

BIOLOGY 205 – COMPARATIVE INVERTEBRATE ZOOLOGY

MY RESPONSES TO STUDENT QUESTIONS

Questions asked prior to the midterm exam:

1. How in depth do we need to know the readings?

It sounds like you are referring to Chapters 3 & 4?. Almost all of that material will be covered at some level and at some point during the term as we cover different animal groups with different characteristics -- so try to be patient. Keep in mind that the exams will only focus on info covered in lecture (know your notes cold). The info you're reading about will be that much more familiar to you when we actually discuss it later on.

2. Does the oncosphere undergo sexual or asexual reproduction?

Neither: the oncosphere larvae of cestodes develop from zygotes. Once inside the gut, the oncosphere enters the circulatory system and bores into the muscle tissue of it's intermediate host (sexual reproduction occurs in the definitive host).

3. Platyhelminthes - is the "protonephridial unit" the flame cell?

The "unit" refers to the flame cell + at least one tube cell.

4. Are cnidocytes in both the epidermis and the gastrodermis?

Yes -- in scyphozoans and anthozoans. Cnidocytes are only in the epidermis of hydrozoans.

5. What are the functions of the verrusae and cinclides in cnidaria?

The cinclides of anemones are holes that allow acontia to stream through -- function: defense. The verrusae of anemones are small warts that often adhere to small particles (e.g. sand grains) -- function: camouflage?

6. For hydromedusae, you drew that they have "sense organs". Are these the rhopalia of the scyphomedusae?

The term "rhopalium" refers to the distinctive organization of sense organs and lappets on the periphery of scyphomedusae. Hydromedusae also have sense organs around the periphery, but they are arranged differently.

7. What is the difference between the dermal epithelium and the pinacoderm?

They're essentially synonyms. I guess dermal epithelium would be more synonymous with "exopinacoderm" (the layer of flat cells - pinacocytes - on the outside of a sponge). "Pinacoderm" is a general term that refers to both the exopinacoderm and the endopinacoderm collectively.

8. Do endopinacocytes line the inner part of the sponge that is NOT the choanocyte chamber only?

Exactly.

9. What is the difference between the dermal pore and the incurrent canal?

A "dermal pore" is the actual hole through the exopinacoderm that leads to canals within the mesohyl -- the "incurrent canals". Incurrent canals bring seawater to choanocyte chambers. Dermal pores are formed by many cells, whereas "ostia" are formed by a single cell -- the "porocyte".

10. What is the difference between the stomodeum and the pharynx in the anthozoa? Are they both epidermal?

A "pharynx" (in general) is the region of the gut positioned just behind the mouth (or GVC opening); it refers to the cavity and the associated epithelial tissues and musculature. A "stomodeum" is a depression in the ectoderm of the oral region of a young embryo, which develops into the mouth (or GVC opening) and oral cavity; it is the ectodermally derived, epithelial lining of the pharynx.

11. You mentioned anthozoans were "clonal" and "solitary". What did you mean by this?

Anemones (Anthozoa) can either be "solitary" (one polyp living by itself) or form large "clonal" populations (lots of genetically identical polyps living side by side with one another). The polyps of corals (Anthozoa) are connected to one another via shared tissues and, thus, form "colonies".

12. What is the oral arm of the scyphomedusae derived from?

Figure 8.14a (pg. 237) shows a nice sketch of the arrangement of oral arms with the GVC. The epidermal lining of the oral arms is derived from ectoderm.

13. I'm not sure what you meant when you said that feeding was primary extracellular, and the final digestion was intracellular.

Sponges are not capable of extracellular digestion -- cnidarians and flatworms are. Extracellular digestions means that the animals are able to release enzymes that break down food items (prey organisms) prior to phagocytosis by gastrodermal cells (where intracellular digestion occurs). "Primary" simply refers to "first"; "final" refers to "last". Primary digestion is extracellular and final digestion is intracellular. Cnidarians and flatworms can therefore consume much larger food items than sponges.

14. I was going through the notes of this class and was wondering if we are responsible for the material in the textbook that is not covered in class.

