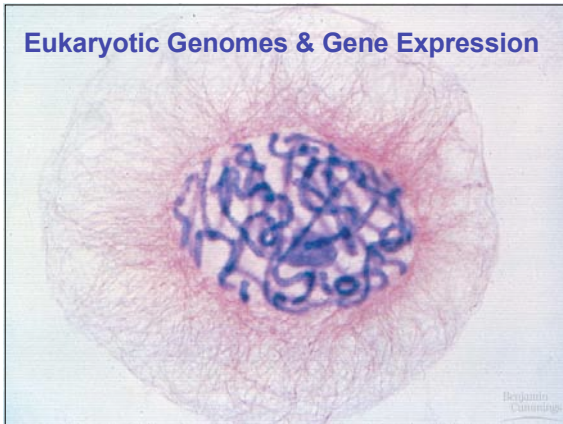
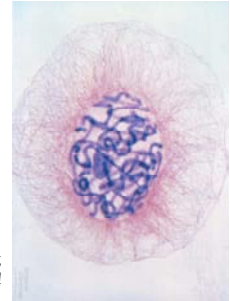


Eukaryotic Gene Expression



Eukaryotic Cells Have Multiple Chromosomes

- Eukaryotic cells have 5–20x more DNA per cell than do bacteria.
- Divided into linear dsDNA + proteins : **chromosomes**
- Typical chromosome averages $\sim 1.5 \times 10^8$ nucleotide pairs.
 - If straight strands would be ~ 4 cm long.
- Humans have 46 different chromosomes
 - So collectively amounts to ~ 2 m long dsDNA packed into each cell nucleus! (4 m after replication!)



Plant cell just before division

Stages in gene expression that can be regulated in eukaryotic cells

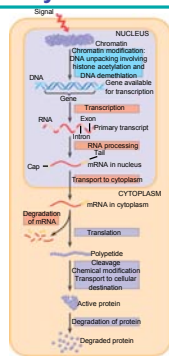
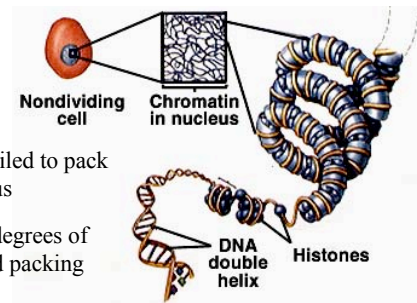


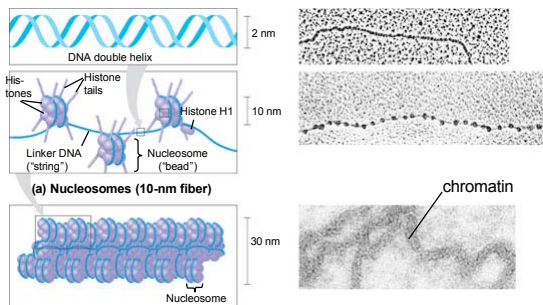
Figure 19.3

Chromatin: nondividing cells



- DNA is coiled to pack into nucleus
- Different degrees of coiling and packing

Levels of chromatin packing



DNA remains coiled around histone "beads" except during replication.

Figure 19.2

Histone tails and the effect of acetylation

- Transcription factors may catalyze histone acetylation
- Acetylated histone tails may recruit transcription factors

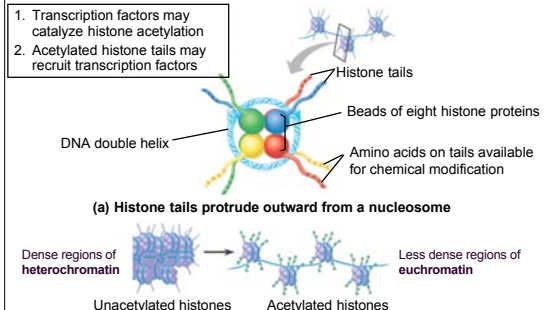
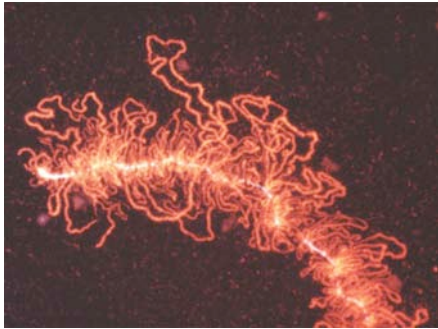


Figure 19.4

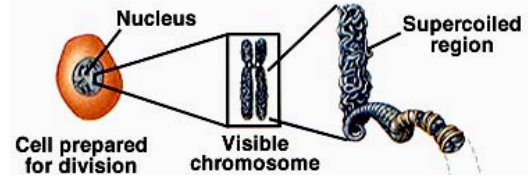
Eukaryotic Gene Expression

DNA in a eukaryotic chromosome from a developing salamander egg



More loosely coiled loops are available for transcription and gene expression.

