Name:_____ Student #_____
Lab Section:_____ TA: _____

Bio153H5: Diversity of Organisms
Instructor: Dr. M. Havelka
Midterm Test

No aids are allowed.

Instructions:

1. This test consists of 2 sections: 40 multiple choice questions (1 mark each = 40 marks), and 5 of 7 short answer questions (2 marks each = 10 marks). There are a total of 50 marks on this test. The test is worth 25% of your final grade.

2. Please answer questions 1 – 40 on the Scantron sheet. The answers to questions 1 – 40 should also be clearly marked on your test paper.

3. The Scantron sheet:

    - Please use an HB pencil to fill in your Scantron sheet, and **avoid making any stray marks on the sheet.** These cause errors in reading the Scantron sheets.
    - In the spaces at the top, enter your name, signature, and course number (Bio153).
    - Print your student number in the spaces provided, and mark the digits in each column.
    - If you change your answer on the Scantron sheet, completely erase any previous entries, or the answer will not be scanned correctly.
    - The exam period cannot be extended to accommodate filling out the Scantron sheet.

Please check that your test paper has 10 pages.

GOOD LUCK!

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Section I: Multiple Choice. Please select the best answer. (1 mark each = 40 marks)

1. What organisms are most numerous on Earth?
   A. Eukaryotes
   B. Archaea
   C. Prokaryotes
   D. Plants
   E. Insects

2. What do the nodes on a phylogenetic tree represent?
   A. species
   B. new kingdoms or domains
   C. ancestral groups that split into two descendant groups
   D. groups that got new names

3. Why did the five-kingdom system of classification fall out of favour?
   A. It was too complex—the original two-kingdom system of Linnaeus was more useful.
   B. It was too difficult to distinguish plants from fungi and animals from protists.
   C. There were too many monerans to be included in a single kingdom.
   D. It did not reflect the actual evolutionary relationships among organisms very well.

4. In the Linnaean classification system, which taxon would generally include the largest number of species?
   A. family
   B. phylum
   C. order
   D. genus

5. Which of the following would be useful in creating a phylogenetic tree of a taxon?
   A. morphological data from fossil species
   B. genetic sequences from living species
   C. behavioural data from living species
   D. all of the above

6. Your professor wants you to construct a phylogenetic tree of orchids. She gives you tissue from seven orchid species and one lily. What is the most likely reason she gave you the lily?
   A. to serve as an outgroup
   B. to see if it's a cryptic orchid species
   C. to see if the lily and the orchids show all the same shared derived characters
   D. to see if orchids and lilies hybridize

7. Which group of fungi most likely assisted plants' evolutionary colonization of land?
   A. Lichens
   B. Basidiomycota
   C. Ascomycota
   D. Glomeromycota
   E. Chitridiomycota

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8. Consider the following data: Among the protists, brown algae, red algae and amoebae are unicellular and multicellular organisms. Which of the following conclusions is consistent with the data presented?
   A. Multicellularity is a synapomorphy that defines a eukaryote.
   B. Multicellularity evolved once; thus, animals are derived from the most recently evolved protists.
   C. Multicellularity evolved multiple times as eukaryotes diversified.
   D. Multicellularity is more adaptive than unicellularity.
   E. None of the above answers apply.

9. Which of the following traits is useful in generating a phylogeny of species W, X, Y, and Z? (A – D indicate character states):

	Species W	**Species X**	**Species Y**	**Species Z**
Trait 1	A	A	A	A
Trait 2	A	A	B	B
Trait 3	A	B	C	D

   A. trait 1
   B. trait 2
   C. trait 3
   D. none of the traits is useful

10. What types of changes in the regulation of development can lead to morphological changes that can be significant in evolution?
   A. changes in when developmental genes are expressed
   B. changes in where developmental genes are expressed
   C. both A and B
   D. None of the above has ever been demonstrated.

11. What do Eubacteria have in common with Archaea but not with Eukarya?
   A. high G-C ratio in their nucleic acids
   B. peptidoglycan cell walls
   C. branched membrane lipids
   D. absence of nucleus
   E. all of the above

12. The purple non-sulfur bacterium *Rhodospirillum* grows best as a photoheterotroph. What are the most favorable sources of energy and carbon for this bacterium?
   A. methane and CO_2
   B. fructose and light
   C. light and CO_2
   D. glucose

13. What is the characteristic feature of Chlamydia?
   A. unusual flagella
   B. formation of colonies
   C. rod shape
   D. parasitic life cycle

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14. Biologists sometimes divide living organisms into two groups: autotrophs and heterotrophs. How do these two groups differ?
    A. They use different sources of energy.
    B. They use different electron acceptors.
    C. They use different sources of carbon.
    D. They differ in the way they generate ATP.