No. Focus on your notes and use the textbook to help you understand them. The pictures/figures should help too.

15. There are many sections that you have put as required reading that we have not covered in lecture and I was wondering if these will be tested on the midterm in both the lecture or the lab?

Unless specifically stated otherwise, the questions on your exam will come directly from the material covered in your notes (in class). The textbook should reinforce your notes and expand what you are able to take away from the course. The notes should help distill the info and guide you in determining what NOT to focus on in the textbook for exam purposes.

16. I'm still a little unclear about the differences between indirect, mixed, and direct development. □ Would you be able to define these terms for me?

Absolutely. Check out pg. 8 in Outline 2 (Phylo & Animal Org):

Indirect development is found in many marine animals. Their life history consists of free spawning, external fertilization and a distinct larval stage that ultimately undergoes metamorphosis into an adult. There are several advantages and disadvantages to this life history strategy (e.g., low cost/zygote, low survival, widespread dispersal and low parental care). Examples: sipunculids, many cnidarians, many nemertean, gastropods, echinoderms etc.

Direct development is found in most terrestrial animals and many marine animals. Their life history consists of internal fertilization and zygotes that develop directly into juveniles/adults (no larval stage). There are several advantages and disadvantages to this life history strategy as well (e.g., high cost/zygote, high survival, restricted dispersal and a lot of parental care). Examples: terrestrial vertebrates, cephalopods, many flatworms, some nemertean etc.

Mixed development is found in many different marine animals and is a mixture of direct and indirect life histories. This life history consists of internal fertilization and a distinct larval stage that ultimately undergoes metamorphosis into an adult. Examples: sea slugs (nudibranchs), some cnidarians, sponges, marine turbellarian flatworms etc.

17. Functions of gastric pouch in the cnidaria & complete mesentery in the cnidaria?

This just refers to the four stomach cavities defined by the "septa". The septa and complete mesenteries increase surface area and provide structural integrity to large scyphomedusae and anthozoans.

18. Functions of incomplete mesentery in the cnidaria?

The incomplete mesenteries of anemones increase surface area and form the foundation for the "acontia" -- stinging projections that are loaded with cnidae and function in prey capture.

19. Functions of shell gland in the platyhelminthes?

The shell gland produces the robust capsule (shell) around the fertilized eggs and developing embryos.

20. Functions of the crop in the gastropods?

The crop in gastropods is a synonym for "stomach". This is where the crystalline style-based extracellular digestion occurs (including the formation of the mucus string or "protstyle" and the sorting of food particles in ciliated grooves).

21. Other than the practice midterm on your site, what else, in terms of practice problems, can we do to prepare for the midterm?

You should also read over the Study Guidelines (on the same site) and the Study Skills listed on the 3rd page of your lecture syllabus. My best advice is to know your notes cold and, if possible, discuss them with classmates. Consult your text and the on-line Glossary when the meaning of a term is unclear. Also, feel free to ask me specific questions whenever they arise via email or in person.

22. Trematoda - are they monoecious or dioecious? I'm pretty sure they're monoecious but for some reason during their life cycle I wrote down that the adult was either a male or a female.

Mostly monoecious. Exceptions: some *Schistosoma* spp. (e.g., the human blood fluke).

23. What does "tripartite" coeloms mean?

We'll revisit tripartite coeloms when we discuss deuterostomes (echinoderms and chordates).

"Tripartite" refers to the following arrangement of coelomic spaces:

- 1) the protocoels - a single or pair of coeloms in front of the mouth (in the head)
- 2) mesocoels - a pair of coeloms just behind the mouth (in the main body)
- 3) metacoels - a pair of coeloms just behind the mesocoels (in the main body)

24. Nemertea nervous system - I understand that they have a more "advanced" NS compared to the other phyla we've discussed so far, but I don't really understand the structures, such as circumproboscis nerve ring (is it just a nerve wrapped around the proboscis?) and the cephalic slit.

Yes, the ventral nerve cords connect with the cerebral ganglia via connectives around the proboscis.

