Answers to Clemson University Biology Merit Exam
22 April 2016

1. a) Correct.
   b) No, the species would be Ursus maritimus. "Maritimus" by itself is the specific epithet.

2. a) No, both of them are deuterostomes and vertebrates.
   b) No, they're both endothermic and bilaterally symmetrical.
   c) Correct. Only the human is a primate.
   d) No, neither one is autotrophic.

3. a) No, this has little to do with species identity.
   b) Correct. This is the classic means by which we identify a species. If polar bears and brown bears can interbreed, maybe they're just one big species, no matter how different they look.
   c) and d). No, these characteristics do not define a species.

4. c) Correct. A white bear would reflect almost 100% of the light that hits it, no matter what the wavelength of the light was. It would also absorb only a tiny amount of the light that hits it.

5. d) Correct. We're talking about the number of genes, not the number of base pairs. The number of genes is surprisingly low.

6. a) Correct. Chloroplasts, like mitochondria, are thought to be captured prokaryotes.

7. b) No. Thylakoids are in chloroplasts, not mitochondria.
   c) Correct. Cristae are the "cross-walls" inside mitochondria that increase the interior surface area and allow for more electron transport chains, proton pumps, and ATP synthases.

8. b) Correct. 400 x 2.2 = 880 pounds, close to 900.

9. d) Correct. 11 feet is 132 inches, and 132 inches/39.4 inches/m = 3.35 m.

10. c) Correct. Temperate zone bears lay on a lot of fat as hibernation approaches.
    d) No. While the polar bears are going to be eating well soon, they have not been eating well for the whole warm part of the year, and they are nearly starving as the ice forms in autumn.

11. a) Correct. Rotating flagella are a strictly prokaryotic characteristic. The other answers are all shared by both prokaryotes and eukaryotes.

12. b) Correct. Flies are members of the order Diptera and have complete metamorphosis (with a larval and a pupal stage).

13. c) Correct. Mosses (and liverworts and hornworts) are non-vascular plants. Also, mosses are very important on the Arctic tundra, and in some places may even be the dominant vegetation.

14. a) Correct. This is the only answer that shows the layers in correct top-to-bottom order.
    b) No. Periderm is in the stem.
    c) No. Pericycle and endodermis are in the root.
    d) No. This sounds like parts of a fruit.

15. d) Correct. All of them are plausible, in the sense that all of them would predict the observed result. If the bear is not exerting itself as much in water or heat is being drained from its body faster in water, its body temperature will not increase as much in water.

16. a) No. While doing the tests at different temperatures is not preferred, conclusions can be drawn. See b).
    b) Correct. If the bear is overheating on land at -34°C, it would overheat even more at -2°C.
c) No, the critic's objection is not irrelevant. Theoretically, the environmental temperature is a controlled variable that should be the same in both treatments. But if we really wanted a controlled test, we should not have the same temperature for the two tests, but rather water and air that drain the same amount of heat from the bear. This would require even colder air than -34°C.

17. c) **Correct.** \((37)(9/5) + 32 = 98.6\), exactly. Polar bears have the same body temperature as humans.

18. a) **Correct.** This would show the time course of the bear's temperature with a curve for no exertion, a curve for 20% exertion, a curve for 40% exertion, etc.
   b) No. This is plausible, but not preferred. We would rather know how the temperature changed over time for 40% exertion, for example, than see the temperature at 5 minutes for 0%, 20%, 40%, 60%, 80%, and 100% exertion, then the temperature at 10 minutes for those exertions, etc.
   c) No. This doesn't even mention exertion percentage. It would be a possible idea to use a bar graph to compare body temperatures in air and water at 20 minutes for all the different exertion percentages. This would strongly contrast air and water, but this is not what the answer proposes, and it doesn't show all the data.
   d) No, the data certainly can be presented in a graph.

19. a) No. This gives the intensity of the stimulus, but does not identify the stimulus.
   b) **Correct.** The polar bear has certain olfactory neurons that respond to a seal breathing hole, others that respond to a female bear in heat, others that respond to a rotting carcass, etc.
   c) and d). No. These will be the same for all stimuli.

20. a) No. Oxygen is a weak factor in controlling breathing rate.
   b) No, oxygen would not be increasing.
   c) **Correct.** In humans, the cerebrospinal fluid (unlike the blood) has no buffers and drops its pH markedly if CO₂ increases. This is the main mechanism for breathing control in humans.
   d) No, blood pH would decrease, not increase.

