Eukaryotic Gene Expression

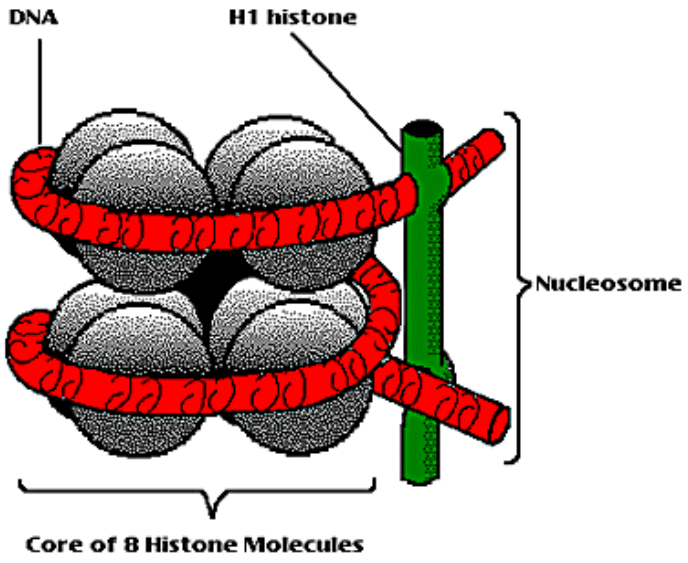
Examples of Euk Gene Control:

1. DNA Structure
2. DNA Methylation
3. Histone Acetylation
4. Pre/Post Transcription Factors
5. Pre/Post Translation Factors