All other protostomes have a nerve ring around the esophagus, consisting of supraenteric cerebral ganglia and circumenteric connectives.

Cephalic slits are specialized chemoreceptors that are intimately associated with the cerebral ganglia and anterior blood lacunae. An arrangement that is synapomorphic for nemerteans.

25. I want to ask about slide eight in your notes on *sexual* reproduction in cnidarians. Hydrozoans and scyphozoans share a similar life cycle with a medusa stage; however, Anthozoans skip the medusa stage and the polyps have the gametes (is this a form of paedogenesis?)

Excellent question! We'll address paedomorphosis when we discuss blastocoelomates and chordates. The answer to your question depends on your inference of what's ancestral: the polyp or the medusa? Read over pp. 261-264 in your text -- what do you think?

26. Are planula larva considered free swimming gametes making all orders mixed dev. or what's going on...did I copy it funky wrong or what?

Planula larvae are not gametes -- they are diploid products of sexual reproduction in cnidarians that have yet to metamorphose into a juvenile polyp or medusa (depending on the species).

27. Please specify the specific classification of hydrozoan & Scyphozoan AND Anthozoan lifecycles and (sorry to ask this) could you please explain the fundamental logic behind this classification scheme. It probably would help with my underlying comprehension of the general scheme for classifying life cycles.

Hydrozoan and Scyphozoan life cycles: polyp to polyp by budding (asexual); polyp to dioecious medusae by budding (sexual), gametes released, external fertilization, zygote, planula larva, settling, polyp. Some scyphozoans have completely eliminated the polyp phase. Some hydrozoans (e.g., *Hydra*) have completely eliminated the medusa phase.

Anthozoan life cycle: polyp to polyp by budding (asexual); polyps are dioecious (sexual), gametes released, external fertilization, zygote, planula larva, settling, polyp. Anthozoans have completely eliminated the medusa phase.

28. I am wondering, are there any synapomorphies for Phylum Sipuncula?

The best synapomorphy for sipunculids is their remarkable introvert and compensation sac system.

29. Wouldn't net like nervous system be a synapomorphy for Cnidarians and ladder-like a synapomorphy for Platyhelminthes?

I suspect not. The most recent common ancestor of cnidarians and flatworms had a nervous system with true neurons (there is no doubt that the nervous systems of all eumetazoa are homologous). What do you suspect that this nervous system was like: net-like or ladder-like? Ladder-like nervous systems are always associated with bilateral symmetry and cephalization. If we infer that bilateral symmetry/cephalization originated after the divergence of cnidarians (i.e., in the common ancestor of flatworms, protostomes and deuterostomes = the bilateria), then the common ancestor of cnidarians and bilaterians likely had a net-like nervous system similar to the cnidarians (or some other arrangement of nerves lacking 'nerve cords'). This ancestor may have been radially symmetrical (like cnidarians) or asymmetrical (like placozoans). What do you think?

30. Could you explain the "Water currents and angle of supply" for the Poriferans?

Angle of supply: refers to the angle that water enters a sponge via the ostia or dermal pores relative to the flow of water exiting a sponge via the osculum. The angle is critical for sponges living in still water in order to prevent the recirculation of expelled water back into the sponge. Accordingly, these sponges often have tall chimneys in order to push contaminated water far away from the re-entry holes. Sponges living in moving water are not subjected to the same problem of potential contamination. These sponges tend to lack chimneys altogether.

31. Do Hydrozoa polyps have retractor muscles too or is that only a characteristic of the Anthozoa polyps?

Although hydrozoans are capable of 'retraction', they do not have the same septal arrangement of myoepithelial cells (i.e., retractor 'muscles') like that found in anthozoans.

