Control in Eukaryotic Genomes: That’s us!

Ch. 19
What makes us different?

• We have a lot more DNA
  – 35,000 genes
• a lot of that doesn’t code for anything
• Cell specialization means not all cells have the same DNA
• All that DNA requires major organization
• How would you deal with all that DNA?
How much DNA is that?

• If extended, each DNA molecule would be about 6 cm long, thousands of times longer than the cell
• Each human chromosome averages about $2 \times 10^8$ nucleotide pairs
• This chromosome and 45 other human chromosomes fit into the nucleus
• How is this done?
Histones: the first level of packing

- Their positively charged amino acids bind tightly to negatively charged DNA.
- Makes chromatin look like beads on a string
  - Beads called nucleosomes, where DNA winds around a core of histone proteins.
**Chromatin**: the DNA suitcase

- **(a) Nucleosomes**
- **(b) 30-nm chromatin fiber**
- **(c) Loopable domains**
- **(d) Metaphase chromosome**
Getting down to the DNA level

- In eukaryotes, most of the DNA (about 97% in humans) does not code for protein or RNA.
  - Some are regulatory sequences
- Some is repetitive DNA, present in many copies
  - 10-15% is satellite DNA where base pairs are repeated up to hundreds of thousands of times in a row
  - This can cause mental retardation, like repeats of CGG
  - The longer the repeat, the worse the conditions
  - Some is helpful.....
Telomeres and Centromeres

- The DNA at the centromeres separates sister chromatids during cell division

- The telomeres protect genes from being lost by protecting the ends of chromosomes from degradation
Multi-gene families that code

- For example, the three largest rRNA molecules are encoded in a single transcription unit that is repeated thousands of times
• Each antibodies consists of four polypeptide chains, each with a constant region and a variable region, giving each a unique function.

  – As a immune cell differentiates, one of several hundred possible variable segments is connected to the constant section by deleting the intervening DNA.
Gene amplification

• Happens during development with ribosomes
Why do you think this is?
Where’s the regulation?

• Now it’s your turn!