DNA Structure: Folding & Coiling

Level 1: beads on a string

- chromatin wraps around histone proteins
- together, called a nucleosome

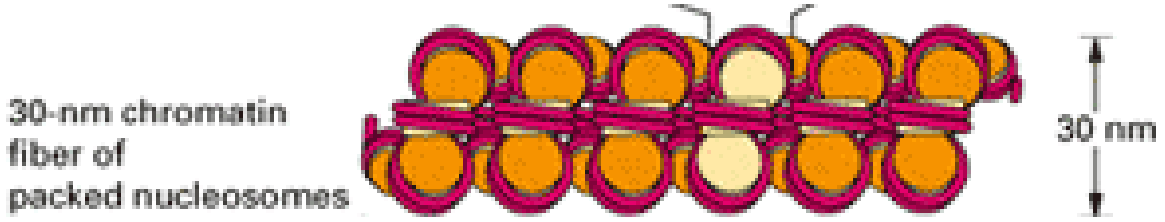


Nucleosome

DNA Structure: Folding & Coiling

Level 2: chromatin fiber

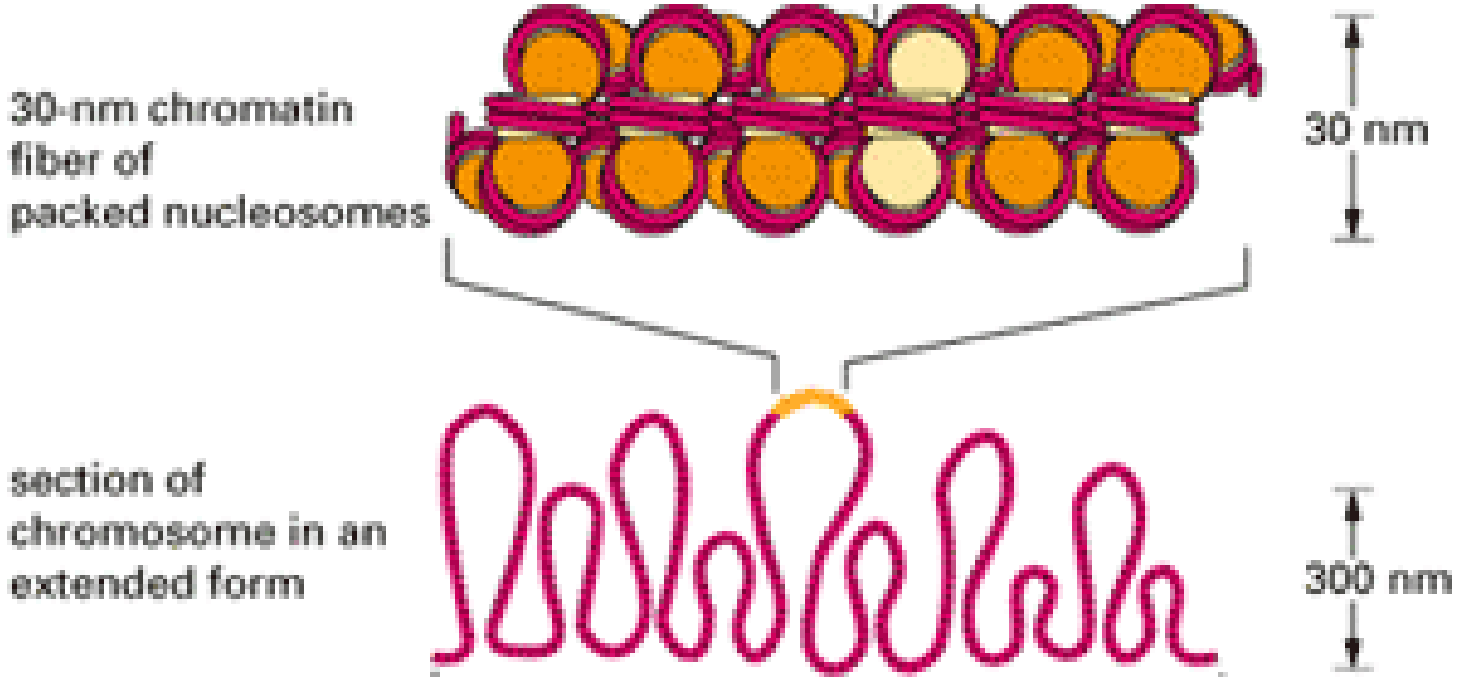
- nucleosomes fold onto itself
- about 6 nucleosomes per turn



