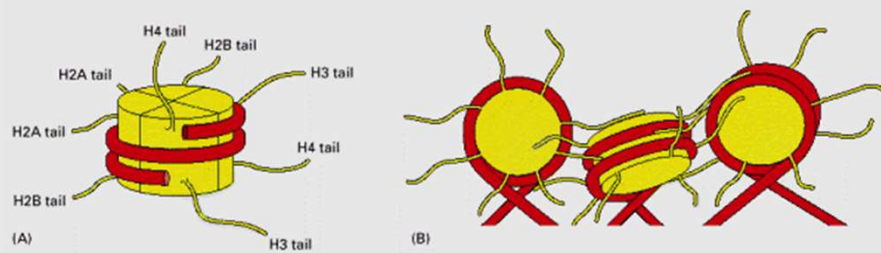
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### Modelo de compactación de DNA en nucleosomas por H1

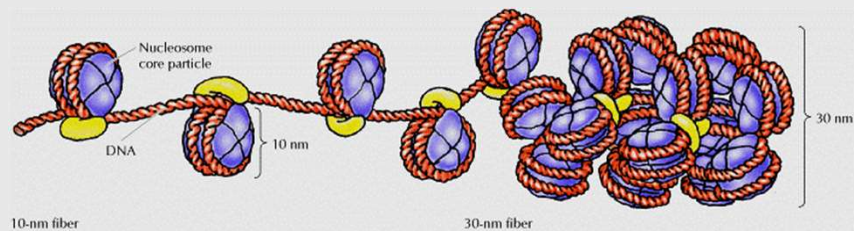


### Modelo de interacción de las histonas en la fibra de 30 nm



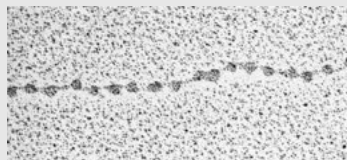
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### Fibras de cromatina de 10 y 30 nm



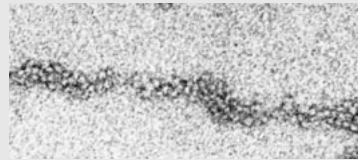
### Electromicrografías de cromatina aislada de núcleo