21. b) No. Lactic acid is correct, but it doesn't come from oxidation of acetaldehyde.
   d) **Correct.** Here, lactate means the same thing as lactic acid, and it is generated from the reduction of pyruvate.

22. a) **Correct...**the surge of adrenaline just before death.
   b) No, cortisol is a stress hormone, but it isn't triggered by the parasympathetic nervous system.

23. d) **Correct.** The largest teeth in a carnivore are the canines.

24. b) **Correct.** Blubber is fat, and muscles are mostly protein.

25. a) No, these would be in proteins.
   b) No, these would be in large carbohydrates like starch and glycogen.
   c) **Correct.** These connect fatty acids and glycerol, and would be the most important enzymes for a meal of blubber.
   d) No. These are found in DNA.

26. d) **Correct.** The fat will be digested into fatty acids and glycerol, and these will be taken into lacteals and go to the lymphatic system.

27. a) **Correct.** This is the first place blood goes in a human heart after it returns to the heart through the vena cava. This is where blood from the gut will enter the heart.

28. a) No. The aortic semilunar and the pulmonary arteries have high and low oxygen, respectively.
   b) **Correct.** Both of them have deoxygenated blood.
   c) No, the mitral valve has oxygenated blood and the pulmonary artery has deoxygenated blood.
   d) No, the right atrium has deoxygenated blood and the mitral valve has oxygenated blood.
29. a) Correct. The hyperosmotic salt solution in the blood would draw water from the RBCs.

30. c) Correct. Lipids are the most reduced macromolecules because they have a lot of hydrogen and little oxygen compared to other macromolecules, such as carbohydrates. This means that they have a very high energy content, and produce lots of water because all that hydrogen has to be taken away as water. Some desert mice can live without drinking on fatty seeds, but will die of dehydration if they try to live on protein-heavy seeds.

31. d) Correct. This is the nematode that causes trichinosis in humans.

32. a) No, the offspring will be less diverse because most males won’t mate.
   b) Correct. If only the biggest, most fit males get to mate, the offspring will have higher quality and lower genetic diversity.
   c) No, the males have no role in raising the young. As a matter of fact, they often kill polar bear cubs. One of the big duties of mothers is to keep her cubs safe from adult males.
   d) No. The mating system cannot affect the mutation rate.

33. a) Correct. This is the "LH surge" just before ovulation.
   b) No, as far as we know, male pheromones have no effect on ovulation.

34. a) No. If this were true, both the parents would have flecks too because they would have to be homozygous for the fleck allele.
   b) No, both parents would have to have flecks in this case too.
   c) Correct. If both parents are Aa, they could produce an aa offspring while not showing the aa phenotype themselves.

35. b) No. All prophase II does is prepare to divide sister chromatids one from another, and both chromatids would either have or not have the flecked allele.
   d) Correct. Assuming that question 34 has the correct answer, in metaphase I, the forming gamete will either get a normal allele or a flecked allele due to random assortment of maternal and paternal chromosomes.

36. a) No. In this case, we’d be looking at all the paternal genes that the mother doesn’t have. But since the mother and the father are heterozygous, this will not include the flecked gene.
   b) No. This will highlight genes present in the dark-eyed cub that are not present in the flecked-eye cub. We’re looking for the flecked allele, which might not be present at all in the dark-eyed cub.  
   c) Correct. This strategy will spotlight genes present in the flecked-eye cub that are not present in the dark-eyed cub, and so has a good chance of spotting the flecked allele.
   d) No. Yellow will highlight genes that are just as active in the two cubs. We want to look for genes that are different in the two cubs.

37. a) Correct. Microarray analysis will not find inactive genes because it depends on mRNA. If the gene was “quiet” when we looked, we wouldn’t detect it.
   b) No. If this were true, why would the two cubs have different eye phenotypes?
   c) No, an insertion of an erroneous stop codon will have a big effect on the proteins the gene makes.

38. b) Correct. The bears have a small litter size and exercise lots of parental care...K-selected.

39. d) Correct. CO$_2$ is a greenhouse gas.

40. c) Correct. Darker land will absorb more sunlight and get warmer. In turn, this will reduce the number of days with snow, which will make the land even warmer and with less snow cover the next year. This is a positive-feedback system.