DNA Structure: Folding & Coiling

Level 3: looped domains

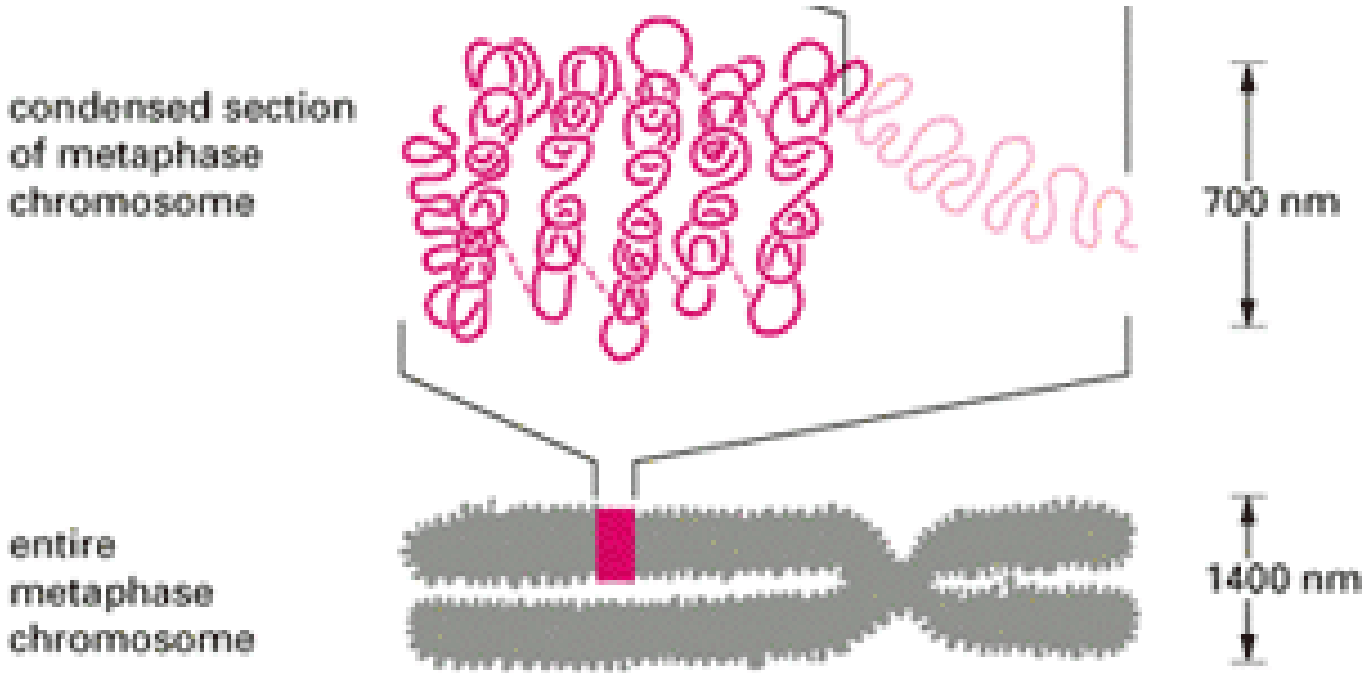
- the 30 nm chromatin fiber forms loops

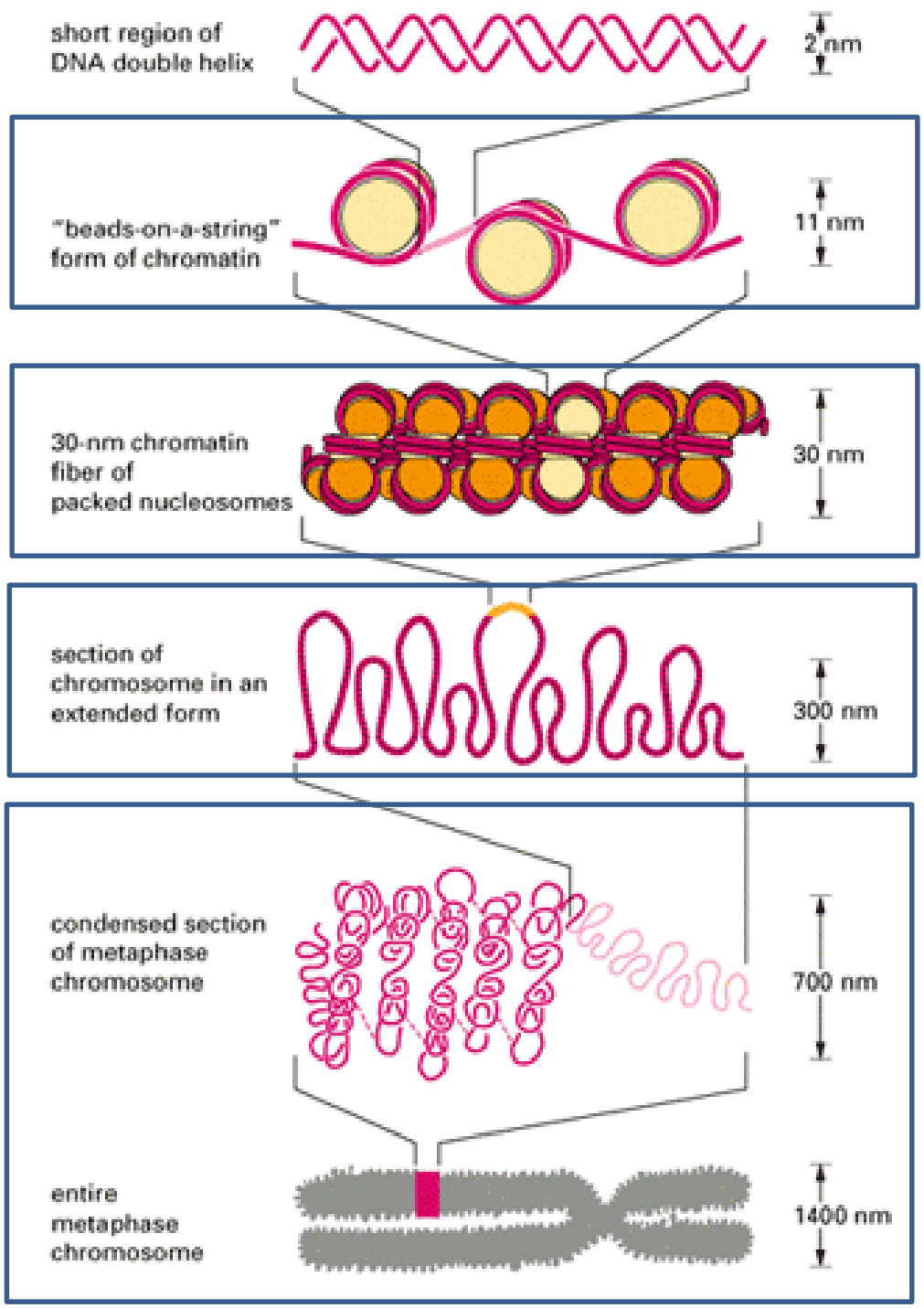


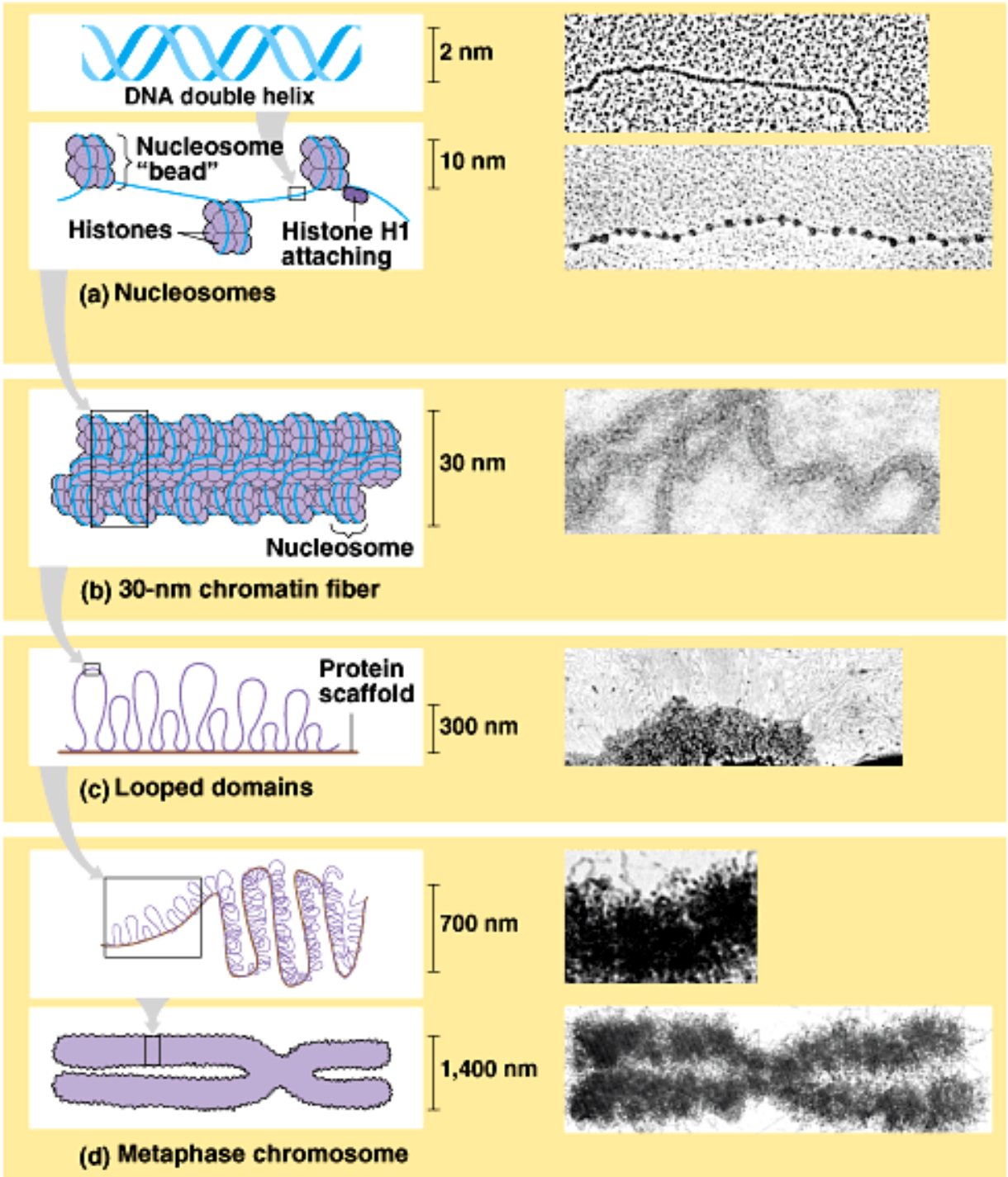
DNA Structure: Folding & Coiling

Level 4: metaphase chromosome

- during metaphase the DNA will further coil & fold

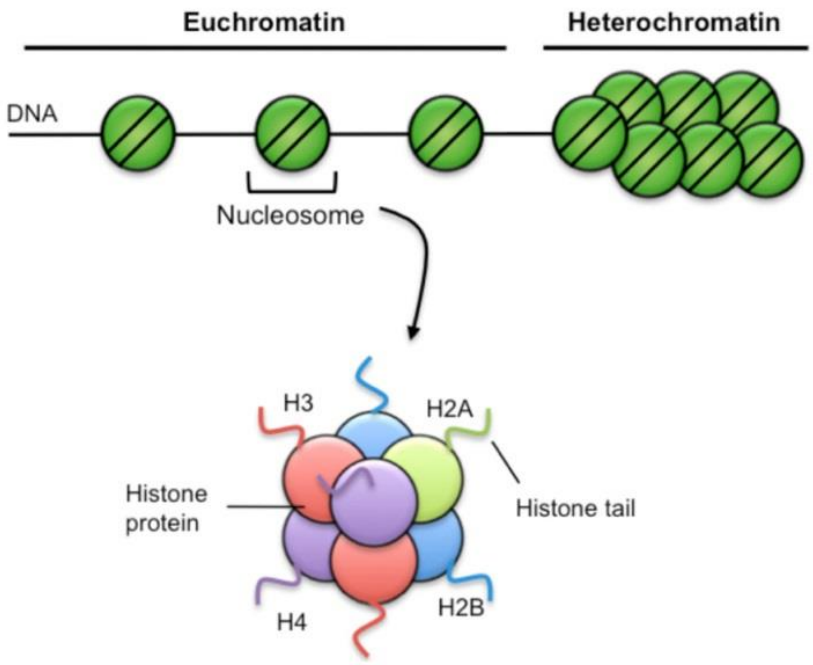



