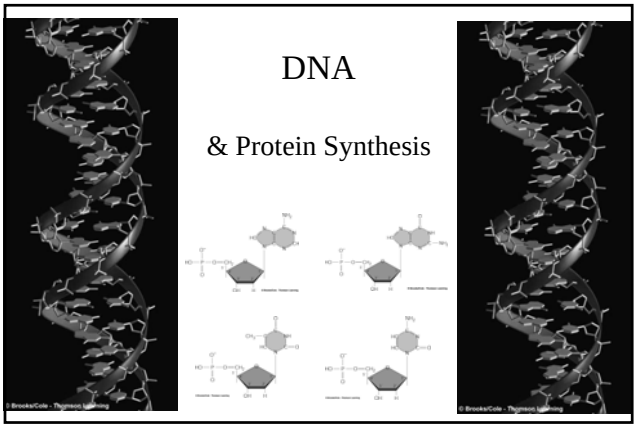
Announcements

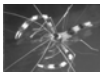
Midterm II is Friday

Shannon and Val Review session on
Wednesday April 5 from 5:30 to 6:30pm
in 2301 Tolman

DNA

& Protein Synthesis





Invertebrates

DNA

- Molecule of inheritance.
- Contains code for all proteins and RNA.
- Responsible for Development.
- Made of four nucleotides strung together by two sugar-phosphate backbones (deoxyribose).
- Strands are coupled by H-bonds between nucleotides (A-T G-C) .
- Composed of two complimentary strands arranged in a helix.
- DNA has direction - 5' to 3'
- Stored as chromosomes in the nucleus.

DNA

Molecule of inheritance

The role of meiosis is to deliver recombined DNA to the next generation packaged in germ cells (sperm and egg).

For most animals, nuclear DNA and mitochondrial DNA are passed on by the egg and only nuclear DNA is passed on by the sperm.

Plants pass on nuclear, mitochondrial and chloroplast DNA.

DNA Code

•Sequences of nucleotides code for the sequences of amino acids that comprise proteins.

•Other nucleotide sequences code for ribonucleic acid (RNA).

•For proteins, the DNA code for individual amino acids is 3 sequential nucleotides known as a codon.

DNA Development

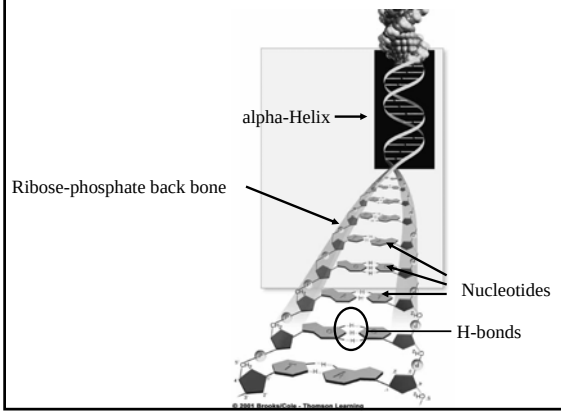
•As an organism develops from a single cell to an adult DNA directs the production of ribosomes and proteins, which are responsible for cell differentiation.

•During development the fate of every single cell is controlled by DNA.

DNA Helix

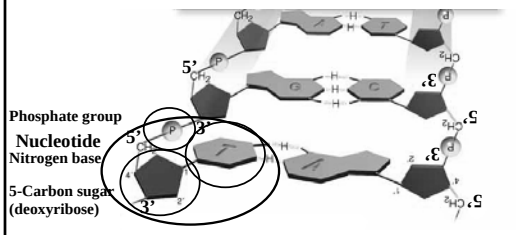
•DNA is composed of two ribose-phosphate strands studded with a sequence of nucleotides, which form hydrogen bonds with complimentary nucleotides on the opposite strand.

•These chemical interactions of these two strands results in a double helix.



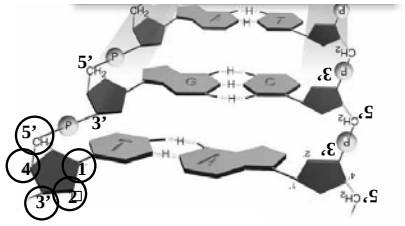
Nucleotides

Each nucleotide has 5-carbon sugar, a phosphate group and the nitrogen base.