During cell division



- chromatin condenses into visible chromosomes
- Tightly wound chromosomes segregate without tangling together

Levels of chromatin packing

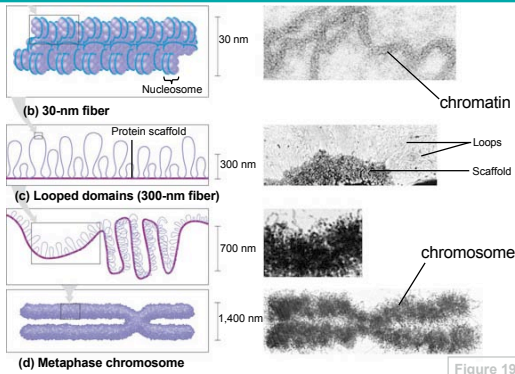


Figure 19.2

Cell Differentiation in Multicellular Organisms

Differential Gene Expression

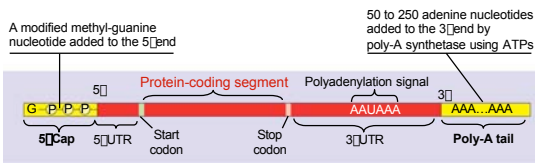
- Even though every cell has the same genome, each cell type only uses a small subset of genes.
 - ~200 cell types in mammals
 - Each uses only ~20% of total genes
 - Fewer in more specialized cells
 - Unused genes may be permanently inactivated
- Histone modification
 - Methylation of histone residues may condense associated DNA into non-transcribable heterochromatin
- DNA methylation
 - Methylation of cytosines related to gene inactivation
 - Methylated DNA may attract/bind histone deacetylation enzymes
 - Epigenic inheritance — patterns of methylation passed on to daughter cells



Figure 47.7 Blastulation

Processing of "primary transcript" RNA

[Review Gene Expression slides!]



- Cap & tail protect mRNA from rapid degradation in the cytoplasm.
- Eukaryotic mRNA stay active for hours, or even days, in the cytoplasm.
- Prokaryotes lack cap & tail; mRNA only lasts for minutes.