short region of
DNA double helix
2 nm
"beads-on-a-string"
form of chromatin
11 nm
30-nm chromatin
fiber of
packed nucleosomes
30 nm
section of
chromosome in an
extended form
300 nm
condensed section
of metaphase
chromosome
700 nm
entire
metaphase
chromosome
1400 nm


DNA double helix
2 nm
Nucleosome "bead"
Histones
Histone H1 attaching
10 nm
(a) Nucleosomes
30 nm
Nucleosome
(b) 30-nm chromatin fiber
Protein scaffold
300 nm
(c) Looped domains
700 nm
1,400 nm
(d) Metaphase chromosome

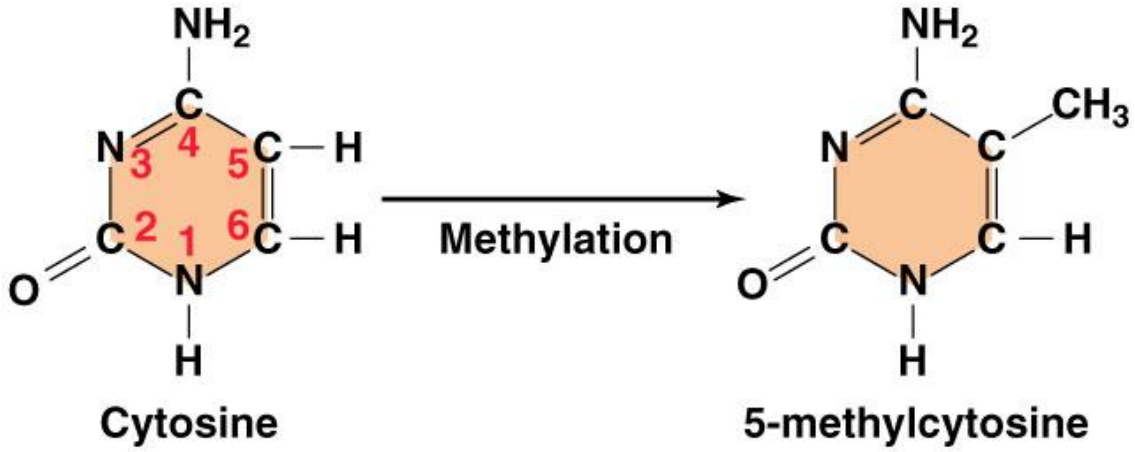
How Coiling Affects Expression

- Heterochromatin
  - DNA that stays highly condensed during interphase is not able to transcribe; inactive
- Euchromatin
  - DNA that remains loose during interphase & can transcribe; active