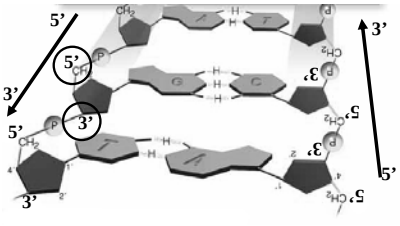
Nucleotides

The carbons of the 5-carbon sugar are numbered



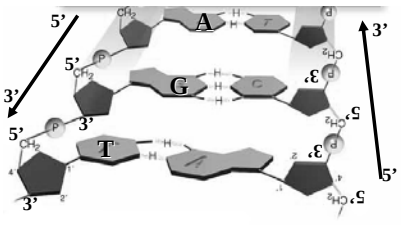
Nucleotides

Nucleotides are joined To one another By carbons 5 and 3



DNA Code

Codon A-G-T is the code for the amino acid Serine.



DNA Code

BUT, mRNA is transcribed from DNA as a complementary strand.

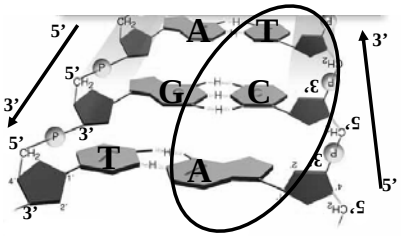
transcription translation

DNA → mRNA → amino acids (Protein)

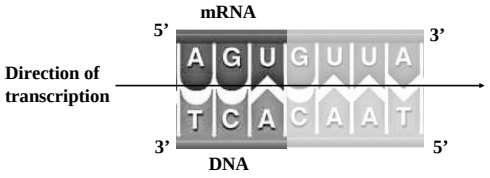
Codons, such as our A-G-T (Serine) eg. are read from the mRNA in the 5’ to 3’ direction during translation.

DNA Code

mRNA is transcribed from the “antisense strand”



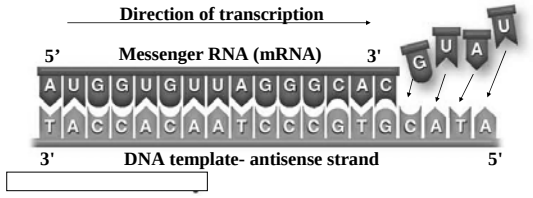
DNA Code



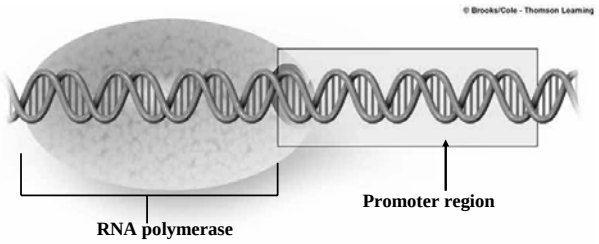
***NOTE: U replaces T in mRNA**

DNA Code

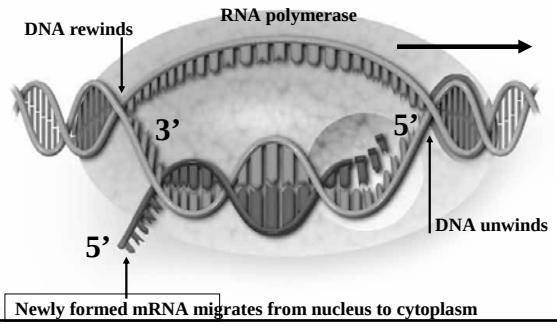
Transcription proceeds in the 3’ to 5’ direction along the antisense strand of DNA.



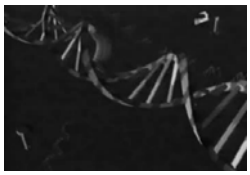
Protein Production



Transcription - nucleus



Protein Production



Genetic Code

- Set of 64 base triplets
- Codons

  Nucleotide bases read in blocks of three
- 61 specify amino acids
- 3 stop translation

Code Is Redundant

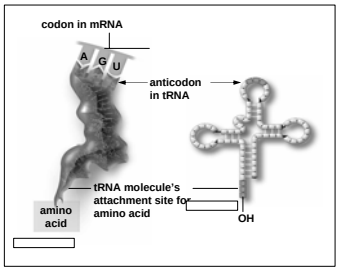
Twenty kinds of amino acids are specified by 61 codons