32. What is an example of a non-homologous characteristic?

Non-homologous characteristics are features in different animal groups that are not derived from common ancestry (if these features have a similar function, then they are referred to as 'analogous' characters). Examples:

1. the wings of birds and insects
2. the camera eyes of fish and octopods
3. the fins of salmon and dolphins
4. the mesoderm in protostomes and deuterostomes
5. the closed circulatory systems of nemertean, cephalopods and chordates

33. Is there a function of the verrucae on a sea anemone?

The patterns of verrucae on the trunks of anemones are used extensively in species identification and taxonomic keys. They are sticky and often have gravel and shell fragments attached to them. Perhaps the main function is camouflage?

34. For the gonoidal sacs in Nemerteans, is it always present but in a reduced form and then matured to make gametes when there is a hormonal signal due to a chemical stimuli?

Yes, I think this is the best way to think about it.

35. Also, for the medusae, what are the ring and radial canals for? Is it for circulation? I thought that both circulation and excretion were performed simply by diffusion?

There are no independent circulatory and excretory systems in cnidarians. The gastrovascular cavity (which includes the ring and radial canals) not only functions in the distribution of nutrients, but also provides ample surface area/contact for the diffusion of gases and the elimination of nitrogenous wastes via diffusion.

36. In the Cnidaria package it says that the Scyphozoa has lost the polyp stage. However, under the lifecycle portion of the notes the polyp stage is written as part of the scyphozoa life cycle. So basically I was wondering if the scyphozoa has a polyp or not?

Many scyphozoans have a reduced polyp stage that buds medusae like the scyphistoma and strobila stages in Aurelia. However, most scyphozoans have lost the polyp stage altogether.

37. What is the difference between Hydra, Hydroids, and Hydromedusa?

All of these terms refer to different kinds of hydrozoans:

Hydras are solitary polyps (e.g., *Hydra*, no medusa stage)

Hydromedusae are the sexual pelagic phase in most hydrozoan life cycles.

Hydroids are colonial hydrozoans, where polyps have become differentiated for different functions (e.g. *Obelia*).

38. Cnidarians: why is it that anthozoans have hexi-octo radial symetry but hydrozoans and schyphozoans have quadri?

One possibility is that hexa- and octo-radial symmetry confers more structural support (via the mesenteries) for the trunk of the sessile polyp phase (anthozoans have lost the medusa phase). This would be particularly important in the intertidal zone, where the animals must withstand the force of waves and water depletion at low tide.

39. Molluscs: in a terrestrial snail, where does the waste that comes out of the anus go if the anus is in the mantle cavity and there's no water to flush it out?

Pulmonates: Muscles are attached to the rectum. The anus is actually protruded out through the pneumostome before the feces are released. If you look closely (and patiently) at the pneumostome of a slug or snail, you can watch this happen.

Aquatic snails: The tissue that lines the mantle cavity (the mantle) is ciliated. The cilia beat in coordination and drive seawater through the mantle cavity in a controlled direction. The water first passes over the osphradia, then over the ctenidia (gills), next over the nephridiopores and gonopores and finally over the anus before leaving the mantle cavity.

40. I have a question regarding the pairs of coelom in protostome, what exactly does the pairs of coelom mean??

Hopefully this makes better sense now that we've discussed the arrangements of coelomic spaces in the repeated segments of annelids. Make sure you understand pg. 5 in the Annelid Outline.

41. I don't quite understand the choanoflagellates hypothesis. You said there were 2 hypotheses and that the 2nd theory was more likely, can you expand on that?

This topic addresses the following question:

Given a choanoflagellate ancestry, how many times did multicellularity evolve in 'animals'?

Two scenarios:

- 1) multicellularity evolved once in the common ancestor of sponges and eumetazoa
- 2) multicellularity evolved twice independently from choanoflagellate-like ancestors -- once in sponges and once in the eumetazoa.

The molecular phylogeny of modern choanoflagellates tests these two possibilities.

Two possible results:

- 1) Sponges are more closely related to eumetazoans than they are to any of the known species of choanoflagellates
- 2) Some choanoflagellates (unicellular) are a sister group to sponges and other choanoflagellates (unicellular) are a sister group to eumetazoans

Result one supports scenario 1

Result 2 supports scenario 2.

Current molecular phylogenetic evidence shows result 1.