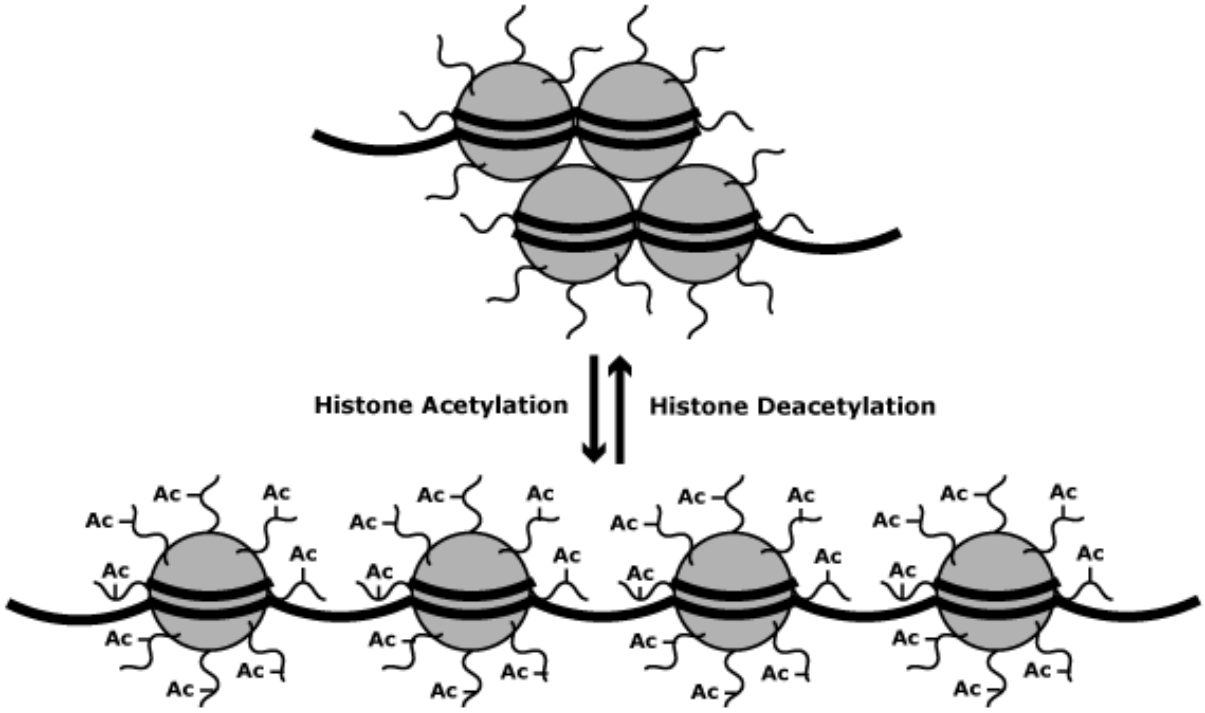
DNA Methylation

- CH_3 groups are added to the C or A bases of DNA
  - causes the DNA to become inactive
  - permanently
- source of genomic imprinting