Most amino acids can be specified by more than one codon

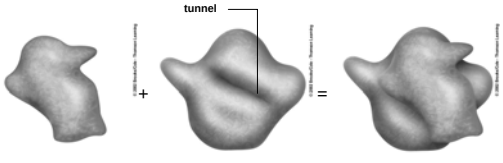
Six codons specify leucine

UUA, UUG, CUU, CUC, CUA, CUG

tRNA Structure



Ribosomes (rRNA)



small ribosomal subunit | large ribosomal subunit | intact ribosome

Three Stages of Translation

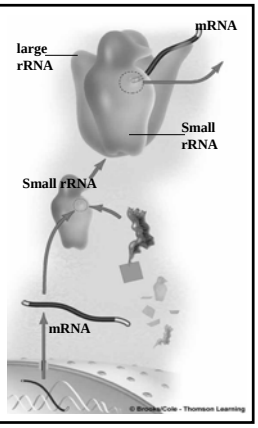
Initiation

Elongation

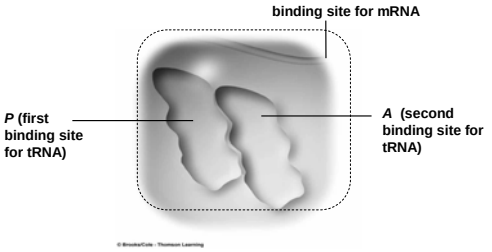
Termination

Initiation

- Initiator tRNA binds to small ribosomal subunit
- Small subunit/tRNA complex attaches to mRNA and moves along it to an AUG "start" codon
- Large ribosomal subunit joins complex



Binding Sites on Large Subunit

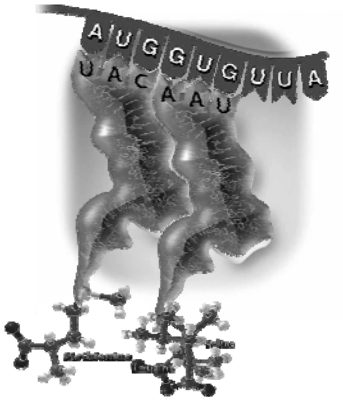


Elongation

mRNA passes through ribosomal subunits

tRNAs deliver amino acids to the ribosomal binding site in the order specified by the mRNA

Peptide bonds form between the amino acids and the polypeptide chain grows



Termination

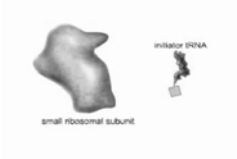
A stop codon in the mRNA moves onto the ribosomal binding site

No tRNA has a corresponding anticodon

Proteins called release factors bind to the ribosome

mRNA and polypeptide are released

Translation Animated

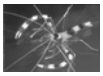


What Happens to the New Polypeptides?

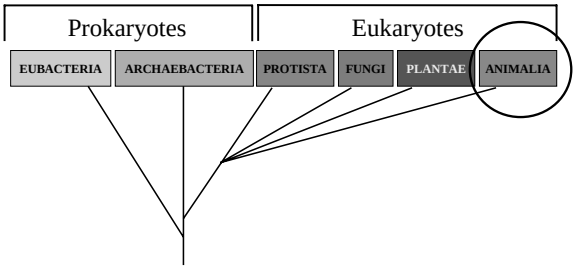
Some just enter the cytoplasm

Many enter the endoplasmic reticulum and move through the endomembrane system where they are modified