42. When you asked if ancestor D was diplo or triplo blastic, I chose diploblastic as the answer b/c it involves 2 evolutionary changes only, ie two seperate evolutions of mesoderm. If it had been triploblastic, this would involve the appearance of mesoderm (in either schizo or enterocoelous form), then the disappearance of mesoderm in one lineage and is reappearance in the other form in that same lineage. First, is my reasoning correct?

Sounds reasonable to me.

43. Second, if ancestor D was diploblastic, is this an example of convergent evolution (in terms of mesoderm)?

Yes -- a very compelling example.

44. IF it was conceivable that one BECAME the other (ie they were a little bit more similar processes), I think ancestor D would've been triploblastic (in accordance with parsimonous reasoning) because this would involve 2 evolutionary changes, evolution of mesoderm at ancestor D and then a CHANGE IN TRAIT in one lineage (ie schizo changing into entero) as opposed to disappearance of the trait and then reappearance. Is my reasoning correct?

Yes. However, evidence for such a transition ('change in trait') is lacking and contrary evidence exists. For example, it is clear that mesoderm in deutoerstomes does not originate from the 4d1 cell (the mesoblast). Moreover, it is clear that the mesoderm in protostomes does not originate from the archenteron.

45. Can there ever be such a thing as a change in trait on the cladogram (and count as 1 evolutionary change), or does it have to disappear and reappear (and count as 2 evolutionary traits)?

The former is actually the usual process. Keep in mind that evolution is constrained by its history and that natural selection can only tweak existing structures (this is the essence of the phrase "**descent with modification**"). For example, the walking limbs of most tetrapods were independently modified into wings in birds, bats and pterosaurs. The gain of wings in each lineage requires one step not two (that is, it does not require the loss of walking limbs and the gain of wings).

Questions asked after the midterm exam:

46. What does "kleptoblasty" refer to?

This should read 'kleptoplasty' -- literally means 'stolen plastids'. The term refers to animals, such as flatworms and nudibranchs, that are able to harvest and maintain chloroplasts from their algal food. The chloroplasts still photosynthesize (produce sugars) within the animal's body. Thus, these animals appear green.

47. What is an aeolid? What is the function of the cerata in aeolids?

Generally, any nudibranch covered with cerata -- also their ctenidia and mantle cavity have been secondarily lost.

48. Does detorsion happen only when the shell is secondarily lost to form a dorid?

Yes. Torsion in opisthobranchs is a developmental 'leftover' from their shelled ancestry, when an anterior position of the mantle cavity was advantageous for protection (i.e., gets the head into the shell quickly). The subsequent detorsion seen during opisthobranch development is associated with the loss of a shell -- a lateral or posterior position of structures associated with the mantle cavity (e.g., the anus) is more advantageous to a shell-less gastropod. Basically, there is no constraint (e.g., a shell with one opening) that requires opisthobranchs to defecate on their heads, so they've changed accordingly (in the evolutionary sense). The neat point here is that the shelled evolutionary history of opisthobranchs is still reflected in its embryology.

49. What is the function of the branchial plume in dorids?

Gas exchange. Whenever you encounter a word with 'branch' in it -- think gas exchange.

50. What is the difference between epiboly and invagination in gastrulation, besides being different types of gastrulation?

Check out Fig. 4.7 in Chapter 4 (p. 100). The two terms refer to different patterns of embryonic tissue formation and are associated with stereoblastulae and coeloblastulae, respectively.

51. What is the function of cirri?

Generally speaking, tactile reception. However, homologous structures function in feeding (e.g., tube worms).

52. You mentioned that in hearts the flow is "reversed" -- what did you mean?

Blood flow in annelids (and protostomes in general) is in the reverse direction found in chordates (like you). This will be clearer after Friday's lecture (if we keep on pace). Annelids: in dorsal vessels, blood flows posterior to anterior; in ventral vessels, blood flows anterior to posterior. Reversed in chordates.

