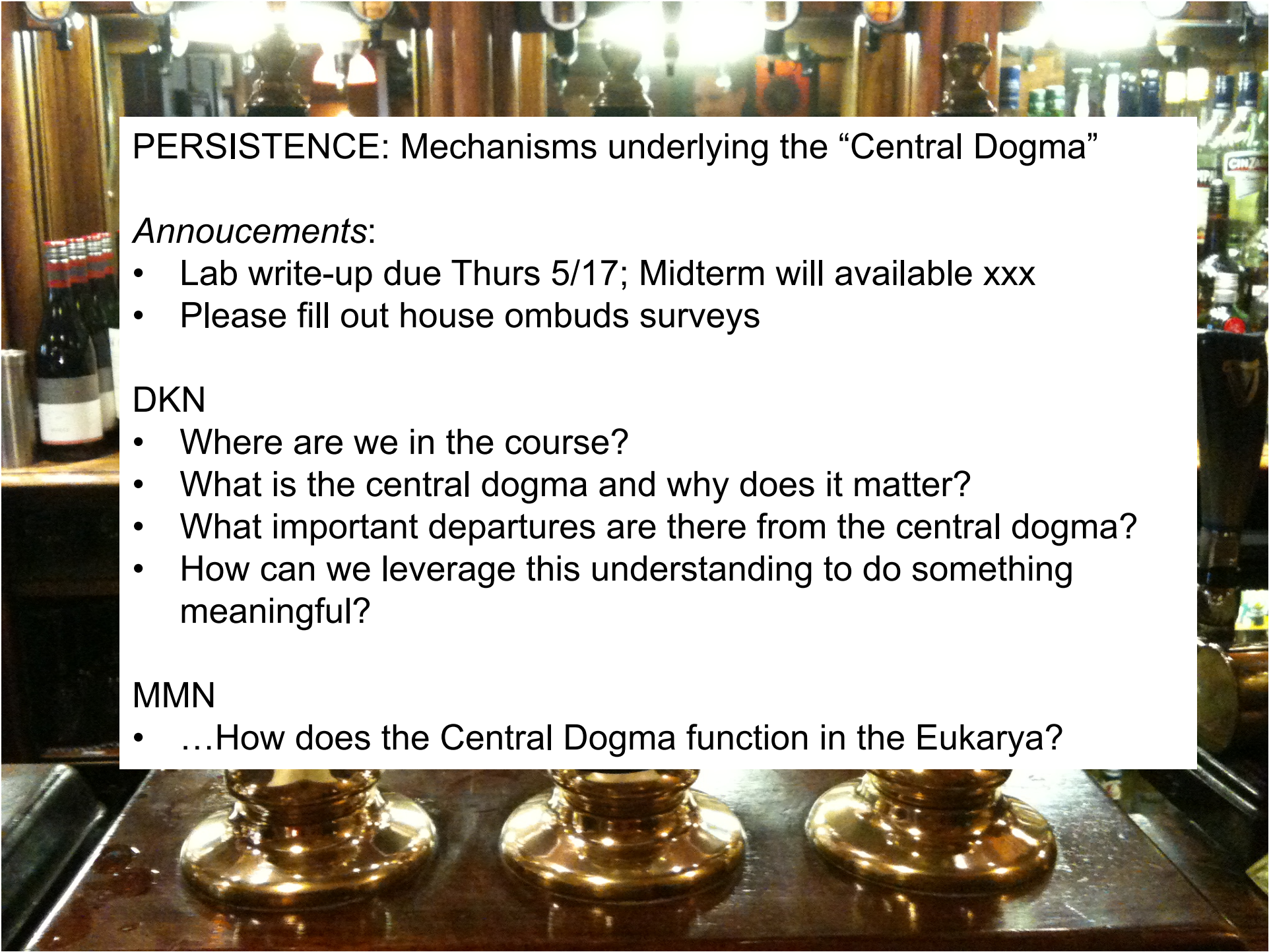




PERSISTENCE: Mechanisms underlying the “Central Dogma”

Announcements:

- Lab write-up due Thurs 5/17; Midterm will available xxx
- Please fill out house ombuds surveys

DKN

- Where are we in the course?
- What is the central dogma and why does it matter?
- What important departures are there from the central dogma?
- How can we leverage this understanding to do something meaningful?