Invertebrates



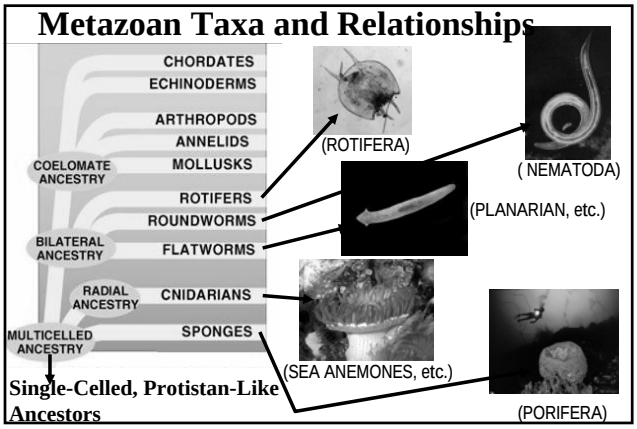
6 Kingdom Classification Scheme

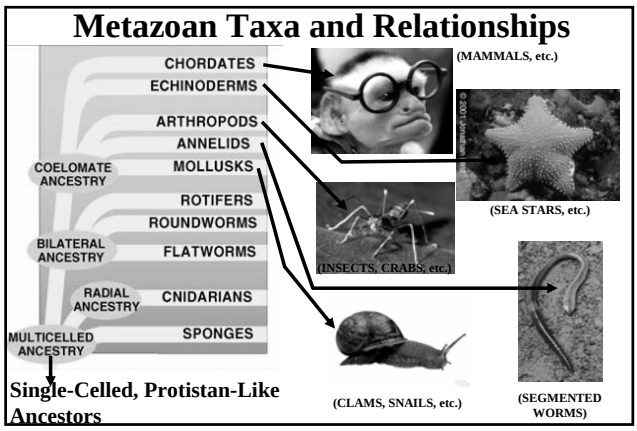


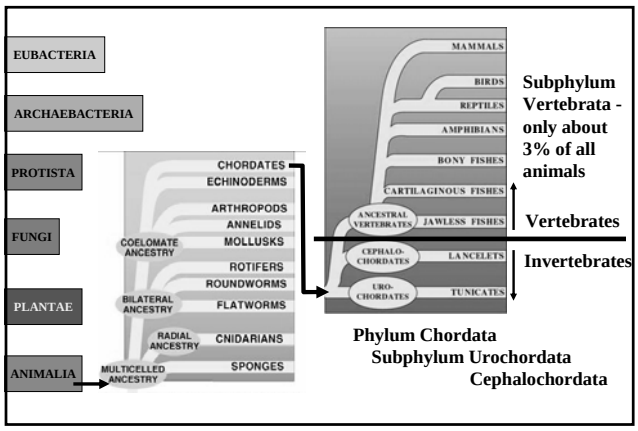
Species Distribution Among Phyla

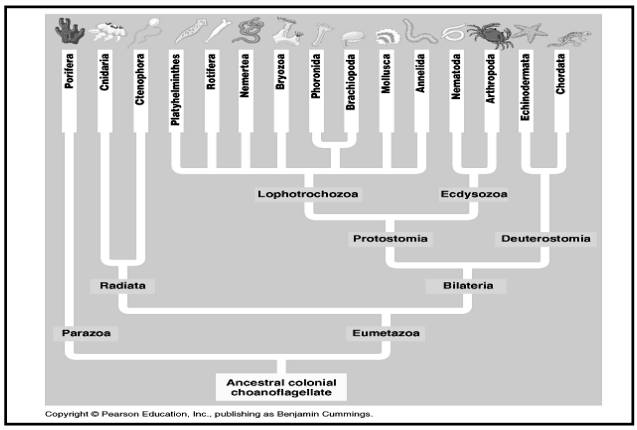
Placozoa (simplest animal)	1	**Arthropoda** (insects, etc.)	1,000,000+
Porifera (sponges)	8,000	**Echinodermata** (sea stars, etc.)	6,000
Cnidaria (jellies, etc.)	11,000	**Invertebrate Chordata**	2,100
Platyhelminthes (flatworms)	15,000	**Fishes**	21,000
Nematoda (roundworms)	20,000	**Amphibians**	3,900
Rotifera (rotifers)	2,000	**Reptiles**	7,000
Mollusca (clams, snails)	110,000	**Birds**	8,600
Annelida (segmented worms)	15,000	**Mammals**	4,500