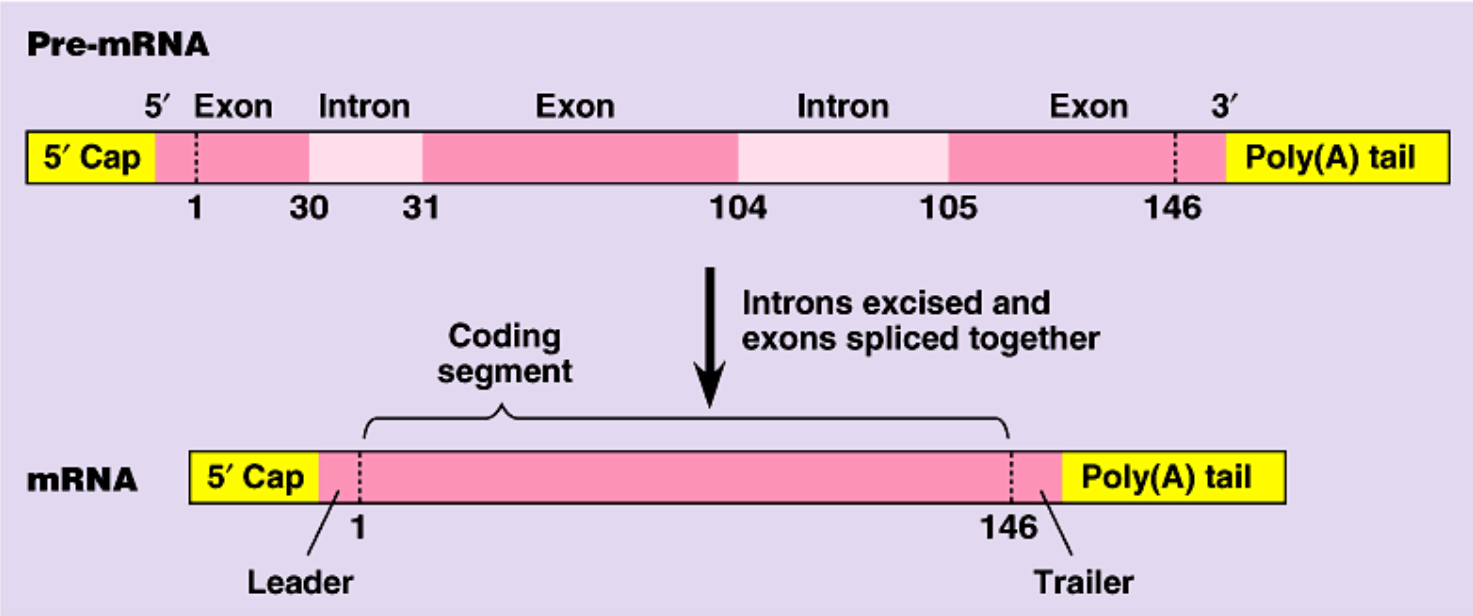
Histone Acetylation

- attaches acetyl groups to histones
- changes shape, grips DNA less tightly
  - increases transcription



4. Regulation of mRNA degradation

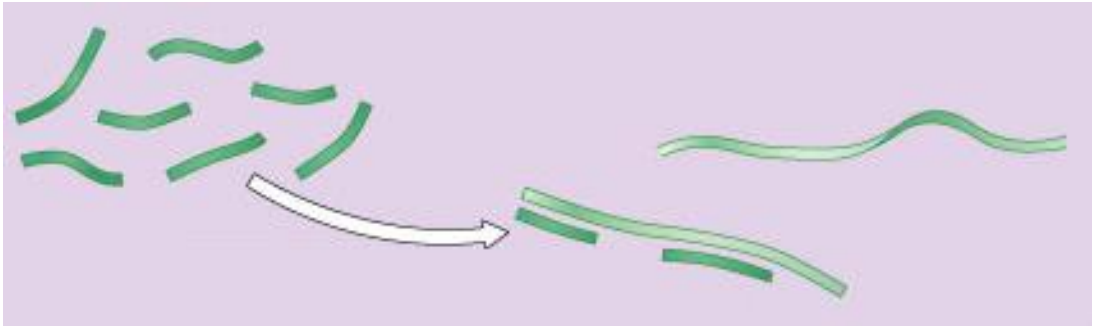
- Life span of mRNA determines amount of protein synthesis
  - mRNA can last from hours to weeks