- baja concentración salina  
- sin  $Mg^{2+}$

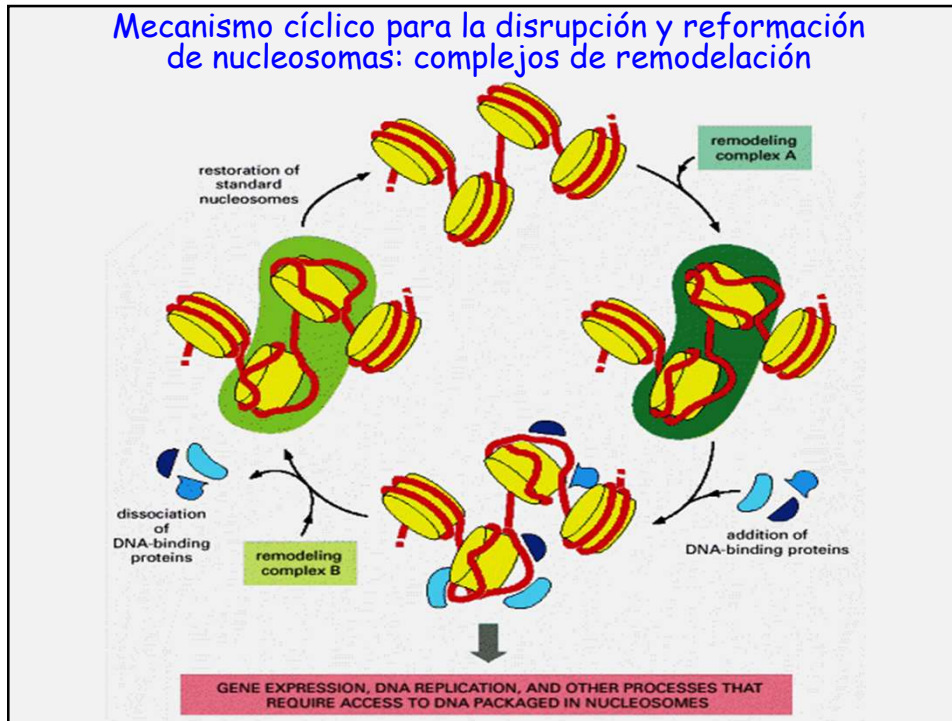


50 nm

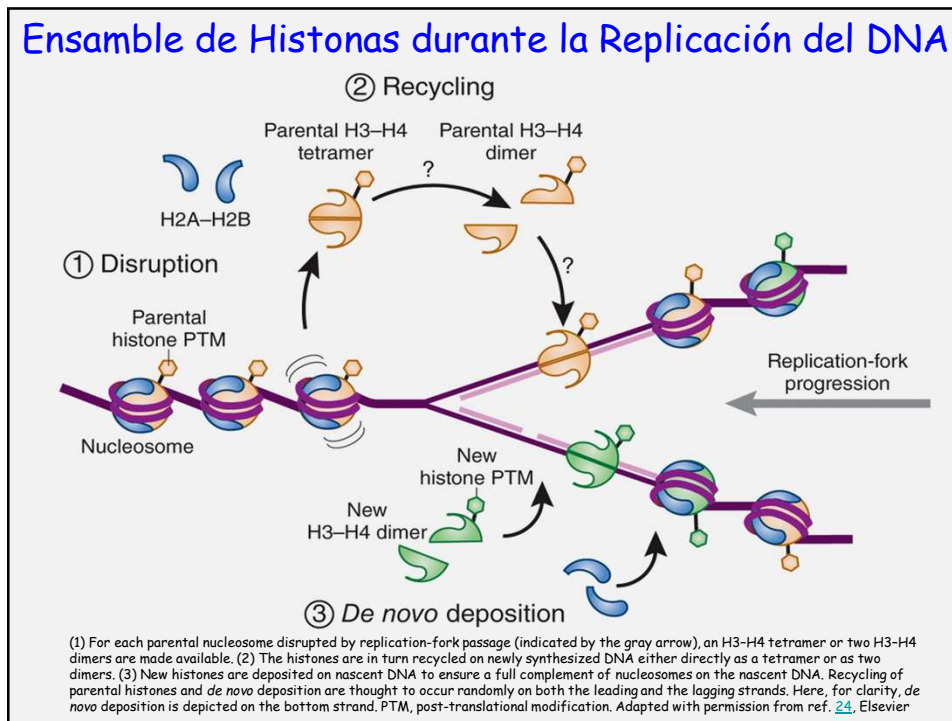
- 150 mM KCl  
- 4 mM  $Mg^{2+}$



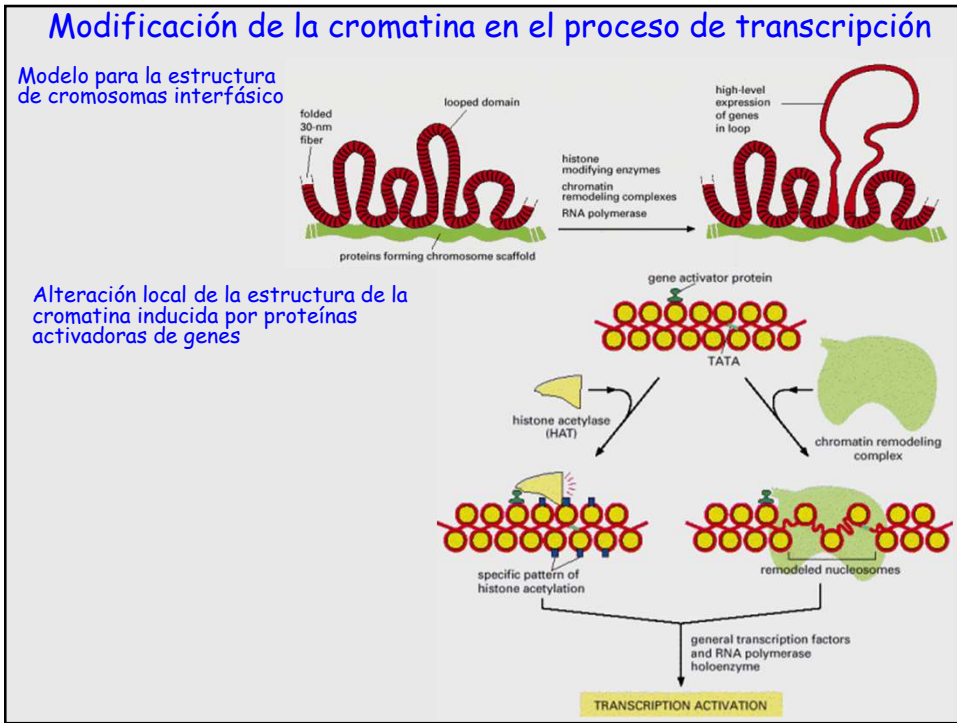
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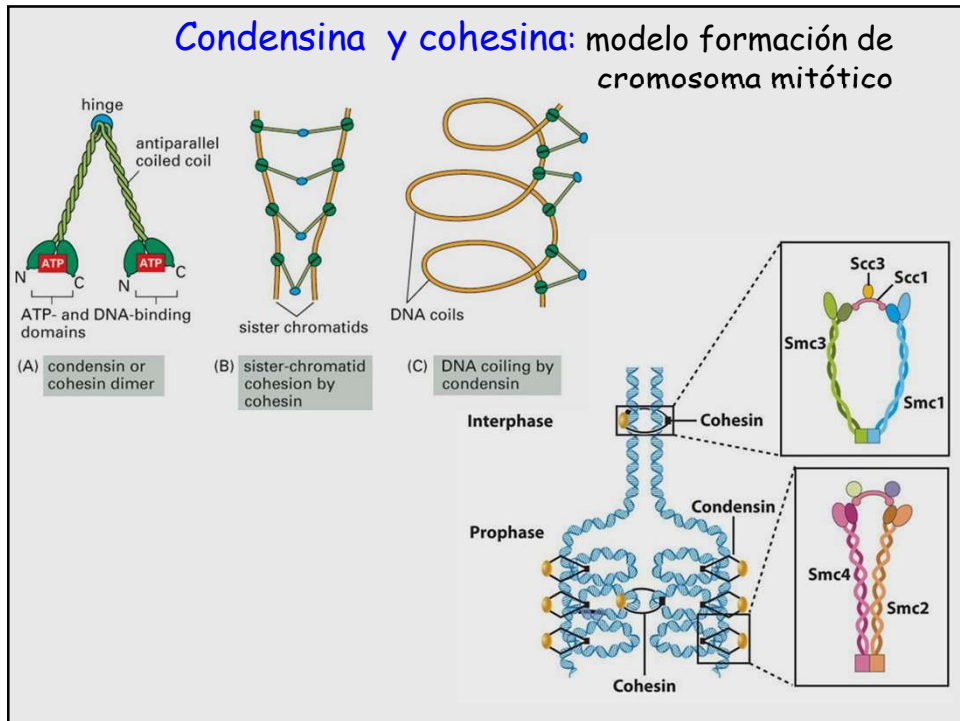
