Taxonomy.

(Your text makes a real mess of this. Use these notes as a guide through the book.)

Study of classifying and naming organisms.

Founded by Linnaeus.

If done properly, is based on evolutionary relationships (at least to some extent).

If based on ancestrally derived similarities, then often this is “automatic”.

Kingdom -> Phylum -> Class -> Order -> Family -> Genus -> species

These categories may be supplemented with “Super-” “Sub-” “Infra-” (below “sub-”) etc.

A few other categories also exist: Domain (above Kingdom), Tribe (between family and genus).

So how does it work?

Complete classification of Humans:

Kingdom: Animalia (grouped with all animals)
Phylum: Chordata (grouped with mostly vertebrates)
Class: Mammalia (grouped with Mammals - fur, milk)
Order: Primates (grouped with Monkeys)
Family: Hominidae (grouped with Humans (fossils incl.))
Genus: Homo (grouped with very similar humans (e.g. Homo erectus))
Species: sapiens (only humans)

Note that fossil species are classified the same way.

Another example [Fig. 26.3, p. 537]:

- note that one can use this classification to make a phylogenetic tree (there's a lab exercise that will let you do this) [Fig. 26.4, p. 538].

Note that the only “objective” category is species:

- although the species concept has problems, we can “test” to see if organisms belong to a particular species or not.

- we have no such “test” for the other categories. Instead, we need to decide what goes where based on what we “think”, which isn't really “objective”.
- much argument about the other categories.

About writing scientific names:

Always include Genus and species.

Genus - always capitalized.
species - always lower case (few very rare exceptions in botany)

Both underlined or italicized.

Favorite quiz/exam question.

More on phylogenetic trees:

Taxon - a group of animals (e.g., a family, a class, etc.)

[Fig. 26.10, p. 542]

Monophyletic - best. Each group includes ancestor and all immediate descendent species. E.g., cats.

Polyphyletic - pretty bad. Organisms with different ancestors are grouped together. E.g., grouping humans and jelly fish together in the same Genus (an obviously silly example).

Paraphyletic - not good, but okay (depending on who you talk to). Ancestor is grouped with some (but not all) descendents. Birds and dinosaurs. (Birds are in their own class, as are dinosaurs).

Comments on the text:

The text makes a big deal about a lot of this, including why paraphyletic is really bad.

- note that to get rid of paraphyletic groups we'd need to reclassify birds as dinosaurs or reptiles.

- this may reflect a true evolutionary relationship, but it's nonsense for most people.

- I refuse to make a big deal out of this. We'll stick with the traditional system of classifying animals, even if some scientists want to turn everything upside down.

The text also makes a big deal about clades and such. We will ignore this almost
entirely. But before we do, let's at least explain just a little of the fuss:

- there are many ways of coming up with classification trees.

  - we need a way to build our trees - for example, how do we decide to group big cats together, and separate them from smaller cats? At what point do we put cats in one family and dogs in another? What about bears, which are related to both?

- there are three main ways of coming up with classifications: traditional, cladistic, & phenetic.

  - traditional uses expert knowledge, often based on shape/morphology, but can also use DNA and other methods.

  - cladistics uses computers to make decisions based on the input of characters (e.g. size, color, shape) by “experts”. Cladistics also insists on monophyletic trees and single branching points.

  - phenetics isn't used much anymore since it arbitrarily lets computers do everything.

Cladidistics seems to have won out recently.

  - It's hailed as a more objective way of finding relationships.

  - But it does have problems (who decides what characters to use?), and is directly responsible for the mess that taxonomy is in (e.g. birds are reptiles, and other silliness).

  - until this is straightened out, I suggest ignoring this.

Finally: don't worry about some of the concepts in chapter 26 such as PhyloCode (which promises to make taxonomy a nightmare for the average person), outgroups, ingroups, etc.

Finally, what are animals?

They belong the the Kingdom Animalia.

- Incidentally, your book puts them into the Domain Eukarya. If you've had cell biology, you should remember eukaryotes.

- But domains are in flux, and though your book tries to be reasonable here, domains are changing so much that it's hard to know what will be happening a few years from now.
Animal origins:

Probably the group most closely related to animals are the choanoflagellates [Fig. 32.3, p. 656].

Belong to the protists (a name for sometimes unrelated eukaryotes).

- protists include such things as ameobas, algae, paramecium, slime molds, etc.

They frequently form large colonies.

They bear a remarkable similarity to the choanocytes found in sponges.

Characteristics of animals:

- multicellular - this should be obvious.

- heterotrophic - means they get their energy by consuming other organisms (they can not “generate” their energy like a plant from sunlight (plants are “autotrophs”).

- eukaryotic - we don't have the time to go into details here, but the essence of being a eukaryote means having membrane bound organelles like a nucleus or endoplasmic reticulum. [Fig. 6.6, p. 98 & 6.9, p. 100].

Animal development:

Before starting our survey of the animal kingdom, we need to know a little bit about how animals develop.

- For example, how do we go from a single cell to a human being?

- how does an individual cell give rise to heart, muscles, nerves, etc.

- we, will not go into a lot of detail here.

In general, we’ll follow the development of a zygote [Fig. 32.2, p. 655]:

- division occurs until a hollow ball (blastula)forms

- one side of ball folds in (like poking a tennis ball)

- we now have two cavities, the original, and a new one with an opening to the outside (go through parts)
- also note that now we have two cell layers:
  
  inside - endoderm
  
  outside - ectoderm

- if a middle layer forms (mesoderm), this can happen in one of two ways [Fig. 32.9, p. 661]:
  
  - mesoderm forms from outpocketings of endoderm (archenteron)
  
  - mesoderm forms from cells at the sides of the opening (blastopore) of the archenteron

- depending on which happens, one gets either:
  
  - protostome - blastopore forms mouth, anus is formed through another opening that is eventually made.
  
  - deuterostome - second opening forms mouth, anus is formed from blastopore

- most animals are protostomes, but echinoderms and chordates are deuterostomes.

  - one reason that chordates and echinoderms are thought to be closely related.

- Some other differences between protostomes and deuterostomes include the type of cleavage and determinate vs. indeterminate cleavage.

  Protostomes - spiral and determinate

  -spiral - oblique

  determinate - each cell's fate is determined early on.

  Deuterostomes - radial and indeterminate

  radial - parallel or perpendicular

  indeterminate - each cell can still form an entire individual until late

The three layers eventually form all the structures within the organism [Fig. 47.14, p. 1032]
Exactly how the various structures form often has to do with how these different layers interact with each other.

Body cavities

- important note - the gastrocoel, which goes on to form the gut, is NOT a body cavity.

- a “place” for internal organs.

- a silly example:
  - a box of macaroni - the container is the cavity
  - animals don’t need cavity (acoelomate) - if one fills the container with stuff (say, cement), the macaroni are still there.

- more advanced animals have body cavities

- if derived from (contained within) mesoderm, this is considered a “true” body cavity, or coelom.

- if not derived from mesoderm, this is termed a pseudocoelom, or “false cavity”.

  - see [Fig. 32.8, p. 660] for a confusing picture.

Symmetry - [Fig. 32.7, p.637]

- assymetrical - no symmetry whatsoever (e.g., a blob).

- radial - can cut animal any way, like slicing a circle in half.

- bilateral - can cut animal only one way.