53. You mentioned that polychaetes move via metachronal waves. Is this analogous to lateral undulations?

"Metachronal wave" is a general term for a sequence of movements that run along the longitudinal axis of an animal. "Lateral undulation" is one kind of metachronal wave. Other

types: the movements of legs in a centipede, the movement of pleopods in a swimming shrimp, the peristaltic waves of earthworms, etc.

54. What is the neurotroch? In the text it states that it is the mid-ventral band. Is this where the somatic plate meets on either side around the stereoblastula?

Yes. It is a band of cilia in trochophore larvae that runs longitudinally along its ventral surface. The neurotroch is defined when the two lateral edges of the somatic plate meet on the ventral surface during epiboly and ingress to form the double ventral nerve cord (DVNC).

55. Do the neurotroch/prototroch/telotroch all become sensory organs?

The neurotroch becomes the DVNC; the prototroch becomes the peristomium; the telotroch becomes the pygidium.

56. What is the correlation between the need for a larval form and a marine vs a freshwater habitat?

In general, freshwater habitats are much smaller (in volume) and much more hostile to organisms than marine environments. Freshwater environments can experience extreme fluctuations in temperature, volume (evaporation, dry seasons, etc.), the amount of suspended particles (silt loads), solute/pollutant concentrations and so forth. Larval stages are relatively vulnerable to these sorts of fluctuations. Accordingly, freshwater animals tend to expend more energy into parental care (e.g., reduce or eliminate larval stages) in order to help ensure that their offspring survive into adulthood. Like in terrestrial animals, development tends to be direct, rather than indirect or mixed.

57. From one of the slide shows on Echinodermata there was a clip/video on "why penta radial symmetry". I was wondering if you wouldn't mind re-stating the reasons why there is penta radial symmetry in some echinoderms.

Sure. There are probably several different factors that gave rise to penta-radial symmetry in echinoderms. One factor might be that penta-radial symmetry confers a structural advantage over other forms of radial symmetry, such as tri-radial, quadri-radial and hexa-radial symmetry. In pure mechanical terms, a 5-parted structure is stronger than a 3-parted structure because the angle of intersection is smaller and thus the parts are more tightly integrated (the angle of intersection is 120 degrees in a 3-parted structure and 72 degrees in a 5-parted structure). Moreover, because 4-parted and 6-parted structures have opposing planes of intersection (i.e., the sutures between parts form straight lines through the center of the structure), they have significantly less structural integrity than a structure that does not consist of opposing planes of intersection (e.g., a 3-parted or 5-parted structure). It turns out that some ancestral echinoderms (now extinct, but in the fossil record) experimented with tri-radial symmetry early on.

58. Forewing in hexapods - you mentioned that it was "elytra" - is this another NAME for the forewing of a description of its protective function? (same for hindwing and halteres)

Yes. In beetles, the forewings have become highly modified as armor -- thus, they're given a name 'elytra'. This is like specifying pectoral appendages (in tetrapods) as either wings (birds), fins (dolphins) and arms (humans). Halteres are highly reduced hindwings in some insects that function as equilibrium sensors.

59. Body wall of arthropods has an "articulating membrane". What did you mean by this? Does this mean that because of the intrinsic muscles the membrane is flexible? Or that they are joints..?

The articulating membranes are flexible parts of the exoskeleton that span joints between rigid sclerites. Think of them as very thin parts of the continuous exoskeleton that allow the animal to move some of its body parts (i.e., they form joints). The appendages have intrinsic musculature that spans joints between sclerites (each of which has a name like coxa, femur, tibia, etc.)

60. Are malpighian tubules in the hindgut of hexapods and endgut in chelicerates?

They are in the hindgut of hexapods (ectodermally derived) and the midgut of chelicerates (endodermally derived).

61. In the picture with the nervous system, the gut is under the tritocerebrum. Shouldn't it be under ALL three parts of the nervous system because the NS is "supraenteric"?