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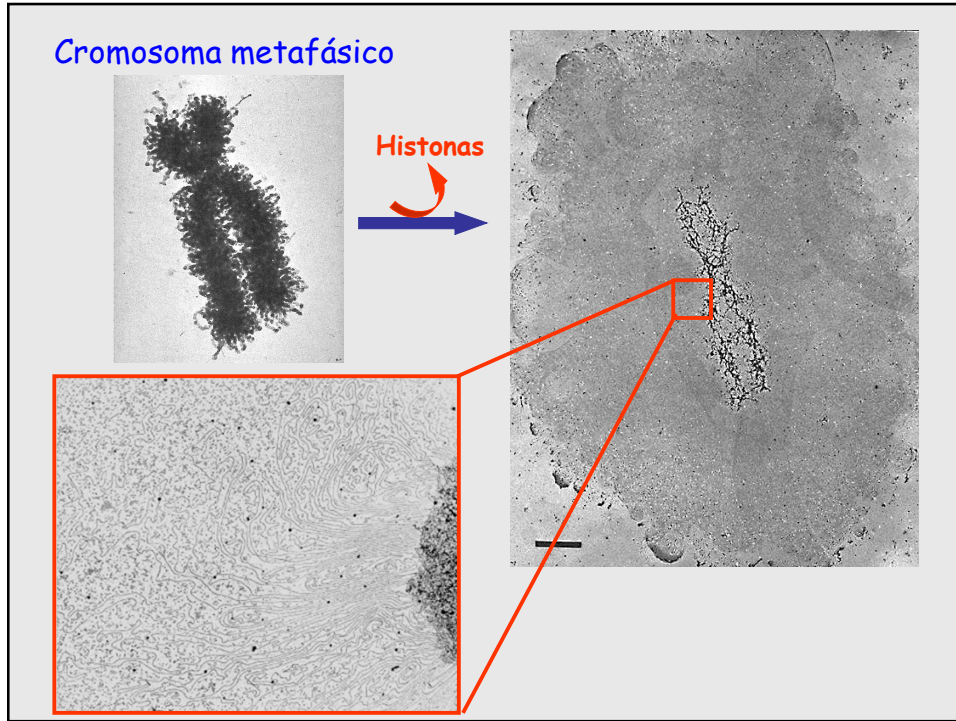
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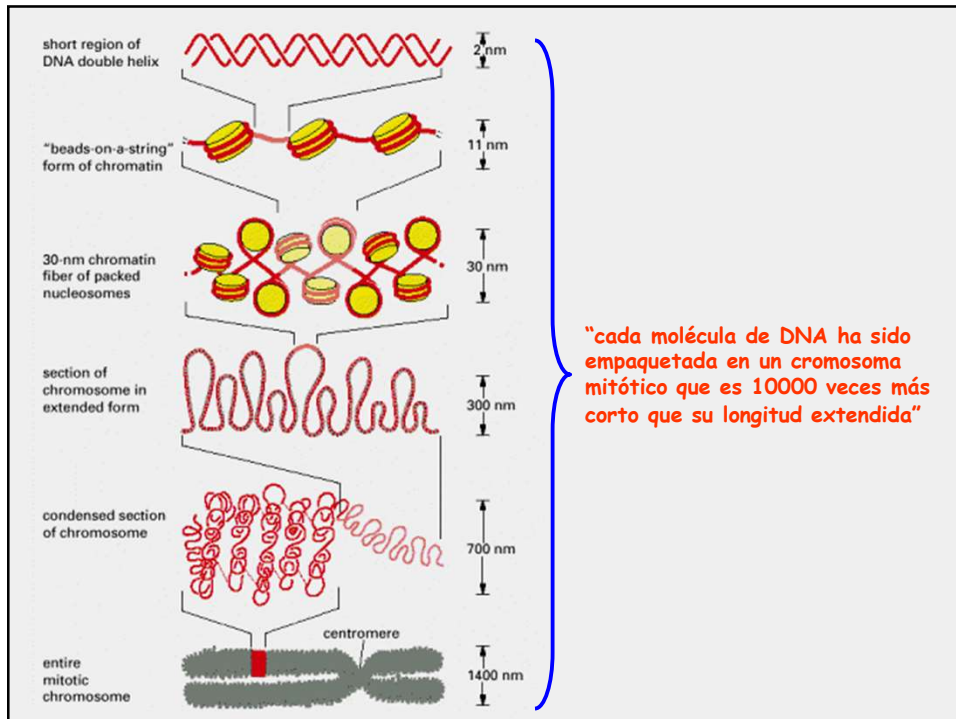
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## RESUMEN sobre Núcleo Interfásico

- Diferentes estructura del núcleo
- Envoltura nuclear: rol de la lámina nuclear en la integridad del núcleo a largo del ciclo celular
- Transporte núcleo-citoplasma: Mecanismo, poros y complejo de poro
- Nucléolo: definición de organizador nucleolar y unidad de transcripción nucleolar, síntesis de ribosomas
- Grados de compactación del ADN: rol de las histonas