15. The most diverse group of Eubacteria are the:
    A. firmicutes
    B. proteobacteria
    C. spirochetes
    D. methanogens

16. Cyanobacteria became very numerous ~3 billion years ago, and are abundant in marine and freshwater systems. Which of their features was responsible for such success?
    A. ability to perform oxygenic photosynthesis
    B. ability to form colonies
    C. ability to use organic compounds as electron donors
    D. ability to fix nitrogen

17. Which of the following protists causes the human disease malaria?
    A. *Giardia*
    B. *Plasmodium*
    C. *Trichomonas*
    D. *Leishmania*

18. Which of the following characteristics is true of *all* protists?
    A. contains a nucleus
    B. very small
    C. unicellular
    D. has a cell wall
    E. photosynthetic

19. Which of the following statements is consistent with the assertion that protists are paraphyletic?
    A. Protists do not constitute all of the descendents of the first eukaryote.
    B. Protists all share a common set of synapomorphies.
    C. Protists are all more primitive than land plants and animals.
    D. Protists do not share a single common ancestor.
    E. All of the above answers apply.

20. Which of the following statements about prokaryotic cells is false?
    A. Prokaryotes are permanently haploid
    B. Prokaryotes lack a cytoskeleton
    C. Prokaryotes lack membrane-bound organelles
    D. Prokaryotes undergo rapid mitosis

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21. Which of these is usually largest in size?
    A. a seed plant sporophyte
    B. a seed plant gametophyte
    C. a bryophyte sporophyte
    D. a bryophyte gametophyte

22. Which of the following is a correct element of alternation of generations in the Type III life cycle?
    A. The sporophyte is haploid and produces gametes.
    B. The sporophyte is diploid and produces spores.
    C. The gametophyte is haploid and produces spores.
    D. The gametophyte is diploid and produces gametes.
    E. Two spores unite to form a zygote.

23. Spores and seeds have basically the same function—dispersal—but are vastly different because:
    A. Spores have a protective outer covering; seeds do not.
    B. Spores have an embryo; seeds do not.
    C. Spores have stored nutrition; seeds do not.
    D. Spores are unicellular; seeds are not.
    E. Spores depend primarily on animals for dispersal; seeds do not.

24. How are gymnosperms and angiosperms similar?
    A. Plants in both groups have flowers and fruits.
    B. Plants in both groups have cones that produce pollen and seeds.
    C. Plants in both groups produce seeds and pollen.
    D. Plants in both groups lack vascular tissue.

25. The closest relatives of pine and spruce trees are:
    A. ferns, horsetails, lycophytes, club mosses
    B. hornworts, liverworts, mosses
    C. gnetophytes, cycads, ginkgoes
    D. elms, maples, aspens

26. Why are mycorrhizal fungi superior to plants at acquiring mineral nutrition from the soil?
    A. Hyphae are 100 to 1000 times smaller than plant roots.
    B. Fungi secrete extracellular enzymes that can break down large molecules.
    C. Fungi can transport compounds through their mycelium from areas of surplus to areas of need.
    D. All of the above answers apply.

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27. In animals, why are fungal infections such as athlete's foot so much harder to cure than bacterial infections?
    A. Fungi and animals are more closely related than bacteria and animals.
    B. Fungi are part of a younger evolutionary lineage than bacteria.
    C. Fungi are more highly evolved than bacteria.
    D. Fungi are a source of many antibiotics that work against bacteria.

28. The dikaryon is present in all fungi except:
    A. Zygomycota
    B. Basidiomycota
    C. Chytridiomycota
    D. Ascomycota

29. In which sequence did these various plant characters appear (earliest to latest)?
    A. seeds → vascular tissue → complex leaves → flowers
    B. vascular tissue → complex leaves → seeds → flowers
    C. complex leaves → seeds → vascular tissue → flowers
    D. seeds → flowers → vascular tissue → complex leaves

30. If adult body size is small relative to its ancestor, and the adult body is less developed than that of its ancestor, the heterochronic process involved is:
    A. progenesis
    B. hypermorphosis
    C. neoteny
    D. deceleration