Figure 17.9

A eukaryotic gene and its transcript

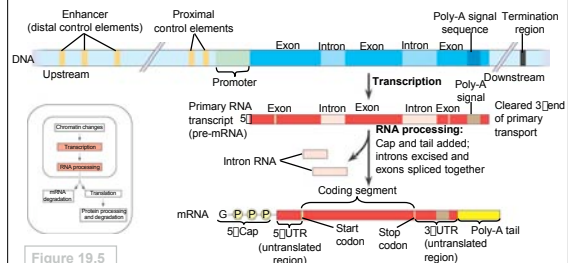
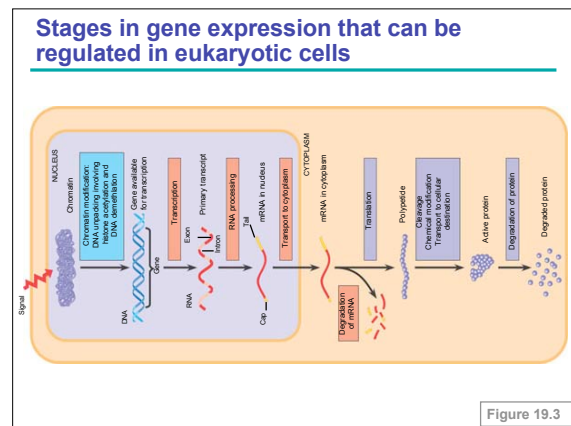
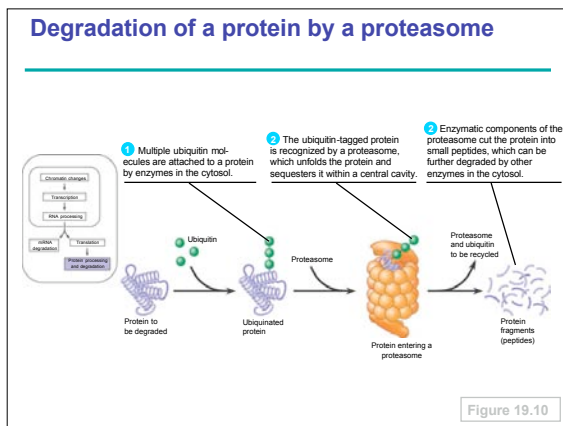
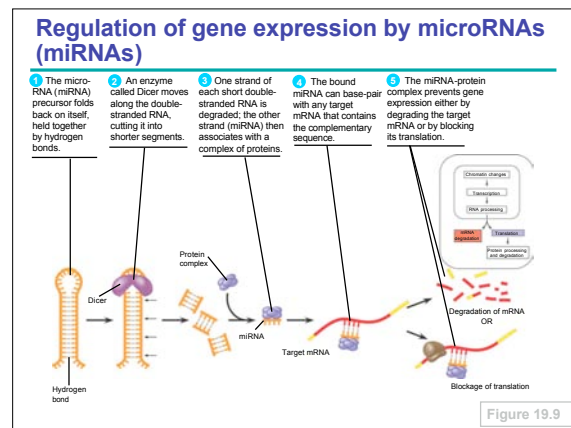
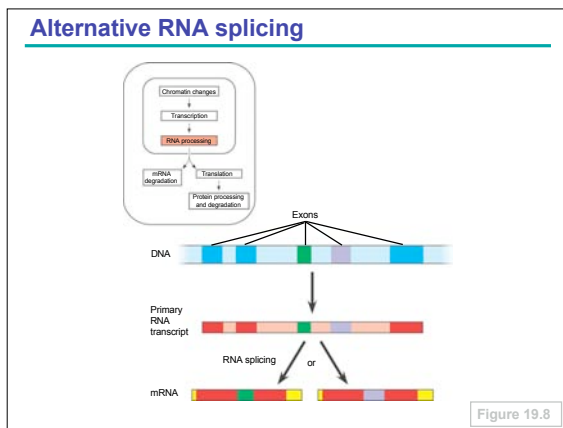
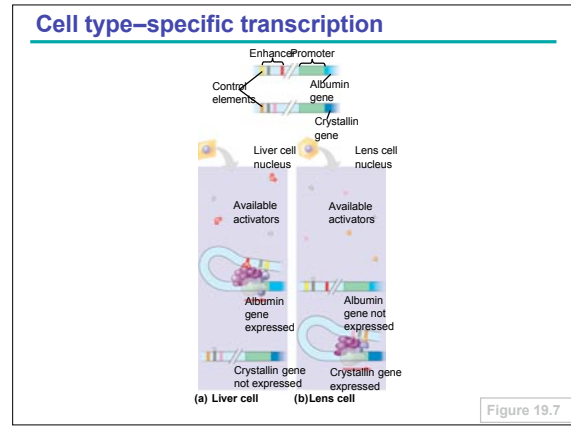
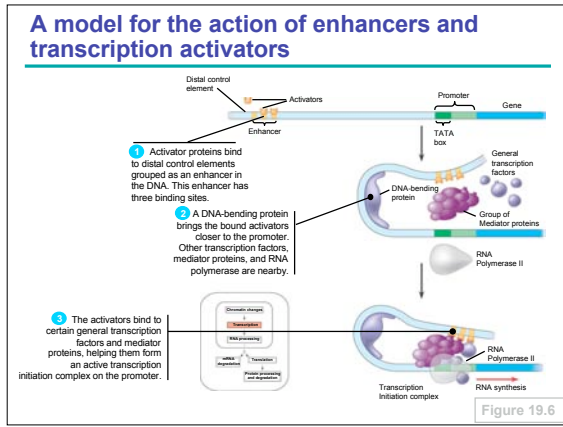


Figure 19.5

- Enhancer sequences may be several kb upstream or downstream of the gene, or within an intron.
- One gene may have several enhancers.

Eukaryotic Gene Expression



Eukaryotic Gene Expression

Movement of eukaryotic transposable elements

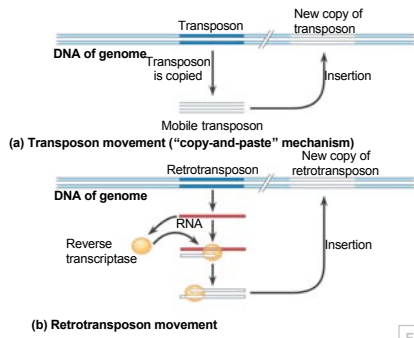


Figure 19.16

The effect of transposable elements on corn kernel color

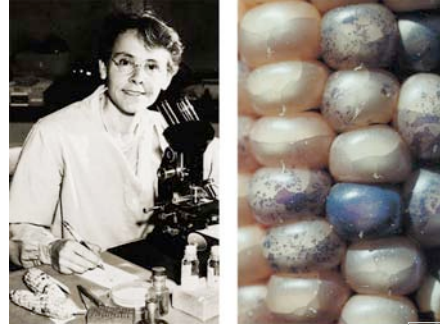


Figure 19.15

Types of DNA sequences in the human genome

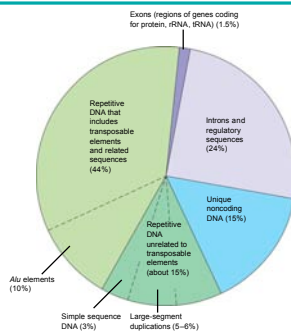


Figure 19.14