RNA interference

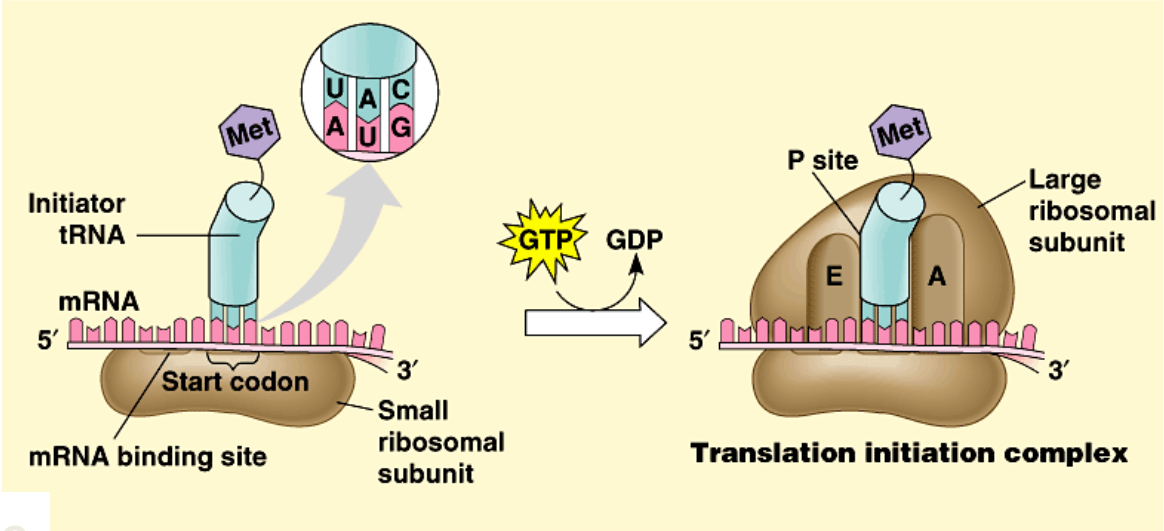
- Small interfering RNAs (siRNA)
  - short segments of RNA (21-28 bases)
    - bind to mRNA
    - create sections of double-stranded mRNA
    - "death" tag for mRNA
      - triggers degradation of mRNA

siRNA



5. Control of translation

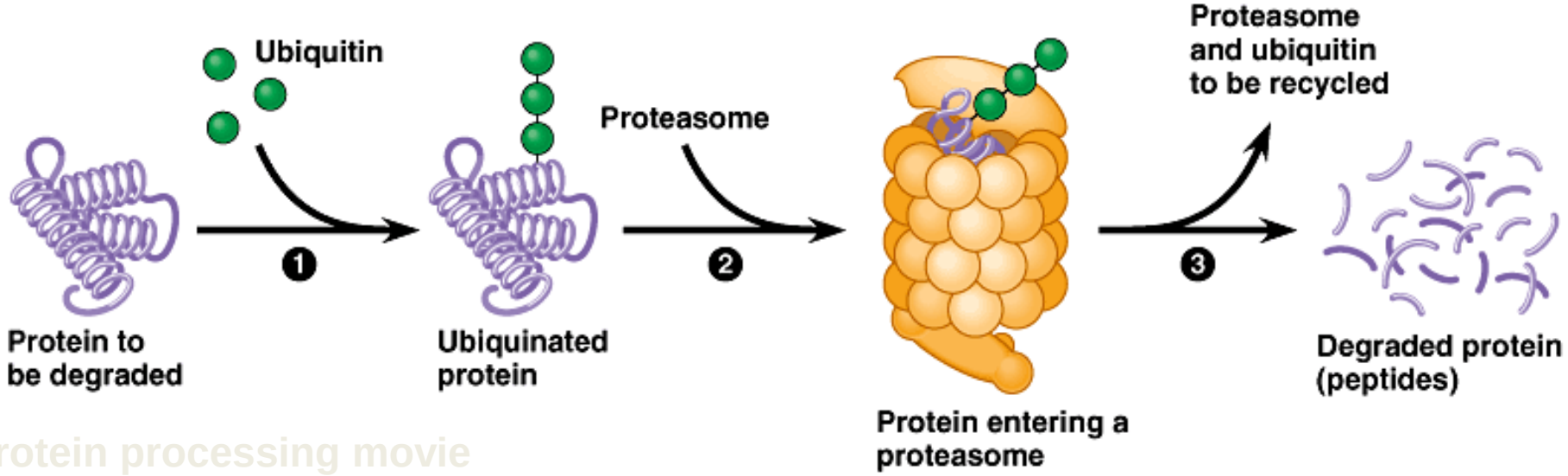
- Block initiation of translation stage
  - regulatory proteins attach to 5' end of mRNA
    - prevent attachment of ribosomal subunits & initiator tRNA
    - block translation of mRNA to protein



Control of translation movie

6-7. Protein processing & degradation

- Protein processing
  - folding, cleaving, adding sugar groups, targeting for transport
- Protein degradation
  - ubiquitin tagging
  - proteasome degradation



Protein processing movie