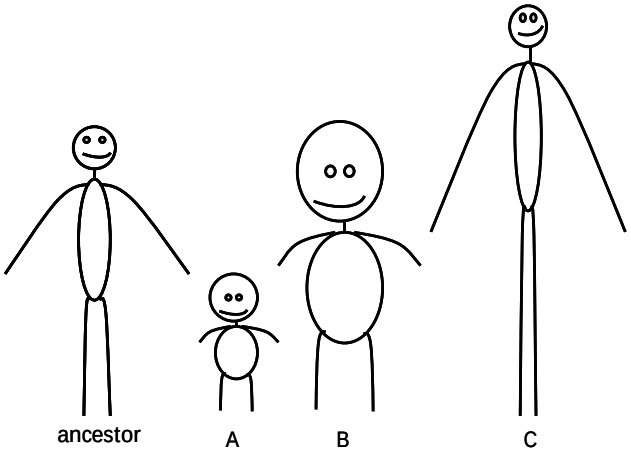
31. Which of the following statements is false?
    A. 2 genes are homologous if they are related by descent from a common ancestral DNA sequence
    B. orthologs are genes (occurring in related species) that evolved from a common ancestral gene
    C. paralogs usually retain their original function, while function usually differs among orthologs
    D. paralogs are genes related by duplication within a genome

32. Which of the following statements about viruses is false?
    A. viruses are acellular
    B. viruses are obligate intracellular parasites
    C. viruses are members of a primitive, polyphyletic group
    D. viruses can contain DNA or RNA

33. Which phase of the life cycle of fungi such as basdiomycetes and ascomycetes is the symbiotic, nutrient-gathering phase?
    A. haploid spore or recently germinated spore
    B. fruiting structure (mushroom and ascocarp)
    C. heterokaryotic mycelium
    D. karyogamy

34. Which is considered to be the sister group of the Embryophyta?
A. Chlorophyta
B. Charophyta
C. Bryophyta
D. Opisthokonta

35. All birds have feathers, and only birds have feathers. Which of the following statements is true?
A. Feathers are ancestral when considering evolutionary relationships among birds, but derived when placing birds within a phylogeny including other groups
B. Feathers are a derived trait used to determine the evolution of flightlessness
C. Feathers are a derived trait when comparing extinct birds to modern birds
D. Feathers are an ancestral trait when considering the evolutionary relationships among all vertebrates



36. In the diagram above, the figure on the far left represents a modern human adult. Figures A – C represent 3 adult specimens of hypothetical descendents of modern humans. What type of heterochronic mutation does each represent?
A. A = neoteny; B = progenesis; C = postdisplacement
B. A = progenesis; B = neoteny; C = hypermorphosis
C. A = peramorphosis; B = deceleration; C = pedomorphosis
D. A = predisplacement; B = hypermorphosis; C = postdisplacement

37. Once plants evolved to live on land and had vascular tissue, megaphylls appeared to be selected for and replaced microphylls in most plant lineages. What is a major advantage of having larger leaves?
A. Plants are better able to cool themselves by waving their leaves in the wind.
B. Plants can shade the stem to prevent too much evaporation.
C. Plants have more photosynthetic tissue for increased sugar production.
D. Plants can better hide their reproductive parts from herbivores.

38. Which of the following types of characters are useful in a cladistic analysis?
A. autapomorphies and synapomorphies
B. shared derived characters
C. all types of characters (morphological, biochemical, etc.)
D. ancestral and derived traits

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39. How are the bryophytes and seedless vascular plants alike?
    A. Plants in both groups have vascular tissue.
    B. In both groups, sperm swims from antheridia to archegonia.
    C. The dominant generation in both groups is the sporophyte.
    D. Plants in both groups have true roots, stems, and leaves.

40. Which statement about *Hox* genes is false?
    A. *Hox* genes encode transcription factors
    B. *Hox* genes are highly conserved
    C. *Hox* genes are organized in gene complexes
    D. *Hox* genes act relatively late in development

Short answer questions. Please answer 5 of the following 7 questions in the spaces provided. Please be brief – a sentence or two should suffice. Point form is acceptable as long as it is unambiguous. If you attempt more than 5 questions, **please indicate clearly which you want marked**; otherwise, the first 5 answers will be marked. Each question is worth 2 marks (10 marks total).

41. What is an evolutionary reversal?

42. In words, describe the difference between phenetic and cladistic analysis.

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43. What is meant by spatial and temporal collinearity in reference to *Hox* genes?

44. In words, compare the Type I and Type II life cycle.

45. In what way is sex separate from reproduction in prokaryotes?

46. Why has neoteny frequently been important in the evolution of new taxa?

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47. Briefly describe how mutations in antennepedia (*Antp*) and ultrabithorax (*Ubx*) result in alterations of phenotype in *Drosophila*.