Like in all protostomes, the nervous system forms a circumenteric ring around the gut. The cerebral ganglia are supraenteric (above the gut). In arthropods, the circumenteric connectives around the gut branch from the tritocerebrum. Therefore, the mouth is located under the cerebral ganglia (all three parts) and the esophagus passes through the tritocerebrum and lies above the ventral nerve cords. Your drawing in the notes simply shows the gut passing through the tritocerebrum. Check out Figures 15.28 and 17.27 in your textbook. Does this make better sense?

62. Did I write down right that the arthropods use SETAE for chemoreceptors (I thought this was synapomorphic to annelids?)

Chemoreception is performed by volcano-shaped "chemo-sensillae", which is a specific type of "setae". Setae simply refer to hair-like structures on the body that usually function in tactile reception. In annelids, we used the term "chaetae" for their stiff bristles. In this case, setae are synonymous with chaetae. It is currently unclear whether arthropod setae and annelid chaetae are homologous.

63. In the guideline for the final exam I saw that we had to compare acoelomate, coelomate and blastocoelomates. I was wondering how we would be able to do that without much knowledge of the blastocoelomates. Pseudocoel kinda directly translates to "fake gut" but how is it fake? if there is still a distinct cavity?

The blastocoel (= blastocoelom = pseudocoelom = pseudocoel = not a 'true' coelom) does not refer to the gut. It refers to a fluid filled body cavity that is NOT completely surrounded by mesodermally driven tissue (e.g., a peritoneum). An adult blastocoel, as seen in nematodes, is actually a persistent embryonic blastocoelom (the hollow space within a cleavage furrow). True coeloms (produced via enterocoely in deuterostomes and schizocoely in protostomes) never materialize during the life cycle of nematodes. Check out pp. 46-49 in your text (Ch. 3) and be able to compare and discuss the following figures in your notes:

Outline 2, pg. 3
Outline 5, pg. 2
Outline 10, pg. 5
Outline 13, pg. 3

64. Position of the ventral heart on the big tree? Is this at #23?

You can ignore the hemichordata and the lophophorates for exam purposes (I wrote the study guidelines before knowing where we'd ultimately finish in lecture). The tree you'll see on the exam will exclude both of these groups (i.e., the deuterostomes will be represented by echinoderms and chordates only). In this context, the best position for ventral heart is at 24 (on your tree).

65. Position of the banded, collar-shaped brain?????

Good question. This is the best synapomorphy for the Cycloneuralia (from which the name is derived). Again, I wrote the study guidelines before knowing where we'd ultimately finish in lecture -- I was REALLY hoping to get to this. The best position for this character is 19 -- you might want to check out the last paragraph of p. 879 to the first part of p. 880 and Fig. 24.4. I've noted the material we were unable to discuss in sufficient detail when writing the exam.

66. Position of the 1 pair of parapodia per segment? Is this at #14 or 15?

Ultimately, this is your call. Can you make a compelling argument either way or is one position more reasonable than the other in your view? I think you can make the best case for 14 by expanding the meaning of "parapodia".

67. Does 'trochophore larva' go at #8 in the big tree?

For our purposes -- YES. Although the larvae of nemertean are trochophore-like, the larvae are different enough to warrant other names, such as "pilidium larvae". Nonetheless, nemertean are almost always included in the so-called "trochozoa", which also includes

molluscs, sipunculids and annelids (plus some other groups we didn't cover).

68. Does 'open circulatory system', 'metanephridia', and 'molting by ecdysis' go at #10?

The first and third characters -- Probably not. Which two groups have ecdysis (excluding the possibility of cyconeuralians)? Which groups have CLOSED circulatory systems? Hint: These have evolved several times independently -- also think about some subgroups inside the phyla shown on the tree.

The second character (metanephridia) -- Probably so.

69. What are some synapomorphies for Platyhelminthes, Nematoda, and one for Onychophora other than slime glands?

This question was on the midterm. In short, there are none for flatworms. How does this influence your understanding of ancestor E? Don't worry about synapomorphies for nematodes -- our coverage was too skimpy (however, there are some novel characters associated with the excretory and nervous systems). Slime glands seem to be pretty good for the onychophorans.

