I. Characteristics of Animals
   • Multicelled heterotrophic eukaryotes
   • Require oxygen for
   • Reproduce sexually, and perhaps
   • Motile at some stage
   • Develop from embryos
   • Originated during the Precambrian

II. Symmetry

III. The Gut
   • Region where food is digested and then absorbed
   • Saclike gut:
     • Complete digestive system:

IV. Body Cavities
   - Acoelomate
   - Pseudocoel
   - Coelom

V. Segmentation
   • Repeating series of body units
   • Units may or may not be similar to one another
   • Earthworms
   • Insects

VI. Animal Origins
   • Originated during the Precambrian (1.2 billion - 670 million years ago)
   • From what? Two hypotheses:

VII. Phylum Placozoa
   • One living species, Tricoplax adherens
   • Simplest known animal
   • Two-layer body, 3 mm across

VIII. Sponges - Phylum Porifera
   • No
   • No
   • No
   • Reproduce
     • Microscopic swimming-larval stage
IX. Phylum Cnidaria
   • Only animals that produce nematocysts
   • Nerve net
   • Hydrostatic skeleton
   • Saclike gut
   • Classes:

X. Two Main Body Plans:

XI. Flatworms: Phylum Platyhelminthes
   • Acoelomate
   • All have simple or complex organ systems
   • Most are
   • Classes
     – Turbellarians (Turbellaria)
     – Flukes (Trematoda)
     – Tapeworms (Cestoda)

XII. Coelomate Lineages

XIII. Cleavage Patterns

XIV. First Opening in Embryo

XV. Phylum Annelida
   • Segmented, coelomate worms
   • Class Polychaeta

   • Class Oligochaeta

   • Class Hirudinea

XVI. Phylum Mollusca
   • Bilateral, soft-bodied coelomate
   • Most have a shell or reduced version of one
   • Mantle drapes over body and secretes shell
   • Most have a fleshy foot
   • Classes
     – Gastropods (snails)
     – Chitons
     – Bivalves (clams)
     – Cephalopods (squid)
XVII. Phylum Echinodermata
• The only
• Almost all are marine
• Body wall has spines or plates of calcium carbonate
• No brain
• Adults are radial with bilateral features
• Classes:

XVIII. Phylum Arthropoda
• The phylum with the greatest number of species
• Four lineages:
  – Trilobites (all extinct)
  – Chelicerates (spiders, mites, scorpions)
  – Crustaceans (crabs, shrimps, barnacles)
  – Uniramians (insects, centipedes, millipedes)

XIX. Chelicerates
• Originated in seas
• A few are still marine:
  • The arachnids are all terrestrial: Spiders, Mites, Scorpions, Chiggers, “Daddy longlegs,” Ticks

XX. Crustaceans
• Most are marine, some freshwater, a few terrestrial
• Head has two pairs of antenna, three pairs of food-handling appendages
• Examples: Copepods, Crayfish, Barnacles, Lobsters, Shrimps, Crabs, Isopods (pillbugs)

XXI. Millipedes and Centipedes
• Segmented bodies with many legs
• Millipedes:
  • Centipedes:

XXII. Arthropods: Adaptations for Success
• Hardened
• Jointed
• Fused
• Respiratory structures
• Specialized

XXIII. Insects
General body plan

Diverse mouthparts

Development
XXIV. Examples
Hemimetabolites
- ODONATA
- ORTHOPTERA
- ISOPTERA
- BLATTERIA
- PHTHIRAPTERA

Holometabolites
- SIPHONAPTERA
- LEPIDOPTERA
- HYMENOPTERA
- DIPTERA
- COLEOPTERA

XXV. Insects: Adaptations for Success
- Holometabolism =
- Flight =
- Exoskeleton =
- Small size =
- Short generation times and high fecundity =
- Co-evolution with angiosperms =

XXVI. Phylogeny Terminology
- Phylogenetics – the study of evolutionary relationships among organisms
- These relationships can be determined by:
  - Other terminology
    - Tips of branches represent species included in analysis
    - Points of division (nodes) represent ancestors
    - Ingroup = the group for which you want to determine relationships
    - Outgroup = ancestral organism of your ingroup
    - Apomorphy = derived character
    - Synapomorphy = shared derived characters

XXVII. Phylogenetic Context: Invertebrates
NEMATODE ORIGINS

ARTHROPODA

XXVIII. VISIT THE ACADEMY: http://www.acnatsci.org/