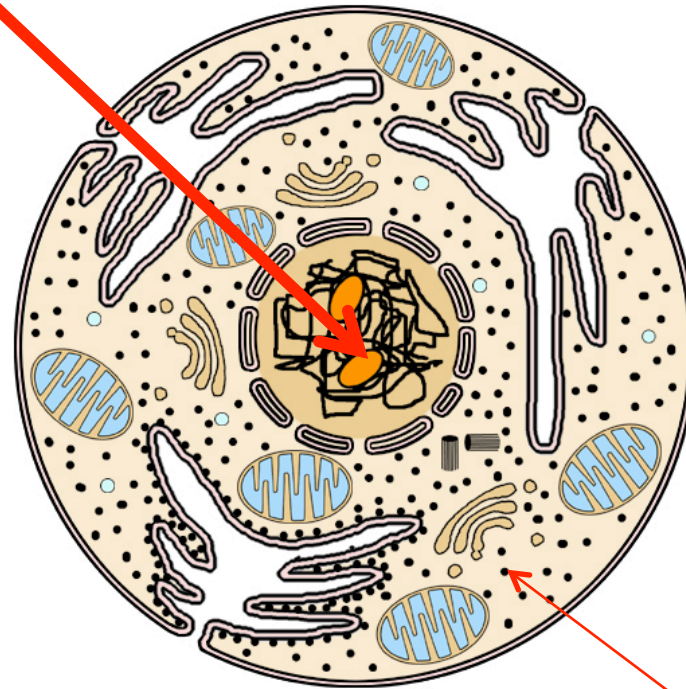
MMN

- ...How does the Central Dogma function in the Eukarya?

Setting the stage – a major challenge of the eukaryotic cell –

The Central Dogma is carried out in:

- the nucleus, where the DNA is housed
- TRANSCRIPTION



Animal (Eukaryotic) Cell

- the cytoplasm, where the ribosomes occur
- TRANSLATION



Consequence?

In Bacteria and Archaea – translation can begin
before transcription ends

In Eukarya – for most circumstances,
a physical impossibility

Chromosome – microscopically-visible elements of the cell, contain the DNA
100,000 to 10,000,000,000 bp

With some exceptions:

in Bacteria and Archaea – one or two, circular



in Eukarya – linear, often as diploid



of chromosomes varies greatly, no correlations with phylogeny:

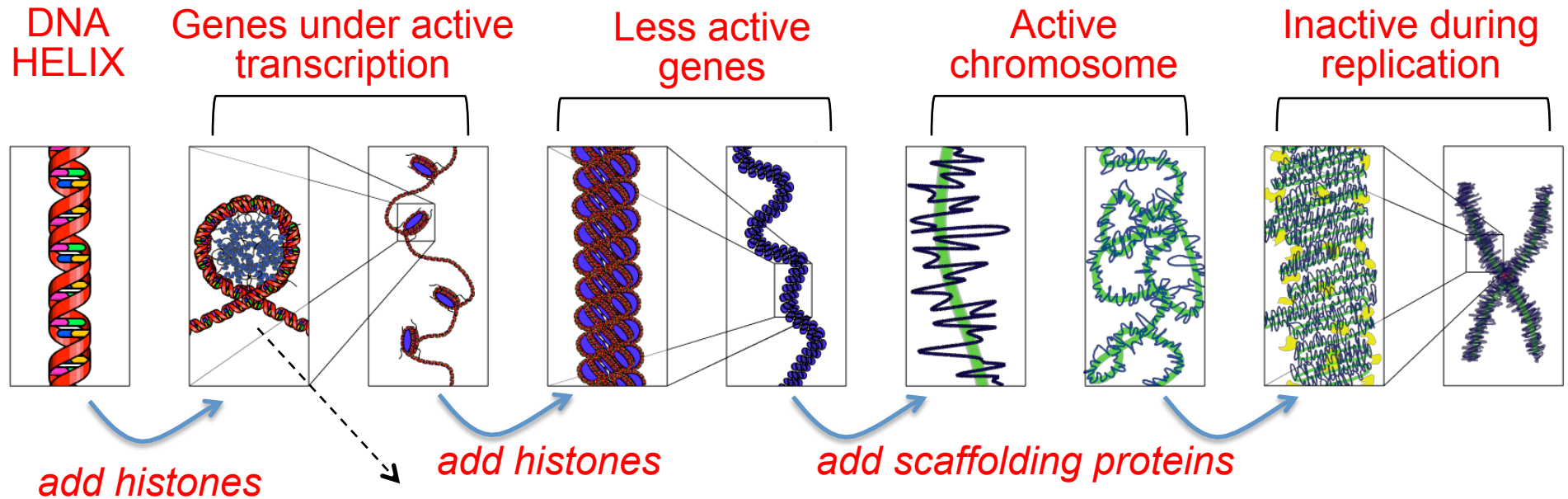


plants – 5 (some flowering plants) to 1200 (fern)
animals – smallest – jack jumper ant-- 2 in females
1 in males
largest – rat spp. 92
humans – 46

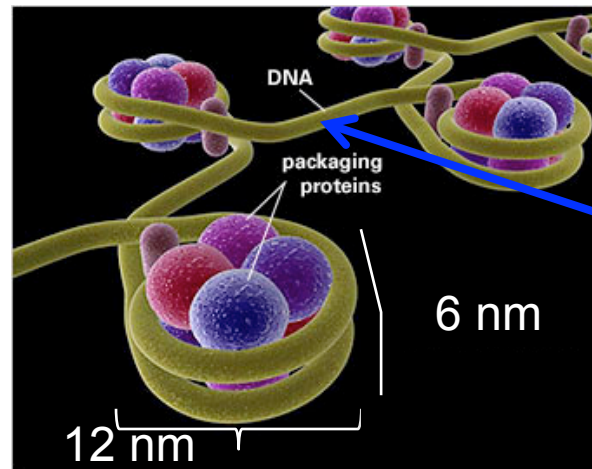
Chromatin – DNA and proteins that make up the chromosomes

Video of epigenetic changes to chromatin –
http://www.youtube.com/watch?v=Tj_6DcUTRnM&feature=related

Levels of Organization of the Chromatin/ Chromatin Packing:



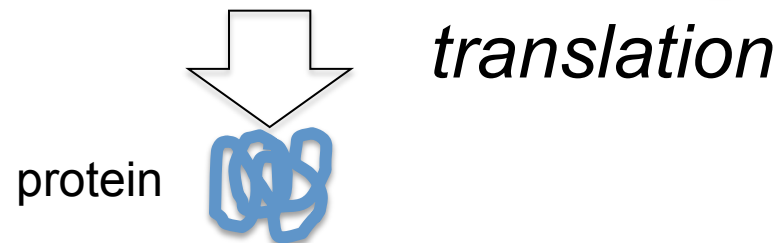
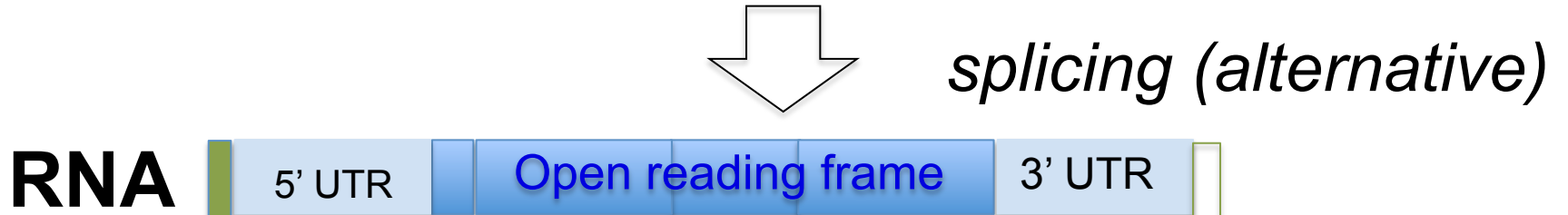
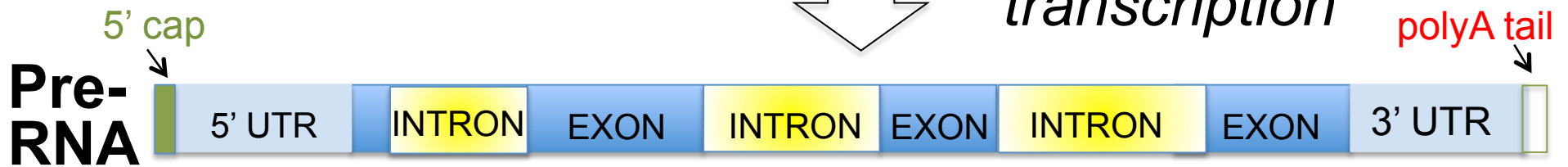
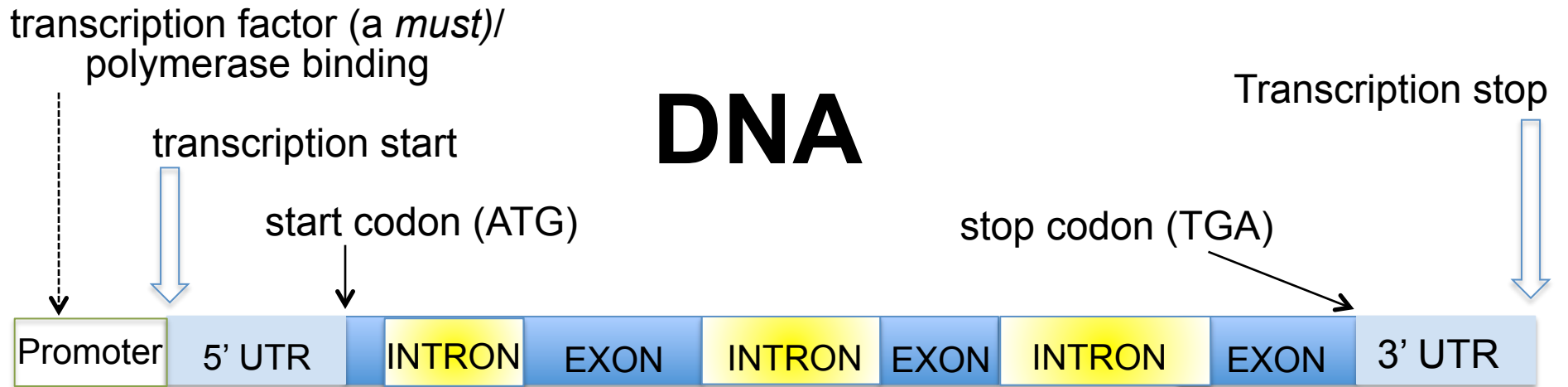
add histones
(+ charged)
 (proteins rich in Arg/Lys thus + and bind to negatively charged phosphates of DNA)

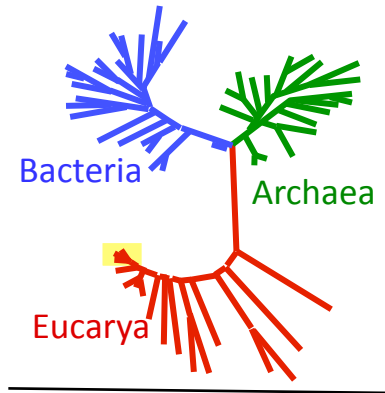


146 bp wrapped dna/histone core\
60 bp linkers

GENE STRUCTURE AND TRANSCRIPTION/TRANSLATION IN EUKARYA

DNA



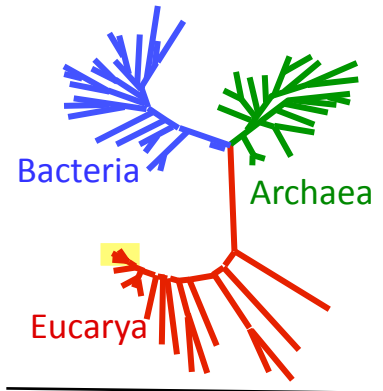


Basic differences among domains
(Bacteria/Archaea/Eukarya) in
transcription,
i.e., usually:

Eukarya:

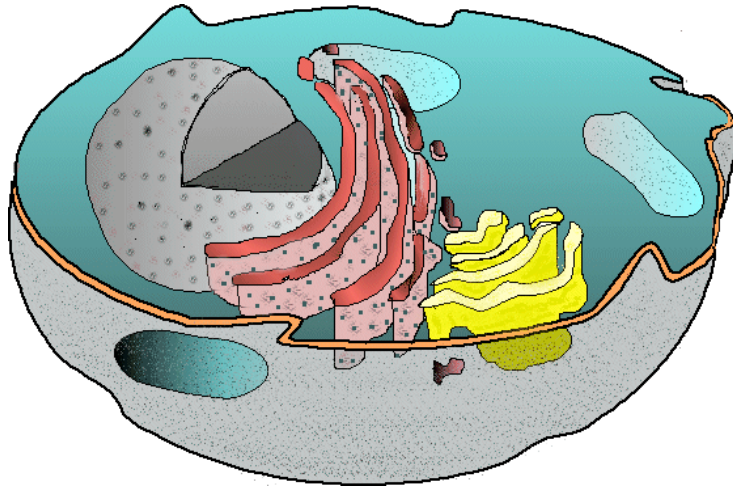
- Multiple polymerases with dedicated functions
- Extensive post-transcriptional modifications
- More regulatory sequences

Will mitochondria and plastids transcribe DNA like Bacteria or like Eukarya? Why?



Transcriptional differences among domains, *i.e., usually:*

	Bacteria/Archaea	Eukarya
Coordinately controlled genes are:	linked	unlinked (same control elements)
Operons	+	-
Control elements found	once/operon	once/gene
Control	usually negative (repressors needed to turn gene off)	usually positive (activator needed to turn gene on)
mRNA	1 mRNA/operon short-lived	1 mRNA/gene variable (short/long-lived)



[SHORT SUMMARY]

Transcription/Translation in Eukarya:

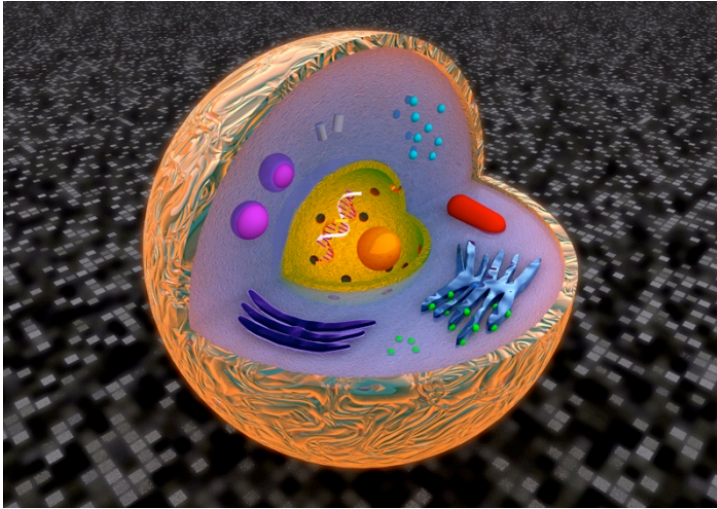
Multiple steps:

- A. must de-condense (loosen) the chromatin (protein mediated)
- B. transcription factors must bind to DNA
- C. polymerase binds to transcription factor (not directly onto DNA)
to get actual transcription (multiple controls here)
- D. transcript gets modified (spliced, 3' polyadenylation, 5' cap)
- E. mature mRNA travels out to the cytoplasm where it makes a single protein

REGULATION

The process is regulated at every level:

- A. Transcriptional – weak and strong polymerase binding; enhancers/repressors
- B. Post-transcriptional – splicing, alternative splicing, different polyadenylation sites
- C. Translational – initiation (+/- 5' cap; activity of initiation factors); variable lifetime of the RNA
- D. Post-translational – maturation of protein, phosphorylation, glycosylation



Take home messages:

How does the Central Dogma function in the Eukarya?

- The presence of a nucleus has profound effects on the processes of transcription and translation.
- Eukarya have more layers of regulation on all facet so the Central Dogma