70. Does Teloblastic growth occur in protostomes and deuterostomes?

No -- this is a characteristic of the so-called "Articulata" (arthropods, annelids, onychophorans, tardigrades). The tree I gave you suggests a single origin, but it might have evolved more than once.

71. In our notes a synapomorphy for Arthropods is 'no functional cilia'. Isn't this also true for Nematoda?

Very good! Both groups also lack circular muscle. Perhaps nematodes are highly derived (paedomorphic) arthropods? This is consistent with some molecular phylogenetic data suggesting that nematodes and arthropods (and their kin, excluding annelids) are closely related and form the so-called "Edysozoa". However, although molting or shedding also occurs in nematodes, ecdysone has not been observed in nematodes. Check out pp. 883-885.

72. Is segmental ganglion in the Annelids a synapomorphy for them?

Maybe. Arthropods and their kin have segmental ganglia too.

73. What is the function of the frontal lobe in the squid?

In general, the frontal lobe processes chemo-tactile information from the arms and tentacles.

74. For the 3 main gas exchange systems in arthropods, how does each system relate to the animal's mode of life ... The gills in crustaceans are necessary b/c they're in an aquatic environment but how do the book lungs of the chelicera and the trachea of hexapods relate to their environment besides the fact that they're mainly terrestrial (ie, why wouldn't hexapods have book lungs)?

The presence of tracheae in insects (rather than book lungs) reflects their intense metabolic activities. Book lungs require a blood/hemolymph intermediate between the environment (air in this case) and the animal's tissues -- tracheae do not. Thus, gases can get into and out of the muscle tissues more rapidly in insects -- this is critical for flight -- think about how fast bumble bee wings can beat! Spiders have book lungs and are generally less active than insects.

75. On #9, you asked to be able to diagram & compare patterns of metachronal wave formation in annelids, molluscs, crustaceans, myriapods and chordates. I try to find out metachronal wave for molluscs, crustaceans, myriapods and couldn't find any answers.

"Metachronal wave" is a general term for a sequence of movements that run along the longitudinal axis of an animal. "Lateral undulation" is one kind of metachronal wave. Other types: the movements of legs in a centipede, the movement of pleopods in a swimming shrimp, the locomotory waves on the ventral surface of the muscular foot in snails, the peristaltic waves of earthworms, etc.

Metachronal waves tend to move from posterior to anterior in protostomes (not always, though) -- e.g., arthropods, annelids and molluscs (a notable exception: the peristaltic waves of earthworms move anterior to posterior). Metachronal waves in deuterostomes, particularly the lateral undulations of chordates, move from anterior to posterior. Check out the following review animations and text figs.:

Polychaete locomotion & eels locomotion

Oligochaete locotion

Fig. 20.19A in your text

Fig. 17.11 in your text

Fig. 18.3 in your text

Fig. 16.22 in your text

76. In Cephalopods (squids) do they have a closed or open circulatory system?

Although molluscs generally have open circ systems, cephalopods have closed circ systems associated with an accessory heart at the base of each ctenidium (3 hearts in total). This is directly correlated with their active predatory life styles.

77. Are gastropods the only ones with a dart sac - i know from lab that the dart sac is used in mating to stun another snail - but in the notes I have a dart sac in the cephalopod diagram -

Cephalopods have an "ink sac" near the anus -- functions as a smoke screen during an escape response.

78. In the blastocoelomate notes, the page with the examples of all the different organisms, are we to memorize the names and the pictures?

Not for exam purposes -- focus your attention on the general features of nematodes. Depending on your level of interest, you might want to learn about these guys on your own, though.

79. What is the function of the bursal slits in a brittle star? understand it to hold the gametes, is this correct? Is it its only function?

The bursea of brittle stars function as a brooding chamber for developing embryos, in the release of gametes (as you said above) and in gas exchange. Fresh seawater is continuously moved through the bursal slits.

80. On the fifth page of slides for the chordates, there is an organ on the first diagram. What is this organ called? fear my notes are illegible.

This is called the "wheel organ". It functions to prevent relatively large inedible particles from entering the pharynx.