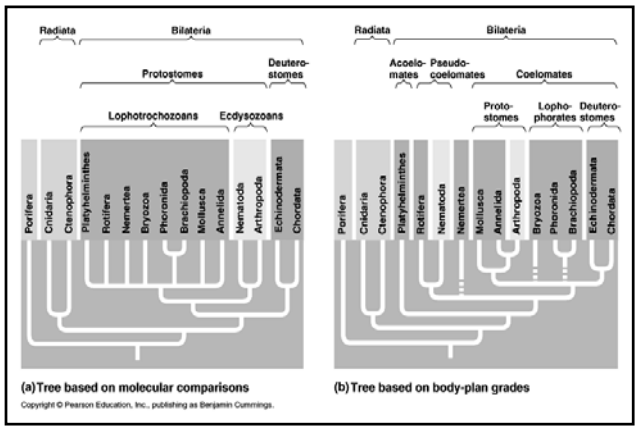
Metazoan Taxa and Relationships

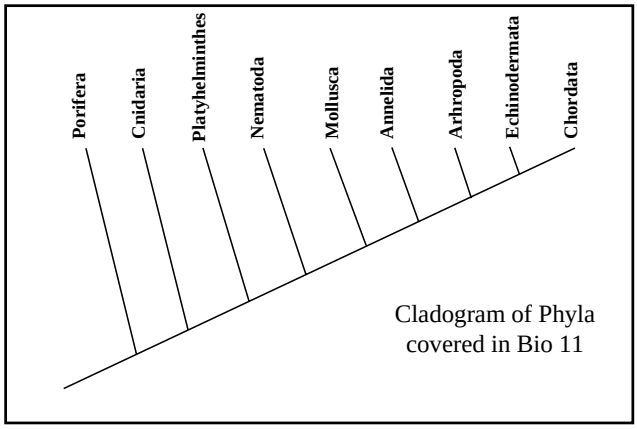












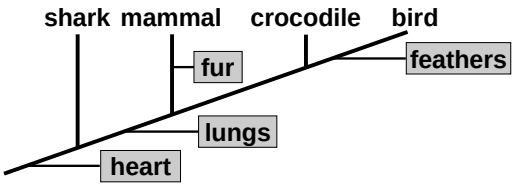
Cladograms

Cladograms are evolutionary tree diagrams that show relationships based on shared-derived characters.

Shared-derived characters (synapomorphies) are characters that are shared by two or more groups which originated in (and were derived from) their immediate (last) common ancestor.

Another term you may see is **homologous characters**. Homology and synapomorphy are synonyms.

Distinguishing Characteristics



Analogous Characters

Two anatomical structures are considered to be **analogous** when they serve similar functions but are not evolutionarily related.

Analogous structures are the result of **convergent evolution** and are contrasted with homologous structures.

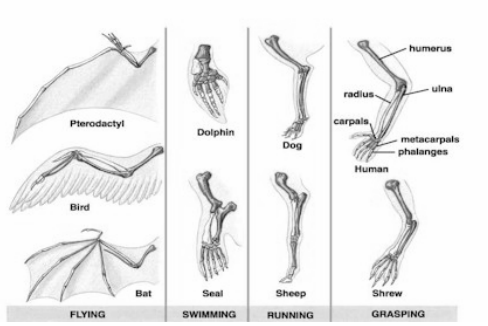
Convergent evolution or **homoplasious characters** show phenotypic similarity among different taxa that does not represent patterns of common evolutionary descent.

Example

Bird Wing | Bat Wing | Insect Wing

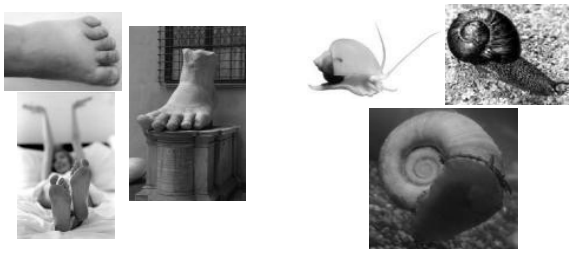
Homologous or Homoplasious Characteristics?

Homologous bones



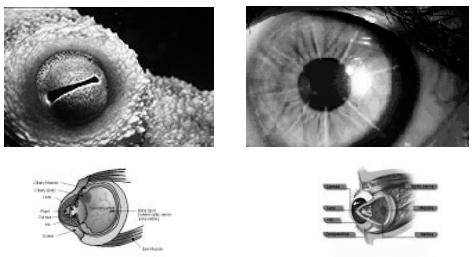
Homologous or Homoplasious?

Foot of a human and foot of a snail
Compare the Similarities and Differences



Homologous or Homoplasious?

Eye of an octopus and the eye of a human



Characteristics That Unite **All** Animals

1. Eukaryotic (nucleus present), permeable cell membrane, no cell wall
2. Heterotrophic (no chloroplasts)
3. Multicellular

Appreciate Their:

1. Diversity
2. Innovations
3. Lifestyles

Recognize their variations on a theme (body plan).

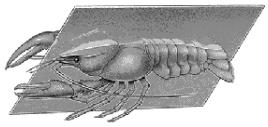
Recognize convergence.

Compare the Similarities and Differences

1. Body Symmetry
2. Cephalization
3. Type of Gut
4. Type of Body Cavity
5. Segmentation

Body Symmetry and Cephalization

Radial – body parts are arranged regularly around a central axis. (example: sea anemone)



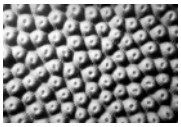
Bilateral – right half and left half are mirror images.

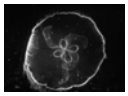
Anterior/Posterior – head/tail

Dorsal/Ventral – back/stomach

Examples of Body Symmetry

Radial





Bilateral